160XD 4X4 REPAIR MANUAL

619728

ISSUED APRIL 2011

PREFACE

This manual is to provide servicing personnel with information on the general specifications, service, operating principle, troubleshooting, exploded view including part name, removing and installing procedures for **OFF - ROAD Utility Vehicle** with high-end technology.

All information in this manual is based on the latest product information available at the time of publication. Therefore, some of the information in this manual may differ from the machine you have.

We have a principle to apply update to the next edition of the manual if there is any. However, We have no obligation to modify the contents in this manual, especially the contents in the manual which is already distributed or published.

The modified information is available in our online electronic manual system (DEMSS).

This manual is ultimately to satisfy customers with best performance of this UTV. If there is any typo, wrong information or question for this manual, feel free to contact us.

Apr. 2011

service division

DAEDONG INDUSTRIAL Co., Ltd.

IMPORTANT

- **Using unspecified parts, fuel and lubricants other than DAEDONG's genuine parts can damage the UTV and such damage will not be covered by warranty.**

REMARK

- **We reserve the right to make changes throughout the entire manual at any time without notice.**

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SAFETY FIRST

CHAPTER 1

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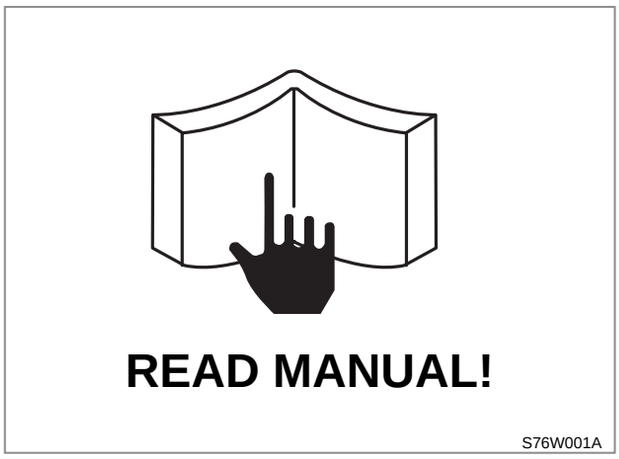
1. SAFETY DECALS

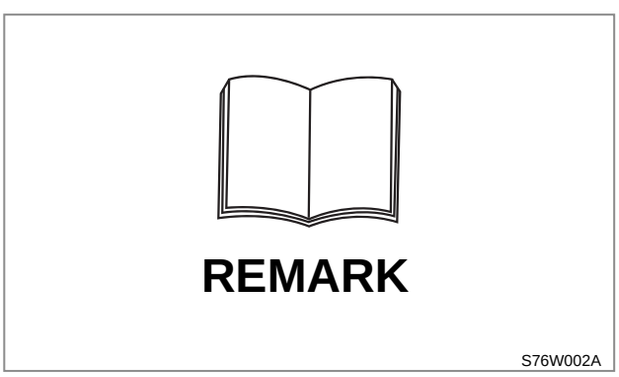
- Most accidents can be avoided if basic safety instructions and regulations are followed. Always follow the safety regulations and avoid any dangerous situation to prevent an accident.
- You can be unexpectedly injured if inspecting or servicing the UTV without full knowledge of it. Read the manual carefully before starting service, and follow the instructions on service, maintenance and inspection to prevent any injury.



1.1 ALERT SYMBOLS

The meanings of the safety-alert symbols used in this manual are as follows:

A. REMARK



- Broaden your knowledge with additionally supplied service information for optimal service.

C. CAUTION

- This mark indicates potentially hazardous situation which, if not observed, may result in serious injury.

B. IMPORTANT

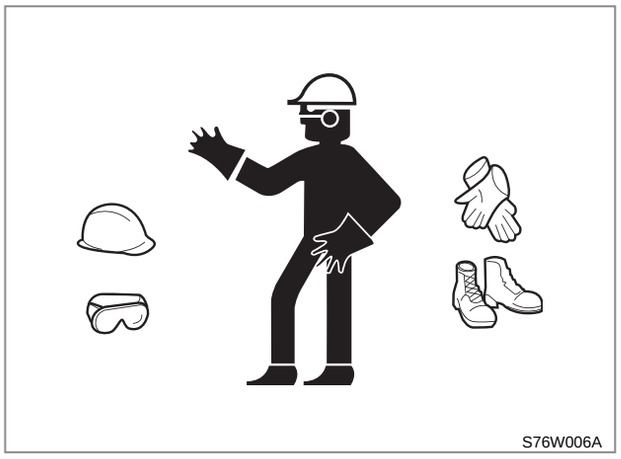
- This mark indicates emphasis on information which can be confused when servicing. If this information is not carefully read and observed, the UTV cannot fully function or may be damaged.

D. WARNING

- This mark indicates hazardous situation which, if not observed, may result in death or injury.

2. SAFETY TIPS

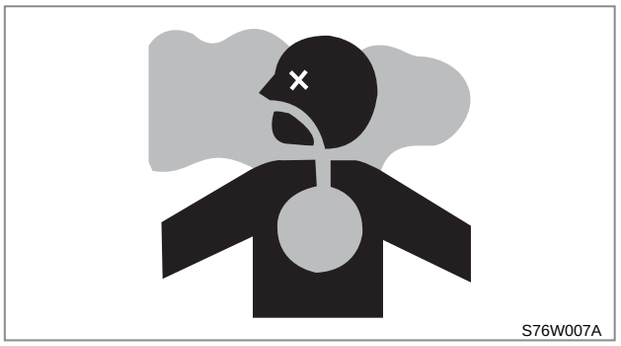
2.1 SAFETY GEAR


S76W006A

When operating on the vehicle, wear safety gloves, safety shoes, ear plugs, safety goggles, safety helmet, working clothes, etc. appropriate for your working environment.

Never wear loose fitting clothing or a tie which can be caught by rotating part. According to the statistics, most accidents occurred with rotating parts are due to this inappropriate manner of wearing clothes.

2.2 WORKPLACE


S76W007A

2.2.1 VENTILATING SYSTEM

The service should be performed in a well-ventilated area. If the engine should be started in an enclosed place, an exhaust gas vent pipe should be installed.

⚠ WARNING

- **California Proposition 65 Warning**

  Inhaling exhaust gas can cause cancer or damage the generative function leading to infertility.

2.2.2 SAFE WORKPLACE


S76W008A

The work should be done in a wide, level and safe place to prevent slip and fall accident.

2.2.3 ILLUMINATION

The work place should be well illuminated. If working in a dark place or under the vehicle, use the work lamp. The work lamp should be covered with the safety cover. The bulb can start a fire due to the leaked fuel when it is broken.

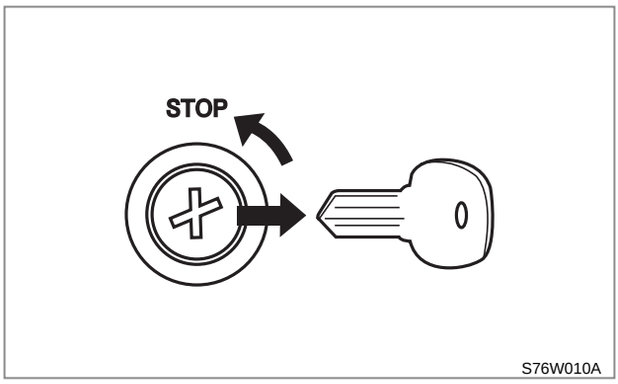
2.2.4 SAFETY EQUIPMENT

Be sure to keep a first aid kit and fire extinguisher handy at all times.

2.2.5 KEEPING YOUR WORK AREA CLEAN

Keep the working area clean before and during work. If any oil or fuel is spilled, it should be cleaned up immediately.

2.3 SAFETY INSTRUCTIONS WHEN PREPARING TRACTOR



S76W010A

- Stop the engine and remove the key.
- Put "No Operation" label on the tractor if necessary.

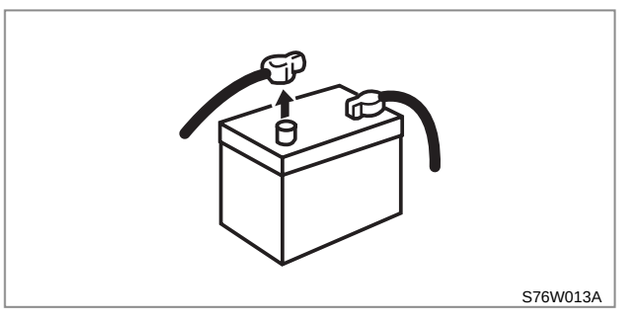
2.4 FIRE


S76W011A

- Never smoke or allow flames or sparks in your work area when maintaining the fuel system.


S76W012A

- Keep flames or sparks away from the fuel container, spray paint, etc. and be careful of leaks.

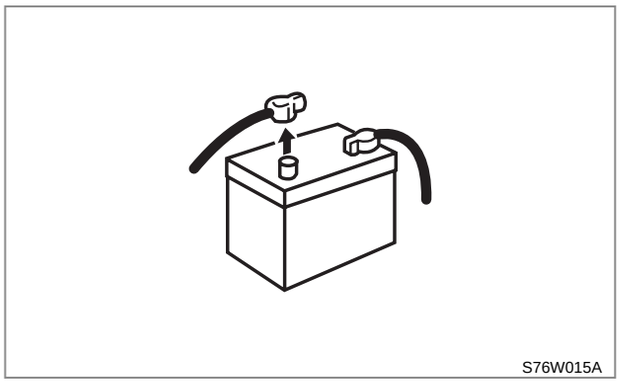

S76W013A

- Disconnect the negative battery cable.
- Always disconnect the battery cable for fire prevention before wiring service.
- Be extra cautious of fire when welding.

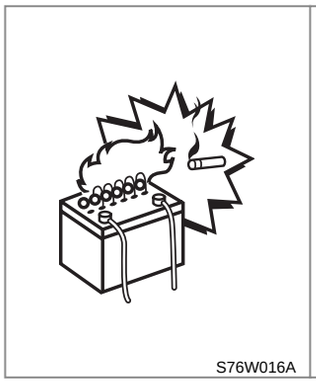

S76W014A

- Always keep a fire extinguisher in workplace.

2.5 CAUTIONS WHEN HANDLING THE BATTERY

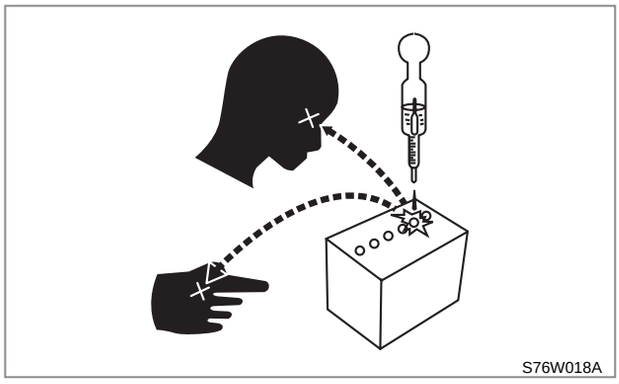

S76W015A

- Always disconnect the negative battery cable first and reconnect it last to avoid sparks from an accidental short circuit. Otherwise, it could result in fire or injury.


S76W016A

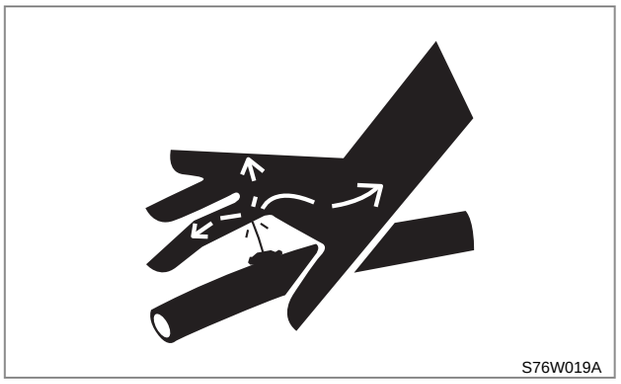

S76W017A

- Do not charge the frozen battery. Charging the frozen battery can cause explosion. Let the battery warm up to ambient temperature (16°C, 60°F) before charging.
- Keep sparks and flames (match, lighter) away from the battery. The battery can explode due to hydrogen gasses inside the case.Never connect the battery's negative and positive cables with metal for test. Use only tester when checking. the battery voltage.

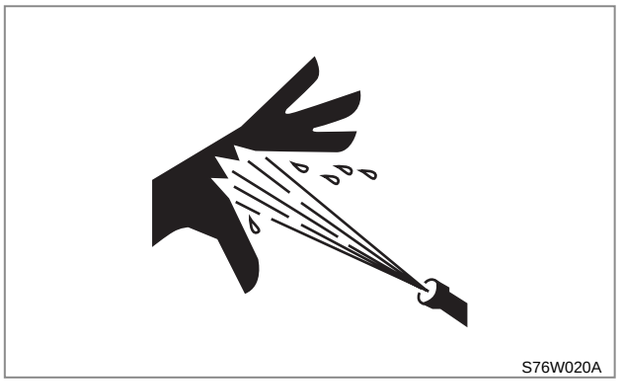

S76W018A

- The battery can be very hazardous because it contains sulfuric acid. It can damage your cloth, and even burn your skin when directly contacted. If it contacts with your eyes, you may lose your sight.

2.6 CAUTIONS FOR HIGH PRESSURE HOSES


S76W019A

- The hydraulic fluid leaks from high pressure hoses or pipes can penetrate your skin.


S76W020A

- Before connecting a high pressure hose or pipe, stop the engine and depressurize it by valve. Check the bolts for tightness before starting the engine after the hydraulic system service.
- Use a cardboard or plank when checking leakage.


S76W021A

- Never weld the high pressure pipe or the surrounding area. The pipe or hose can be heated and explode which can lead to fire or burn.

2.7 USE OF APPROPRIATE TOOLS AND EQUIPMENT

- Use the standard tools in proper size. If an inappropriate tool is used, it can slip which can damage parts or injure you.
- Do not confuse units (mm, inch, etc.). Use the air impact wrench only when unscrewing the bolts or nuts. Such wrench should not be used especially when assembling precisely machined parts which its tightening torque should be strictly followed. It can cause malfunctions.
- Be careful of a socket popped out due to the turning force when using the air impact wrench. Especially, be extra cautious when working on connection or socket with joint.

S76W022A

- When lifting the tractor with a hydraulic jack or a hoist, fix it firmly and install the auxiliary support. Never work under the tractor if the support and the hydraulic jack (hoist) are not installed.
- When using a hydraulic jack or a hoist, do not use it over the limit of the equipment and the conveying belt.
- Make sure that the hydraulic lock operates properly before used. Improper use of lock can cause a serious accident.
- Check the buttons and operating direction of the hoist before using it. Improper operation can cause a serious accident.
- Do not use wooden blocks or bricks as support under the tractor. As the tractor's weight is continuously applied to them, they can be broken or collapsed.

2.8 HANDLING OF HAZARDOUS MATERIALS

- Do not blow out hazardous materials, such as clutch dust, with compressed air. Inhaling such hazardous materials can damage your health.

REMARK

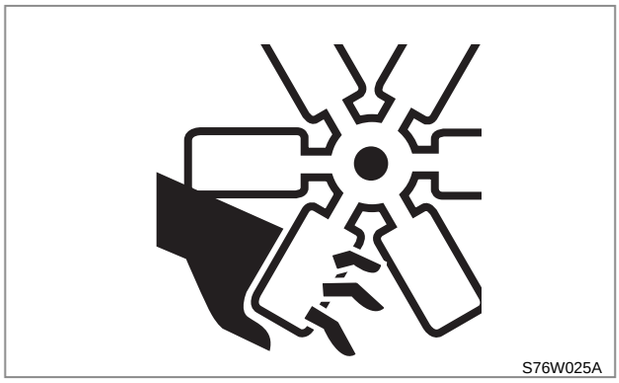
All DAEDONG's genuine parts do not contain asbestos.

- These materials should be rinsed or wiped away after sprayed with oil.

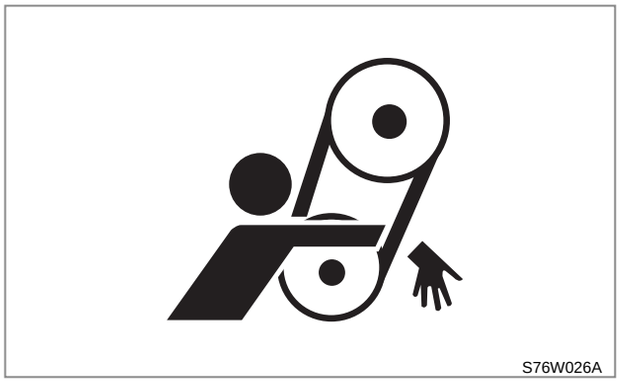
2.9 HANDLING OF ROTATING SHAFT AND DRIVING BELT


S76W024A

- Do not set a hand or a foot into the vehicle's rotating shaft or belt.
- Be extra careful when you are in loose clothes.

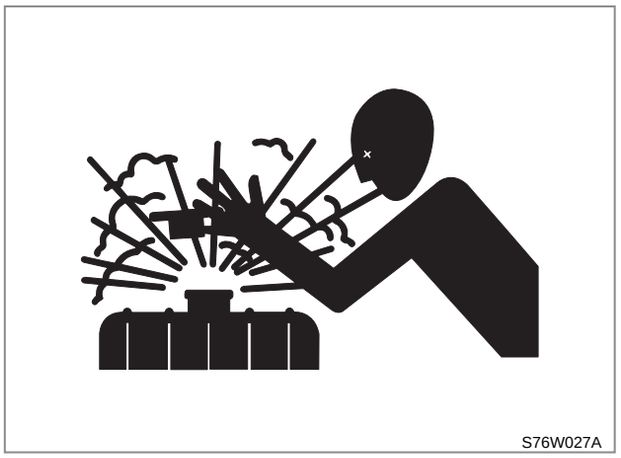

S76W025A

- Be careful not to get caught by the rotating engine cooling fan.


S76W026A

- You can be seriously injured if your hand or clothes is caught by the rotating fan belt or A/C belt.

2.10 SCALD PREVENTION

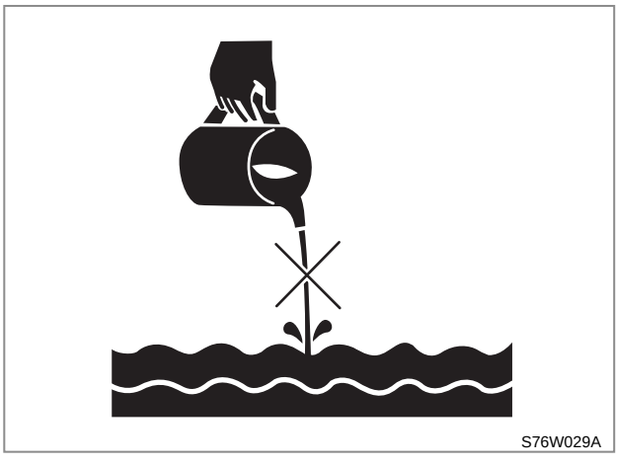

S76W027A

- Do not open the radiator cap when the radiator is hot. Hot coolant or steam can be surged leading to a serious scald.


S76W028A

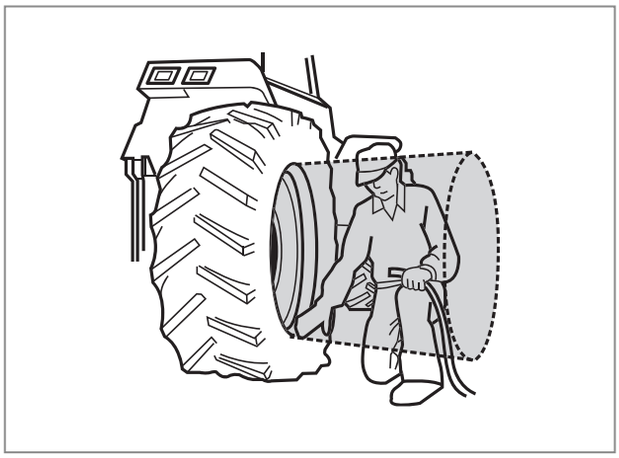
- Check the surface temperature of the container before draining the engine oil, transmission fluid, coolant, etc. If it is hot, let it cool down before draining it. There is a high risk of burning.
- Perform any service on the engine parts (muffler, exhaust manifold, etc.) only when they are not hot.

2.11 DISPOSAL OF ENVIRONMENTAL WASTE

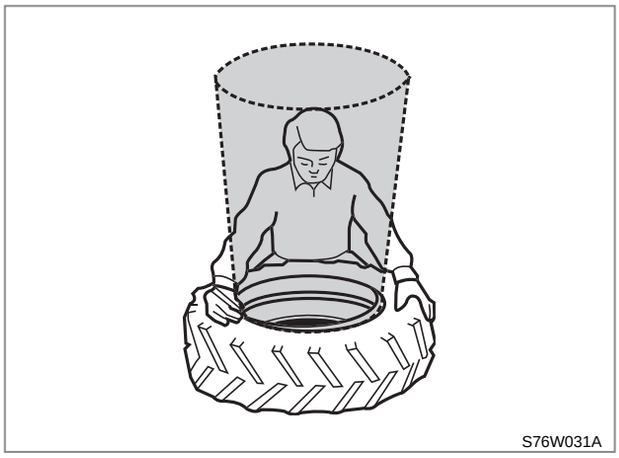


- Observe relevant environmental protection regulations when disposing used oil, transmission fluid, coolant, oil filter, etc. Otherwise, they can pollute the environment seriously and you could be charged in violation of regulations.

2.12 CAUTIONS WHEN HANDLING TIRES



- The tire rims can fall out of the tires. Therefore, stay out of its way when checking or inflating tires.

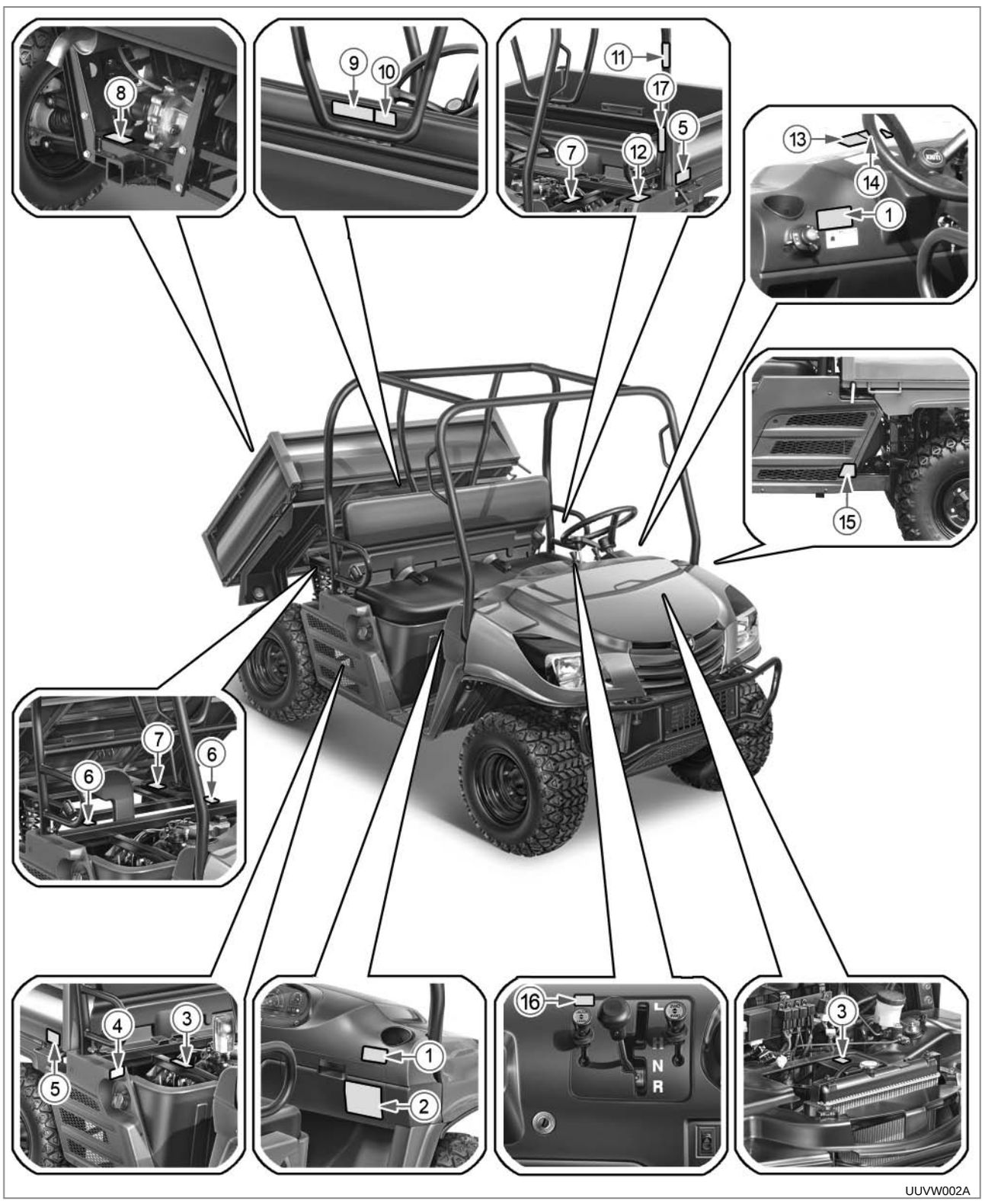


- Do not weld or apply heat to the tire rim or disc. The tire can explode due to the rapidly increased pressure in the tire.
- Check tires for inflation pressure, damage, deformation, extended wear on lug and damage of rim and disc. Also check if wheel nuts are loose.

3. SAFETY DECALS

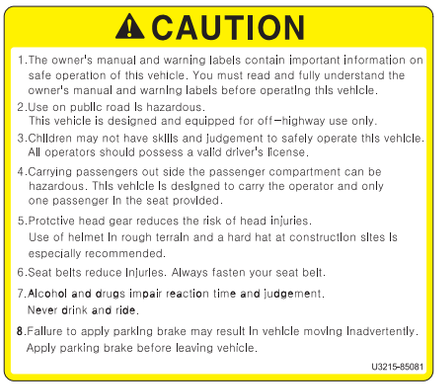
- When replacing the existing part with a new one, attach the same safety decal to the new part. Otherwise, the customer's safety will be threatened.
- If a decal is damaged or detached, attach the same decal to the part.
- The decals and their attaching locations are as follows.
- There is part number on the bottom of decals.

3.1 THE LOCATION OF SAFETY DECAL



(1) Part No. : U3215-85011

(2) Part No. : U3215-85081



(3) Part No. : T4625-52351

(4) Part No. : T2615-54112

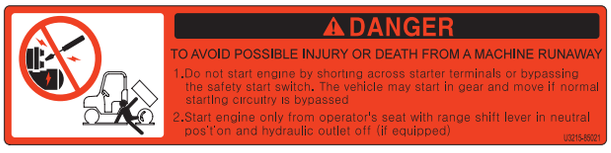
(5) Part No. : U3215-85101

(6) Part No. : U3215-85071

(7) Part No. : T4625-52361

(8) Part No. : U3215-85091

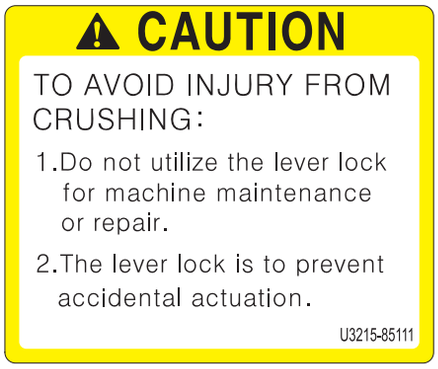
(9) Part No. : U3215-85021



(10) Part No. : U3215-85031

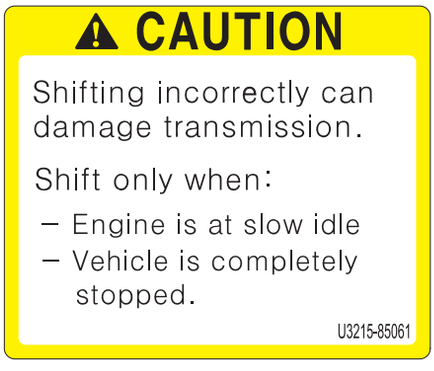
(11) Part No. : U3215-85041

(12) Part No. : U3215-85111

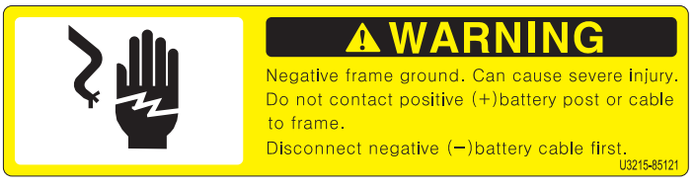


(13) Part No. : U3215-85051

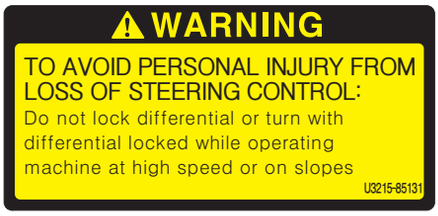
(14) Part No. : U3215-85061



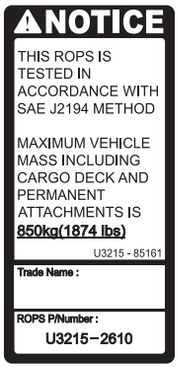
(15) Part No. : U3215-85121



(16) Part No. : U3215-85131



(17) Part No. : U3215-85161



GENERAL

CHAPTER 2

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1. DESCRIPTION FOR SYMBOLS AND ABBREVIATIONS

There are various symbols used in this manual. Their design and meanings are as follows:

Symbols


Fuel-level


Engine coolant-temperature


Parking brake


Battery not charged


Engine oil pressure


Turn signal lamp


Differential lock


Hazard warning lamp


Headlamp - low beam


Headlamp - high beam


Front wheel drive-engage

N
Neutral position


Preheat

H
High travel light

L
Low travel light

Abbreviations

- **4WD .....** Four Wheel Drive
- **API .....** American Petroleum Institute
- **HI-LO .....** High speed-Low speed
- **RH/LH ....** Right Hand side and Left Hand side (Determined based on driving direction)
- **ROPS .....** Roll Over Protection Structure
- **RPM .....** Revolutions Per Minute
- **SAE .....** Society of Automotive Engineers
- **SMV .....** Slow Moving Vehicle
- **CVT ..... Continuously Variable Transmission**
- **UTV ..... Utility Vehicle**

2. UTV APPEARANCE

3. SERIAL NUMBER

3.1 UTV SERIAL NUMBER LOCATION

This vehicle serial number(1) is located on the structure frame where the battery is installed.

UTV serial number assignment standard

J Z9 1 00001

Production serial number

Example) 0 0 0 0 1: The first chassis manufactured in that year

Tire division

1	Work Site Tire
2	Mud Tire
3	Turf Tire

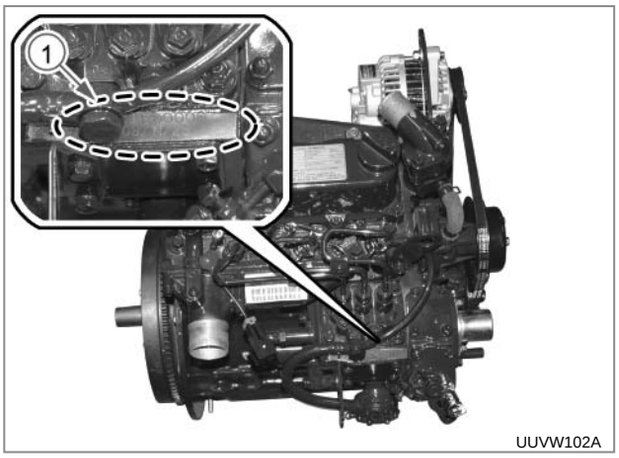
Model

Year of manufacturing

Example)

⋮	⋮
2	2002
3	2003
D	2004
E	2005
F	2006
G	2007
H	2008
J	2009
K	2010
⋮	⋮

3.2 ENGINE SERIAL NUMBER LOCATION



The engine number(1) is stamped on the machined front surface below the fuel injection pump.

Engine number assignment standard

J K 1 9 0 0 0 0 6

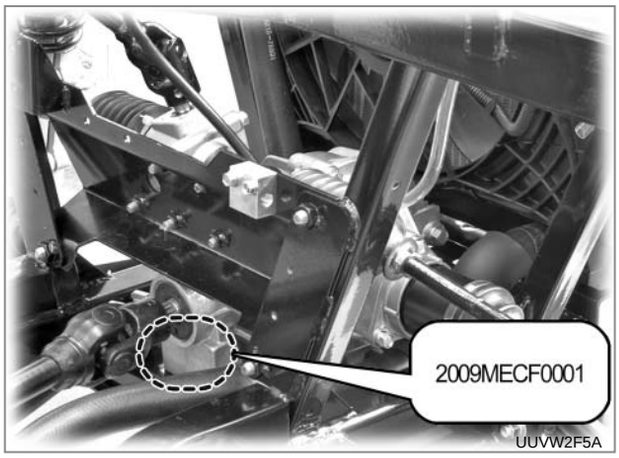
- Production serial number
- Engine model (3C100LWU)
- Year of manufacturing

REMARKS

For detailed information on how the engine number is assigned, refer to chapter "Engine".

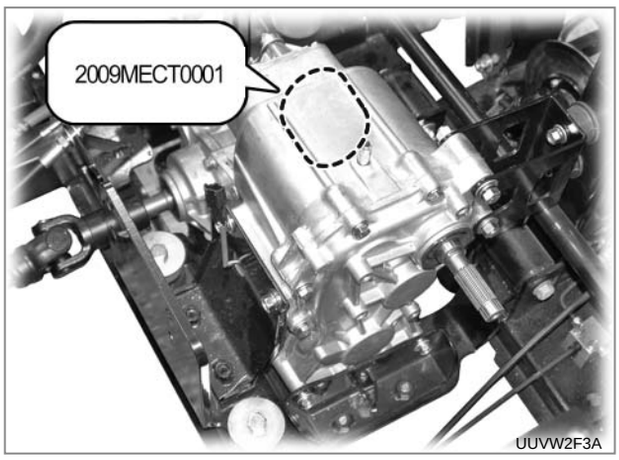
3.3 OTHERS LOCATION

- Front axle case serial number



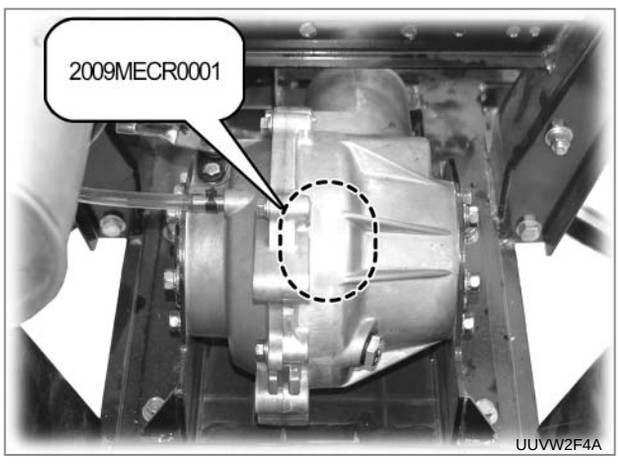
It is marked on the flat surface on the lower section of the spiral bevel pinion shaft of the front axle case.

- Transmission serial number



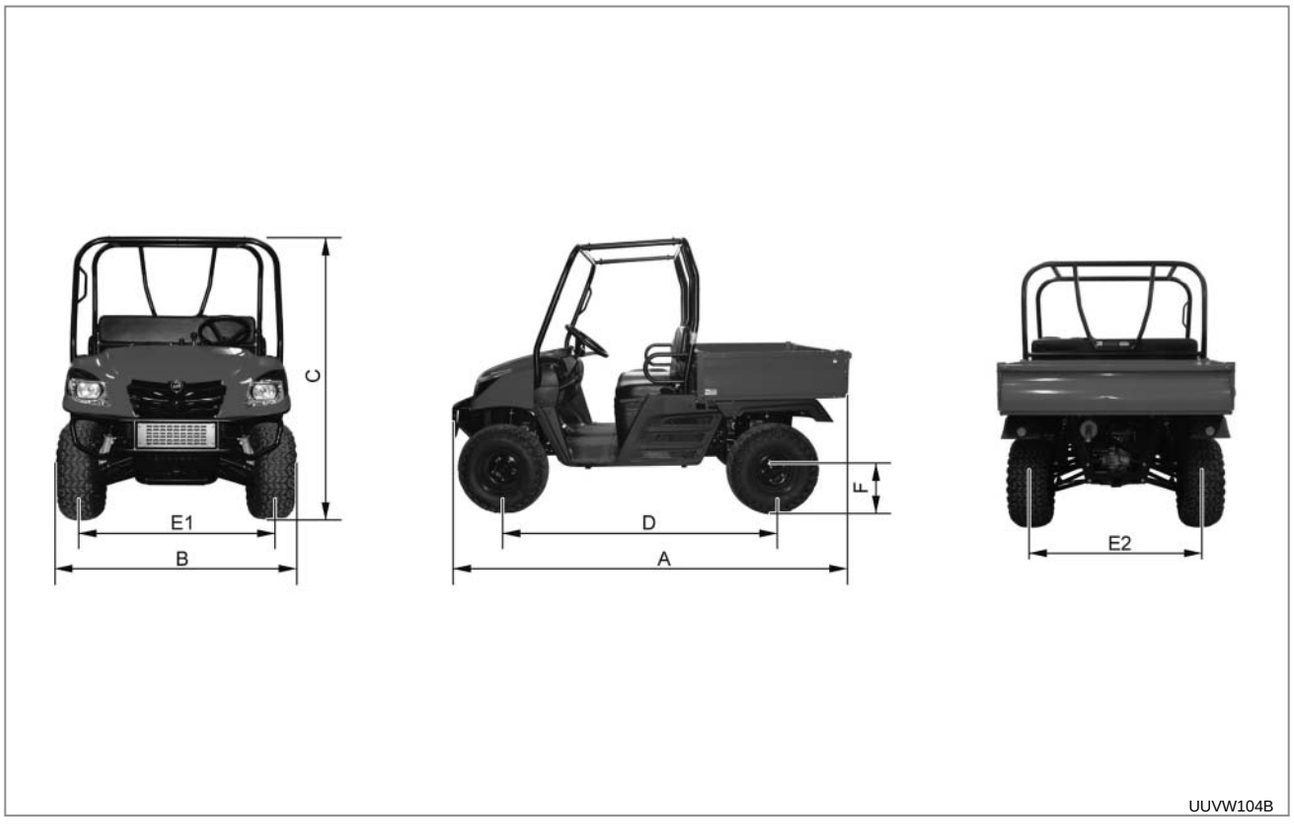
It is marked on the side of the bleeding pipe on top of the transmission case.

- Rear axle case serial number



It is marked on the right side of the mating surface of the rear axle case and cover.

4. DIMENSIONS



mm (inch)

DESCRIPTION				REMARKS
A : Overall length			2,852 (112.3)	-
B : Overall width			1,543 (60.7)	-
C : Overall height			1,940 (76.4)	-
D : Wheel base			1,940 (76.4)	-
E : Tread	**E_1** : Front	25 x 10 - 12	1,262 (49.7)	-
	E_2 : Rear	25 x 11 - 12	1,228 (48.3)	-
F : Min. ground clearance			304 (12.0)	-

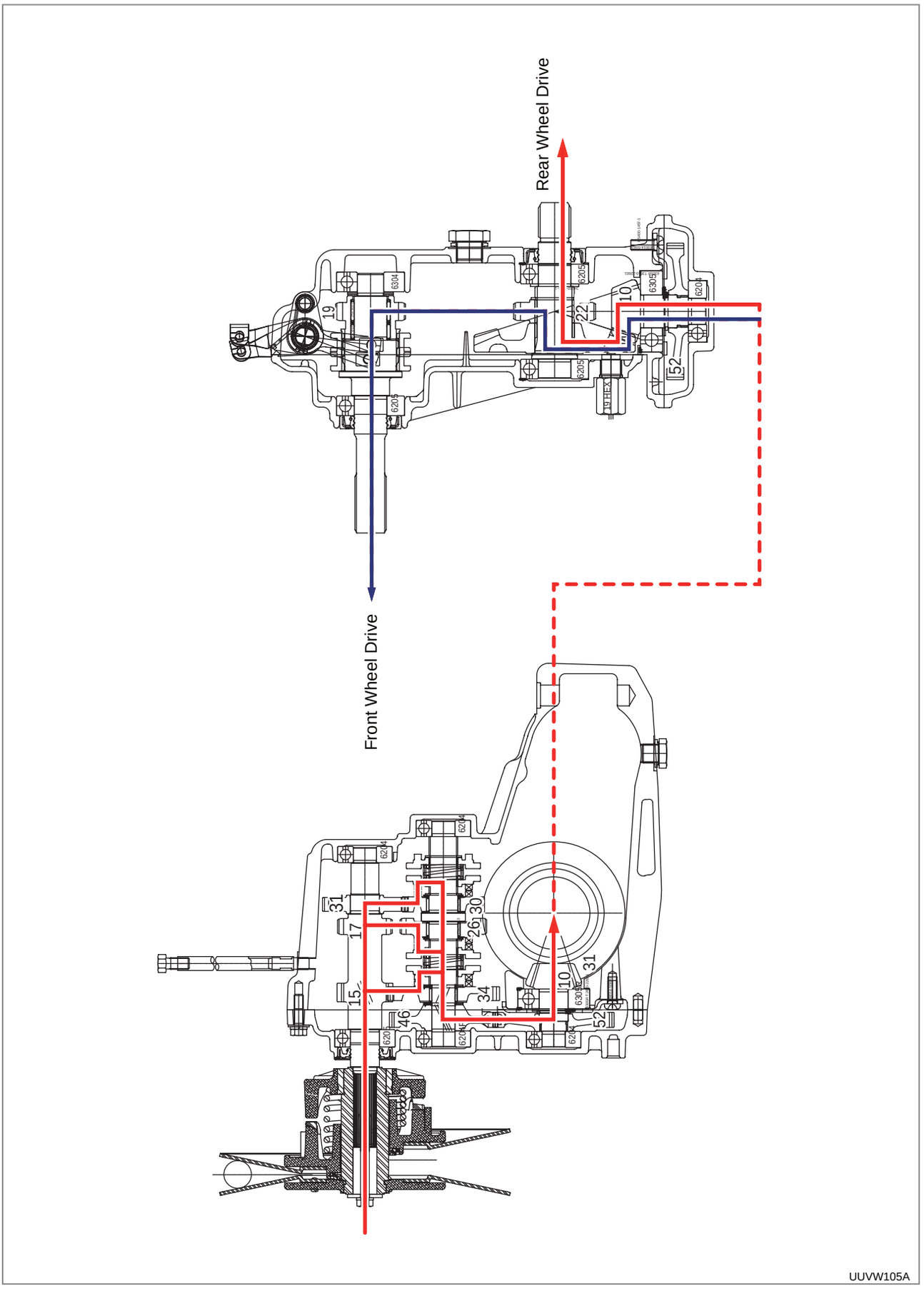
5. SPECIFICATIONS

DESCRIPTION			
Engine	Model		3C100LWU
	Type		4Cyl., In-line Vertical, Water-cooled, Indirect injection, diesel
	Max. power	HP (Kw)/rpm	22 (16.2) / 2,800
	Number of cylinders		3
	Bore x stroke	mm (in.)	75 X 76 (2.95 X 2.99)
	Displacement	cc (cu in.)	1,007 (61.45)
	Rated revolution	(rpm)	2,800
	Injection timing		BTDC 18°
	Injection sequence		1 - 2 - 3
	Compression ratio		21.5 : 1
Capacity	Fuel tank	ℓ(U.S.gal)	28 (7.39)
	Engine crankcase	ℓ(U.S.gal)	3.2 (0.85)
	Engine coolant	ℓ(U.S.gal)	6.3 (1.66)
	Transmission case	ℓ(U.S.gal)	0.9 (0.24)
	Front axle case	ℓ (U.S.gal)	0.5 (0.13)
	Rear axle case	ℓ (U.S.gal)	0.8 (0.2)
Drive train	Type		Belt CVT
	Transmission		Forward 2 (High/Low), Reverse 1, Mechanical
	Brake		Front / Rear hyd. dry caliper disc
	4WD system		Manual
	Differential lock	Front	Limit slip
		Rear	Manual
	Tire size	Front	25 x 10 - 12 6PR
		Rear	25 x 11 - 12 6PR
Suspension	Front		Independent, McPherson strut
	Rear		Independent, Double A-arm (Wishbone)
Steering	Type		Rack & Pinion
Cargo bed	Size	mm (in.)	980 x 1,427 x 293 (38.6 x 56.2 x 11.5)
	Capacity	kg (lbs)	500 (1,102)
Driving speed	Forward	Km/h(mile/h)	0 ~ 40 (0 ~ 25.0)
	Reverse	Km/h(mile/h)	0 ~ 25 (0 ~ 15.5)
Turning radius		m (ft.)	4.0 (13.1)
Weight		kg (lbs)	765 (1,687)
Towing capacity		kg (lbs)	590 (1,300)
Payload capacity (include driver)		kg (lbs)	726 (1,600)

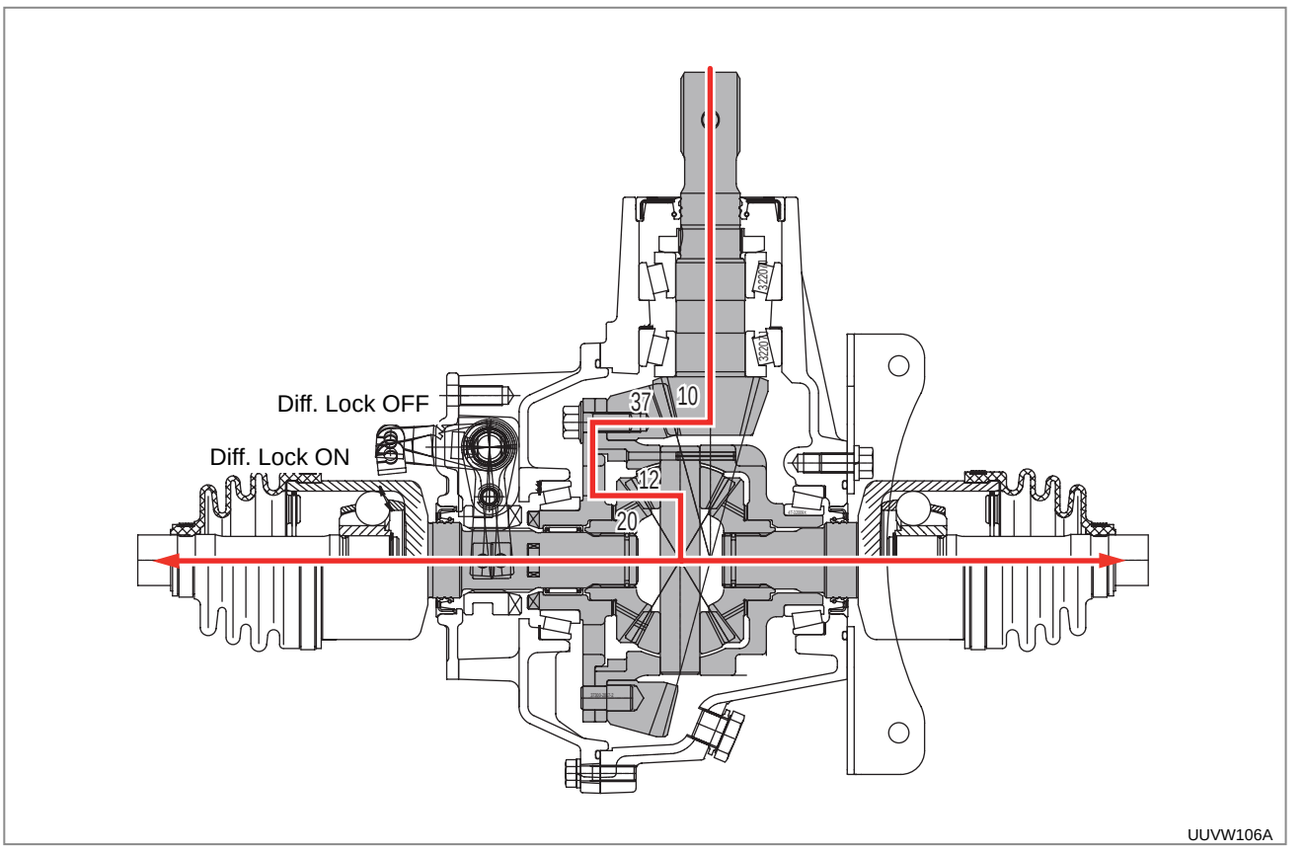
NOTE: The specifications are subject to change without notice.

6. GEAR ARRANGEMENT AND DRIVING SPEED

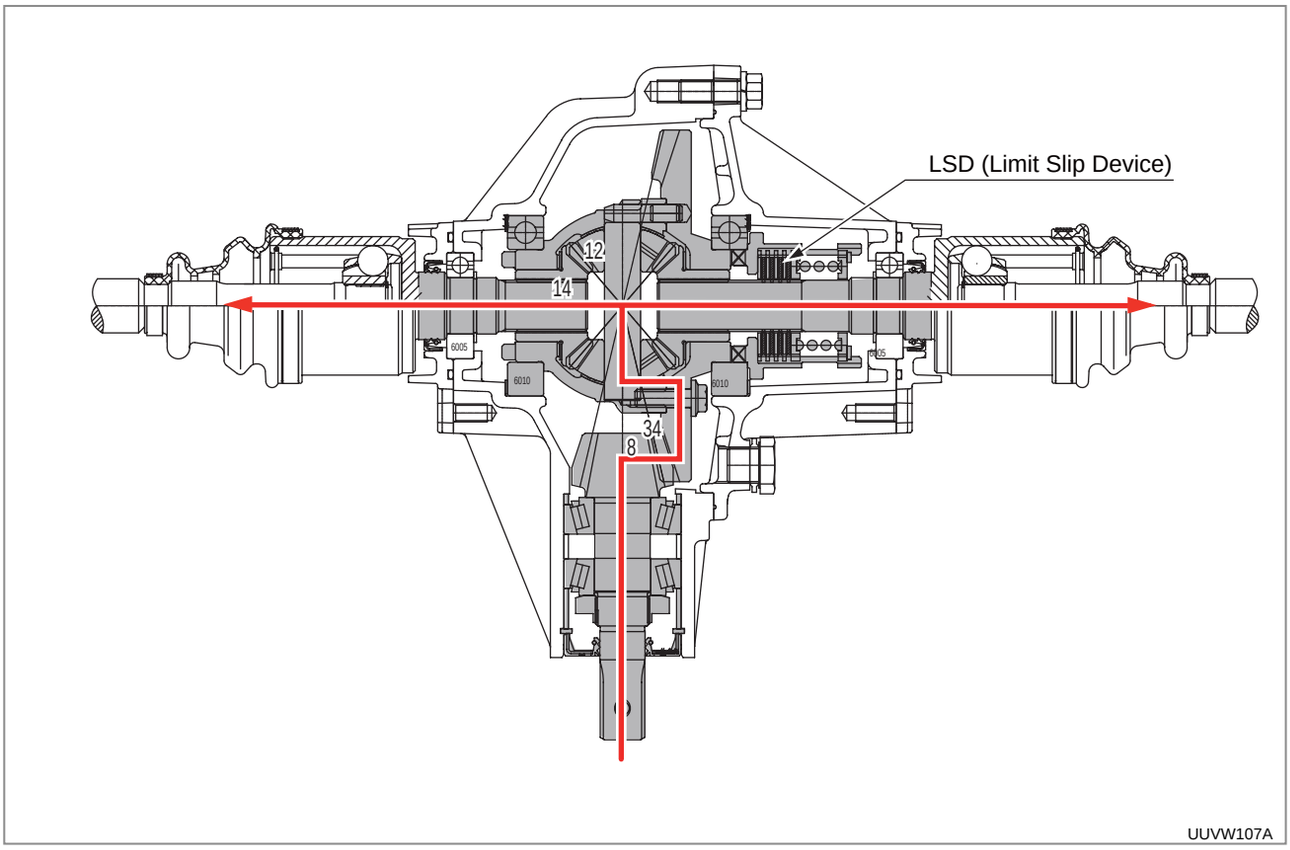
6.1 GEAR ARRANGEMENT OF TRANSMISSION



6.2 GEAR ARRANGEMENT OF REAR AXLE



6.3 GEAR ARRANGEMENT OF FRONT AXLE



6.4 DRIVING SPEED

DESCRIPTION		
Rear tire size		25 x 11 - 12
Forward / Low	km/h (MPH)	17 (10.6)
Forward / High		40 (24.9)
Reverse		25 (15.5)

- Calculation of driving speed

  : Engine rpm x CVT Pulley reduction ratio x Rotating speed ratio x Tire rolling circumference

1. Forward / Low : $2800 \text{ rpm} \times \frac{1}{0.68} \times \frac{15}{34} \times \frac{46}{52} \times \frac{10}{31} \times \frac{10}{37} = 140 \text{ rpm}$

   $140 \times 0.635 \times \pi \times \frac{60}{1000} = 17$

2. Forward / High : $2800 \text{ rpm} \times \frac{1}{0.68} \times \frac{31}{30} \times \frac{46}{52} \times \frac{10}{31} \times \frac{10}{37} = 328 \text{ rpm}$

   $328 \times 0.635 \times \pi \times \frac{60}{1000} = 40$

3. Reverse : $2800 \text{ rpm} \times \frac{1}{0.68} \times \frac{17}{26} \times \frac{46}{52} \times \frac{10}{31} \times \frac{10}{37} = 207 \text{ rpm}$

   $207 \times 0.635 \times \pi \times \frac{60}{1000} = 25$

Where ; 140 : Rear axle rpm, Forward / Low at engine rated speed (2,800 rpm)
328 : Rear axle rpm, Forward / High at engine rated speed (2,800 rpm)
207 : Rear axle rpm, Reverse at engine rated speed (2,800 rpm)
0.635 : Rear tire rolling diameter

7. MAINTENANCE

7.1 MAINTENANCE SCHEDULE CHART

No.	Item \ Maintenance interval		Run hour							Run age		Remarks	
			10	50	100	200	400	800	1000	1 year	2 year		
1	Engine oil and filter	Replace		⦿	○								
2	Fuel filter	Replace				○							#
3	Fuel line and hose connection	Check	⦿		○								
4	Fuel tank and its filler cap	Check			○								#
5	Air cleaner filter	Check			○							*1	#
		Replace								○		*2	
6	Air intake hose connection and filter body anti-dust valve	Check	⦿		○							*3	
7	Valve clearance	Check							○				
8	Injection nozzle	Check							○				#
9	Spark arrester	Check				○							#
10	Coolant	Replace									○		
11	Cooling system (radiator grill, coolant hose, cooling fan)	Check	⦿			○							
12	CVT belt	Check				○							
		Replace						○					
13	CVT pulley and system	Check					○						
14	Gearbox and front/rear axle oil	Check	⦿			○							
		Replace					○						
15	Hydraulic oil (if equipped with hydraulic kit)	Replace		⦿			○						
16	Pump, cylinder, levers, oil tank and hoses related to hydraulic kit (if equipped)	Check					○						
17	Brake fluid level	Check	⦿		○								
18	Front/rear wheel and parking brake pads	Check				○							
19	Suspension mounting bushing play and mounting rubber	Check				○							
20	Leakage from shock absorber	Check					○						
21	Wheel hub bearing clearance	Check							○				
22	Wheel hub bolt tightness	Check	⦿			○							
23	Other bolt tightness	Check				○							
24	Battery	Check				○						*3	
25	Steering rack and pinion, ball joint	Check					○						
26	Drive shaft and CV boots	Check		○									
27	ROPS and safety belt	Check	⦿			○							
28	Greasing drive shaft	Check			○								

IMPORTANT

- **⊙must be performed only 1 time after the initial of operation.**

  ***1 The air cleaner should be cleaned more frequently in dusty conditions than in normal conditions.**

  ***2 Every year or every 5 times of cleaning, whichever comes first.**

  ***3 Replace only if necessary.**

- **The items listed above (# marked) are registered as emission related critical parts by DAEDONG in the U.S.EPA exhaust emission standards non-road emission regulation. As the engine owner, you are responsible for the performance of the required maintenance on the engine according to the above instructions.**

7.2 LUBRICATION AND REPLENISHMENT

To prevent serious equipment damage, use only genuine DAEDONG oils or equivalents.

No	Item	Capacity	Lubricants
1	Fuel tank	28 ℓ (7.39 U.S.gal.)	Diesel fuel
2	Radiator & water tank	6.3 ℓ (1.66 U.S.gal.)	Fresh clean water with Ethylene glycol (50:50)
3	Engine crankcase	3.2 ℓ (0.85 U.S.gal.)	Engine oil: API Service Classification CC or CD, SAE 15W-40
4	Transmission case	0.9 ℓ (0.24 U.S.gal.)	SAE gear oil No. 90 or DAEDONG: UTF55 Shell: DONAX-TD Exxonmobil: Mobilfluid 423 or 424 BP: Tractran UTH
5	Front axle case	0.5 ℓ (0.13 U.S.gal.)	
6	Rear axle case	0.8 ℓ (0.2 U.S.gal.)	
7	Brake fluid tank	Max level after bleeding	DOT3 or equivalent
8	Front axle knuckle case Rear universal joint	Apply until grease leaks out from a gap other than grease nipple.	SAE multi-purpose grease.
9	Hydraulic oil tank (Option)	15 ℓ (3.97 U.S.gal.)	DAEDONG: UTF55 Shell: DONAX-TD Exxonmobil: Mobilfluid 423 or 424 BP: Tractran UTH

8. TIRE MAINTENANCE

8.1 SPECIFIED INFLATION PRESSURE

Tires	Front		Rear	
	Size	Inflation pressure	Size	Inflation pressure
Standard	25 x 10 - 12 6PR	0.84 kg/cm² 82.7 Kpa 12 psi	25 x 11 - 12 6PR	1.27 kg/cm² 124 Kpa 18 psi

8.2 TIGHTENING TORQUE FOR WHEEL


UUVW111A

UUVW109A

UUVW110A

Tightening Torque

Items		Tightening torque
Front	Wheel nut (1)	39.2 ~ 45.1 Nm 4.0 ~ 4.6 kgf-m 28.8 ~ 33.1 lb-ft
Rear	Wheel nut (2)	

9. TIGHTENING TORQUES

9.1 GENERAL USE SCREWS, BOLTS AND NUTS

Screws, bolts and nuts whose tightening torques are not specified in this workshop manual should be tightened according to the table below.

Mark on bolt head	4 No-grade or 4T						7 7T						9 9T		
Material of bolt	SS400, S20C						S43C, S48C						SCr435, SCM435		
Material of steel or gray iron part	Steel or gray iron			Aluminum			Steel or gray iron			Aluminum			Steel or gray iron		
Unit / Code	Nm	kgf-m	lb-ft	Nm	kgf-m	lb-ft	Nm	kgf-m	lb-ft	Nm	kgf-m	lb-ft	Nm	kgf-m	lb-ft
M6 (6 mm, 0.24 in.)	7.85 ~ 9.31	0.80 ~ 0.95	5.79 ~ 6.87	7.85 ~ 8.82	0.80 ~ 0.90	5.79 ~ 6.50	9.81 ~ 11.2	1.00 ~ 1.15	7.24 ~ 8.31	7.85 ~ 8.82	0.80 ~ 0.90	5.79 ~ 6.50	12.3 ~ 14.2	1.25 ~ 1.45	9.05 ~ 10.4
M8 (8 mm, 0.31 in.)	17.7 ~ 20.5	1.8 ~ 2.1	13.1 ~ 15.1	16.7 ~ 19.6	1.7 ~ 2.0	12.3 ~ 14.4	23.6 ~ 27.4	2.4 ~ 2.8	17.4 ~ 20.2	17.7 ~ 20.5	1.8 ~ 2.1	13.1 ~ 15.1	29.5 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
M10 (10 mm, 0.39 in.)	39.3 ~ 45.1	4.0 ~ 4.6	29.0 ~ 33.2	31.4 ~ 34.3	3.2 ~ 3.5	23.2 ~ 25.3	48.1 ~ 55.8	4.9 ~ 5.7	35.5 ~ 41.2	39.3 ~ 44.1	4.0 ~ 4.5	29.0 ~ 32.5	60.9 ~ 70.6	6.2 ~ 7.2	44.9 ~ 52.0
M12 (12 mm, 0.47 in.)	62.8 ~ 72.5	6.4 ~ 7.4	46.3 ~ 53.5				77.5 ~ 90.2	7.9 ~ 9.2	57.2 ~ 66.5	62.8 ~ 72.5	6.4 ~ 7.4	46.3 ~ 53.5	103 ~ 117	10.5 ~ 12.0	76.0 ~ 86.7
M14 (14 mm, 0.55 in.)	108 ~ 125	11.0 ~ 12.8	79.6 ~ 92.5				124 ~ 147	12.6 ~ 15.0	91.2 ~ 108				167 ~ 704	17.0 ~ 20.0	123 ~ 144
M16 (16 mm, 0.63 in.)	167 ~ 191	17.0 ~ 19.5	123 ~ 141				197 ~ 225	20.0 ~ 23.0	145 ~ 166				260 ~ 304	26.5 ~ 31.0	192 ~ 224
M18 (18 mm, 0.71 in.)	246 ~ 284	25.0 ~ 29.0	181 ~ 209				275 ~ 318	28.0 ~ 32.5	203 ~ 235				344 ~ 402	35.0 ~ 41.0	254 ~ 296
M20 (20 mm, 0.79 in.)	334 ~ 392	34.0 ~ 40.0	246 ~ 289				368 ~ 431	37.5 ~ 44.0	272 ~ 318				491 ~ 568	50.0 ~ 58.0	362 ~ 419

9.2 STUD

Material of component part	Steel or gray iron			Aluminum		
Unit / Diameter	Nm	kgf-m	lb-ft	Nm	kgf-m	lb-ft
M8 (8 mm, 0.31 in.)	11.6 ~ 15.6	1.2 ~ 1.6	8.68 ~ 11.5	8.82 ~ 11.6	0.90 ~ 1.2	6.51 ~ 8.67
M10 (10 mm, 0.39 in.)	24.6 ~ 31.3	2.5 ~ 3.2	18.1 ~ 23.1	19.7 ~ 25.4	2.0 ~ 2.6	14.5 ~ 18.8
M12 (12 mm, 0.47 in.)	29.5 ~ 49.0	3.0 ~ 5.0	21.7 ~ 36.1	31.4	3.2	23.1

9.3 AMERICAN STANDARD SCREWS, BOLTS AND NUTS WITH UNC OR UNF THREADS

Grade / Unit	SAE GR.5			SAE GR.5		
Diameter	Nm	kgf-m	lb-ft	Nm	kgf-m	lb-ft
5/16	23.1 ~ 27.8	2.35 ~ 2.84	17.0 ~ 20.5	32.5 ~ 39.3	3.31 ~ 4.01	24.0 ~ 29.0
3/8	47.5 ~ 57.0	4.84 ~ 5.82	35.0 ~ 42.0	61.0 ~ 73.2	6.22 ~ 7.47	45.0 ~ 54.0
1/2	108.5 ~ 130.2	11.07 ~ 13.29	80.0 ~ 96.0	149.2 ~ 179.0	15.22 ~ 16.27	110.0 ~ 132.0
9/16	149.2 ~ 179.0	15.22 ~ 18.27	110.0 ~ 132.0	217.0 ~ 260.4	22.14 ~ 26.57	160.0 ~ 192.0
5/8	203.4 ~ 244.1	20.75 ~ 24.91	150.0 ~ 180.0	298.3 ~ 358.0	30.44 ~ 36.53	220.0 ~ 264.0

10. PART NUMBER ASSIGNMENT STANDARD FOR DAEDONG BOLTS AND NUTS

10.1 BOLTS

0 1 1 3 3 - 5 1 0 5 5

Length: 55 mm

※ In case the bolt length is over 100 mm, its length is identified by the last number.

Bolt size: M10

Plating

5	MFZn5-C (Electric zinc)
6	MFZn5-G (Green chromate)
0	No plating

Hardness and thread

0	4T	Partial thread (bolt)	* Hardness is shown on the head of bolt. (with number or punching)
2	4T	Full thread (set screw)	
3	7T	Partial thread (bolt)	
5	7T	Full thread (set screw)	
6	9T	Partial thread (bolt)	

Spring washer and pitch

No.	Spring washer	Pitch	M5	M6	M8	M10	M12	M14	M16	M18	M20
2	Yes	Regular	0.8	1	1.25	1.5	1.75	2	2	2.5	2.5
3	Yes	Fine	-	-	1	1.25	1.25	1.5	1.5	1.5	1.5
5	No	Regular	0.8	1	1.25	1.5	1.75	2	2	2.5	2.5
7	No	Fine	-	-	1	1.25	1.25	1.5	1.5	1.5	1.5

Head size (mm)

No.	Type	M5	M6	M8	M10	M12	M14	M16	M18	M20
0	Regular	8	10	13	17	19	22	24	27	30
1	Small	-	-	12	14	17	19	22	24	27

Part name (bolt)

Example) 01120-50850

This is a zinc-plated 4T partial thread screw which its spring washer thread pitch is 1.25 mm, head size is 12 mm, diameter is 8 mm and length is 50 mm.

10.2 NUTS

0 2 1 1 4 - 5 0 0 8 0

Nut size: M8

Plating number

5	MFzn5-C (Electric zinc plated)
6	MFzn5-GR (Electric flat chrome plated)
0	No plating

Hardness, pitch, width

Item	Hardness	Thread	Height	Remarks
54	4T	Regular	Type 2	• Height - Type 2: longer - Type 3: shorter • Hardness - For 6T nut, its hardness is indicated in number or chronometric method. - For 4T nut, its hardness is not usually indicated.
52	4T	Regular	Type 3	
74	4T	Fine	Type 2	
72	4T	Fine	Type 3	
14	4T	Regular	Type 2	
12	4T	Regular	Type 3	
56	6T	Regular	Type 2	
18	4T	Fine	Type 2	
16	4T	Fine	Type 3	
76	6T	Fine	Type 2	

Cross distance

0	Regular
1	Small

Part name: nut

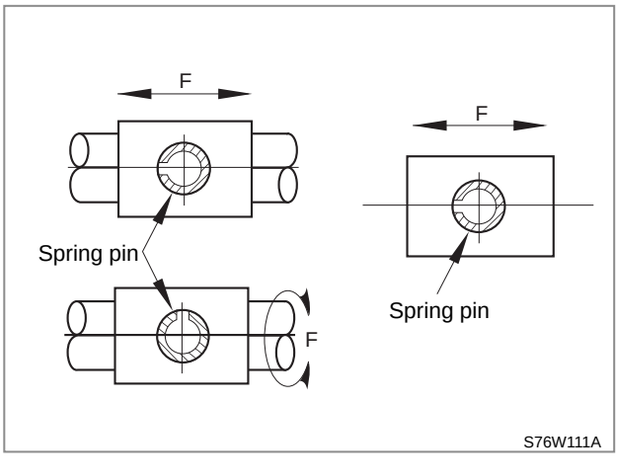
▶ NUT SPECIFICATION STANDARD TABLE

Item		No.	M5	M6	M8	M10	M12	M14	M16	M18	M20	M22
Pitch	Regular	-	1	1	1.25	1.5	1.75	2	2	2.5	2.5	2.5
	Fine	-	-	-	1	1.25	1.25	1.5	1.5	1.5	1.5	1.5
Cross distance	Regular	0	8	10	13	17	19	22	24	27	30	32
	Small	1	-	-	12	14	17	19	22	24	27	30
Height	Type 2	-	4	5	6.5	8	10	11	13	15	16	18
	Type 3	-	3	3.6	5	6	7	8	10	11	12	13

11. HOW TO INSTALL SPRING PIN AND SNAP RING

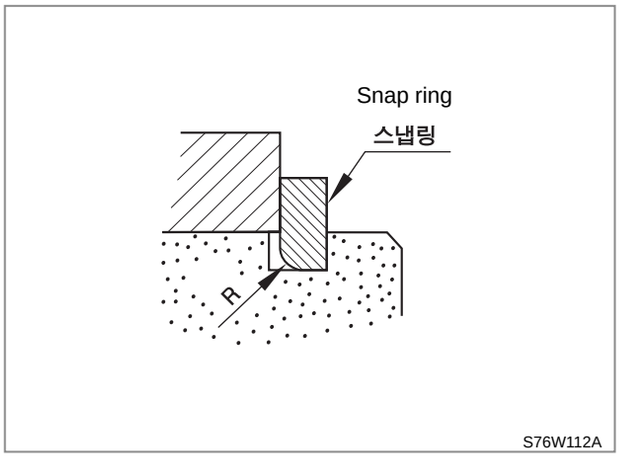
11.1 SPRING PIN INSTALLATION

Since a spring pin can be displaced depending on its direction that may cause shaking, it should be assembled, its split groove face the directin from which a force is applied.



11.2 SNAP RING ASSEMBLY

In order to prevent displacement of a snap ring, assemble its rounded area (R) against the opponent part as seen in the picture below.



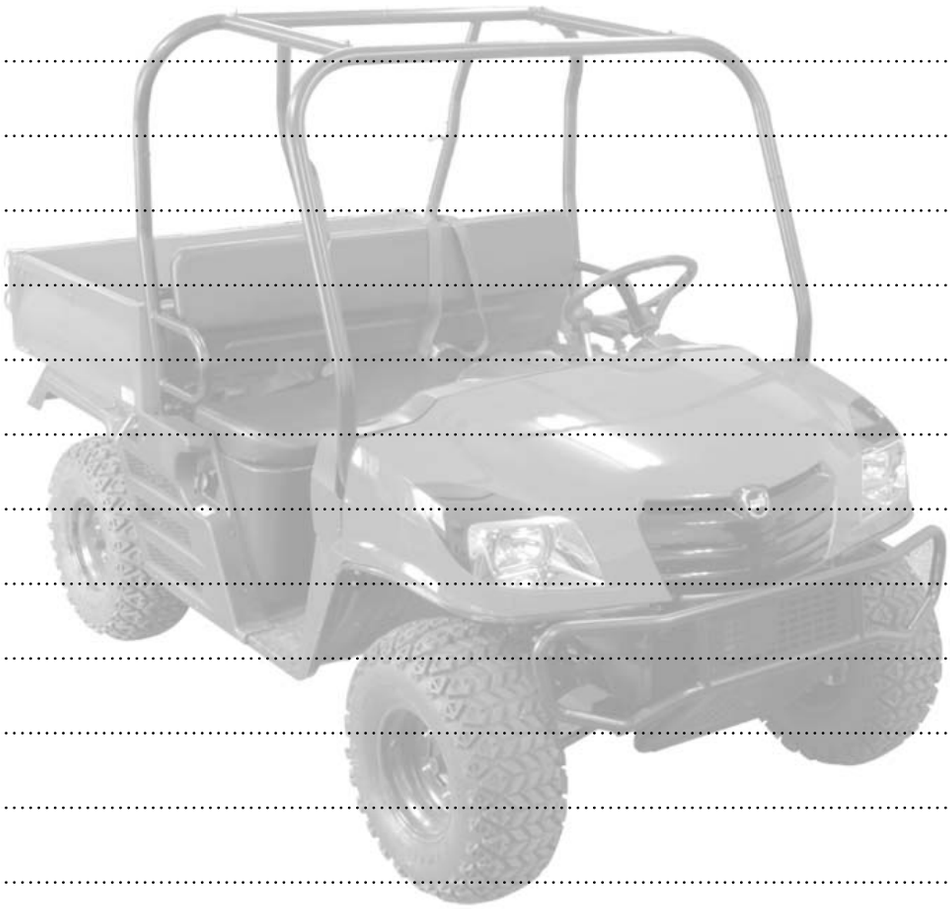
12. UNIT CONVERSION TABLE

Torque		
Nm	x 0.738	lbf-ft
lbf-ft	x 1.356	Nm
kgf-m	x 9.8	Nm
Nm	x 0.102	kgf-m
kgf-m	x 7.2	lbf-ft
lbf-ft	x 0.139	kgf-m
Capacity		
ℓ	x 0.2640	U.S.gal.
U.S.gal.	x 3.7850	ℓ
gal	x 1.2010	U.S.gal.
U.S.gal.	x 0.8330	gal
ℓ	x 0.2200	gal
gal	x 4.5640	ℓ
mℓ	x 0.0351	fl oz
fl oz	x 28.413	mℓ
Length		
in.	x 25.400	mm
mm	x 0.0394	in.
m	x 3.2808	ft
ft	x 0.3048	m
km	x 0.6214	mile
mile	x 1.6093	km
Volume		
m^3	x 35.315	ft^3
ft^3	x 0.0283	m^3
cm^3	x 0.06102	in^3
in^3	x 16.387	cm^3

Pressure		
kgf/cm^2	x 98	kPa
kPa	x 0.0102	kgf/cm^2
kgf/cm^2	x 14.22	psi
psi	x 0.0703	kgf/cm^2
kPa	x 0.1451	psi
psi	x 6.8917	kPa
bar	x 14.504	psi
psi	x 0.0690	bar
Temperature		
°C	°C x 1.8 + 32	°F
°F	(°F-32)/1.8	°C
Power		
ps	x 0.9863	hp
hp	x 1.0139	ps
kw	x 1.3410	hp
hp	x 0.7457	kw
Speed		
km/h	x 0.6214	mph
mph	x 1.6093	km/h
Dimension		
mm^2	x 0.0016	in^2
in^2	x 645.16	mm^2
m^2	x 10.764	ft^2
ft^2	x 0.0929	m^2
ha	x 2.4711	acre
acre	x 0.4047	ha

Weight		
g	x 0.0353	oz
oz	x 28.350	g
kg	x 2.2046	lb
lb	x 0.4536	kg
kg	x 0.00098	UK ton
UK ton	x 1016.1	kg
t	x 0.9842	UK ton
UK ton	x 1.016	t
t	x 1.1023	US ton
US ton	x 0.9072	t

MEMO



ENGINE

CHAPTER 3

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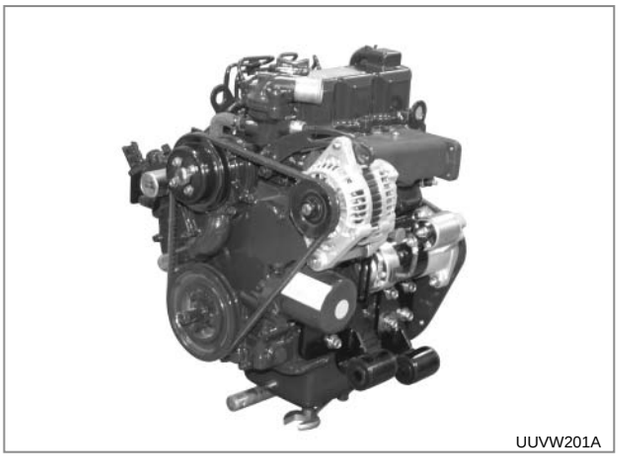
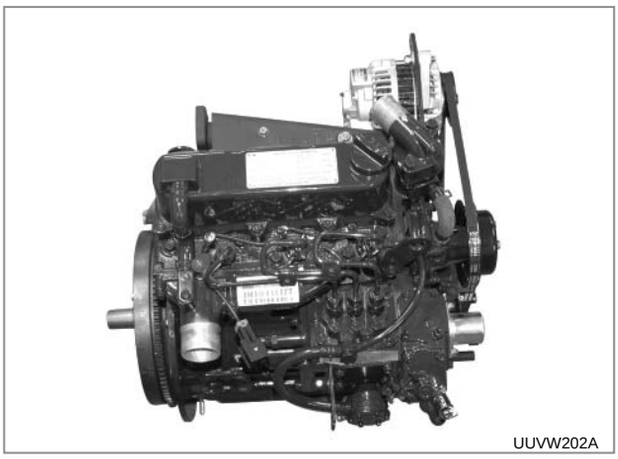
1. GENERAL INFORMATION

1.1 ENGINE VIEWS


UUVW201A

1.2 ENGINE IDENTIFICATION


UUVW202A

- **ENGINE EPA PLATE**

UUVW203A

This aluminum plate is riveted on the engine cylinder head cover. This provides the information such as model number, displacement, rated output, valve clearance, injection timing, etc.

This plate represents that this engine is in compliance with the U.S.EPA and California (CARB) exhaust emission regulation.

- **ENGINE NUMBER**

The engine number is stamped on the cylinder block where the fuel injection pump is installed.

IMPORTANT

The engine number is necessary information that is requisite for the warranty registration form. This number should be on the form as well as the UTV number and the amount of runtime.

Engine number assignment standard

J K 1 9 0 0 0 0 6

- Production serial number
- Engine model

K19	3C100 LWU

- Year of manufacturing

⋮	⋮
1	2001
2	2002
3	2003
D	2004
E	2005
F	2006
G	2007
H	2008
J	2009
⋮	⋮

Engine model code assignment standard

3 C 1 0 0 L W U

- Utility
- Tier 3 type
- Displacement

100	Approx. 1,007 cc

- Stroke

A	92.4 mm (3.638 in.)
B	102.4 mm (4.031 in.)
C	76.0 mm (2.992 in.)

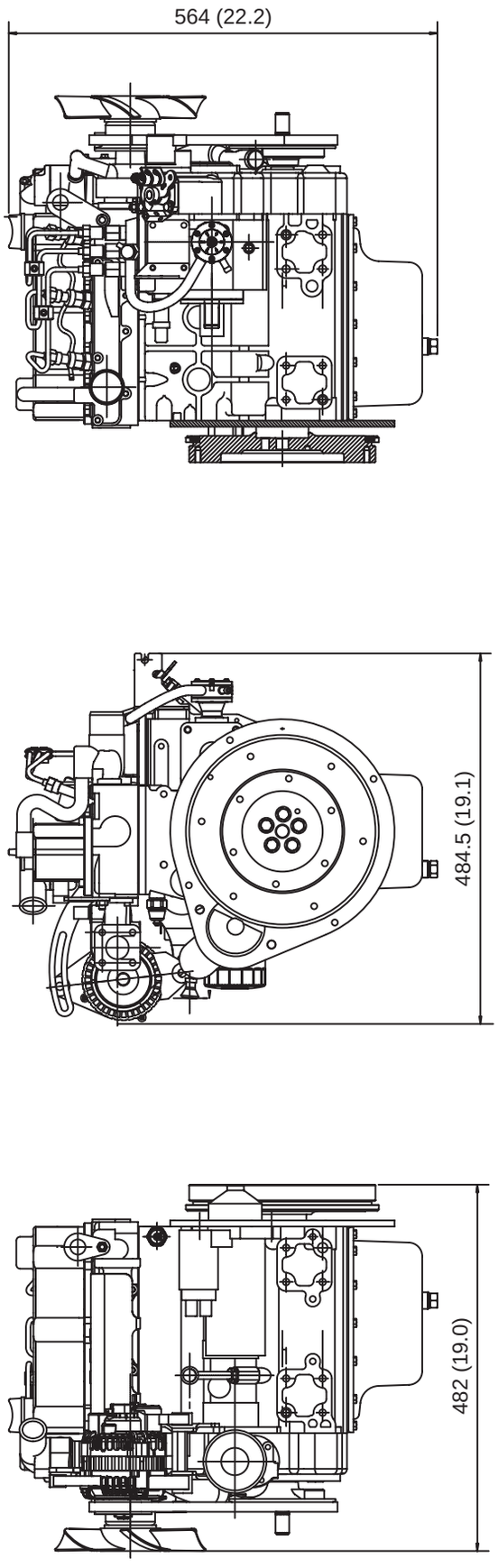
- Number of cylinders

3	3 cylinders

2. SPECIFICATIONS

2.1 ENGINE DIMENSIONS

mm (in.)



UUVW204A

2.2 GENERAL SPECIFICATIONS

DESCRIPTION	
Engine model	**3C100LWU**
Bore I.D. × Stroke	Ø 75×76 mm (Ø 2.953 x 2.992 in.)
Honing	Plateau honing
Number of cylinders	3
Ignition sequence	1 - 2 - 3
Displacement cc (cu)	1,007 (61.45)
Max./Min. speed rpm	3,000 / 1,000
Max. power(Gross) HP (KW) / rpm	22 (16.2) / 2,800
Max. torque	6.5 kgf-m / 1,900 rpm (46.8 lb-ft / 1,900 rpm)
Compression ratio	21.5 : 1
Combustion chamber type	Indirect injection type (Vortex chamber type)
Injection timing (BTDC)	18°
Fuel injection pump type	CTD Pump
Injection pressure	145 Kgf/cm² (2,062 psi)
Engine oil capacity	3.2 ℓ (0.84 U.S. gal.)
Engine oil specification	SAE 15W 40, CD or higher of API grade
Coolant capacity	6.3 ℓ (1.66 U.S. gal.)
Anti-freeze	Ethylene glycol 50% with anti-corrosive agent

- The engine gross power is measured without cooling fan and generator.
- The cylinder number for ignition sequence is given from the cylinder on the engine cooling fan side.
- If the coolant level drops due to evaporation, add water only. If the coolant level drops due to leakage, add coolant mixed with anti-freeze.
- The freezing point of the 50% coolant mixture is -37°C (-34°F) in a normal condition.
- If the coolant needs to be changed with another type, the cooling system should be flushed thoroughly before its use.

2.3 SERVICE SPECIFICATIONS

2.3.1 CYLINDER HEAD

Item	Reference Value	Allowable Limit
Distortion of cylinder head surface length.	-	0.05 mm (0.0020 in.) / 100 mm (4 in.) of cylinder head surface length.
Thickness of gasket	When tightened 1.15 ~ 1.25 mm (0.045 ~ 0.049 in.)	-
Top clearance	0.7 ~ 0.9 mm (0.0275 ~ 0.0354 in.)	-
Tightness of head bolts	Refer to “NOTE” in 2.3.15 “TIGHTENING TORQUE”	-

2.3.2 VALVES

Item	Reference Value	Allowable Limit
Valve seat width	2.1 mm 0.083 in.	-
Valve seat angle (intake, exhaust)	1.047, 0.785 rad. 60°, 45°	-
O.D. of valve stems (intake, exhaust)	6.960 ~ 6.975 mm 0.2740 ~ 0.2746 in.	-
I.D. of valve guides (intake, exhaust)	7.010 ~ 7.025 mm 0.2759 ~ 0.2765 in.	-
Clearance between valve stems and guides	0.035 ~ 0.065 mm 0.0014 ~ 0.0026 in.	0.1 mm 0.004 in.
Valve recessing	-0.05 ~ +0.15 mm -0.002 ~ +0.006 in.	1.3 mm 0.051 in.
Valve clearance (intake, exhaust) cold	0.15 mm 0.006 in	-

2.3.3 VALVE SPRINGS

Item	Reference Value	Allowable Limit
Free length	35.1 ~ 35.6 mm 1.382 ~ 1.402 in.	34.8 mm 1.37 in.
Fitted length	30.99 mm 1.2201 in.	-
Load to compress to fitted length	74 N / 31 mm 7.5 kgf / 31 mm, 16.5 lbs / 1.22 in.	63 N / 31 mm 6.4 kgf / 31 mm, 14.1 lbs / 1.22 in.
Squareness	1.3 mm 0.051 in.	-

2.3.4 VALVE ROCKER ARMS

Item	Reference Value	Allowable Limit
O.D. of rocker arm shafts	12.955 ~ 12.980 mm 0.5100 ~ 0.5110 in.	-
I.D. of rocker arm bushings	13.000 ~ 13.025 mm 0.5118 ~ 0.5128 in.	-
Clearance between rocker arm shafts and bushings	0.02 ~ 0.07 mm 0.0008 ~ 0.0027 in.	0.12 mm 0.0047 in.
Adjustment of compression release	0.750 ~ 1.125 mm 0.0295 ~ 0.0443 in.	-

2.3.5 CAMSHAFT

Item		Reference Value	Allowable Limit
O.D. of camshaft bearing journal		32.934 ~ 32.950 mm 1.2966 ~ 1.2972 in.	-
I.D. of camshaft bearing		33.000 ~ 33.025 mm 1.2992 ~ 1.3002 in.	-
Clearance between camshaft bearing journals and bearings		0.050 ~ 0.091 mm 0.0020 ~ 0.0036 in.	0.15 mm 0.0020 in.
Alignment of camshaft		-	0.05 mm 0.0020 in.
Cam height	Intake	26.75 mm 1.0530 in.	26.83 mm 1.0563 in.
	Exhaust	26.88 mm 1.0583 in.	26.88 mm 1.0583 in.
Gear backlash		0.042 ~ 0.115 mm 0.0017 ~ 0.0045 in.	0.2 mm 0.0079 in.

2.3.6 PISTON RINGS

Item		Reference Value	Allowable Limit
Ring gap	Top ring	0.15 ~ 0.30 mm 0.0059 ~ 0.0118 in.	1.25 mm 0.0492 in.
	2nd ring	0.30 ~ 0.45 mm 0.0118 ~ 0.0177 in.	1.25 mm 0.0492 in.
	Oil ring	0.20 ~ 0.35 mm 0.0079 ~ 0.0138 in.	1.25 mm 0.0492 in.
Side clearance of ring in groove	Top ring	-	-
	2nd ring	0.04 ~ 0.08 mm 0.0016 ~ 0.0031 in.	-
	Oil ring	0.02 ~ 0.06 mm 0.0008 ~ 0.0024 in.	-

2.3.7 PISTONS

Item	Reference Value	Allowable Limit
I.D. of piston bosses	20.000 ~ 20.013 mm 0.7874 ~ 0.7879 in.	20.03 mm 0.7885 in.
O.D. of piston pin	20.002 ~ 20.011 mm 0.7875 ~ 0.7878 in.	-
I.D. of connecting rod small end bushings (fitted)	20.025 ~ 20.040 mm 0.7884 ~ 0.7890 in.	-
Clearance between piston pin and small end bushings	0.014 ~ 0.038 mm 0.0006 ~ 0.0015 in.	0.15 mm 0.0059 in.
Connecting rod alignment	0.02 mm 0.0008 in.	0.05 mm 0.0020 in.

2.3.8 CRANKSHAFT

Item	Reference Value	Allowable Limit
Crankshaft alignment	0.02 mm 0.0008 in.	0.08 mm 0.0031 in.
O.D. of crankshaft journals	47.934 ~ 47.950 mm 1.8872 ~ 1.8878 in.	-
I.D. of crankshaft bearing 1	48.068 ~ 48.138 mm 1.8924 ~ 1.8952 in.	-
I.D. of crankshaft bearing 2	47.980 ~ 48.006 mm 1.8890 ~ 1.8900 in.	-
Clearance between crankshaft journals and bearing 1	0.118 ~ 0.204 mm 0.0046 ~ 0.0080 in.	0.20 mm 0.0079 in.
Clearance between crankshaft journals and bearing 2	0.030 ~ 0.072 mm 0.0012 ~ 0.0028 in.	0.20 mm 0.0079 in.
O.D. of crankpins	39.959 ~ 39.975 mm 1.5732 ~ 1.5738 in.	-
I.D. of crankpin bearings	39.994 ~ 40.020 mm 1.5746 ~ 1.5756 in.	-
Clearance between crankpins and bearings	0.035 ~ 0.061 mm 0.0014 ~ 0.0024 in.	0.20 mm 0.0079 in.
End play of crankshaft	0.15 ~ 0.31 mm 0.0059 ~ 0.0122 in.	0.5 mm 0.0197 in.

2.3.9 FUEL INJECTION NOZZLES

Item	Reference Value	Allowable Limit
Opening pressure	14.2 ~ 15.2 MPa 145 ~ 155 kgf/cm², 2,062 ~ 2,204 psi.	-
Fuel tightness of nozzle valve seat	Dry nozzle at 12.7 MPa 130 kgf/cm², 1,848.6 psi.	-

2.3.10 INJECTION PUMP

Item	Reference Value	Allowable Limit
Tightness of plunger	More than 60 seconds; initial pressure from 34.32 ~ 39.23 MPa 350 ~ 400 kgf/cm^2, 4,978 ~ 5,689 psi.	30 seconds
Tightness of delivery valve	More than 10 seconds; initial pressure from 20.59 ~ 21.57 MPa 210 ~ 220 kgf/cm^2, 2,987 ~ 3,129 psi	5 seconds
Injection timing	22° Before Top Dead Center	-

2.3.11 OIL PUMP

Item		Reference Value	Allowable Limit
Oil pressure	At rated speed	245 ~ 441 kPa 2.5 ~ 4.5 kgf/cm^2, 36 ~ 64 psi.	245 kPa 2.5 kgf/cm^2, 36 psi
	At idle speed	More than 49 kPa 0.5 kgf/cm^2, 7.11 psi.	-
Rotor type	Rotor lobe clearance	0.11 ~ 0.15 mm 0.0043 ~ 0.0059 in.	0.20 mm 0.0079 in.
	Radial clearance between outer rotor and pump body	0.07 ~ 0.15 mm 0.0028 ~ 0.0059 in.	0.25 mm 0.0098 in.
End clearance between rotor and cover		0.105 ~ 0.150 mm 0.00413 ~ 0.00591 in.	0.2 mm 0.0079 in.

2.3.12 RADIATOR

Item	Reference Value	Allowable Limit
Opening pressure of cap	88.3 kPa 0.9 kgf/cm^2, 12.8 psi.	-
Test pressure	88.3 kPa 0.9 kgf/cm^2, 12.8 psi.	-

2.3.13 THERMOSTAT

Item		Reference Value	Allowable Limit
Opening temperature of cap	Beginning	69.5°C ~ 72.5°C 157.1°F ~ 162.5°F	-
	Full-open	85°C 185°F	-
Distance of lift		8 mm 0.3150 in.	-

2.3.14 FANBELT

Item	Reference Value	Allowable Limit
Belt sag under load of 78.5 N (8 kgf, 17.6 lbs.)	8 mm (0.32 in.)	-

2.3.15 TIGHTENING TORQUE

Indicate the bolts with ■ mark and manually tighten first.

Item		Nm	kgf-m	lb-ft
Head bolt		Refer to "NOTE" below		
■ Bearing case bolt 1		20.0 ~ 24.0	2.0 ~ 2.4	15.0 ~ 17.0
■ Bearing case bolt 2		29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
■ Flywheel bolt		53.9 ~ 58.8	5.5 ~ 6.0	39.7 ~ 43.4
■ Connecting rod bolt		26.5 ~ 30.4	2.7 ~ 3.1	19.5 ~ 22.4
Rocker arm bracket sink bolt		23.5 ~ 27.5	2.4 ~ 2.8	17.4 ~ 20.3
Idle gear shaft bolt		7.8 ~ 9.8	0.8 ~ 1.0	5.7 ~ 7.2
Glow plug (No lubrication)		19.6 ~ 24.5	2.0 ~ 2.5	14.4 ~ 18.1
Waste oil plug		32.4 ~ 37.3	3.3 ~ 3.8	23.9 ~ 27.5
Nozzle holder		49.0 ~ 68.6	5.0 ~ 7.0	36.1 ~ 50.5
Overflow pipe nut		29.4 ~ 34.3	3.0 ~ 3.5	21.7 ~ 25.3
Oil switch	Bis	1.4 ~ 1.9	0.14 ~ 0.20	1.0 ~ 1.4
	Taper screw	14.7 ~ 19.6	1.5 ~ 2.0	10.8 ~ 14.5
Fuel supply limit cap nut		27.5 ~ 34.3	2.8 ~ 3.5	20.3 ~ 25.3
Idle limit fixing nut		13.7 ~ 15.7	1.4 ~ 1.6	10.1 ~ 11.5
Injection pipe nut		24.5 ~ 34.3	2.5 ~ 3.5	18.0 ~ 25.3
Crankshaft nut		137.2 ~ 156.9	14 ~ 16	101.2 ~ 115.7

⚠ CAUTION

- **For ■ maked bolts on the table, apply engine oil to their threads and seats before tightening.**

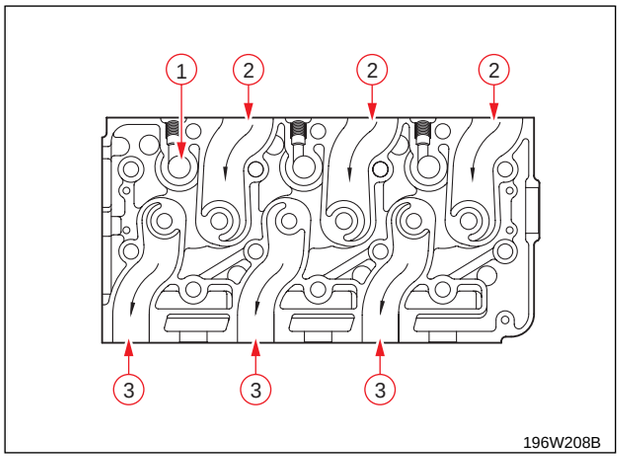
NOTE

- **Tightening torque for cylinder head bolts**
  Tightening order (using the angle controlled tightening method)
  1st step: Tighten the bolts to 2.5 kgf-m (24.5 Nm, 18.0 lb-ft)
  2nd step: Rotate the bolts additional 90°
  3rd step: Rotate the bolts additional 70°
- **For more details, refer to 6.2.1 “Cylinder head disassembly and assembly.”**

3. STRUCTURE AND FUNCTION

3.1 BODY AND POWER TRAIN

3.1.1 CYLINDER HEAD



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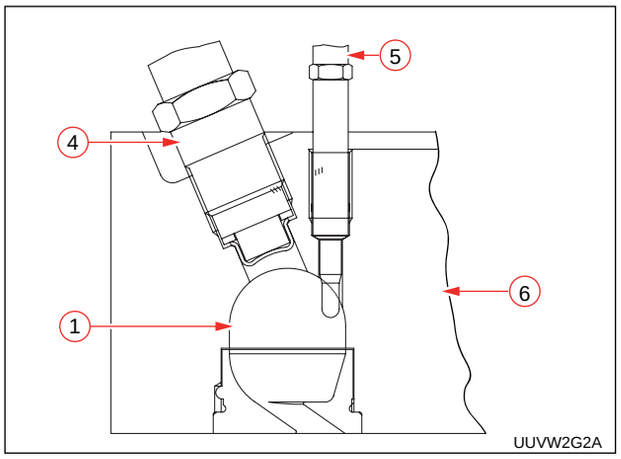


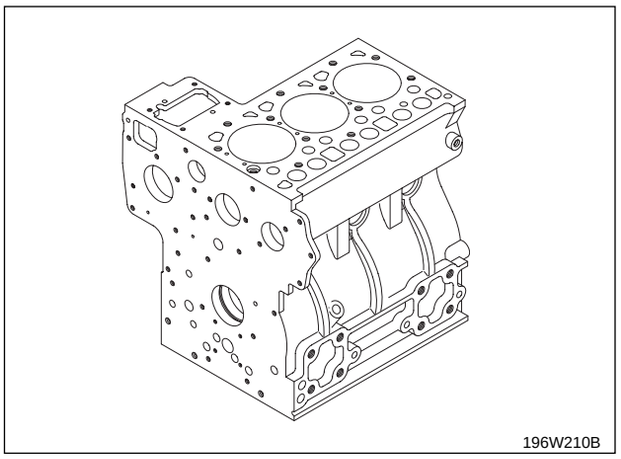
UUVW2G2A

(1) Combustion chamber
(2) Inlet port
(3) Exhaust port
(4) Nozzle assembly
(5) Glow plug
(6) Cylinder head

The cylinder head has openings on both sides that allow cross-flow type inlet/exhaust ports to the engine. Because the inlet/exhaust ports overlap and are smaller than other ports, the suction air can be protected from being heated and expanded by exhaust air. The cool, high mass suction air has a high,large effectiveness and raises the power of the engine. Deformation of the cylinder head by heat exhaust air is reduced because inlet ports are arranged alternately. The combustion chamber is of DAEDONG' s select circular combustion chamber type. Suction air is combustion and reduces fuel consumption. Throttle type injection nozzles and rapid heating enclosed glow plugs are installed in the combustion chamber.

This glow plug assures easier engine starts even at a temperature of -15°C (5°F).

3.1.2 CYLINDER BLOCK


196W210B

The engine features a high resilience tunnel-type cylinder block. Pressure-fitted cylinders allow effective cooling, less distortion, higher wear-resistance qualities and each cylinder having its own chamber helps to minimize noise.

REMARK

- **CYLINDER HONING**

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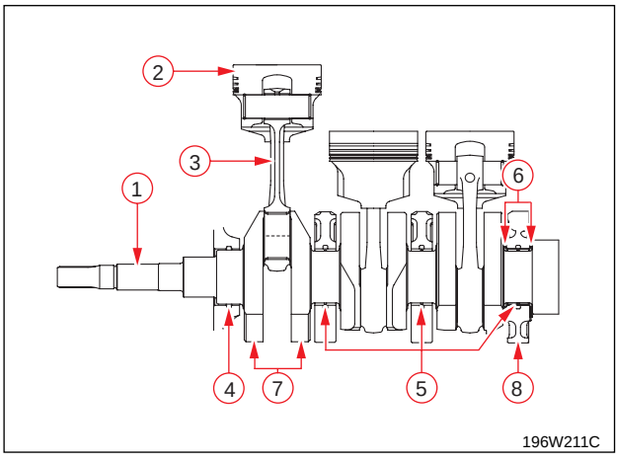
3.1.3 CRANKSHAFT



(1) Crankshaft
(2) Piston
(3) Connecting rod
(4) Crankshaft bearing 1
(5) Crankshaft bearing 2
(6) Thrust bearing
(7) Counterweight
(8) Main bearing case

The crankshaft drives the pistons and connecting rods, and transfers its reciprocating movement to a circular camshaft. Six counterweights are integrated into one unit to minimize bearing wear and lubricating oil temperature rise.

Seal sliding sections are induction-hardened to raise wear resistance quality.

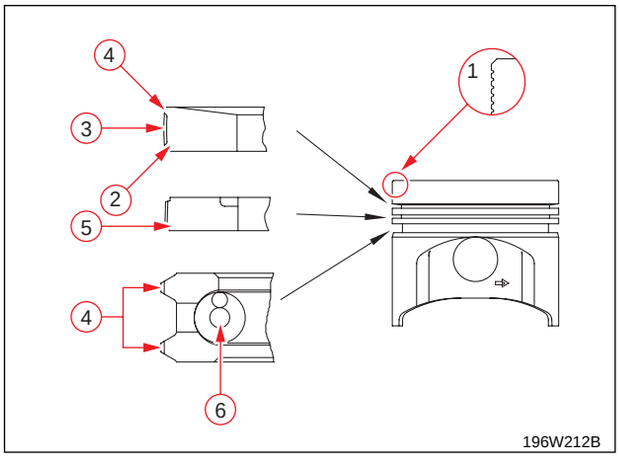
Crankshaft journals are supported by the main bearing cases in which bearings are used.

Crankshaft bearing 1 at the front end is a wind type bushing.

Thrust bearing 1, 2 of split type are mounted on both sides of the main bearing case at the flywheel side.

Crankshaft bearing and thrust bearings are plated with special raised alloy wear resistance.

3.1.4 PISTON AND PISTON RINGS



(1) Rib
(2) Top ring
(3) Surface
(4) Hard chrome
(5) 2nd ring
(6) Coil expander ring

Piston circumference has special elliptic shape in consideration of expansion due to heat. The piston head is flat formed and ribbed to reduce distortion and to help heat radiation.

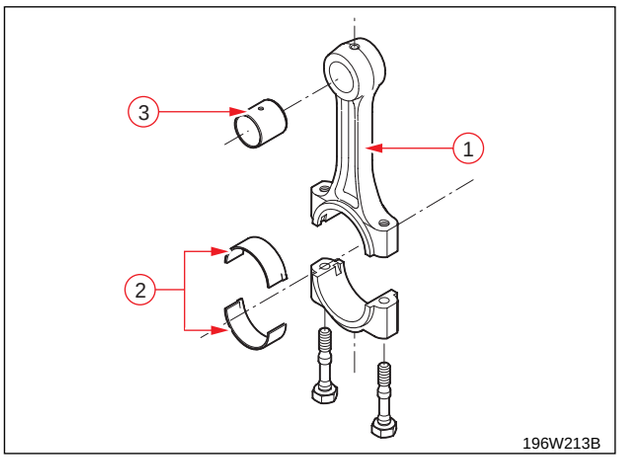
Pistons are made of special aluminum alloy of low thermal expansion and high temperature resistance. The key stone type top ring is well fitted to the wall and plated with hard chrome.

Second ring type is effective in preventing oil rising.

The oil ring is effective because it is closely fitted to the cylinder wall by a coil so oil can be scraped from the upper and lower ends of its sliding cylinder walls.

A portion of the scraped oil is forced inside the piston through escape holes of the. rings and pistons. The oil ring is plated with hard chrome to raise the wear resistance quality.

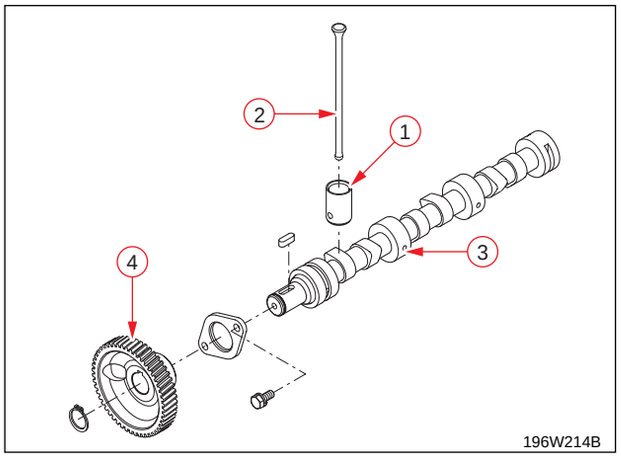
3.1.5 CONNECTING RODS

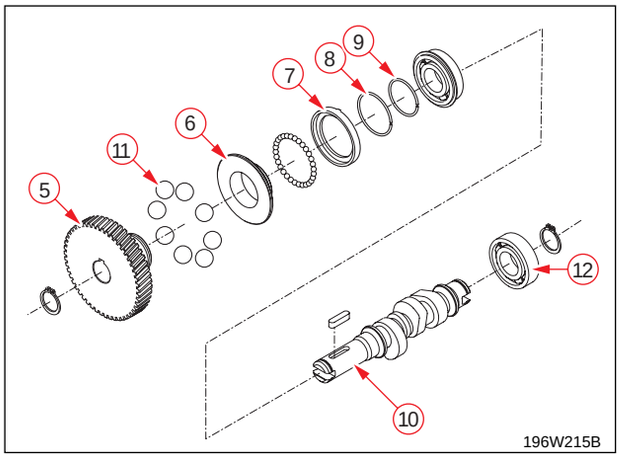


(1) Connecting rod
(2) Crankpin bearing
(3) Bushing

The connecting rod is used to connect the piston with the crankshaft. The big end of this rod has crankpin bearings (split type) and the small end has a bushing (solid type).

3.1.6 CAMSHAFT AND FUEL CAMSHAFT

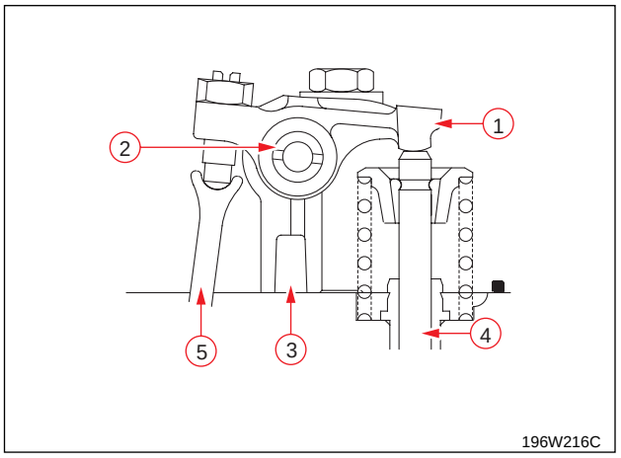




(1) Tappet
(2) Push rod
(3) Camshaft
(4) Camshaft gear
(5) Injection pump gear
(6) Governor sleeve
(7) Governor ball case
(8) Cir-clip
(9) Cir-clip
(10) Fuel camshaft
(11) Ball
(12) Ball bearing

The camshaft is made of special cast iron; the journal and cam sections are chromed to resist wear. The journal sections are force-lubricated. The fuel camshaft controls the reciprocating movement of the injection pump, and is also equipped with a ball to control the governor. Fuel camshaft is made of carbon steel and cam sections are covered and tempered to provide greater wear resistance.

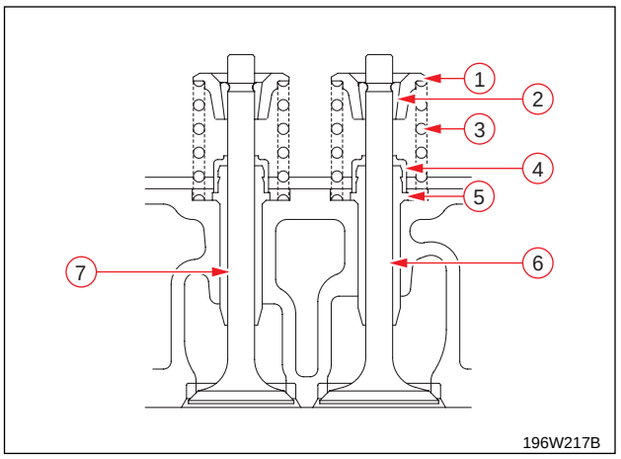
3.1.7 ROCKER ARM ASSEMBLY



(1) Rocker arm
(2) Rocker arm shaft
(3) Rocker arm bracket
(4) Valve
(5) Push rod

The rocker arm assembly includes the rocker arms, arm brackets and arm shafts and converts the movement of the push rods to open/close of the inlet and exhaust valves. Valve controlled timing must be adjusted with screws on the rocker arms. Lubrication oil is pressurized through arm bearings and the entire system is lubricated.

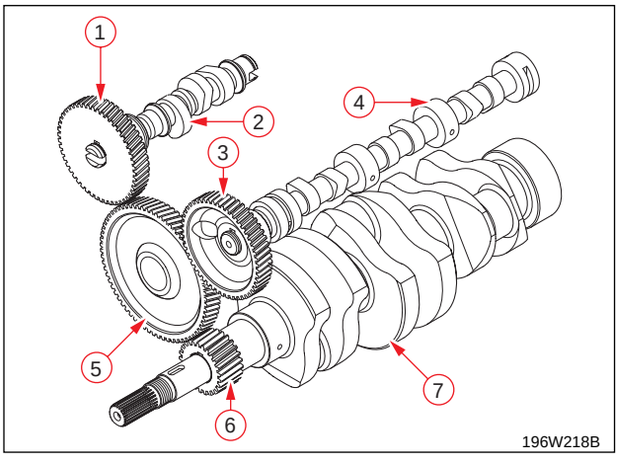
3.1.8 INLET AND EXHAUST VALVES



(1) Valve spring retainer
(2) Valve spring collets
(3) Valve spring
(4) Valve stem seal
(5) Valve guide
(6) Intel valve
(7) Exhaust valve

The inlet and exhaust valves and their guides,are different from each other. Other parts, such as valve springs, spring retainers, valve spring collets, valve stem seals,valves,and all contact or sliding parts,are covered and tempered to resist, wear.

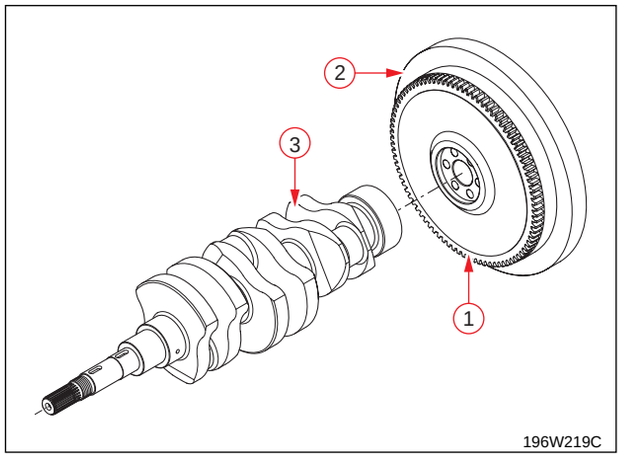
3.1.9 TIMING GEARS



(1) Injection pump gear
(2) Fuel camshaft
(3) Camshaft gear
(4) Camshaft
(5) Idle gear
(6) Crankshaft gear
(7) Crankshaft

The crankshaft drives the oil pump and the idle gear engages the fuel camshaft and engine camshaft. The timings for opening and closing the valve are extremely important to achieve effective air intake and sufficient gas exhaust. The appropriate timing can be obtained when assembling by aligning the mark on the crankshaft gear either with (6) the one on the idle gear or (5), the idle gear with camshaft gear (3), idle gear (5) or with injection pump gear (1).

3.1.10 FLYWHEEL

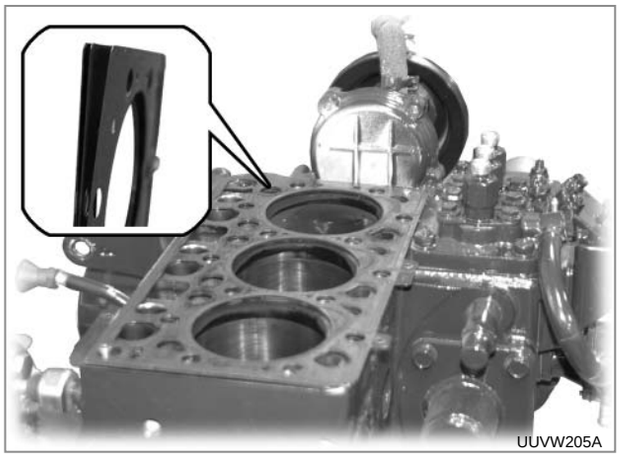


(1) Ring gear
(2) Flywheel
(3) Crankshaft

The flywheel is installed on the rear end of the crankshaft and keeps the flywheel turning at a constant speed. While the crankshaft tends to speed up during the power stroke it slows down during other strokes. The flywheel has a ring gear (1), which meshes with the drive pinion of the starter. The flywheel has marks “TC” and “FI” on its outer rim. The mark TC shows the piston’s top dead center and the mark FI shows the fuel injection timing, when they are aligned with the mark of window on the clutch housing.

- Injection sequence
  Three cylinders: 1 → 2 → 3

3.1.11 MLS CYLINDER HEAD GASKET

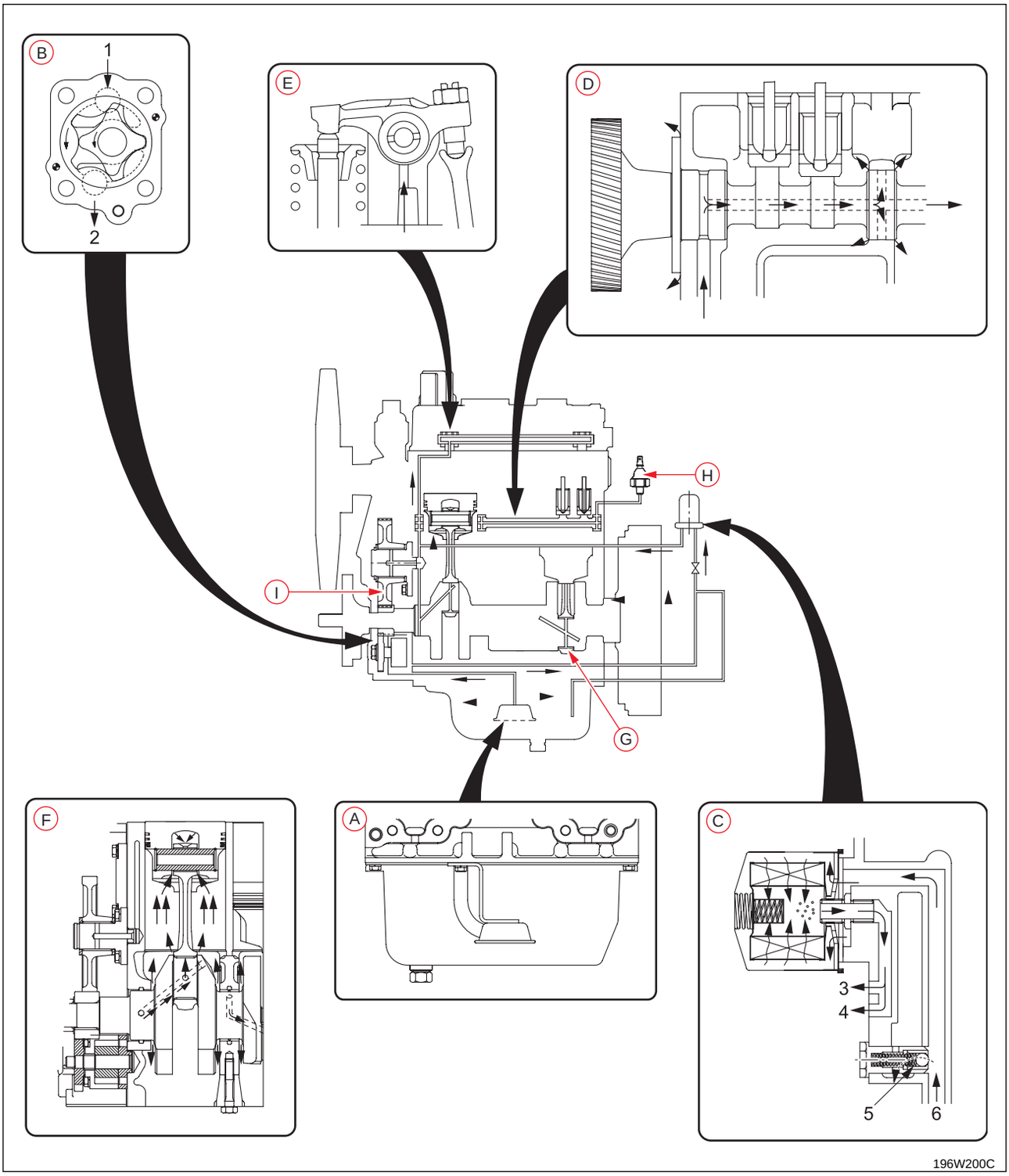


The MLS (Multi Layer Steel) cylinder head gasket has a triple-layered steel structure complemented with non-asbestos gasket features. The top clearance variation is minimized and the thermal load is reduced while increasing durability.

⚠ CAUTION

- **When disassembling the cylinder head, its gasket and all head bolts should be replaced with new ones.**
- **Be sure that there is no scratch or foreign material between the cylinder head and the surface of the block.**

3.2 LUBRICATION SYSTEM



A. Oil sump screen

B. Oil pump

1. Inlet hole
2. Outlet hole

C. Oil filter cartridge and relief valve

3. To rocker arm shaft and camshaft
4. To crankshaft
5. Relief valve
6. From pump

D. Camshaft

E. Rocker arm rocker arm shaft

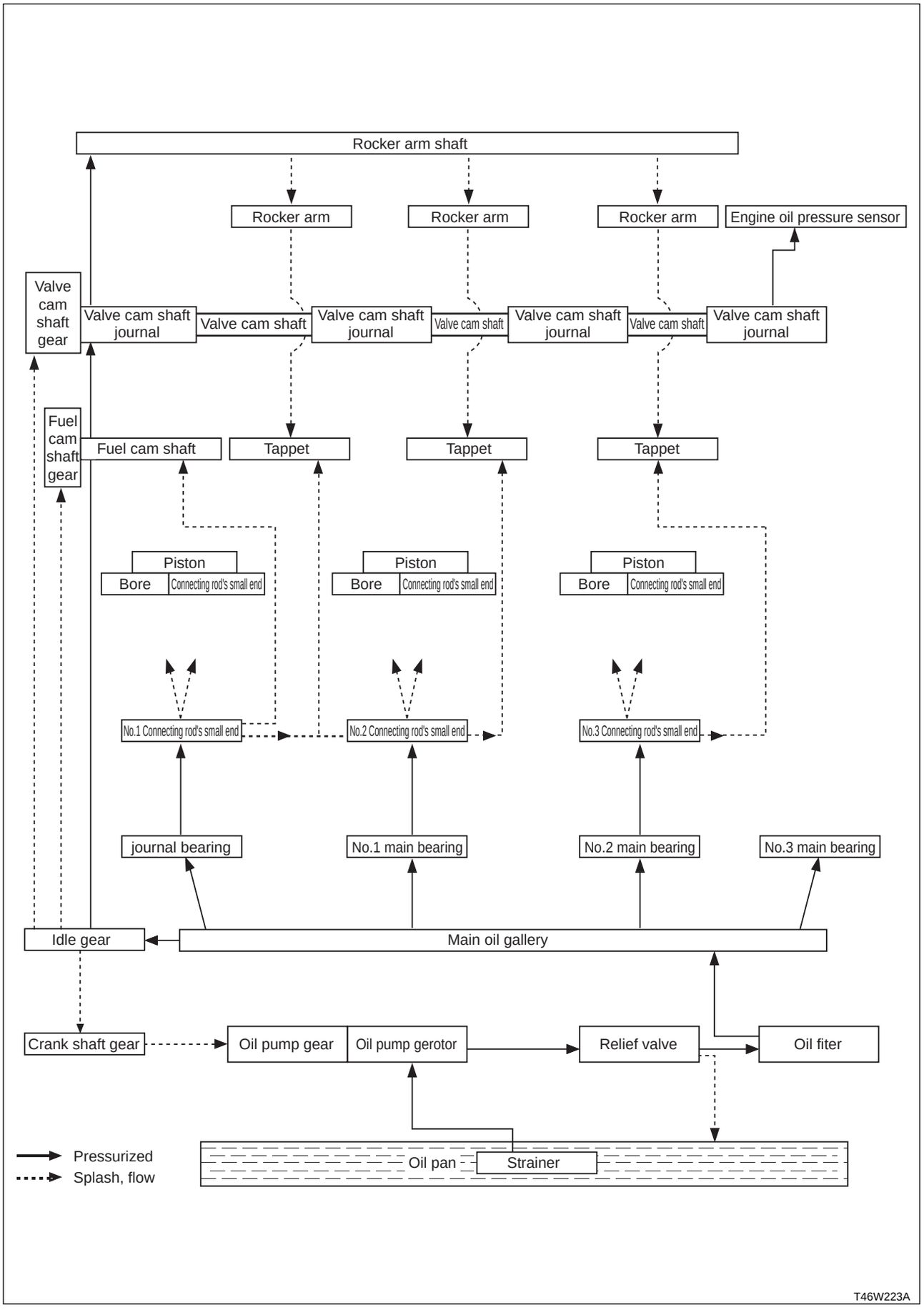
F. Piston

G. Crankpin bearing

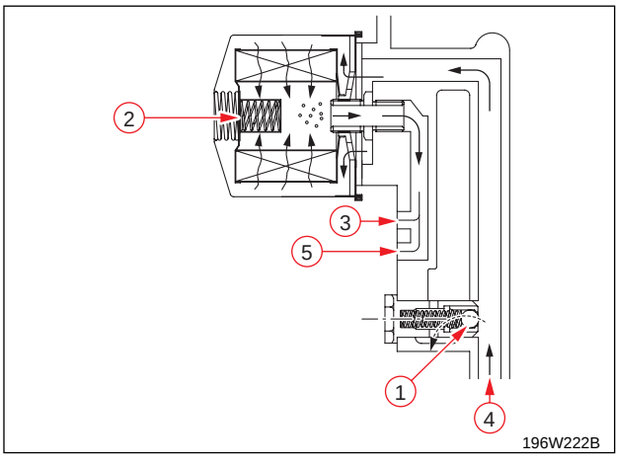
H. Oil switch

I. Idle gear

3.2.1 ENGINE OIL FLOW



3.2.2 RELIEF VALVE



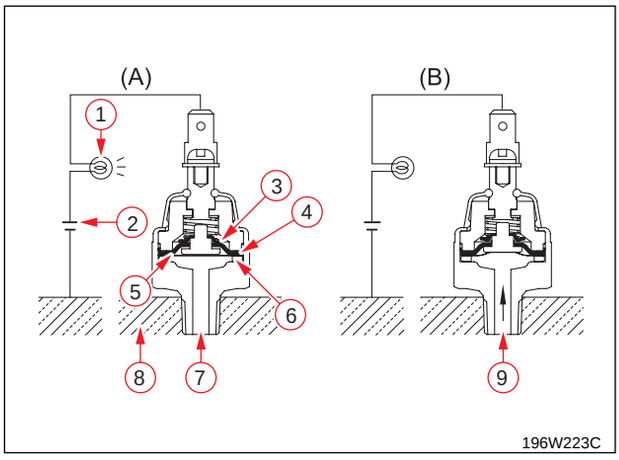
(1) Relief valve
(2) By-pass valve
(3) To rocker arm shaft and camshaft
(4) From pump
(5) To crankshaft

The relief valve prevents damage to the lubrication system due to high oil pressure. Control range of the relief valve is 196 to 441 Kpa (2.0 to 4.5 kgf/cm², 28 to 64 psi).

3.2.3 BY-PASS VALVE

Oil filter cartridge has a by-pass valve inside, to prevent the lack of lubrication oil in the engine, If the oil filter element is clogged the by-pass valve opens and lets the oil pass to each part of the engine without passing through the filter.

3.2.4 OIL PRESSURE SWITCH



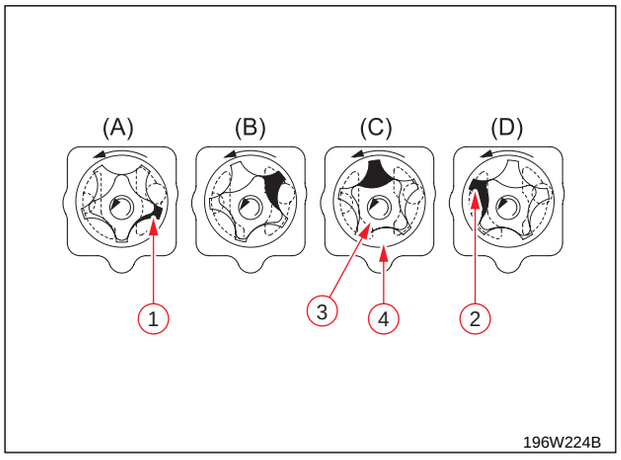
(1) Warning lamp
(2) Battery
(3) Rubber gasket
(4) Contact rivet
(5) Contact
(6) Oil passage
(7) Cylinder block
(8) Oil

The oil pressure switch is installed on the cylinder block and leads to the oil passage of the lubricating oil.

When the oil pressure falls below the specified value, the contacts of the oil pressure switch closes to turn on the warning lamp (1).

(A) At lower oil pressure
[49 kPa (0.5 kgf/cm^2, 7 psi) or less]
(B) At proper oil pressure

3.2.5 OIL PUMP



(1) Inlet
(2) Outlet
(3) Inner rotor
(4) Out rotor

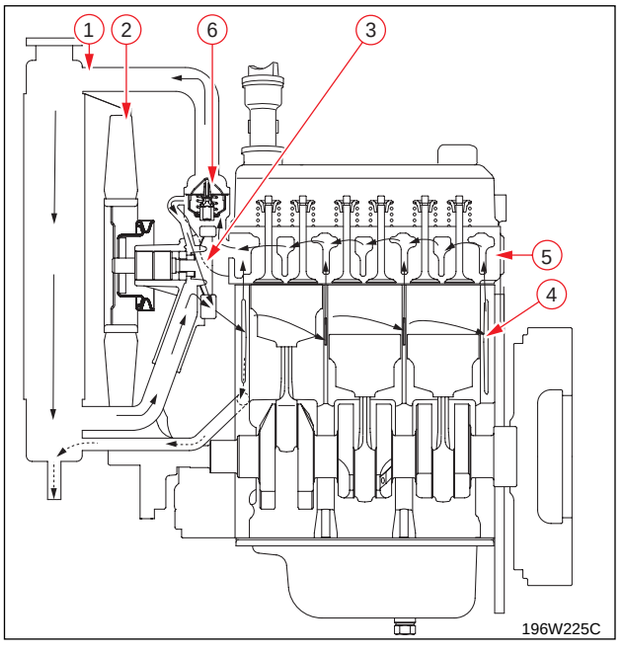
The oil pump is a gear pump, whose rotors have trochoid lobes. The inner rotor (3) has 4 lobes and the outer rotor (4) has 5 lobes, and they are eccentrically engaged with each other. The inner rotor, which is driven by the crankshaft through the gears, rotates the outer rotor in the same direction, varying the space between the lobes.

While the rotors rotate from (A) to (B), the space leading to the inlet port increases, which causes the oil to flow through the inlet port.

When the rotors rotate to (C), the port to which the space leads,is changed from inlet to outlet.

At (D),the space decreases and suctioned oil is discharged from the outlet port.

3.3 COOLING SYSTEM



(1) Radiator
(2) Suction fan
(3) Water pump
(4) Cylinder block
(5) Cylinder head
(6) Thermostat

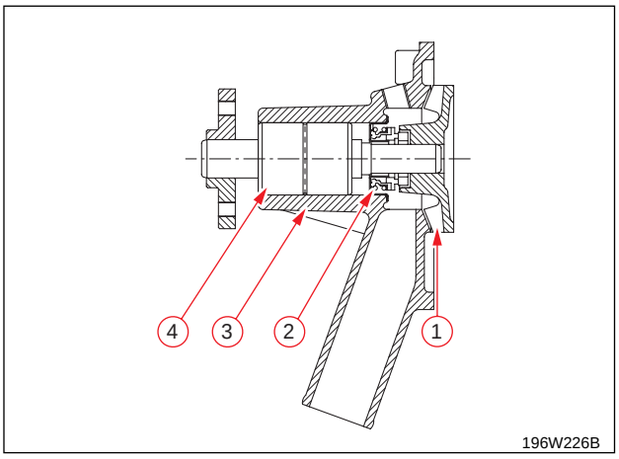
The cooling system consists of a radiator, centrifugal water pump, suction fan and thermostat.

The water is cooled through the radiator core, and the fan set behind the radiator pulls cooling air through the core to improve cooling.

The pump draws in the cooled water, forces it into the cylinder block and draws out the hot water. Then the cooling is repeated. Furthermore, to control temperature of water, a thermostat is provided on the way. When the thermostat opens, the water moves directly to radiator, but when it closes, the water moves toward the water pump through the by-pass between thermostat and water pump.

The opening temperature of thermostat is about 83°C (180°F).

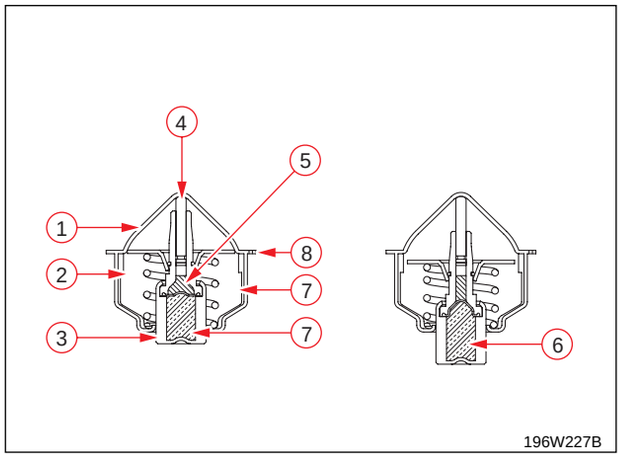
3.3.1 WATER PUMP



(1) Water pump impeller
(2) Mechanical seal
(3) Water pump body
(4) Bearing unit

35 ℓ /min. (7.7 lmp.gals/min, 9.2 U.S gals/min) of water is forced into the crankcase and cylinder head to cool them. The impeller, of backward type, is bent as far as possible from the center, in the opposite direction to rotation; the bearing unit prevents cooling water from entering by a special mechanical seal.

3.3.2 THERMOSTAT



(1) Seat
(2) Valve
(3) Pellet
(4) Spindle
(5) Synthetic rubber
(6) Wax (Solid)
(7) Spring
(8) Leak hole
(9) Wax (Liquid)

The thermostat is wax pellet type, which controls the flow of the cooling water to the radiator to keep the proper temperature. The case has a seat (1) and the pellet has a valve (2). The spindle attached to the case is inserted into the synthetic rubber in the pellet. The pellet is charged with wax.

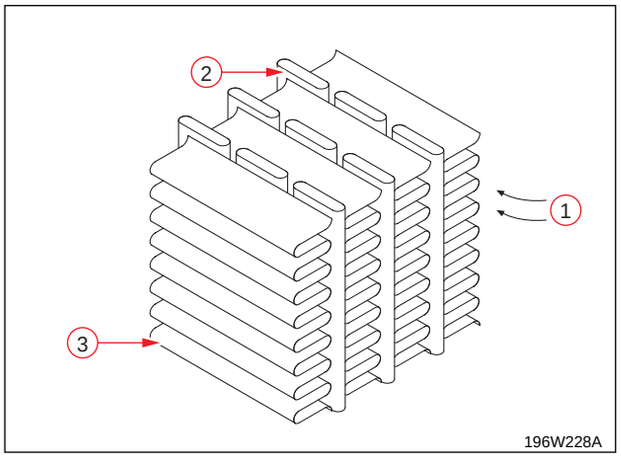
(A) At low temperature (lower than 71°C (160°F))

The valve (2) is seated by the spring (7) and the cooling water circulates in the engine through the water return pipe but not the radiator.

(B) At high temperature (higher then 71°C (160°F))

As the water temperature rises, the wax in the pellet (3) melts and expands, repelling the spindle. The pellet lowers and the valve (2), opens to send the cooling water to the radiator.

3.3.3 RADIATOR

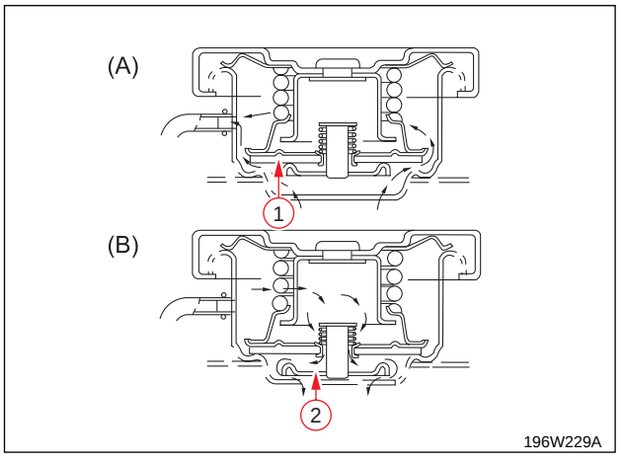


(1) Cooling air
(2) Tube
(3) Fin

The radiator core consists of water carrying tubes (2) with fins (3) at a right angle to it.

The air flowing between the tube wall and the fins cools the water in the radiator.

3.3.4 RADIATOR CAP



(1) Pressure valve
(2) Vacuum valve

The pressure type cap is installed on the radiator, which prevents the pressure difference between the inside and the outside of the radiator from deforming the radiator.

(A) At high pressure(higher than 88 kPa (0.9 kgf/cm², 13 psi))

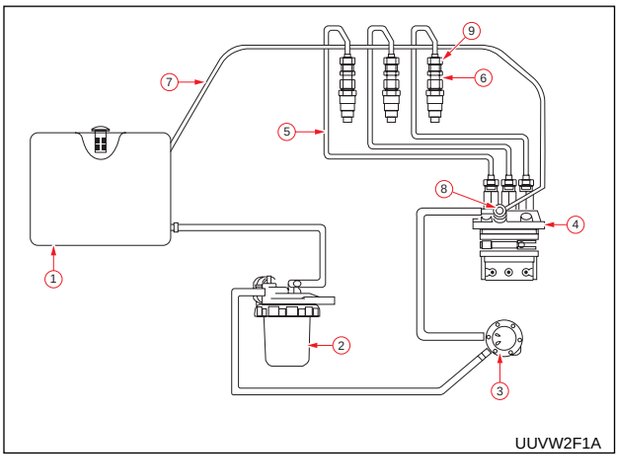
When the water temperature rises and the pressure in the radiator increases above the specified pressure, the pressure valve (1) opens to reduce the internal pressure.

(B) At low pressure

When the water temperature falls and a vacuum is formed in the radiator, the vacuum valve (2) opens to allow the air to enter the radiator.

3.4 FUEL SYSTEM

3.4.1 FLOW OF FUEL

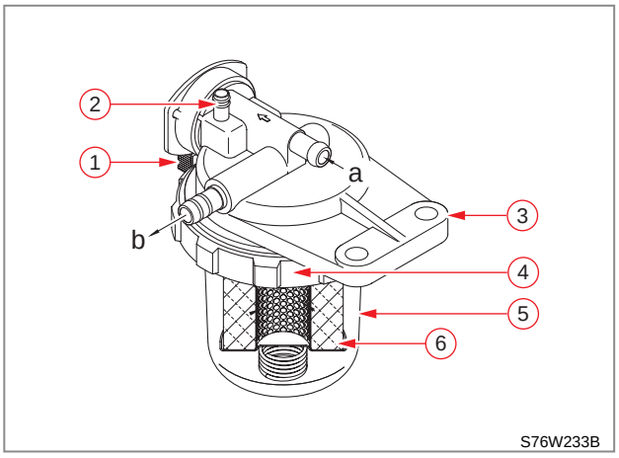


UUVW2F1A

(1) Fuel tank
(2) Fuel filter
(3) Fuel feed pump
(4) Injection pump
(5) Injection pipe
(6) Injection nozzle
(7) Fuel overflow pipe
(8) Air bleed bolt
(9) Nozzle holder nut

The fuel is fed from the fuel tank (1) through the fuel filter (2) to the injection pump (4) by the fuel feed pump (3). The injection pump force-feeds the fuel through the injection nozzles (6), which inject the fuel into the cylinders for combustion. Any excessive fuel from the injection pump to the injection nozzles is collected in the fuel overflow pipes (7) and returns to the fuel tank.

3.4.2 FUEL FILTER AND BLEEDING



S76W233B

(a) From fuel tank
(b) To fuel feed pump
(1) Petcock
(2) Air vent
(3) Filter body
(4) Retainer ring
(5) Filter bowl
(6) Filter element

The fuel from fuel tank enters into the filter bowl through the port (a) and passes through the filter element. Then, it is drawn out through the port (b) and supplied to the fuel feed pump. The filter element collects the particles of 90 microns (0.0034 in.) or bigger at 20 kPa (0.2 kgf/cm², 3 psi).

3.4.3 BLEEDING THE FUEL SYSTEM

1. Make sure that the amount of fuel in the fuel tank is sufficient.
2. If there is air in the fuel filter, turn the filter petcock (1), shown in the figure 3.4.2, to the “air” side and wait until the fuel filter port is filled with the fuel. (The port can be filled with the fuel by head pressure when the fuel tank is full.)

REMARK

- **The bleeding process could be skipped if filling the fuel bowl with fuel before installing it.**

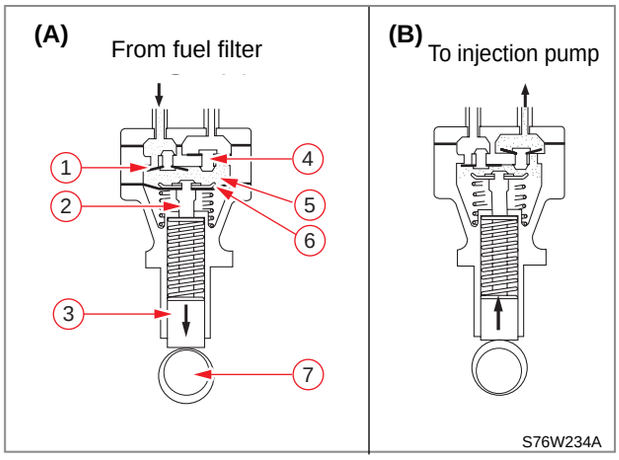
3. When no more fuel is drawn into the fuel filter port, turn the petcock (1), shown in the figure 3.4.2, to the “ON” position.

CAUTION

- **Do not operate the start motor for more than 10 sec. continuously, instead operate it for several times within 10 sec. each time.**

4. Loosen the bleeding bolt (8) shown in the figure (3.4.1), and crank the engine to bleed air. Then, tighten the bolt again.
5. If the engine still cannot be started, loosen 1 or 2 injection pipe holder nuts (9) (figure 3.4.1) and crank the engine to bleed air.
6. When the air bubbles are not seen anymore in the drained fuel, tighten the loose parts and start the engine.

3.4.4 FUEL FEED PUMP



(1) Suction valve
(2) Push rod
(3) Tappet
(4) Discharge valve
(5) Chamber
(6) Diaphragm
(7) Fuel camshaft

The diaphragm (6) is linked to the tappet (3) with the push rod (2). The tappet is reciprocated by the eccentric cam on the fuel camshaft (7).

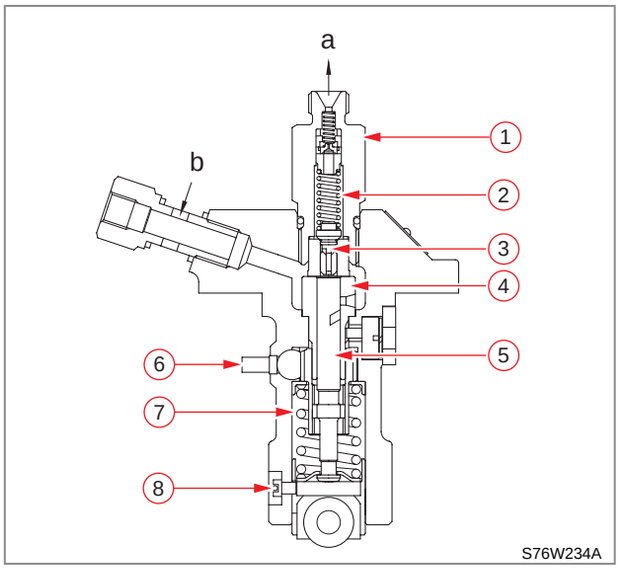
(A) SUCTION STROKE

When the diaphragm is pulled down by the spring, it builds a vacuum in the chamber (5) causing the discharge valve (4) to close and the atmospheric pressure in the fuel tank to force the fuel into the chamber, opening the suction valve (1).

(B) DISCHARGE STROKE

When the diaphragm is pushed up by the cam, the pressure in the chamber causes the suction valve to close and forces out the fuel, opening the discharge valve.

3.4.5 FUEL INJECTION PUMP

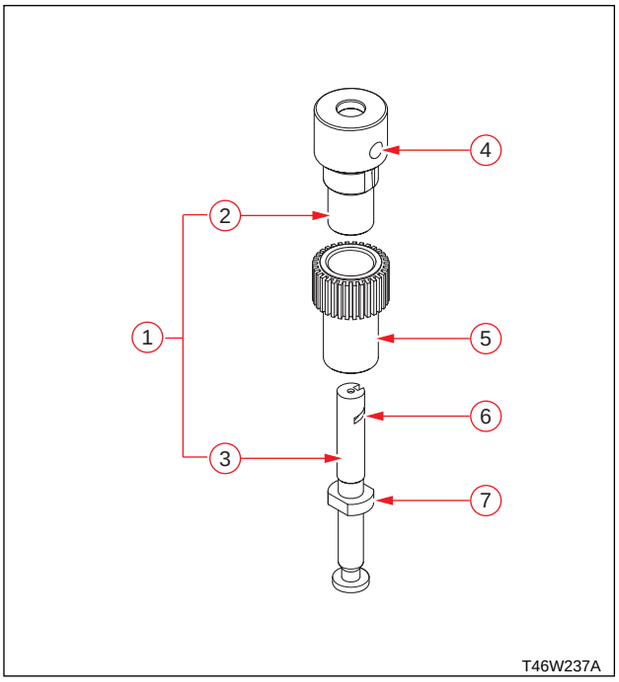


(a) To injection nozzle
(b) From fuel feed pump

(1) Delivery valve holder
(2) Delivery valve spring
(3) Delivery valve
(4) Cylinder
(5) Plunger
(6) Control rack pin
(7) Plunger spring
(8) Tappet

This fuel injection pump is Bosch K (type) fuel injection pump. It features a compact and light weight design.

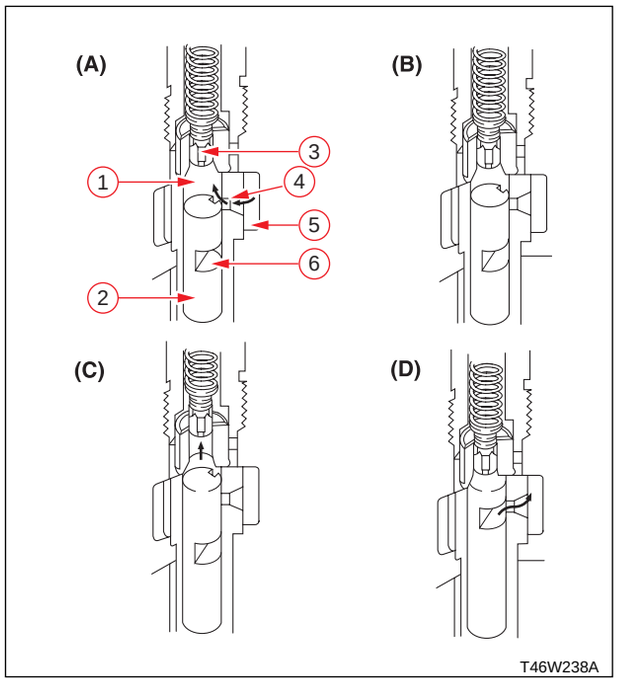
A. PUMP ELEMENT



(1) Pump element
(2) Cylinder
(3) Plunger
(4) Feed hole
(5) Control sleeve
(6) Control groove
(7) Sliding surface

The pump element (1) consists of a plunger (3) and cylinder (2) which their sliding surfaces are finely machined to maintain the fuel tightness. The plunger (3) is installed in the control sleeve (5) and the sleeve is engaged with the control rack that rotates the plunger in the cylinder to control the amount of fuel delivered.

B. OPERATION OF PUMP ELEMENT



(1) Delivery chamber
(2) Plunger
(3) Delivery valve
(4) Feed hole
(5) Fuel chamber
(6) Control groove

a. Before delivery

As the plunger (2) lowers, fuel is drawn into the delivery chamber (1) through the feed hole (4) from the fuel chamber (5).

b. Beginning of delivery

When the plunger is pushed up by the cam and the head of the plunger closes the feed hole (4), the pressure in the delivery chamber (1) rises to push the delivery valve (3) open.

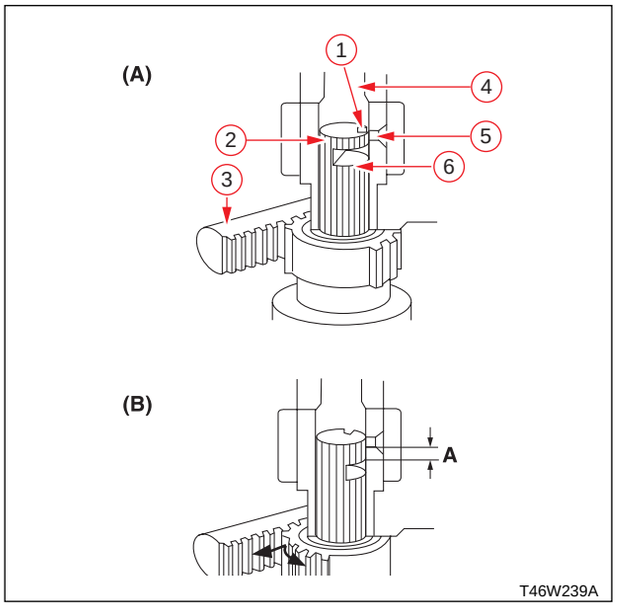
c. Delivery

While the plunger (2) is rising, delivery of fuel continues.

d. End of delivery

When the plunger rises further and the control groove (6) on its periphery,meets the feed hole, the injection stops because the pressure in the delivery chamber (1) is reduced to the opening pressure.

C. AMOUNT OF FUEL DELIVERY

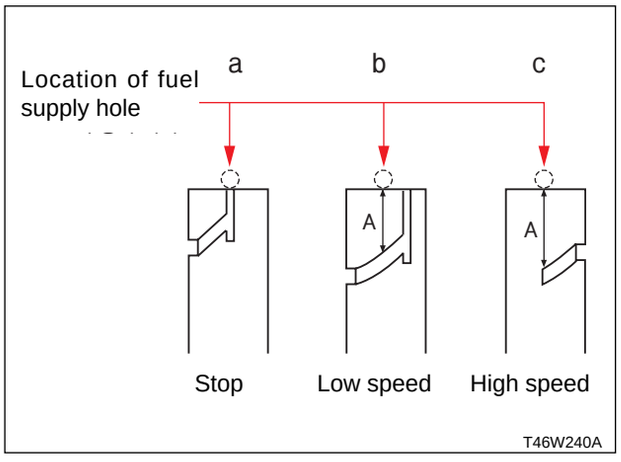


(1) Slot
(2) Plunger
(3) Control rack
(4) Delivery chamber
(5) Feed hole
(6) Control groove

a. No fuel delivery

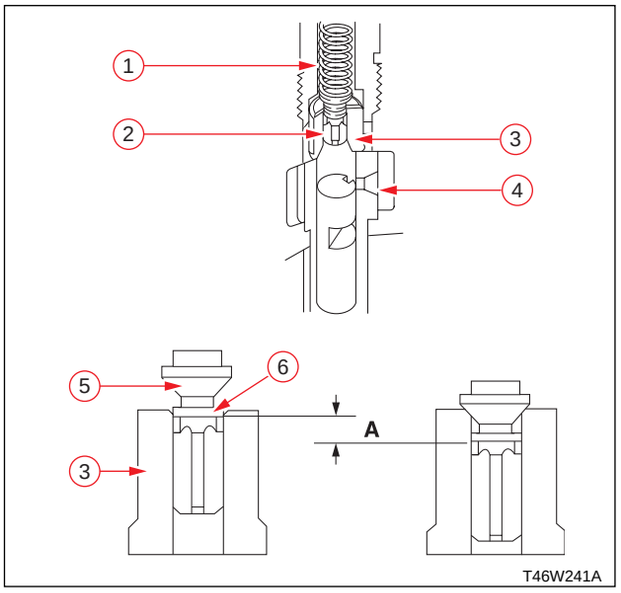
When the control rack (3) is at the engine stop position, the lengthwise slot (1) on the plunger (2) aligns with the feed hole (5). The pressure in the delivery chamber does not build up and no fuel is forced to the injection nozzle since the delivery chamber (4) is opened to the feed hole during the entire stroke of the plunger.

b. Fuel delivery



The plunger is rotated by the control rack and the feed hole is not aligned with the lengthwise slot. When the plunger is pushed up, the feed hole is closed by the plunger. The pressure in the delivery chamber builds up and forces the fuel to the injection nozzle until the control groove (6) meets the feed hole. The amount of the fuel to be forced into the nozzle corresponds to distance A. In the above figure, the amount of injected fuel in (c) is larger than the amount of injected fuel in (b).

D. DELIVERY VALVE



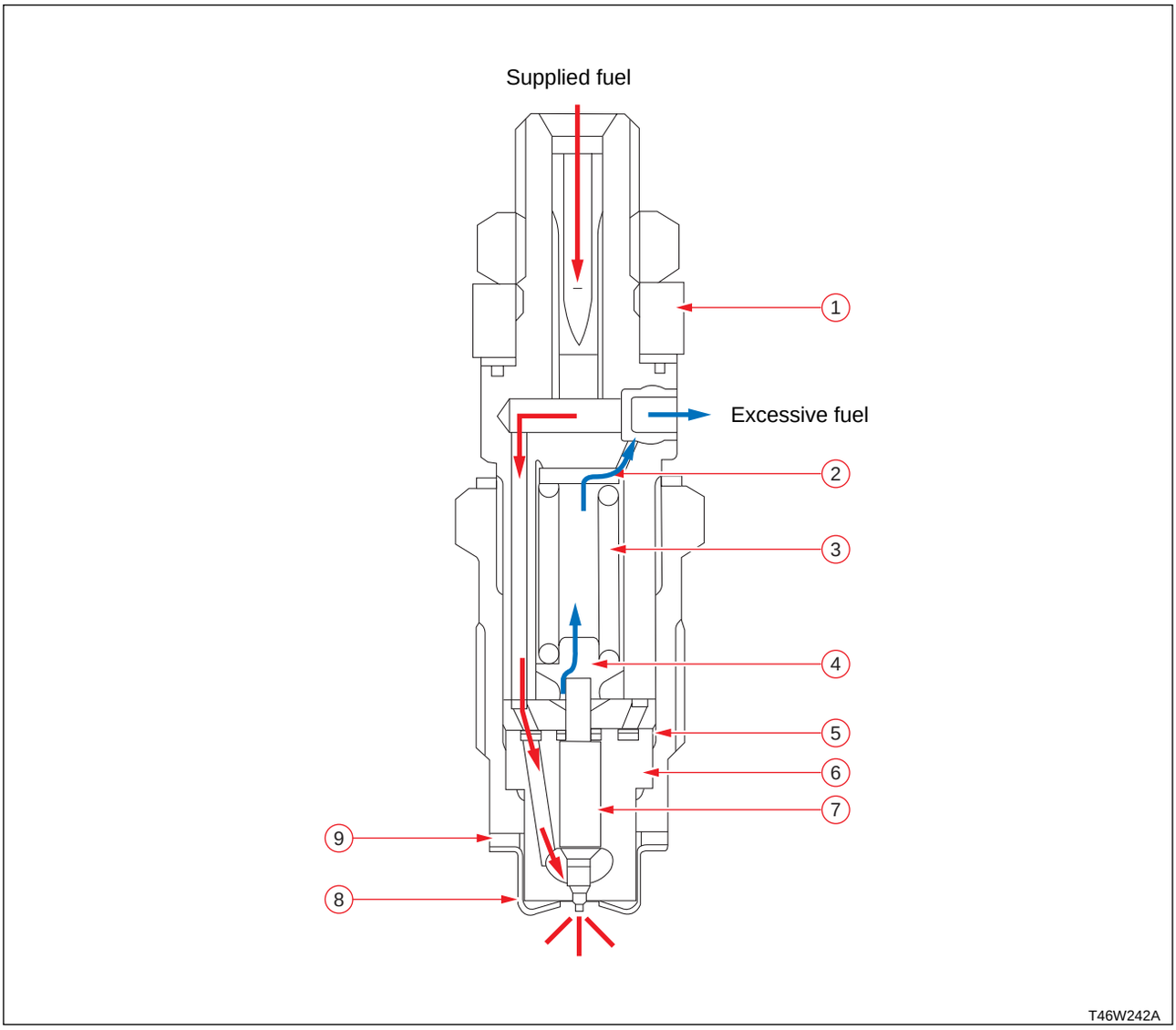
(1) Valve spring
(2) Delivery valve
(3) Valve seal
(4) Fuel chamber
(5) Valve face
(6) Relief plunger

The delivery valve (2) prevents the fuel in the injection pipe from flowing back into the delivery chamber and the fuel in the injection nozzle from dribbling after injection.

The relief plunger (6) sucks the fuel back from the injection pipe to prevent the leakage dribbling and unnecessary subsequent injection after the major injection.

The stroke of A corresponds to the amount of fuel sucked back (35 mm^3).

E. INJECTION NOZZLE



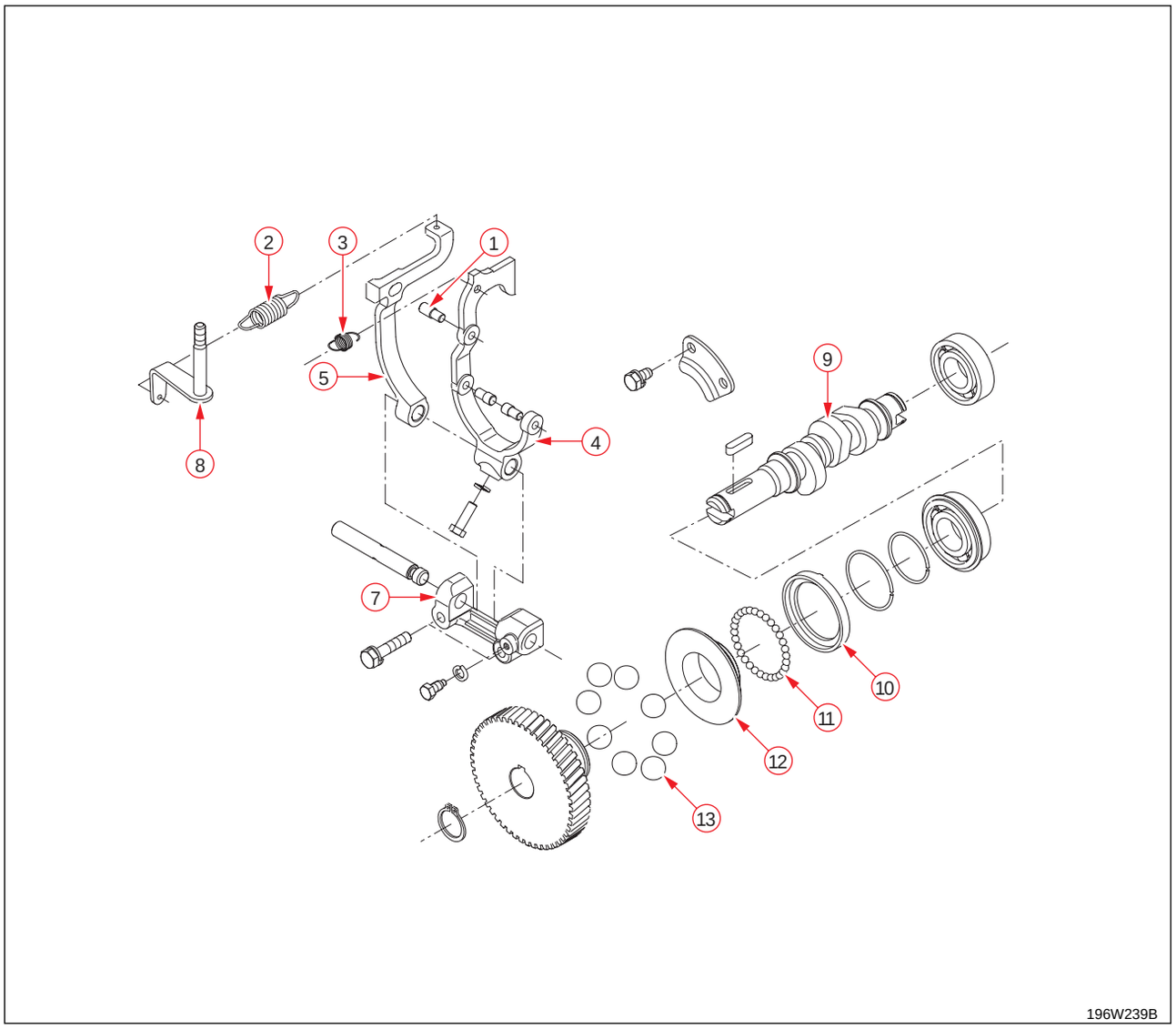
(1) Nozzle holder assembly
(2) Adjusting washer
(3) Nozzle spring
(4) Push rod
(5) Lock nut
(6) Nozzle body
(7) Needle valve
(8) Heat seal
(9) Packing

This injection nozzle is throttle type nozzle. It features the low fuel consumption and works well with DAEDONG combustion chamber. The nozzle valve opening pressure is about 14.7 MPa (150 kgf/cm², 2134 psi). When the pressure overcomes the counterforce of nozzle valve spring (3), the pressure pushes up the needle valve (7) constantly and then the proper amount of fuel is injected into the swirling air inside the combustion chamber for combustion.

The opening pressure can be adjusted by adding or reducing the washer (2). A washer of 0.1 mm corresponds to 980 kPa (10 kgf/cm², 142 psi) change in opening pressure. The heat seal (8) is used to improve the durability and reliability of the nozzle.

3.5 GOVERNOR SYSTEM

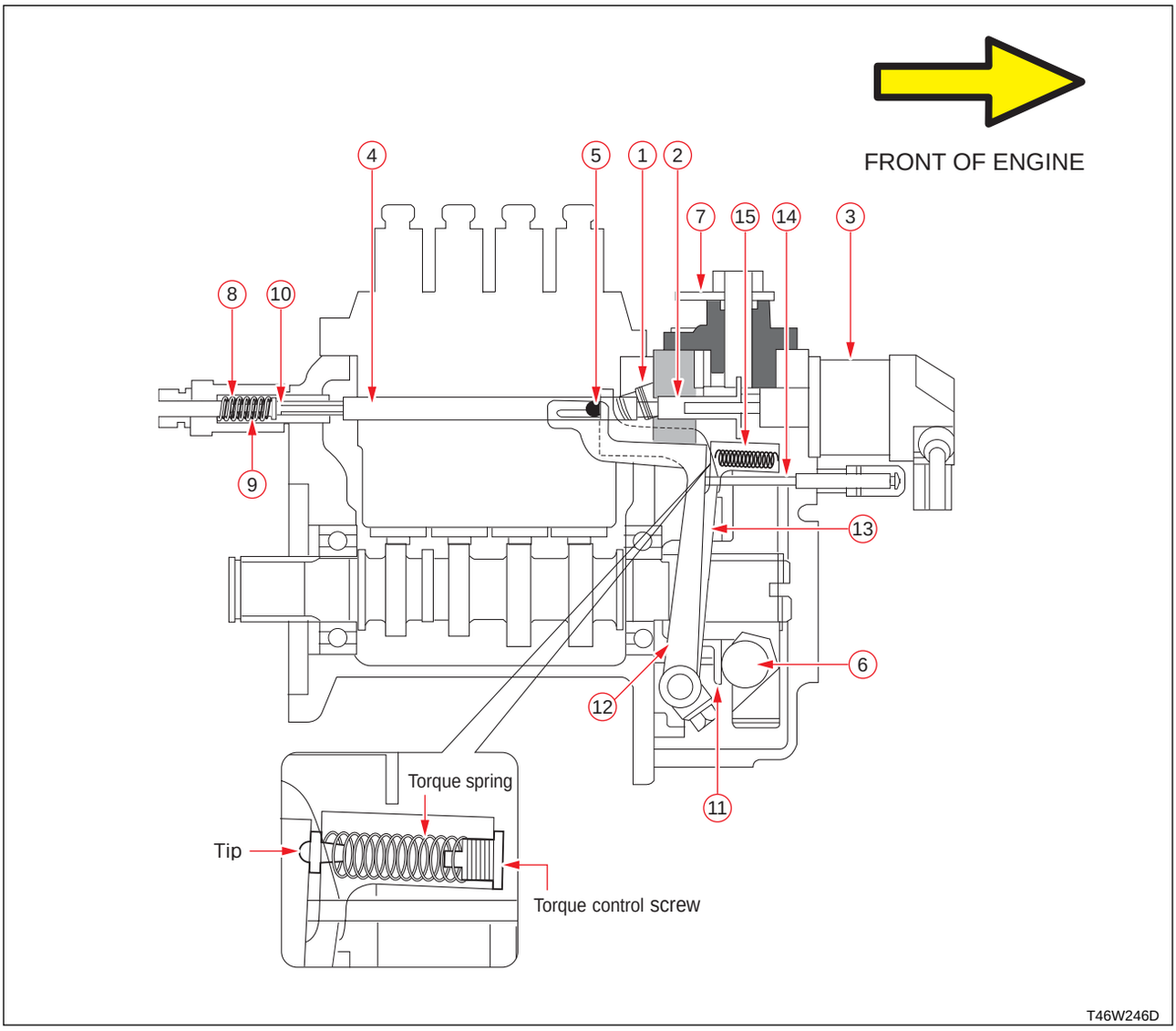
3.5.1 DISASSEMBLED VIEW



(1) Pin
(2) Governor spring 1
(3) Governor spring 2
(4) Fork lever 1
(5) Fork lever 2
(6) Fork lever shaft
(7) Fork lever holder
(8) Governor lever
(9) Fuel injection camshaft
(10) Governor ball case
(11) Steel ball
(12) Governor sleeve
(13) Steel ball
(14) Fork lever pin

The governor keeps the engine speed constant by automatically adjusting the amount of fuel supplied to the engine according to changes in the load. The engine employs an all-speed governor, which controls centrifugal force of the steel balls(13) weight, produced by rotation of the fuel camshaft (9), and tension of the governor spring 1 (2) and 2 (3) are balanced.

3.5.2 BASIC PRINCIPLE OF GOVERNOR SYSTEM



(1) Governor spring 1, 2
(2) Solenoid guide
(3) Stop solenoid
(4) Pump rack
(5) Rack pin
(6) Steel ball
(7) Governor lever
(8) Idle spring
(9) Start spring
(10) Idle shaft
(11) Governor sleeve
(12) Fork lever 2
(13) Fork lever 1
(14) Fuel limit bolt
(15) Torque spring

As shown in the above figure, the steel ball (6) in the fuel camshaft gear is supported by the governor sleeve (11) to prevent from coming out. The sleeve pushes the fork lever 1 (13) to transfer the power to the fuel injection pump pin (5).

3.5.3 OPERATION OF GOVERNOR

A. WHEN STOPPED

The fuel is blocked since the solenoid (3) pushes the speed control rack (4) to the left.

B. WHEN TURNING THE KEY SWITCH ON

When the electromagnet in the stop solenoid operates and the pin is retracted, the speed rack (4) of the fuel injection pump is pushed to the right by the start spring (9) and the start shaft (10) to supply the sufficient amount of fuel to start the engine.

C. WHEN STARTING THE ENGINE AND RUNNING THE ENGINE AT LOW IDLE SPEED

When the engine is started, the steel ball (6) pushes the sleeve (11) to the left as the centrifugal force of the steel ball increases. Therefore, the governor fork lever 1 (13) pushes the speed rack (4) of the pump to the left to reduce the amount of fuel supplied.

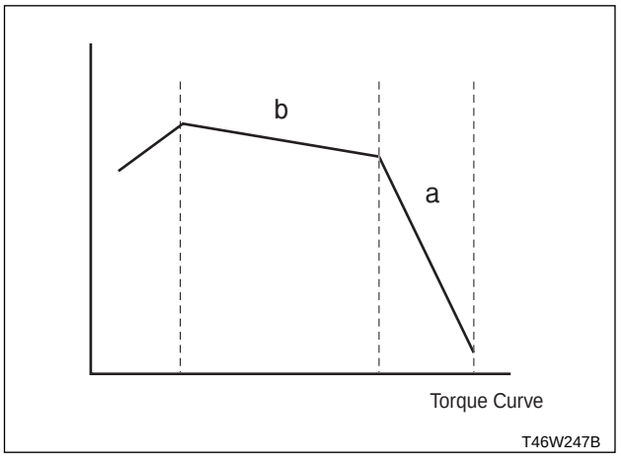
As the speed rack is stopped by the idle spring (8), it keeps the balance with the centrifugal force of the steel ball so that at least minimum amount of fuel is delivered for stable engine running at idle speed.

D. ACCELERATION AND DECELERATION

When depressing the accelerator pedal, the governor spring (1) pulls the fork lever 2 (12) to the right and then pushes the fork lever 1 (13) to the right. The fork lever (13) is stopped by the sleeve (11).

When the centrifugal force of the steel ball (6) that is proportional to the engine speed is balanced with the tension of the governor spring (1) that is determined by the driver, the stable speed is maintained.

E. LOAD INCREASE AT HIGH SPEED



When a load is applied to the engine running at a high speed, the centrifugal force of steel ball (6) decreases as the engine speed drops. Also, the fork lever 2 (12) is pulled to the right by the governor spring until it contacts the fuel limit bolt (14). Until then, the amount of injected fuel per one stroke of the injector plunger and the torque increase.

This range (a) is between the max. speed point with no load and the max. power point of the torque curve.

When the fork lever 2 is blocked by the fuel limit bolt (14) and does not move any more and the load is increased, the centrifugal force of steel ball drops further and the torque spring (15) compressed between the fork lever 1 and 2 is loosened. Then, the fork lever 2 moves to the right until the torque spring is free, and the amount of fuel supplied and the torque increase simultaneously.

This range (b) is between the max. power and the max. torque point in the torque curve.

IMPORTANT

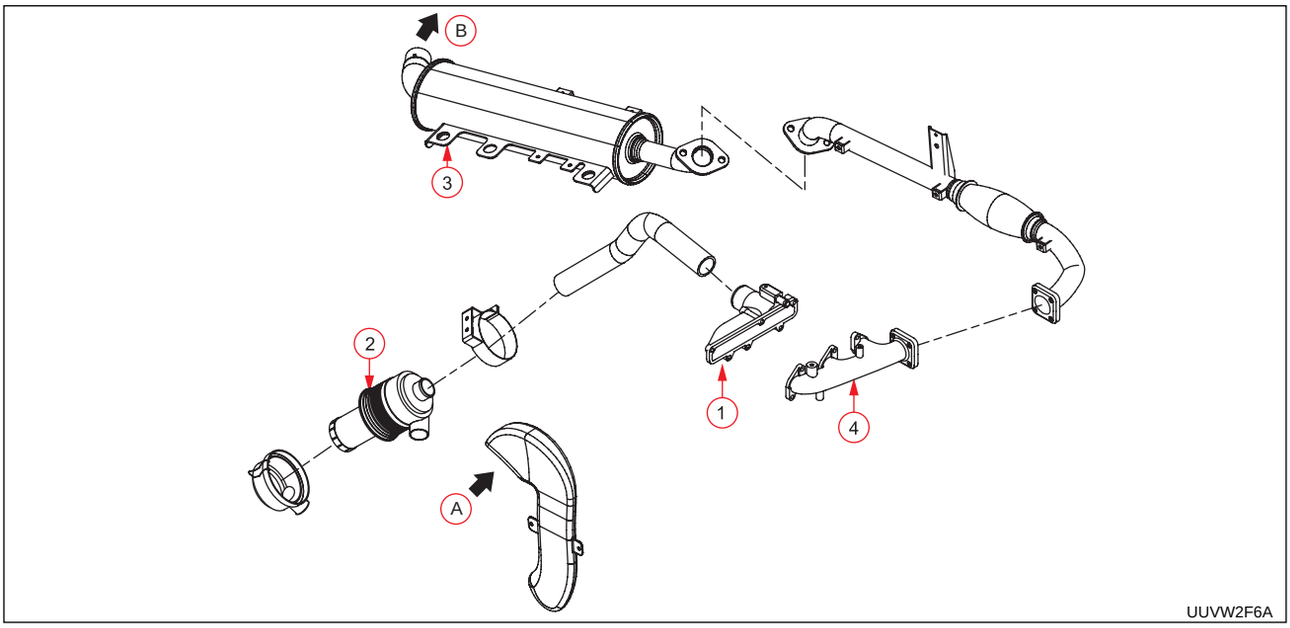
- **The fuel limit bolt (14), idle spring (9) and max. rpm setting bolt are set at factory. Unauthorized adjustment of such components can negatively effect the performance of the engine. Therefore, never adjust them without permission from DAEDONG. Such action violates the EPA regulation and also can void the warranty.**

F. WHEN STOPPED

When the key switch is moved to the “OFF” position, the stop solenoid power is cut off to release the electromagnet. Therefore, the stop pin comes off by the return force of the spring and pushes the solenoid guide (2) and fuel injection pump rack to the stop position to stop the engine.

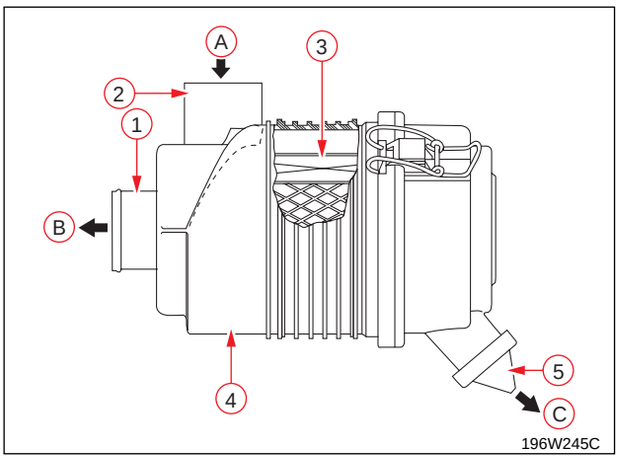
3.6 INTAKE AND EXHAUST SYSTEM

3.6.1 FLOW OF INTAKE AIR AND EXHAUST GAS



(A) Inlet air
(B) Exhaust gas
(1) Inlet manifold
(2) Air cleaner
(3) Muffler
(4) Exhaust manifold

3.6.2 AIR CLEANER

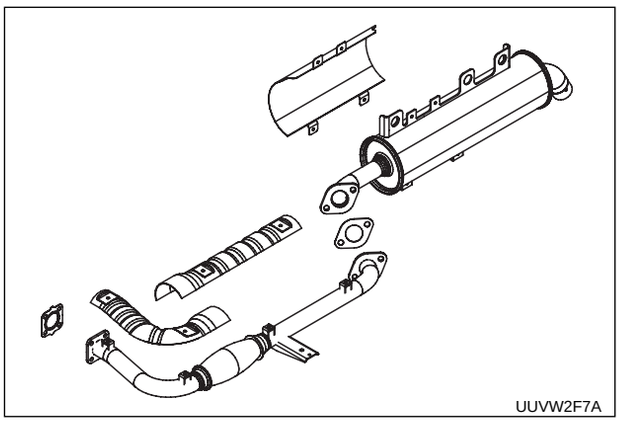


(A) Inlet air
(B) To inlet manifold
(C) Heavier dust
(1) Outlet port
(2) Inlet port
(3) Air cleaner element
(4) Body
(5) Evacuator

The air cleaner is dry-cyclone type and easy to maintain. The air from the inlet port (2) circulated along the fin (3) and around the air cleaner element (3) and the heavier dust is carried to the evacuator (5), where the dusts exhaust port. The fine dust in the air is filtered with the air cleaner element (3), and the filtered air flows to the outlet port (1).

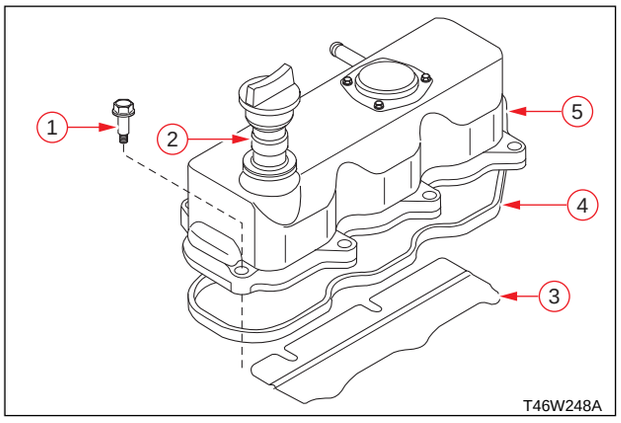
3.6.3 MUFFLER

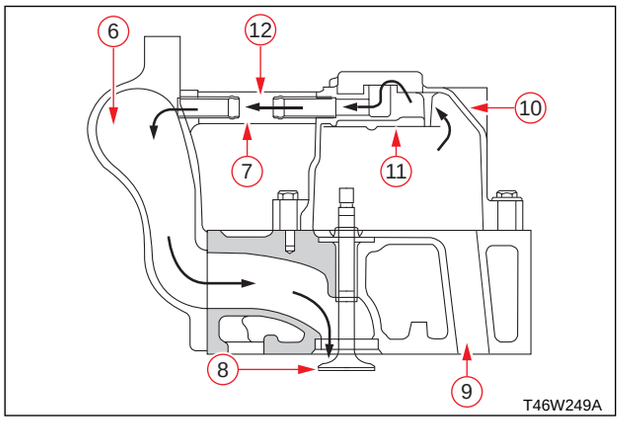
The exhaust noises are absorbed and dumped, while the gas pass through a series of holes on the inner tube and fiberglass wool of muffler.



3.6.4 PCV VALVE

A. PCV (POSITIVE CRANKCASES VENTILATION)





(1) Head cover bolt
(2) Oil filler flange
(3) Oil baffle plate
(4) Head cover gasket
(5) Cylinder head cover
(6) Intake manifold
(7) Bleeding pipe
(8) Intake valve
(9) Cylinder head
(10) Cylinder head cover
(11) Oil baffle plate
(12) Bleeding pipe connection

The PCV system is a system that prevents air pollution by returning the blow-by gas to the intake manifold through the bleeding pipe of the cylinder head cover for recirculation of the gas. (However, the turbo charged engine has the open crankcase type that discharges the blow-by gas to the air.)

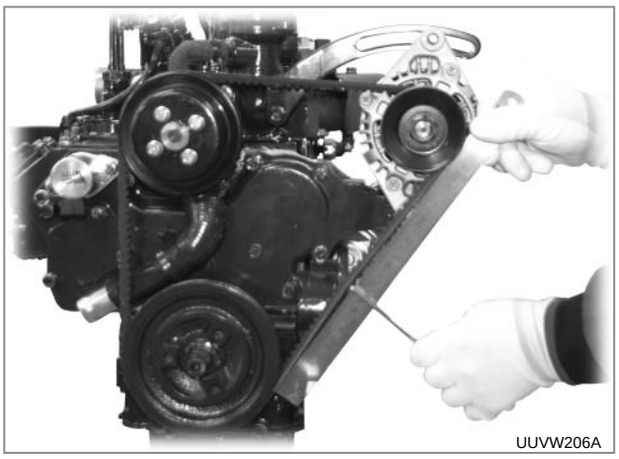
4. TROUBLESHOOTING

Symptom	Cause	Solution
Engine does not start	• No fuel	• Add fuel
	• Air in fuel system	• Bleed air
	• Water in fuel system	• Change fuel and repair or flush fuel system
	• Clogged fuel pipe	• Clean
	• Clogged fuel filter	• Clean or replace
	• Excessively high viscosity of fuel or engine oil at low temperature	• Use the specified fuel or engine oil
	• Fuel with low cetane number	• Use the specified fuel
	• Fuel leak due to loose injection pipe mounting nut	• Tighten nut
	• Incorrect injection timing	• Adjust
	• Clogged injection nozzle	• Clean or replace
	• Defective fuel injection pump	• Repair or replace
	• Defective fuel transfer pump	• Repair or replace
	• Defective piston, cylinder bore or bearing	• Repair or replace
	• Compression leak from cylinder	• Replace head gasket, tighten cylinder head bolts, glow plug and nozzle holder
	• Improper valve seating, damaged valve spring, valve seized	• Repair or replace
	• Improper valve timing	• Correct or replace timing gear
	• Worn piston ring and bore	• Repair or replace
	• Excessive valve clearance	• Adjust
Start motor does not run	• Discharged battery	• Charge
	• Defective start motor	• Repair or replace
	• Defective key switch	• Repair or replace
	• Disconnected wiring	• Connect
Engine running is not smooth	• Clogged or dirty fuel filter	• Clean or replace
	• Clogged air cleaner	• Clean or replace
	• Fuel leak due to loose injection pipe mounting nut	• Tighten nut
	• Defective fuel injection pump	• Repair or replace
	• Incorrect nozzle opening pressure	• Adjust or replace
	• Seized or clogged nozzle	• Repair or replace
	• Clogged fuel overflow pipe	• Clean or replace
	• Defective governor	• Repair or replace
Either white or blue exhaust smoke is produced	• Excessive engine oil	• Reduce to the specified level
	• Worn piston ring and bore or seized piston ring	• Repair or replace
	• Incorrect injection timing	• Adjust
	• Insufficient compression pressure	• Adjust valve clearance

Symptom	Cause	Solution
Either black or dark gray exhaust smoke is produced	• Overheat or overload • Low grade fuel used • Clogged fuel filter • Clogged air cleaner	• Reduce load • Use the specified fuel • Clean or replace • Clean or replace
Insufficient power	• Incorrect injection timing • Seized engine components • Uneven fuel injection • Insufficient nozzle injection • Compression pressure leak	• Adjust • Repair or replace • Repair or replace the fuel injection pump • Repair or replace the nozzle • Replace head gasket, check tightness of cylinder head bolts, glow plugs and nozzle holders.
Hard to start in cold weather	• Not enough pre-heating • Defect on pre-heating system • No winter diesel fuel • Excess valve clearance • Low battery charge level • T/M oil viscosity too high	• Give enough pre-heating time • Repair or replace pre-heating components • Use winter diesel fuel • Adjust valve clearance • Charge of replace battery • Use low viscosity oil as specified

5. INSPECTION AND ADJUSTMENT

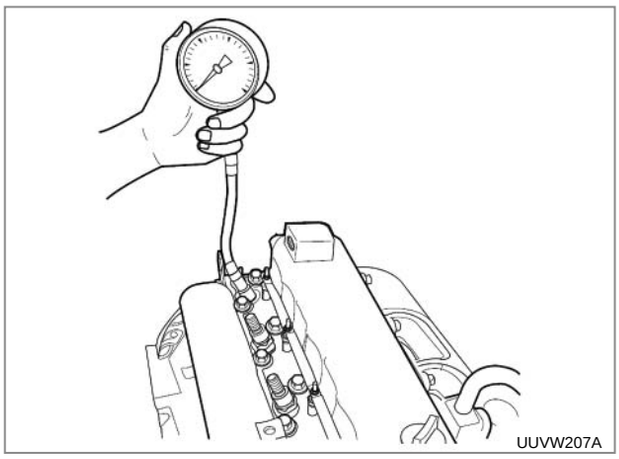
5.1 FAN BELT TENSION ADJUSTMENT


UUVW206A

1. Measure the deflection, depressing the belt halfway between the fan drive pulley and the alternator pulley at 78.5 N (8 kgf, 17.6 lbs) of force.
2. If the deflection is not between the factory specifications, loosen the bolts and nuts, and relocate the alternator to adjust.
3. Replace the belt if damaged or worn

Item	Factory spec.
Belt tension (deflection)	8 mm(0.32 in.) at 78.5 N (8 kgf, 17.6 lbs) of force

5.2 MEASURING THE PISTON COMPRESSION PRESSURE


UUVW207A

1. Run the engine until warm.
2. Stop the engine and remove the air cleaner, the muffler and all nozzle holders.
3. Set a compression tester to the adaptor installed in the nozzle holder hole and fixed with the locating screw.
4. Turn the petcock to the OFF position on the fuel filter assembly to cut the fuel and run the engine with the starter at 200 to 300 rpm for 5 to 10 seconds.

   Measure the maximum pressure while running, several times

- For the test, use a fully charged battery and the specified valve clearance.
- If the pressure does not reach the allowable limit, apply a small amount of oil to the cylinder wall through the nozzle holder hole and measure the pressure again.

▶ JUDGMENT

- If the pressure raises after applying oil, check the cylinder wall and piston rings.
- If the pressure still low, check the top clearance, valve clearance and cylinder head.
- If the compression differs more than 10% among the cylinders, trace the cause of pressure variation and take corrective measures.

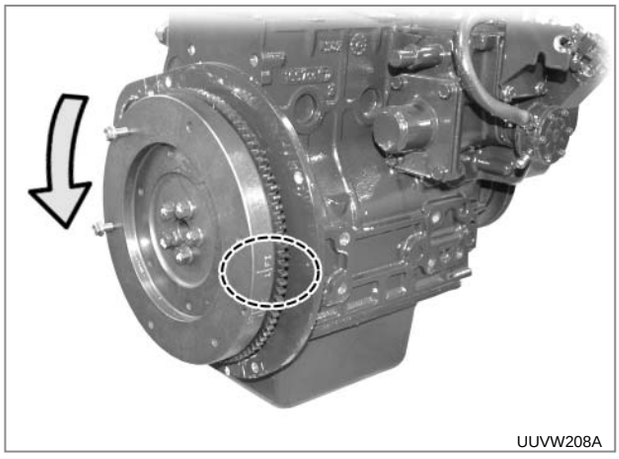
Item	Factory spec.	Allowable limit
Compression pressure	2.8 ~ 3.2 Mpa 29 ~ 33 kgf/cm^2 412 ~ 469 psi.	2.32 Mpa 23.7 kgf/cm^2 337 psi.
Difference between two cylinders	-	10 %

⚠ CAUTION

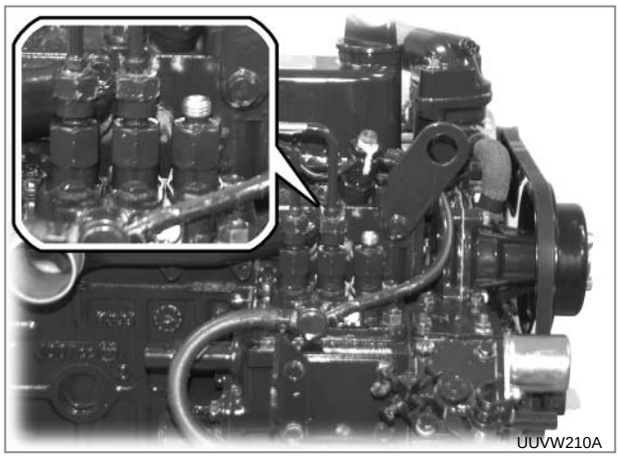
- **Check the compression pressure with the specified valve clearance for proper air intake.**

5.3 CHECKING AND ADJUSTING THE INJECTION TIMING

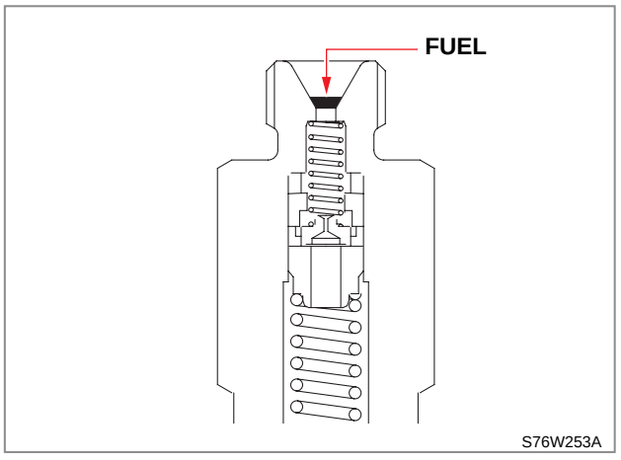
1. Park the vehicle on firm and level ground.
   Then, engage the parking brake and stop the engine.
2. Remove the CVT cover.



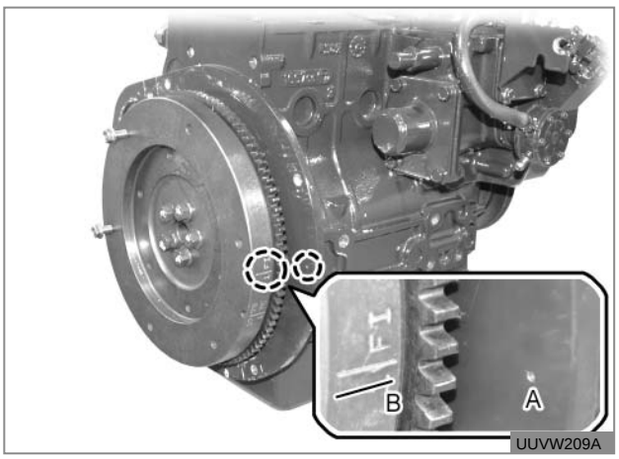
3. Find the compression T.D.C while turning the flywheel counterclockwise.
   Make sure the mark “1 TC” on the side of the flywheel is aligned with the reference mark on top of the rear plate of the flywheel.
4. Then, turn the flywheel clockwise for approx. 30˚.



5. Remove the No. 1 high pressure pipe.
6. Unscrew the nozzle holder slightly and tighten it when it is filled with fuel.



7. Remove the fuel in the nozzle holder with cloth and leave only small amount of fuel.
8. Observe the fuel of the nozzle holder while turning the crankshaft clockwise (when looking at the front of the engine) slowly.
9. When the amount of the fuel in the nozzle holder increases abruptly, that moment is the injection timing.
   - If the amount of fuel increases excessively, it means that the injection timing has already been passed.
   - If the amount of fuel does not increase, it means the exhaust stroke. Therefore, turn the crankshaft 360° to set to the compression stroke and repeat the above procedures.

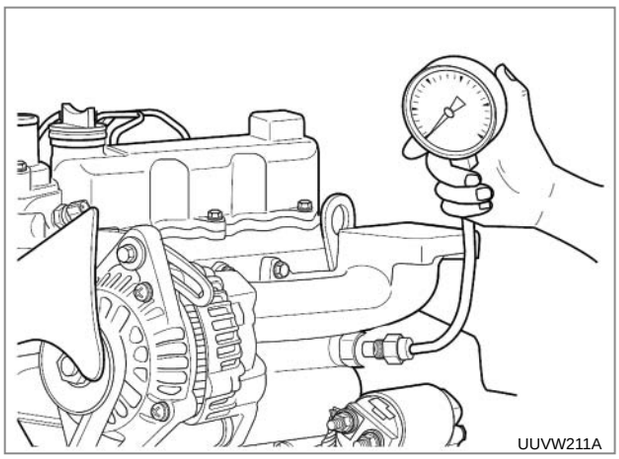


10. When the injection timing is measured, stop the flywheel and mark the position (B) for the injection timing on the flywheel where it is aligned with the reference mark (A).
11. Measure the distance between the measured injection timing mark (B) and the previous mark “1FI” to check if the injection timing has been changed.
12. To advance the injection timing, reduce the amount of shims. To delay the injection timing, increase the amount of shims.

Injection timing	Diameter of flywheel	Flywheel circumference for 1°	Amount of shims to adjust 1°
BTDC 18°	270 mm (10.6 in.)	2.35 mm (0.093 in.)	0.1 mm (0.004 in.)

※ BTDC : Before Top Dead Center

5.4 ENGINE OIL PRESSURE



1. Remove the oil pressure switch and install adaptors and pressure tester.
2. Start the engine and run it until it is warmed up, and measure the oil pressure both at idling and rated speed.
3. If the oil pressure is less than the allowable limit, check the amount of oil, oil filter, oil pump relief valve, oil passages and oil clearances.

- Supply the specified amount of recommended oil.
- The oil filter must not be clogged or broken.

Item		Factory spec.	Allowable limit
Engine oil pressure	At idle speed	More than 49 kPa 0.5 kgf/cm^2 7.11 psi.	-
	At rated speed	245 ~ 441 kPa 2.5 ~ 4.5 kgf/cm^2 36 ~ 64 psi.	245 kPa 2.5 kgf/cm^2 36 psi.

(Reference)

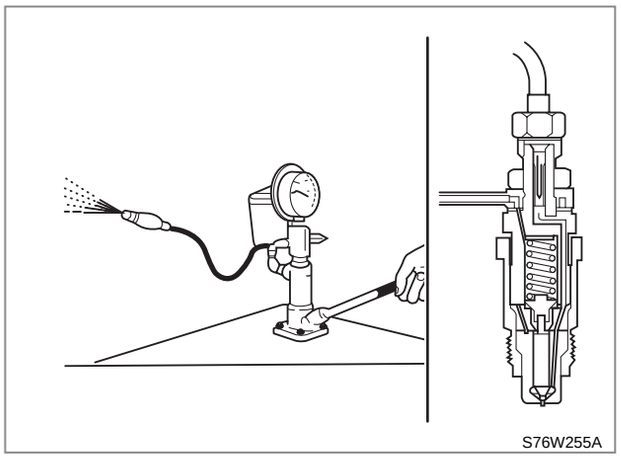
Item	Tightening torque
Oil pressure switch	14.7 ~ 19.6 Nm 1.5 ~ 2.0 kgf-m 10.8 ~ 14.5 lb-ft

5.5 INJECTION NOZZLE INSPECTION

⚠ CAUTION

- **Never come in contact with spraying diesel fuel under pressure, which can have sufficient force to penetrate the skin, causing serious personal injury.**
- **Be sure no one is in direction of the spray.**

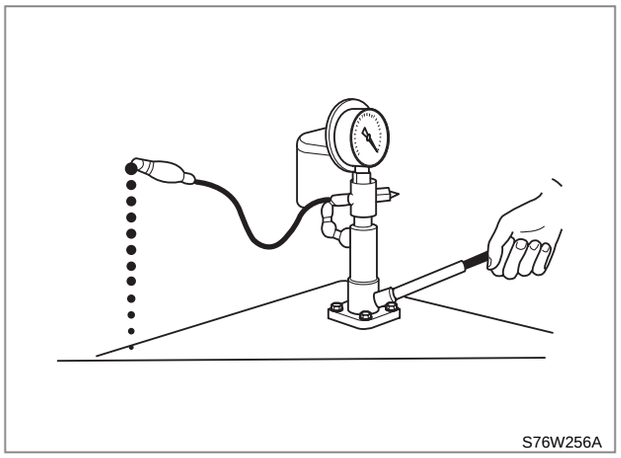
A. FUEL INJECTION PRESSURE


S76W255A

1. Set the injection nozzle to the nozzle tester.
2. Measure the injection pressure.
3. If the measurements are not within the specified range, replace the injection nozzle.

Specified fuel injection pressure .....13.73 ~ 14.71 MPa
140 ~ 150 kgf/cm²
1,991 ~ 2,133 psi

B. FUEL TIGHTNESS OF NEEDLE VALVE SEAT


S76W256A

1. Set the injection nozzle to the nozzle tester.
2. Apply 130 kgf/cm² (12.74 MPa, 1,849 psi) of pressure consistently for 10 seconds and check if the fuel is leaked from the nozzle.
3. If the fuel is leaked, replace the nozzle.

5.6 BUBBLE TEST FOR RADIATOR

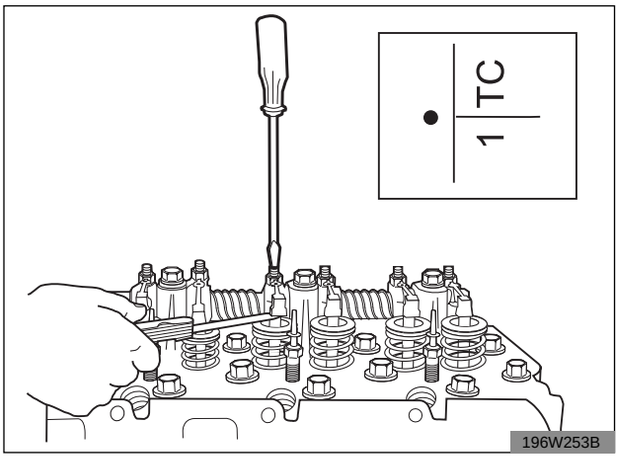
REMARK

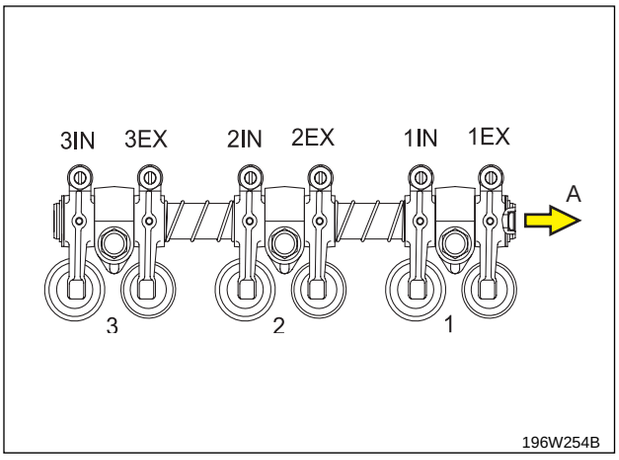
Check if water is leaked through crack on the cylinder wall.

1. Check the coolant level of the radiator and the reservoir tank. Add the coolant if necessary.
2. Start the engine with the radiator cap closed and the reservoir tank cap open.
3. Check if any bubble can be seen in the overflow hose on the bottom of the reservoir tank around 5 minutes later.
4. If any bubble keep coming, remove the engine cylinder head to check the head gasket for damage, the cylinder bore for crack and the cylinder head for crack. Replace the components if necessary.

5.7 INTAKE AND EXHAUST VALVES

5.7.1 CLEARANCE ADJUSTMENT





(A) Cooling fan

1. Remove the cylinder head cover.
2. Turn the flywheel and align the 1TC mark with the timing mark of the rear end plate to position the 1st cylinder piston at the top dead center of its compression cycle. (At this time, both valves of 1st cylinder are closed to allow the gap between rocker arms and valves and Ex. valve of 2nd cylinder and IN. valve of 3rd cylinder are open, and moving at the same time.)
3. Measure the clearance at the valves marked with ○ in the table below with a feeler gauge.

Fly-wheel	3		2		1		Cooling fan
	IN.	EX.	IN.	EX.	IN.	EX.	
	○	●	●	○	●	●	

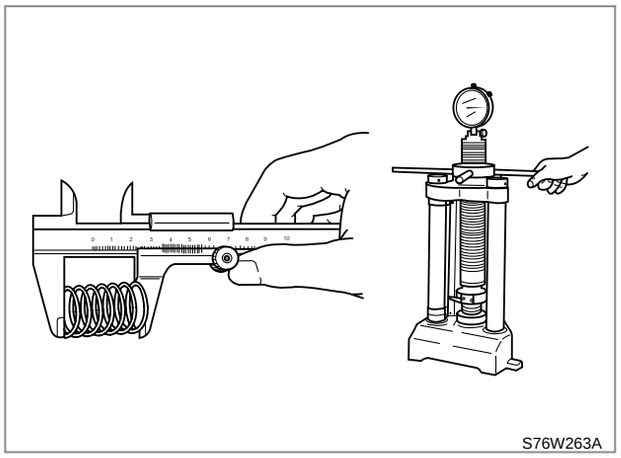
4. If the clearance is not within the factory specifications, turn the adjusting screw to adjust.
   After adjusting valve clearance, be sure to tighten the lock nut of each valve securely.
5. Turn the flywheel just one turn to position the 1st cylinder piston at top dead center. (At this time, two valves are in their over lap position without any gab between rocker arms and valves.)
6. Measure the clearance at the valves marked with ● in the table below with a feeler gauge.

Fly-wheel	3		2		1		Cooling fan
	IN.	EX.	IN.	EX.	IN.	EX.	
	●	○	○	●	○	○	

7. If the clearance is not within the factory specifications, adjust.
   After adjusting valve clearance, be sure to tighten the lock nut of each valve securely.

Item	Factory spec.
Valve clearance	0.15 mm 0.006 in.

5.7.2 VALVE SPRING INSPECTION (LENGTH, TENSION AND SQUARENESS)


S76W263A

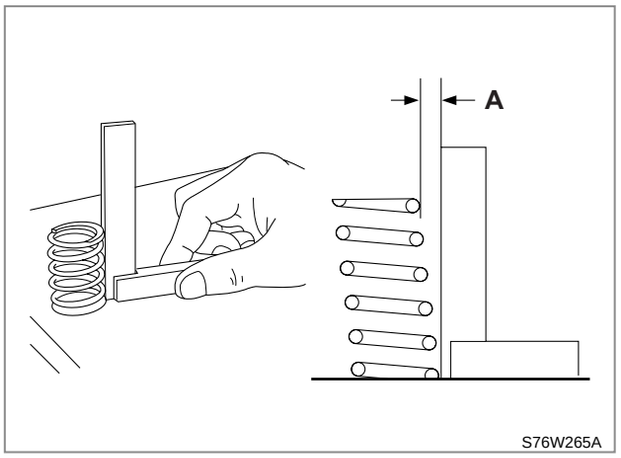
1. Measure the free length of the spring with vernier calipers.

S76W264A

2. Place the spring on a spring compression tester and compress to the specified length to measure the tension.
3. If the measured value is less than the allowable limit, replace the valve spring.

Tension	Specified value	74 N / 31 mm 7.5 kgf / 31 mm 16.5 lbs / 1.22 in.
	Allowable limit	63 N / 31 mm 6.4 kgf / 31 mm 14.1 lbs / 1.22 in.
Free length	Specified value	35.1 ~ 35.6 mm 1.382 ~ 1.402 in.
	Allowable limit	34.8 mm 1.37 in

5.7.3 VALVE SPRING SQUARENESS (TILT)



S76W265A

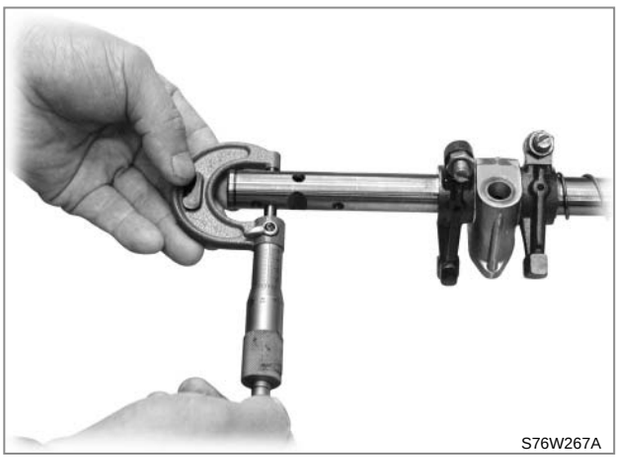
1. Place the spring on a flat plate and then put a square at its side.


S76W266A

2. Measure the maximum distance "A" while rotating the spring.
3. If the measurement exceeds the allowable limit, replace the spring.

Valve spring squareness	Allowable limit	1.3 mm 0.051 in.

5.8 ROCKER ARM ASSEMBLY CHECK


S76W267A

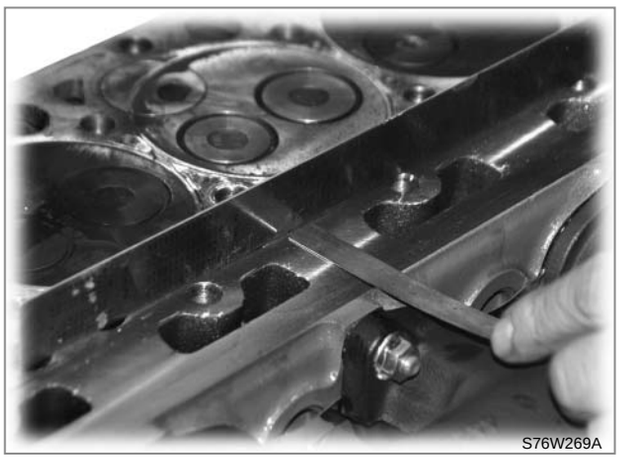

S76W268A

1. Measure the rocker arm shaft O.D. with an outside micrometer.
2. Measure the rocker arm I.D. with an inside micrometer.
3. If the clearance exceeds the allowable limit, replace the rocker arm.
4. If the clearance still exceeds the allowable limit after replacing the rocker arm, replace the rocker arm shaft.

Clearance	Specified value	0.020 ~ 0.080 mm (0.0008 ~ 0.0031 in.)
	Allowable limit	0.12 mm (0.0047 in.)
Rocker arm shaft O.D.	Specified value	12.955 ~ 12.980 mm (0.5100 ~ 0.5110 in.)
Rocker arm I.D.	Specified value	13.000 ~ 13.035 mm (0.5118 ~ 0.5132 in.)

5.9 CYLINDER HEAD CHECK

5.9.1 CYLINDER HEAD SURFACE FLATNESS


S76W269A

1. Thoroughly clean the cylinder head surface.
2. Place a straight edge on the cylinder head and measure the clearance with a feeler gage as shown in the figure.
3. If the measured value exceeds the allowable limit, replace the cylinder head.

IMPORTANT

Do not place the straight edge on the combustion chamber.

Allowable limit .....0.05 mm (0.0019 in.)

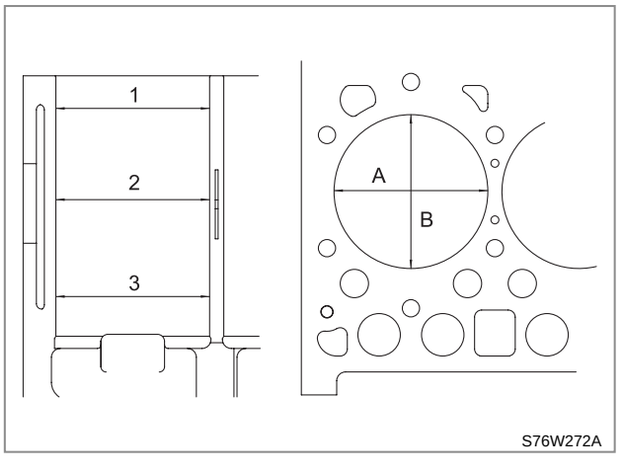
5.9.2 CYLINDER HEAD VALVE RECESS

1. Clean the cylinder head, the valve face and the valve seat.
2. Insert the valve into the guide.
3. Measure the valve recess with a depth gauge.
4. If the recess value exceeds the allowable limit, replace the valve and check the valve seat.

Valve recess	Specified value	0.9 ~ 1.1 mm 0.035 ~ 0.043 in.
	Allowable limit	1.3 mm 0.051 in.

5.9.3 CYLINDER BORE CHECK

1. Check the worn condition of the honing groove on the bore.
2. Check the bore for scuffing or scoring.



(A) Axial direction (B) Transverse direction

1,2,3 Measuring Points

3. Measure the cylinder liner I.D. at six locations as shown in the figure to find the largest worn area.

Specified cylinder I.D.	75.000 ~ 75.022 mm (2.9528 ~ 2.9536 in.)

5.10 PISTON CHECK

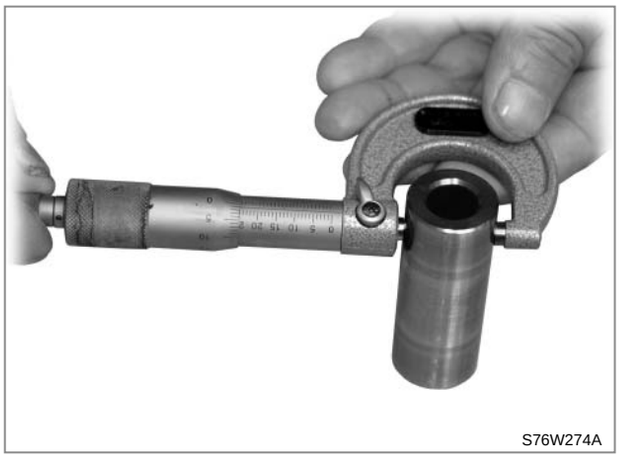
5.10.1 PISTON PIN BORE


S76W273A

1. Measure the I.D. of the piston pin bore (lengthwise and widthwise of the piston) with a cylinder gauge.
2. If the measured value exceeds the allowable limit, replace the piston.

Piston pin bore I.D.	Specified value	20.000 ~ 20.013 mm (0.7874 ~ 0.7879 in.)
	Allowable limit	20.03 mm (0.7886 in.)

5.10.2 CLEARANCE BETWEEN PISTON PIN AND BUSHING


S76W274A


S76W275A

1. Measure the piston pin O.D. with an outside micrometer.
2. Measure the piston pin busing I.D. with an inside micrometer.
3. If the clearance still exceeds the allowable limit after replacing the bushing with a new one, replace the piston pin.

Clearance between piston pin and bushing	Specified value	0.014 ~ 0.038 mm (0.00055 ~ 0.00150 in.)
	Allowable limit	0.15 mm (0.0059 in.)
Piston pin O.D.	Specified value	20.002 ~ 20.011 mm (0.7875 ~ 0.7878 in.)
Bushing I.D.	Specified value	20.025 ~ 20.040 mm (0.7884 ~ 0.7879 in.)

5.10.3 PISTON RING END GAP


S76W276A

1. Place the piston ring to be measured on the top face of the piston in the cylinder block and slightly push in the piston and piston ring. (Do not put the piston ring on the carbon layer.)
2. Measure the ring end gap with a feeler gauge.
3. If the gap exceed the allowable limit, replace the piston ring.

Item		Factory spec.	Allowable limit
Piston ring gap	Top ring	0.15 ~ 0.30 mm 0.0059 ~ 0.0118 in.	1.25 mm 0.0492 in.
	2nd ring	0.30 ~ 0.45 mm 0.0118 ~ 0.0177 in.	1.25 mm 0.0492 in.
	Oil ring	0.25 ~ 0.35 mm 0.0098 ~ 0.0138 in.	1.25 mm 0.0492 in.

4. If the gap is still over the allowable limit with even new ring, measure the diameter of bore. (Refer to page 3-42)

5.10.4 PISTON RING CLEARANCE

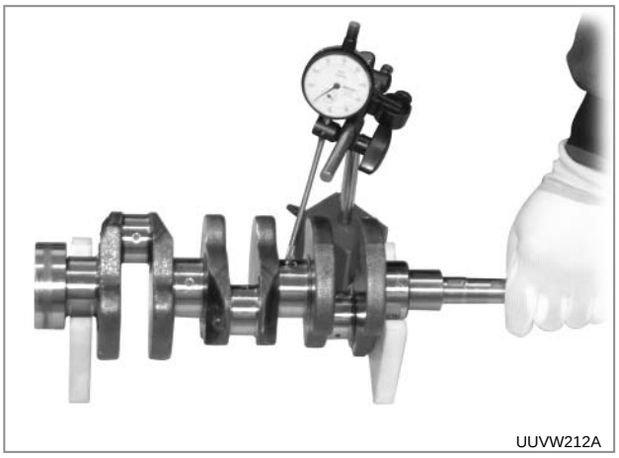

S76W277A

1. Clean the piston ring and piston ring grooves, and install each ring in its groove.
2. Measure the clearance between the piston ring and the ring groove with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the piston ring.
4. If the clearance still exceeds the allowable limit after replacing the ring with new one, replace the piston.

Piston ring clearance	Second ring (compression ring)	Specified value	0.085 ~ 0.112 mm (0.0033 ~ 0.0044 in.)
	Oil ring	Specified value	0.020 ~ 0.055 mm (0.0008 ~ 0.0022 in.)

5.11 CRANKSHAFT CHECK

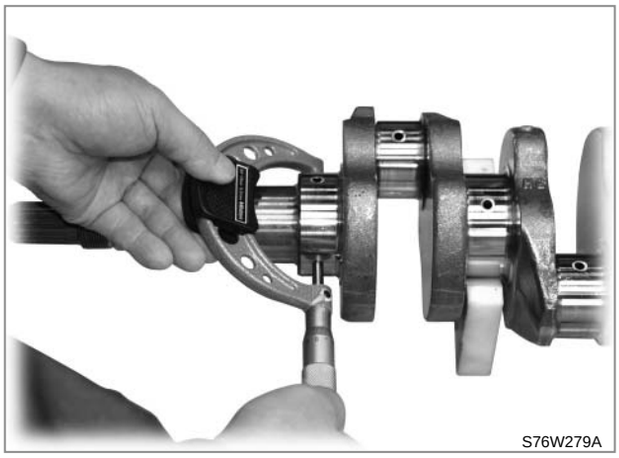
5.11.1 CRANKSHAFT DEFLECTION

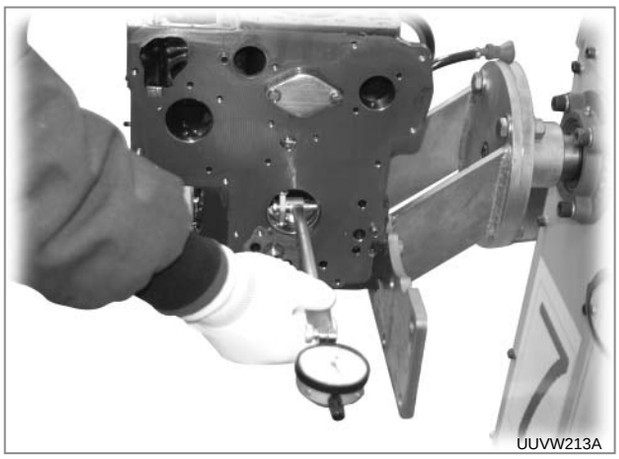

UUVW212A

1. Place the crankshaft on V blocks with its journals supported and set a dial indicator with its tip on the intermediate journal.
2. Measure the eccentricity (half of the measured value) while turning the crankshaft on the V blocks.
3. If the eccentricity exceeds the allowable limit, replace the crankshaft.

Eccentricity	Second ring (compression ring)	0.02 mm (0.0008 in.)
	Allowable limit	0.08 mm (0.0031 in.)

5.11.2 OIL CLEARANCE BETWEEN CRANKSHAFT JOURNAL AND BEARING 1

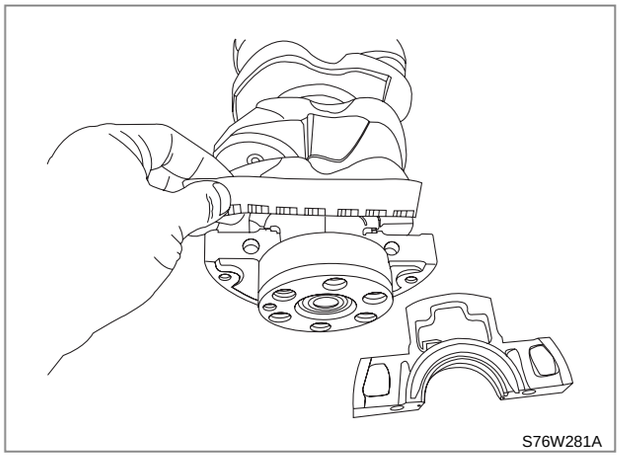

S76W279A


UUVW213A

1. Measure the O.D. of the crankshaft journal with an outside micrometer.
2. Measure the I.D. of the crankshaft bearing 1 with an inside micrometer.
3. If the clearance exceeds the allowable limit, replace the crankshaft metal bearing.

Oil clearance	Specified value	0.034 ~ 0.092 mm (0.0013 ~ 0.0036 in.)
	Allowable limit	0.20 mm (0.0079 in.)
Journal O.D.	Specified value	43.934 ~ 43.950 mm (1.7297 ~ 1.7303 in.)
Bearing 1 I.D.	Specified value	43.984 ~ 44.040 mm (1.7317 ~ 1.7339in.)

5.11.3 OIL CLEARANCE BETWEEN CRANKSHAFT JOURNAL AND BEARING 2

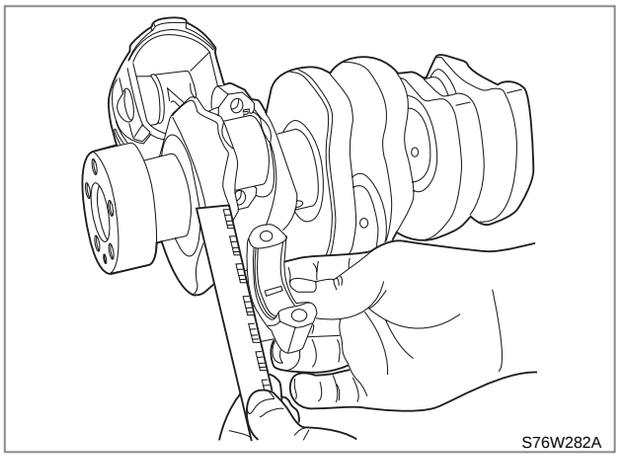


1. Place a plastigauge in lengthwise on the center of the journal.
2. Install the bearing cap, tighten the bolts to the specified torque once and remove the cap again.
3. Measure the amount of the flatness with a scale and get the oil clearance.
4. If the clearance exceeds the allowable limit, replace the bearing.

Oil clearance	Specified value	0.034 ~ 0.092mm (0.0013 ~ 0.0036 in.)
	Allowable limit	0.20 mm (0.0079 in.)
Journal O.D.	Specified value	43.934 ~ 43.950 mm (1.7297 ~ 1.7303 in.)
Metal 2 I.D.	Specified value	43.984 ~ 44.026 mm (1.7317 ~ 1.7333 in.)

Bearing cap bolt
tightening torque .....20 ~ 24 N.m
2.0 ~ 2.4 kgf/cm²
15 ~ 17 lb-ft

5.11.4 OIL CLEARANCE BETWEEN CRANK PIN AND CONNECTING ROD BIG END BEARING



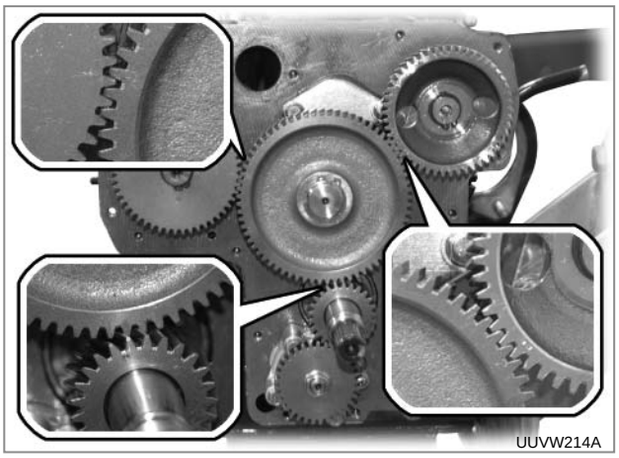
1. Place a plastic gauge in lengthwise on the center of the crank pin.
2. Install the connecting rod, tighten the bolts to the specified torque once and remove the cap again.
3. Measure the amount of the flatness with the scale and get the oil clearance.
4. If the clearance exceeds the allowable limit, replace the big end bearing.

Oil clearance	Specified value	0.029 ~ 0.091 mm (0.0011 ~ 0.0036 in.)
	Allowable limit	0.20 mm (0.0079 in.)

Connecting rod cap bolt
tightening torque .....26.5 ~ 30.4 N.m
2.7 ~ 3.1 kgf/cm²
19.52 ~ 22.42 lb-ft

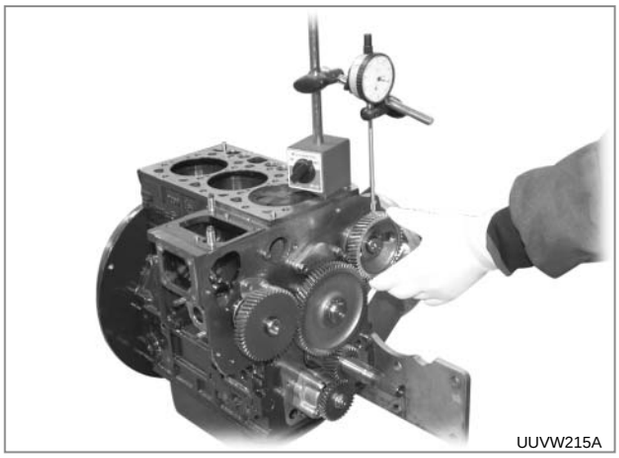
5.12 TIMING GEAR

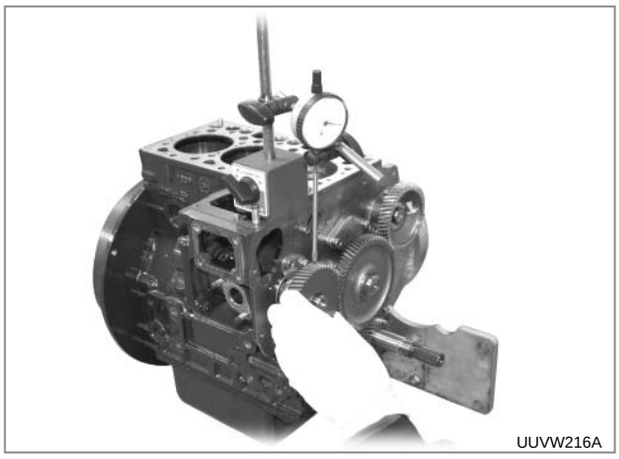
5.12.1 TIMING GEAR SETTING


UUVW214A

- The crankshaft gear drives the valve camshaft gear and fuel camshaft gear by driving idle gear. The timings for opening and closing the valves is very important to achieve the effective air intake and gas exhaust. When assembling, the appropriate timing can be obtained by aligning the mark on the crankshaft gear with idle gear, idle gear with camshaft gear, and idle gear with fuel camshaft gear.

5.12.2 TIMING GEAR BACKLASH

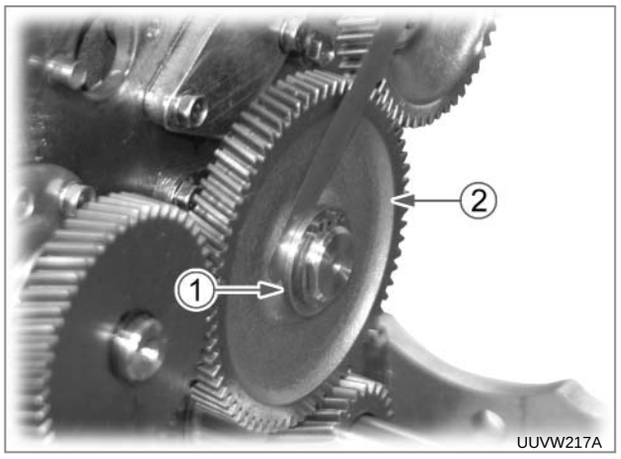

UUVW215A

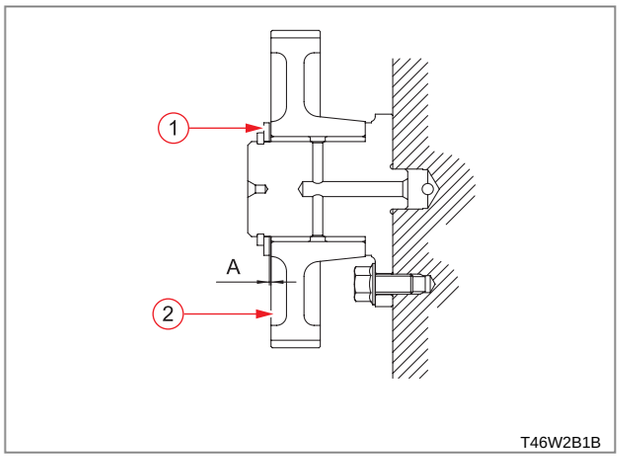

UUVW216A

1. Set a dial indicator (lever type) with its tip on the gear tooth.
2. Move the timing gear to measure its backlash while holding the engaged gear to it.
3. If the backlash exceeds the allowable limit, check the oil clearance of the shafts and the gear. (See 5.12.6)
4. If the oil clearance is proper but the backlash is over the allowable limit, replace the gear.

Backlash	Specified value	0.042 ~ 0.115 mm 0.0017 ~ 0.0045 in.
	Allowable limit	0.2 mm 0.0079 in.

5.12.3 IDLE GEAR SIDE CLEARANCE

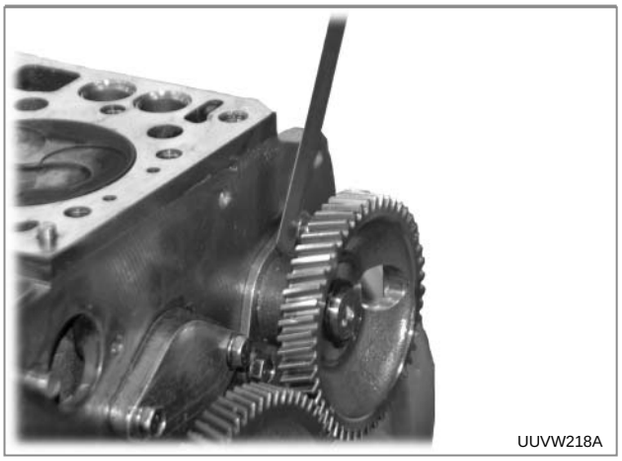


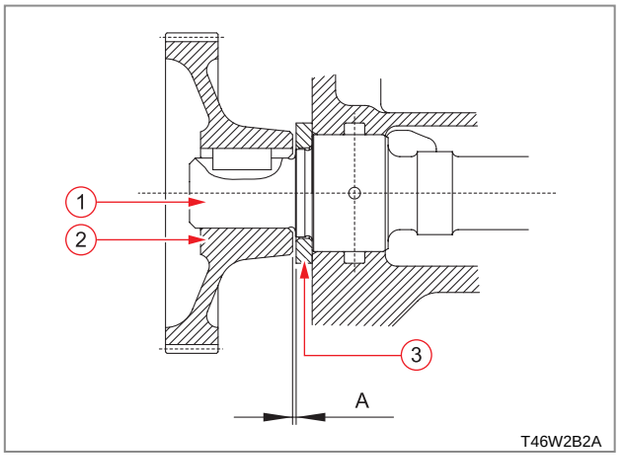


1. Pull the idle gear collar 2 (1) and push the idle gear (2) at its end.
2. Measure the clearance (A) between idle gear and idle gear collar 2 with a feeler gauge.
3. If the clearance exceeds the allowable limit, replace the idle gear(2).

Side clearance	Specified value	0.20 ~ 0.51 mm 0.0079 ~ 0.0201 in.
	Allowable limit	0.9 mm 0.035 in.

5.12.4 VALVE CAMSHAFT GEAR SIDE CLEARANCE





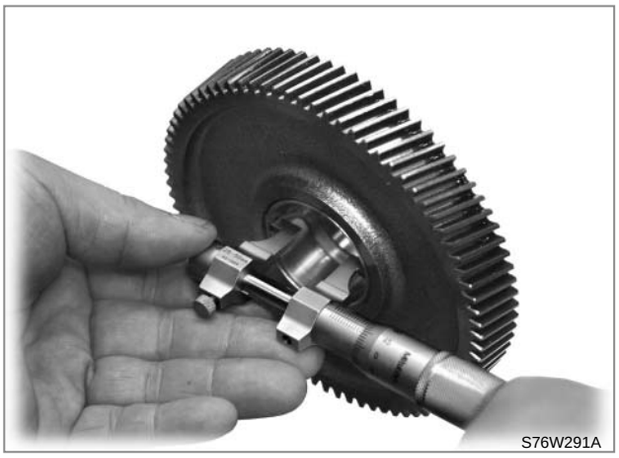
(1) Camshaft
(2) Camshaft gear
(3) Camshaft stopper

1. Pull the cam gear (2) forward.
2. Measure the clearance (A) between cam gear (2) and camshaft stopper (3).
3. If the clearance exceeds the allowable limit, replace the camshaft stopper (3).

Side clearance	Specified value	0.07 ~ 0.22 mm 0.028 ~ 0.078 in.
	Allowable limit	0.3 mm 0.0118 in.

5.12.5 IDLE GEAR OIL CLEARANCE MEASUREMENT


S76W290A

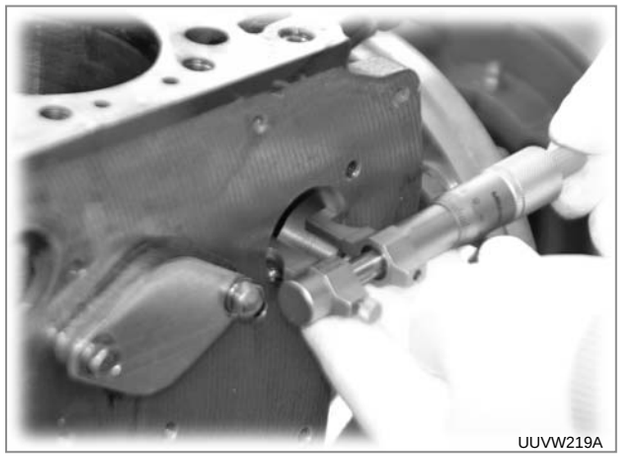

S76W291A

1. Measure the idle gear shaft O.D. with an outside micrometer.
2. Measure the idle gear bushings I.D. with an inside micrometer.
3. If the clearance exceeds the allowable limit, replace the bushing.

Oil clearance	Specified value	0.025 ~ 0.066 mm 0.00098 ~ 0.00259 in.
	Allowable limit	0.1 mm 0.004 in.
Shaft O.D.	Specified value	23.967 ~ 23.980 mm 0.9436 ~ 0.9441 in.
Bushing I.D.	Specified value	24.000 ~ 24.021 mm 0.9449 ~ 0.9457 in.

5.12.6 VALVE CAMSHAFT OIL CLEARANCE MEASUREMENT

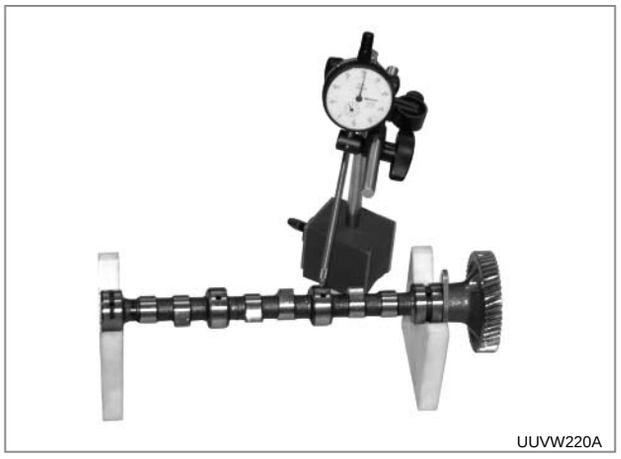

S76W292A


UUVW219A

1. Measure the O.D. of the camshaft journal with an outside micrometer.
2. Measure the I.D. of the camshaft bore on the crankcase with an inside micrometer.
3. If the clearance exceeds the allowable limit, replace the shaft.

Oil clearance	Specified value	0.050 ~ 0.090mm 0.0020 ~ 0.0036 in.
	Allowable limit	0.15 mm 0.0059 in.
Journal O.D.	Specified value	32.934 ~ 32.950 mm 1.2966 ~ 1.2972 in.
Bore I.D.	Specified value	33.000 ~ 33.025 mm 1.2992 ~ 1.3002 in.

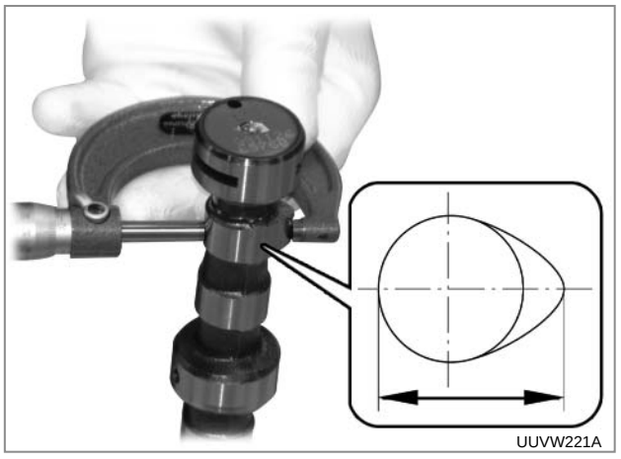
5.12.7 VALVE CAMSHAFT DEFLECTION CHECK



1. Place the camshaft on V blocks with its journals supported and set a dial indicator with its tip on the intermediate journal.
2. Measure the eccentricity (half of the measured value) while turning the camshaft on the V blocks.
3. If the eccentricity exceeds the allowable limit, replace the camshaft.

Eccentricity	Allowable limit	0.08 mm 0.0031 in.

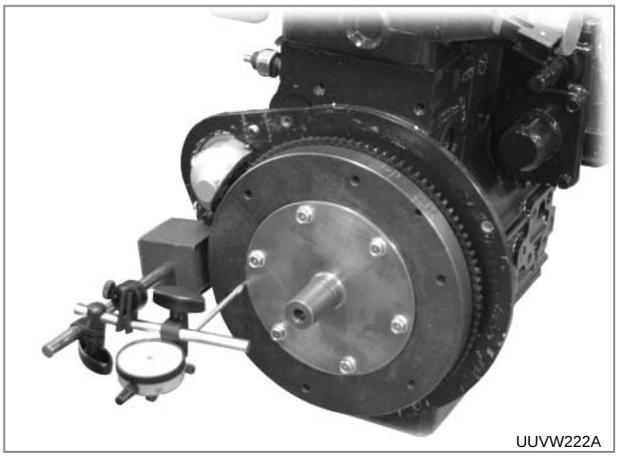
5.12.8 VALVE CAM HEIGHT MEASUREMENT



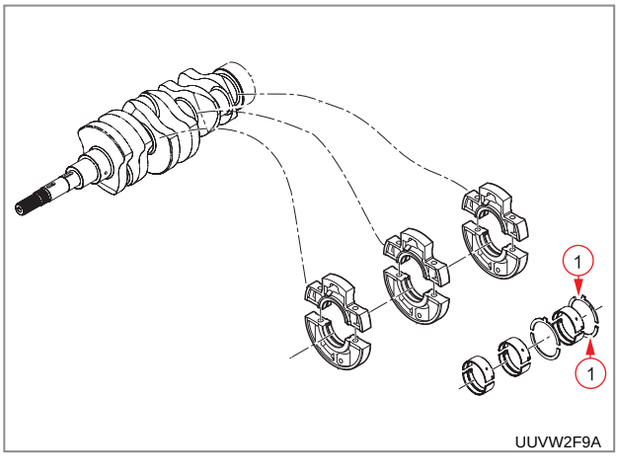
1. Measure the height of the camshaft lobe at largest O.D. with an outside micrometer.
2. If the measured value is below the allowable limit, replace the camshaft.

Cam height	Specification	26.83 mm (1.0563 in.)
	Allowable limit	26.75 mm (1.0531 in.)

5.13 FLYWHEEL DEFLECTION AND CRANKSHAFT END PLAY CHECK


UUVW222A

1. Set a dial indicator with its tip on the rear friction face of the flywheel near the edge.
2. Turn the flywheel to measure the deflection or the uneven wear.
3. If the measured value exceeds the allowable limit, remove the flywheel and check the mating faces of the crankshaft and flywheel.
4. Measure the end play while moving the crankshaft with the flywheel back and forth to each end.



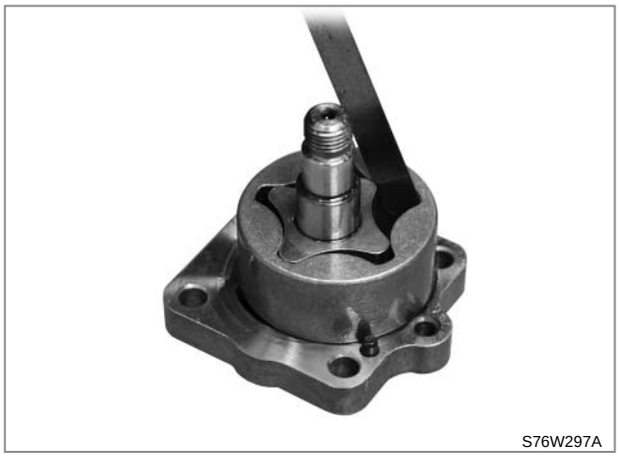
UUVW2F9A

5. If the end play exceeds the allowable limit, replace the side metal bearing (1) .

Deflection	Allowable limit	0.05 mm (0.0020 in.)
End play	Specified value	0.15 ~ 0.31 mm (0.0059 ~ 0.0122 in.)
	Allowable limit	0.5 mm (0.020 in.)

5.14 OIL PUMP CHECK

▶ CLEARANCE BETWEEN ROTOR AND LOBE OF OIL PUMP


S76W297A

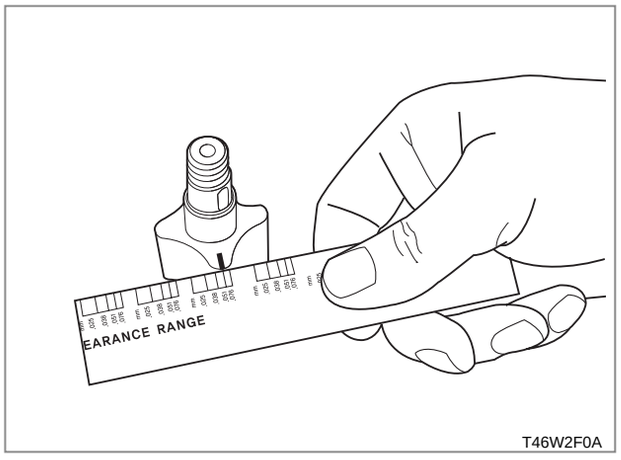

S76W298A


S76W299A

1. Measure the clearance between the outer rotor and inner rotor with a feeler gauge.
2. Measure the clearance between the outer rotor and the housing using a micrometer.
3. If the clearance exceeds the allowable limit, replace the pump.

Clearance between outer rotor and inner rotor	Specified value	0.11 ~ 0.15 mm (0.0043 ~ 0.0059 in.)
	Allowable limit	0.20 mm (0.0079 in.)
Clearance between outer rotor and housing	Specified value	0.07 ~ 0.15 mm (0.0028 ~ 0.0059 in.)
	Allowable limit	0.25 mm (0.0098 in.)

▶ END CLEARANCE OF ROTOR IN OIL PUMP



1. Place a plastigauge on the rotor and assemble the pump.
2. Disassemble the pump and measure the amount of the flatness with a scale to get the clearance.
3. If the clearance exceeds the allowable limit, replace the pump.

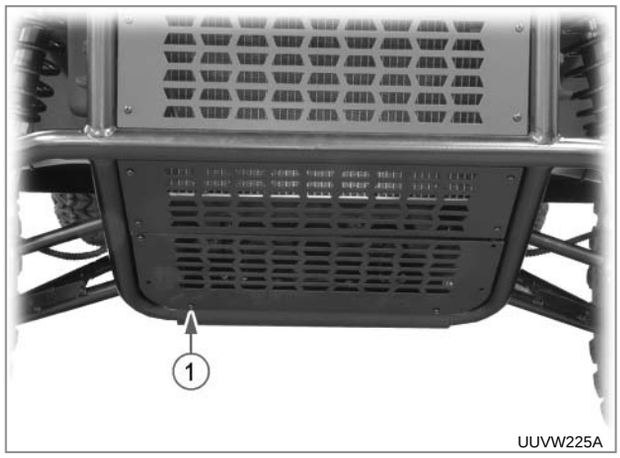
End clearance	Specified value	0.08 ~ 0.13 mm (0.00315 ~ 0.00512 in.)
	Allowable limit	0.20 mm (0.0079 in.)

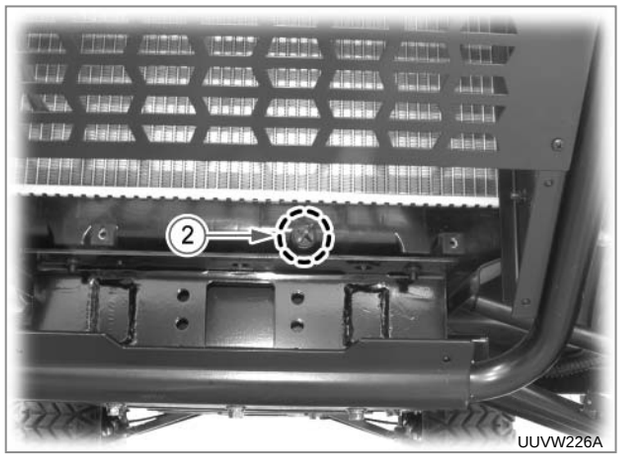
6. DISASSEMBLY, SERVICE AND ASSEMBLY

6.1 ENGINE REMOVAL

1. Park the vehicle on level ground, stop the engine, and then apply the parking brake.

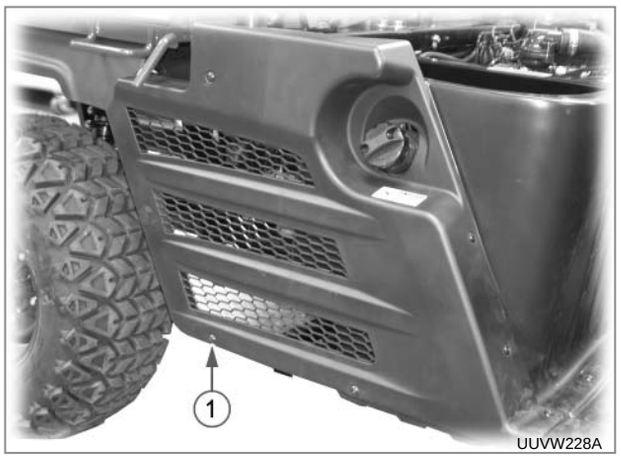
2. Unscrew the four battery cover mounting screws (M6, 1), remove the side cover, and disconnect the negative battery cable.



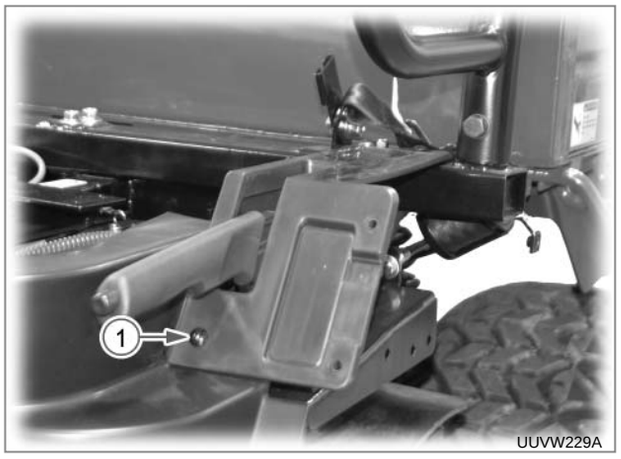


3. Unscrew the four lower screen mounting screws (M5, 1) and remove the lower screen. Then, place a container under the rear of the radiator and unscrew the drain cock (2) of the radiator to drain the coolant.

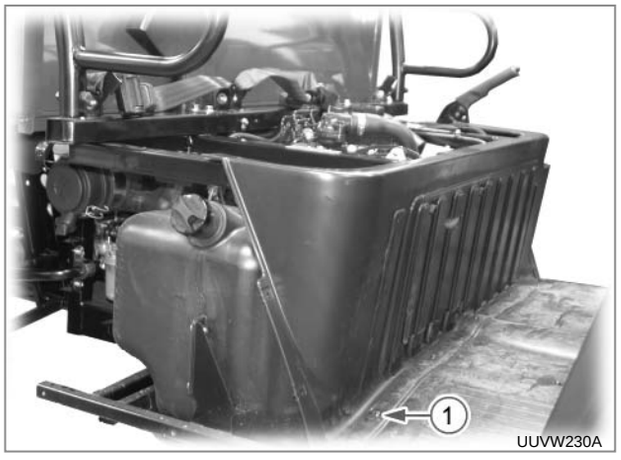
4. Remove the seat (1) by pulling its rear section upward. Then, unscrew the seven seatback screws (M6) to remove the seatback (2).



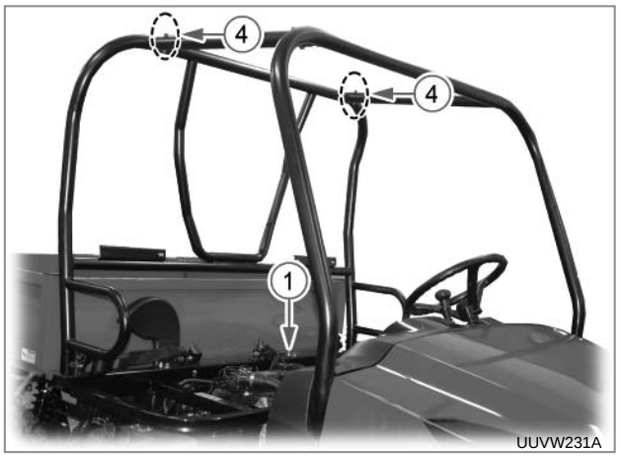
5. Unscrew the 16 mounting screws (M6, 1) for the fender middle covers (LH, RH) to remove the covers.

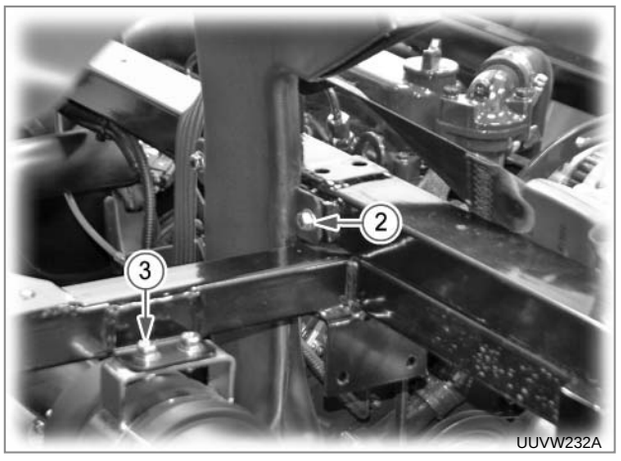


6. Unscrew the two parking brake cover mounting screws (M6, 1) and remove the parking brake cover.



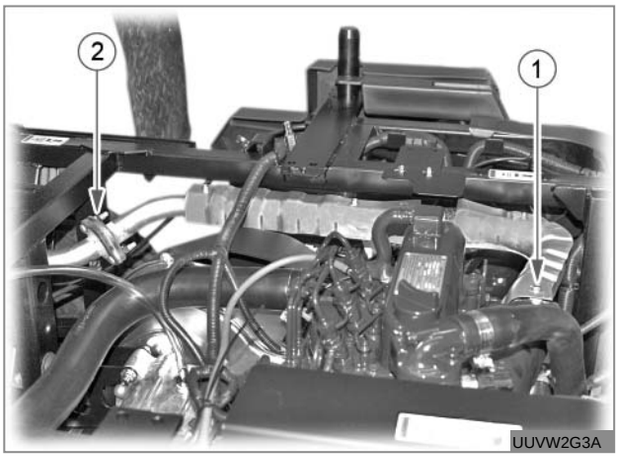
7. Unscrew the nine main floor assembly mounting screws (M6, 1) to remove the main floor assembly.



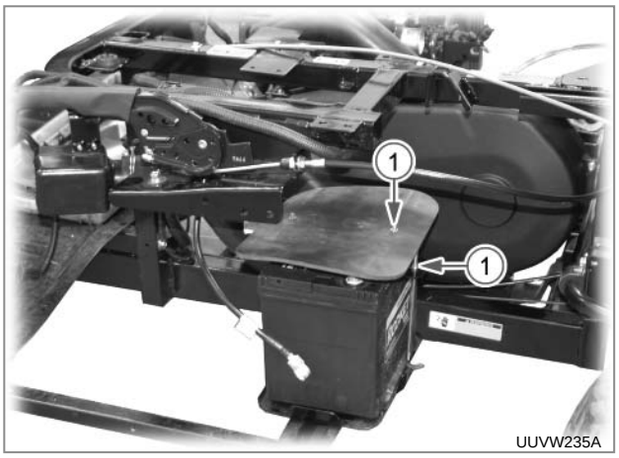


8. Unscrew the six seat frame assembly mounting bolts (M10, 1), two air cleaner mounting nuts (M8, 2), two air cleaner mounting bolts (M8, 3), air cleaner suction hose band and two upper frame mounting bolts (M8, 4) to remove the air cleaner body and frame.

9. Disconnect the various electrical wirings and connectors and unscrew the bands for the fuel hose and coolant hose to disconnect the hoses. Then, disconnect the accelerator pedal cable.

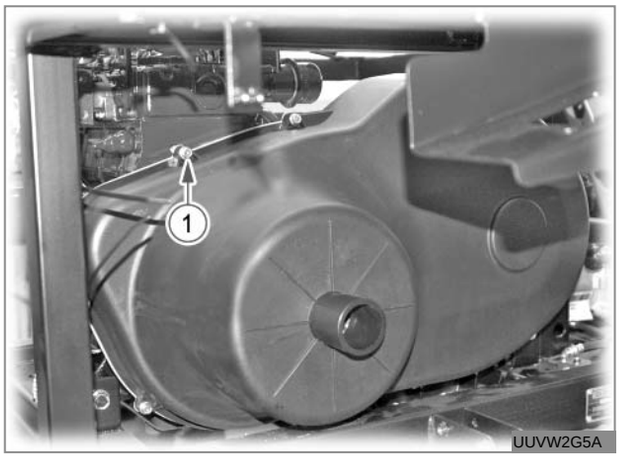


10. Unscrew the four heat shield mounting bolts (M6, 1) to remove the heat shield. Then, unscrew the four muffler pipe mounting bolts (M8) and two muffler pipe mounting nuts (M10, 2) and disconnect the spring to remove the muffler pipe. (10mm, 14mm)

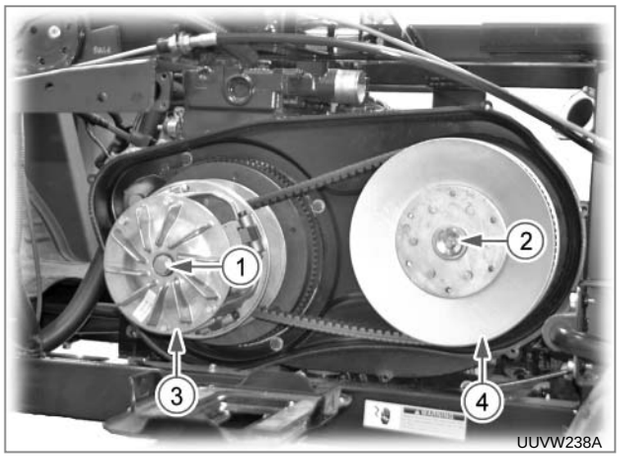


11. Unscrew the battery mounting nuts (1) to remove the battery.

12. Undo the clamps for the CVT intake hose (1) and disconnect the intake hose.



13. Unscrew the nine CVT cover mounting bolts (M6, 1) to remove the CVT cover.



14. Unscrew the CVT drive pulley mounting bolt (1) and CVT driven pulley mounting bolt (2) and fit the removal tool into the CVT drive pulley bolt hole. Then, turn the tool to remove the CVT drive pulley (3) and belt, and pull out the CVT driven pulley (4) using a lever.

CVT drive pulley mounting bolt tightening torque .....54 Nm (5.5 kgf-m, 40 lb-ft)

CVT driven pulley mounting bolt tightening torque .....24.5 Nm (2.5 kgf-m, 18.0 lb-ft)

IMPORTANT

- **Apply LOCTITE #242 or equivalent to the mounting bolts of CVT drive and driven pulleys before installing them.**

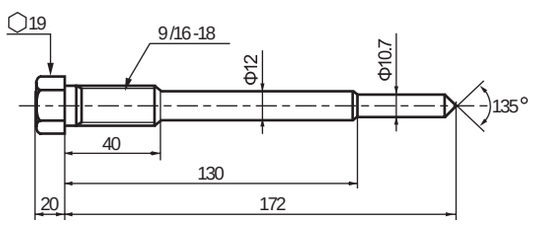
REMARK

• REMOVAL TOOL FOR CVT DRIVE PULLEY

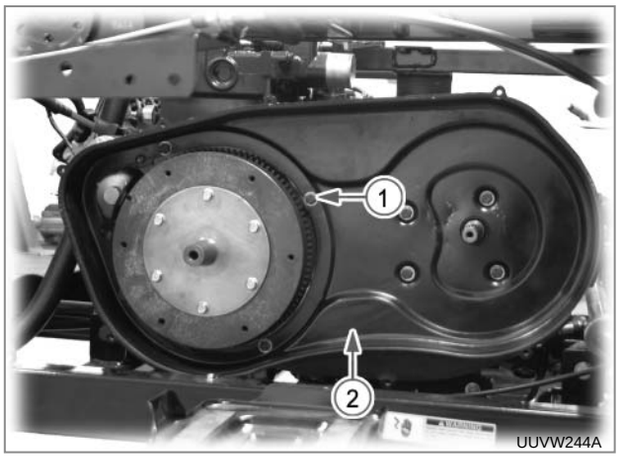
Part number : UCVT-P10

UUVW241A

mm.

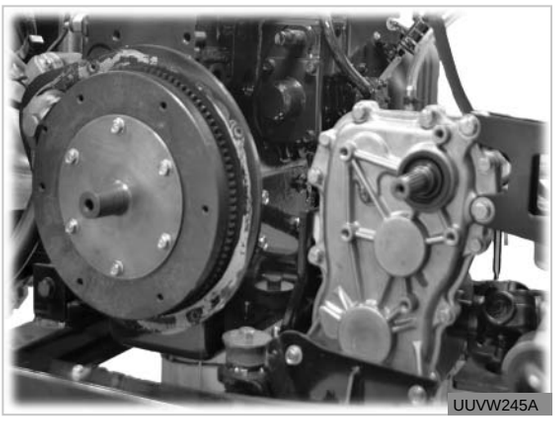


UUVW307A

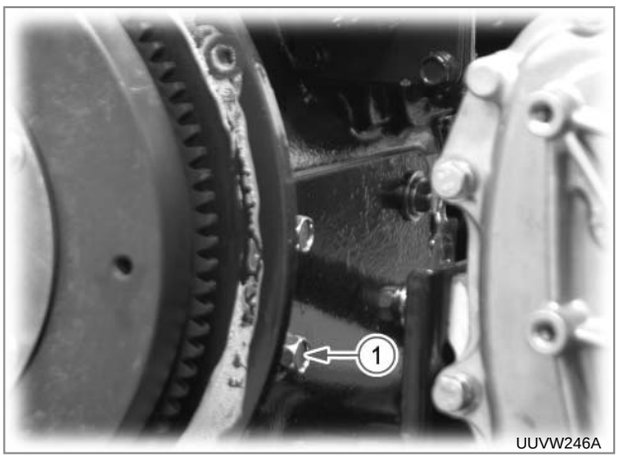


15. Unscrew the eight internal CVT cover mounting bolts (M8, 1) and remove the internal CVT cover (2). (13 mm)

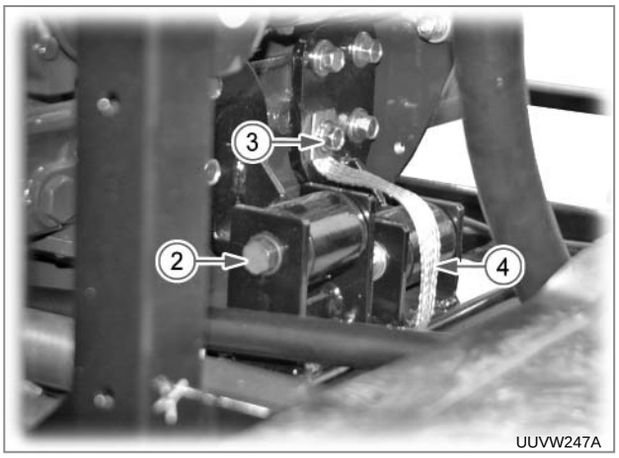
⚠ CAUTION


UUVW245A

- **When installing the internal CVT cover, remove any Three Bond residual from the mating surface of the flywheel's engine installation plate and apply a sufficient amount of Three Bond 1206D or equivalent to the cover surface before installation to prevent leakage.**



UUVW246A



UUVW247A

16. Unscrew the four engine mounting bracket mounting bolts (M10, 1) as well as the two front mounting rubber mounting bolts (M12, 2) and ground wiring mounting bolt (3). Then, disconnect the ground wiring (4). (14mm, 17mm)


UUVW248A

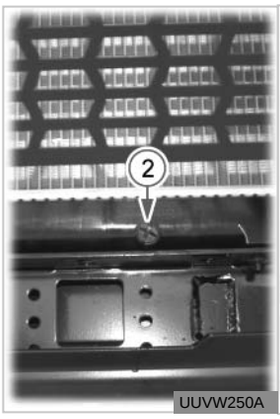
17. Remove the engine by hooking a hoist to the hook on the cylinder head.

REMARK

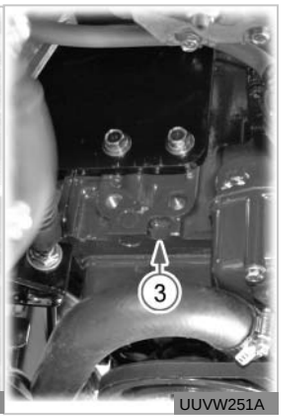
- **Engine coolant change (replenishment)**

1. Park the vehicle on level ground.

UUVW249A



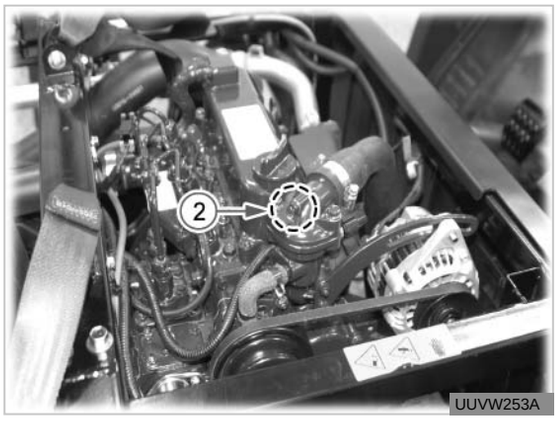
UUVW250A



UUVW251A

2. Open the coolant filler cap (1) and unscrew the drain cock (2) under the radiator and the drain plug (3) of the cylinder block. Drain the coolant completely and install the cap, cock and plug.

REMARK



3. Loosen the bleeding screw (2) on the engine coolant flange cover. Then, add the coolant through the radiator filler hole until the coolant flows out.

4. When the coolant overflows the bleeding screw, turn the bleeding screw to lock it. Then, squeeze the coolant hose (1) on top of the radiator 3 to 5 times to remove air in the hose. When the coolant reaches the radiator reference level, close and lock the filler cap.

5. Fill the reservoir tank (1) with the coolant up to the reference level.

CAUTION

- **Make sure that the coolant is not hot before opening the radiator filler cap.**

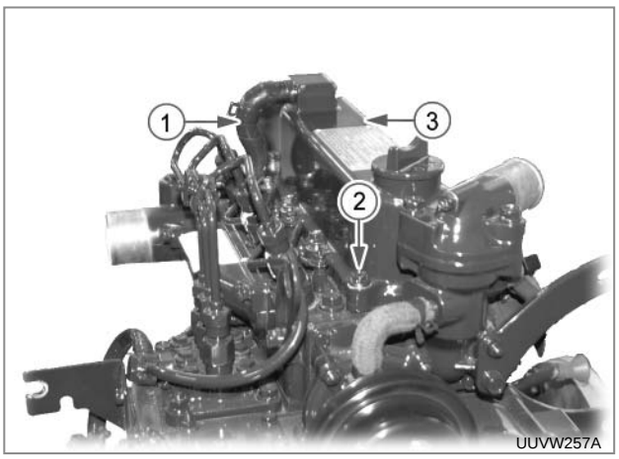
IMPORTANT

- **The coolant mixture ratio of water to anti-freeze should be 50:50. When adding the coolant, pour it slowly.**
- **When installing the cylinder block drain plug, apply sealant to the thread of the plug.**

6.2 ENGINE COMPONENT DISASSEMBLY AND ASSEMBLY

6.2.1 CYLINDER HEAD

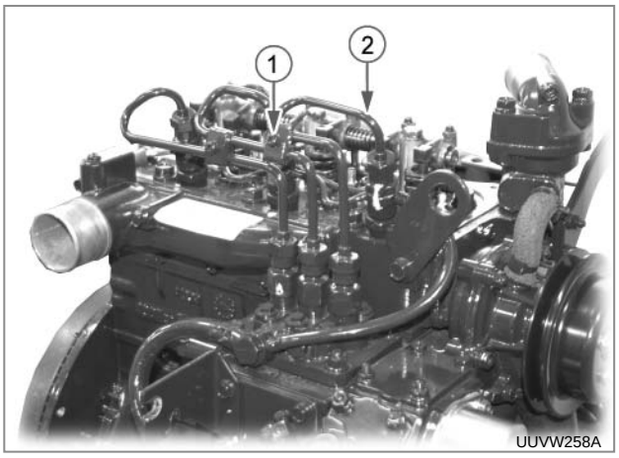
1. Set the engine on level surface and unscrew the drain plug under the oil pan to drain the engine oil.
2. Remove the alternator or other components if necessary.



UUVW257A

3. Undo and remove the PCV hose band (1) and unscrew the five cylinder head cover bolts (M6, 2) and two nuts (M6) to remove the cylinder head cover (3).

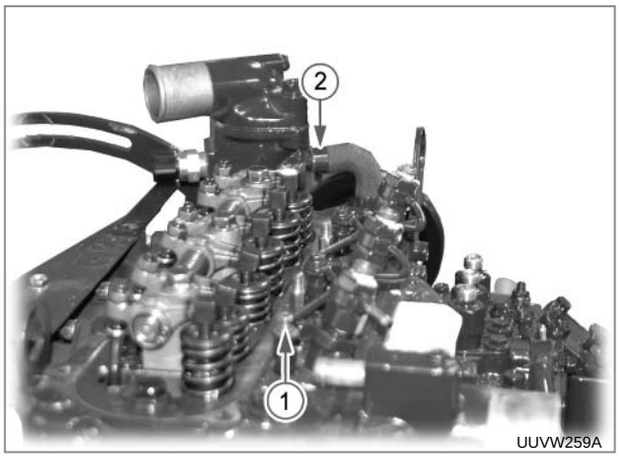
Bolt and nut
tightening torque ..... 48.1 ~ 55.8 Nm
4.9 ~ 5.7 kgf-m
35.5 ~ 41.2 lb-ft



UUVW258A

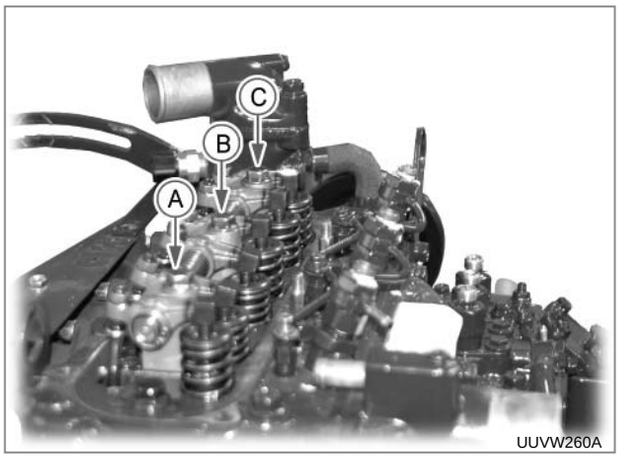
4. Unscrew the high-pressure pipe lock screw (1) and the nut on the injection pump and injection nozzle holder connection to disconnect the high-pressure pipe (2) in order.

Nut tightening torque ..... 24.5 ~ 34.3 Nm
2.5 ~ 3.5 kgf-m
18.1 ~ 25.3 lb-ft



UUVW259A

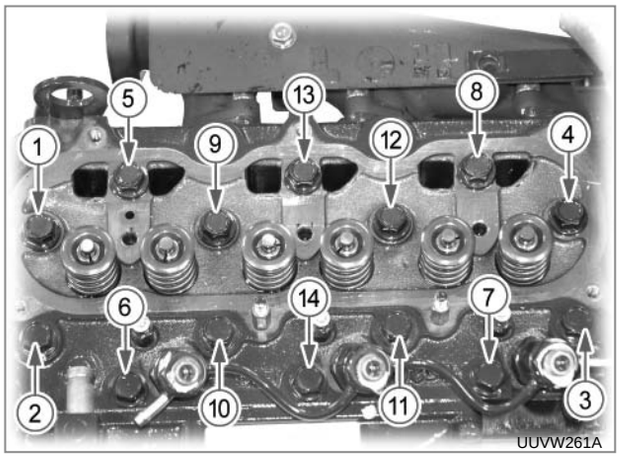
5. Unscrew the glow plug cord nut (1) and undo the coolant return hose band (2) to disconnect the glow plug cord and coolant return hose.



UUVW260A

6. Unscrew the three rocker arm shaft mounting bolts (M8) to remove the rocker arm shaft assembly using the 12 mm socket wrench.
Keep the push rods in removal order to install them to their correct positions later.
Remove the bolts in order of C, A and B. When installing the bolts, install them in reverse order of removal, i.e. B, A and C, and tighten them evenly in several steps.

Mounting bolt (M8)
tightening torque ..... 23.5 ~ 27.5 Nm
2.4 ~ 2.8 kgf-m
17.4 ~ 20.3 lb-ft

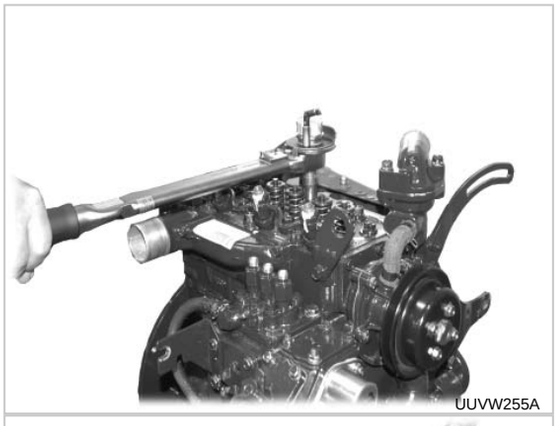


UUVW261A

7. Unscrew the 14 cylinder head bolts (M10) in order using the 13 mm socket wrench and remove the cylinder head.
   When removing the bolts, unscrew them in the numerical order. When installing them, tighten them in reverse of the numerical order evenly in several steps.

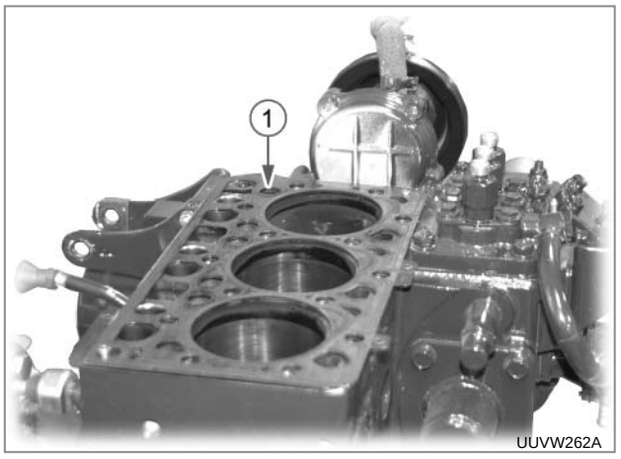
REMARK

- **Cylinder head bolt tightening torque**


UUVW255A

UUVW254A

- **When installing the cylinder head, install the cylinder head bolts in reverse of installation order in several steps. Tighten all bolts to 2.5 kgf-m and tighten them 90 degrees further in the same order. Finally, tighten them 70 degrees further.**
  Therefore, the bolts should be tightened evenly in 3 steps.
- **When using the angle wrench, install it to the head bolt and set the angle dial. Then, tighten the bolt to the necessary angle observing the amount of the needle movement.**

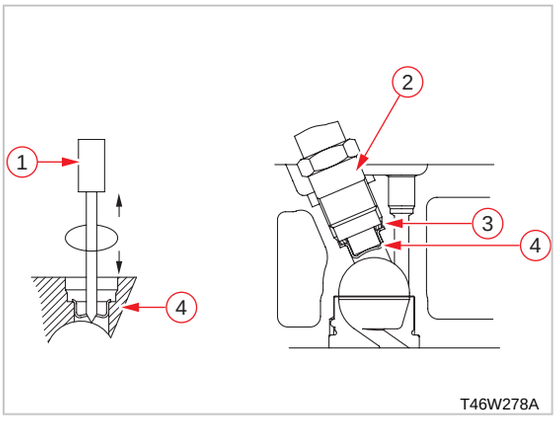


UUVW262A

8. Remove and replace the cylinder head gasket (1).
9. If necessary, remove the injection nozzle holder assembly.

REMARK

- **Removal of heat seal**



T46W278A

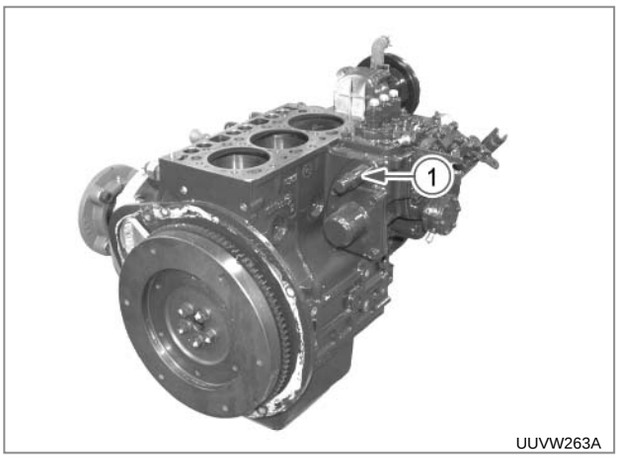
(1) Philips-head screwdriver
(2) Nozzle
(3) Injection nozzle gasket
(4) Heat seal

a. Drive the Philips-head screwdriver lightly into the heat seal hole.
b. Turn the Philips-head screwdriver three or four times each way.
c. While turning the Philips-head screwdriver, slowly pull out the heat seal together with the injection nozzle gasket. If the heat seal drops, repeat the above procedure.
d. The heat seal and injection nozzle gasket must be replaced once the injection nozzle has been removed for cleaning or service.

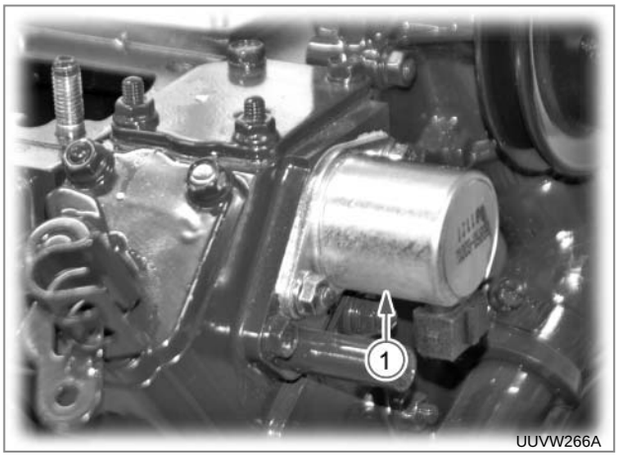
- **Use a Philips screwdriver with the size of ø 6.0 mm. This is slightly larger than the hole diameter of the heat seal (1/4 in).**

6.2.2 FUEL INJECTION PUMP

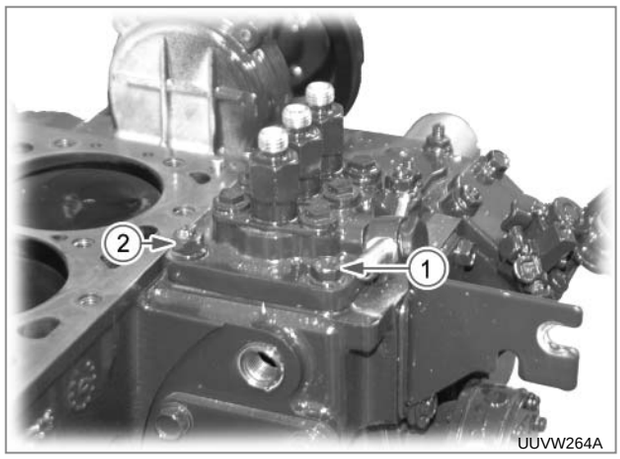
- **DISASSEMBLY**



1. Unscrew and pull out the idle adjusting screw shaft (1).



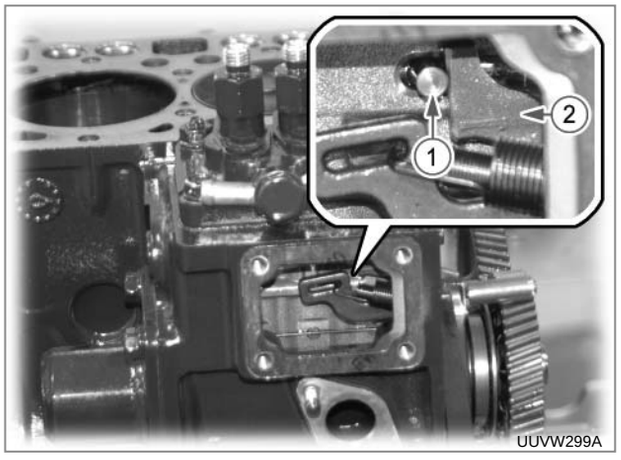
2. Remove the engine stop solenoid (1).



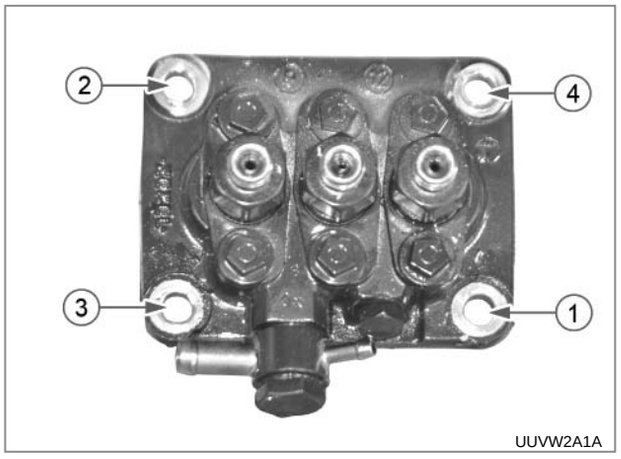
3. Unscrew the two injection pump mounting bolts (M8, 1) and two nuts (M8, 2) to remove the injection pump assembly. (12mm)

- **ASSEMBLY**

1. Apply the liquid gasket (Three bond 1215, 1104 or equivalent) on the pump installation surface of the cylinder block.
2. Install the shims same as the previous state.



3. When installing the fuel injection pump, the pump control rack (1) should be on the side of the fork lever 1 (2).



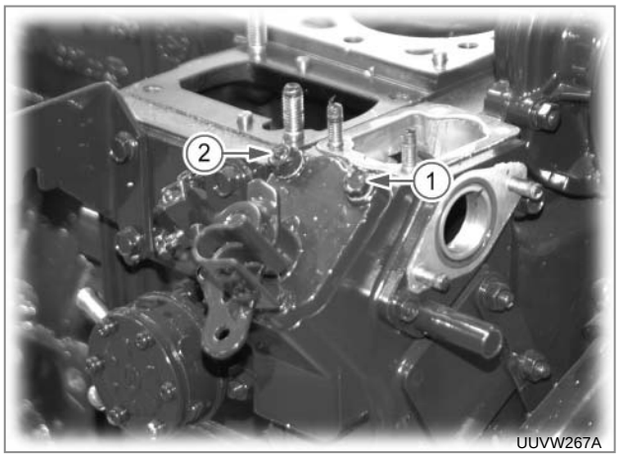
4. The fuel injection pump mounting bolts and nuts should be tightened in order as shown in the figure to the specified torque in several steps.

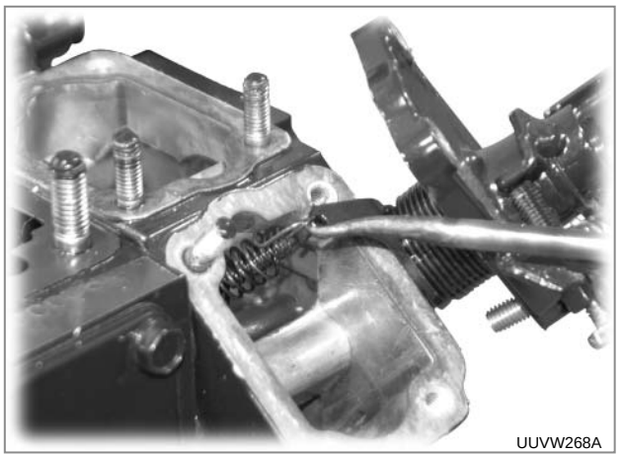
Bolt and nut

tightening torque .....23.5 ~ 27.4 Nm
2.4 ~ 2.8 kgf-m
17.3 ~ 20.2 lb-ft

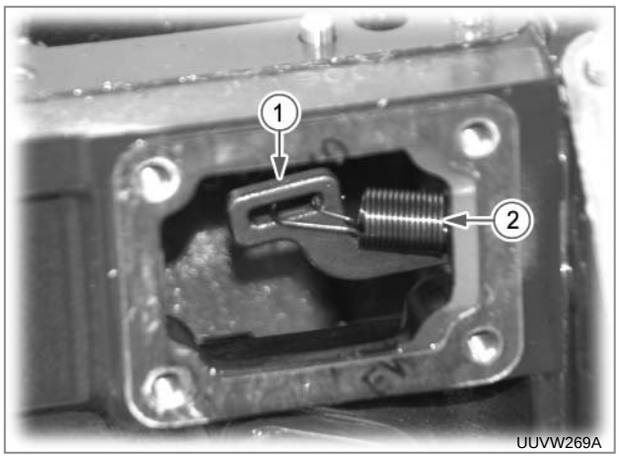
6.2.3 SPEED CONTROL LEVER PLATE AND GOVERNOR SPRING

- **DISASSEMBLY**



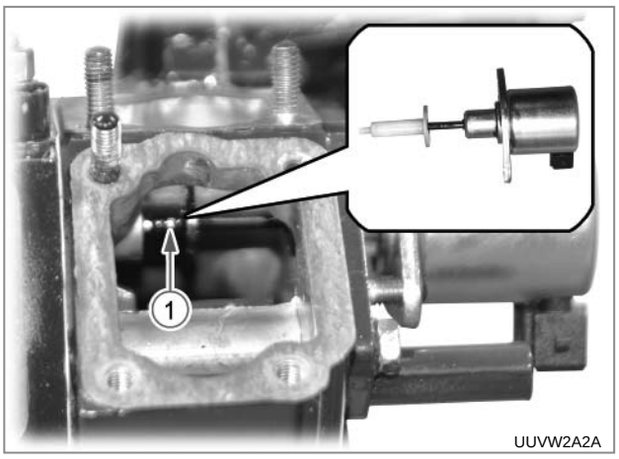


1. Unscrew the three mounting bolts (M6, 1) and one nut (M6, 2) for the speed control plate cover to open the cover. Then, disconnect the governor spring.

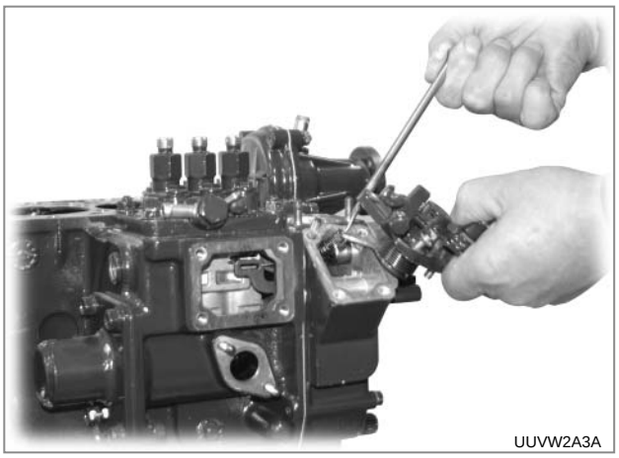


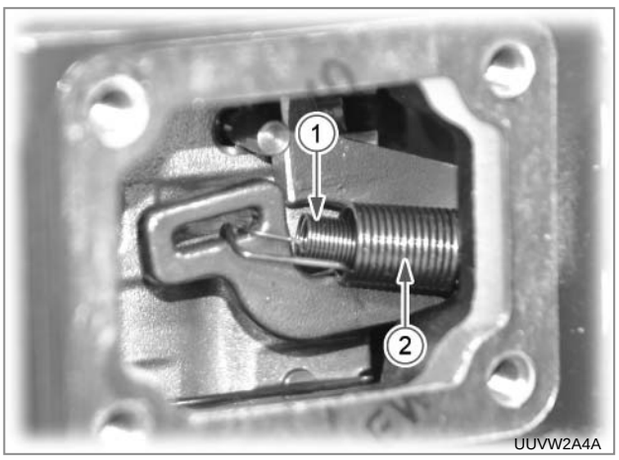
2. Remove the injection pump cover to check the condition of the governor fork lever (1) and spring (2).

- **ASSEMBLY**



1. Be careful not to drop the engine stop solenoid guide (1) when installing the stop solenoid.



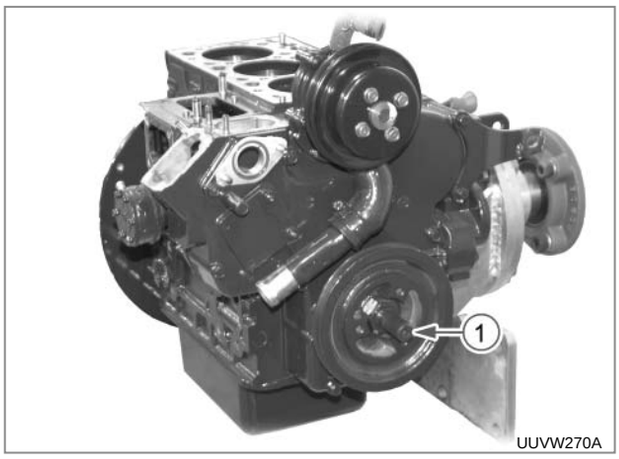


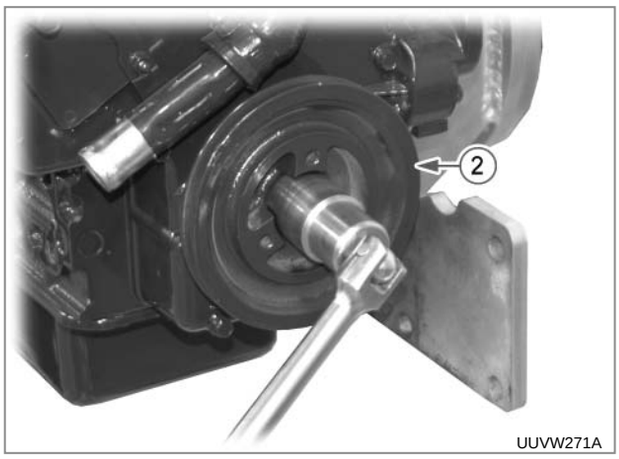
2. When installing the governor spring, make sure that the governor spring 2 (1) is installed on the inside of the governor spring 1 (2).

⚠ CAUTION

- **Be careful of the direction of the governor spring 1. The longer side should face the governor fork.**
- **If the governor spring is dropped during the installation, the crank case should be disassembled again. Therefore, use a hook not to drop the governor spring.**

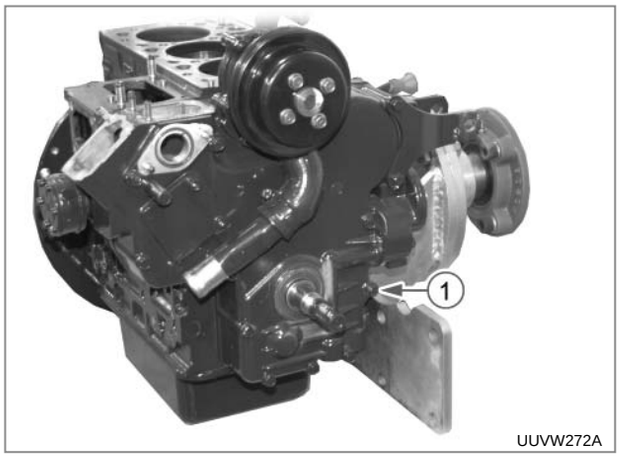
6.2.4 FUEL CAMSHAFT (GEAR CASE)

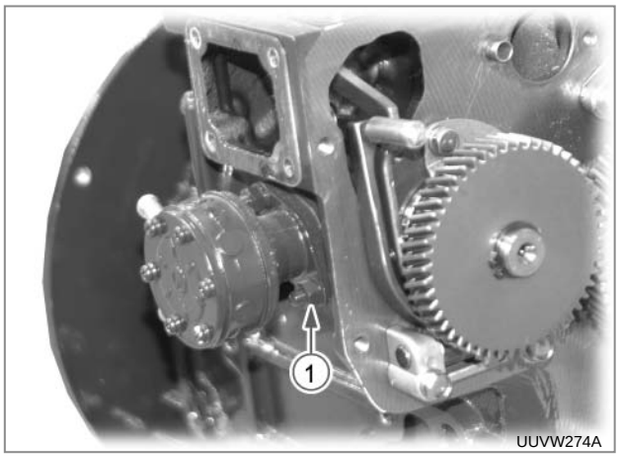


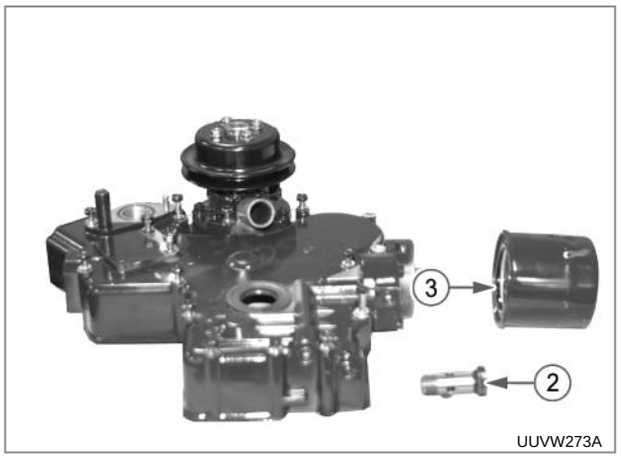


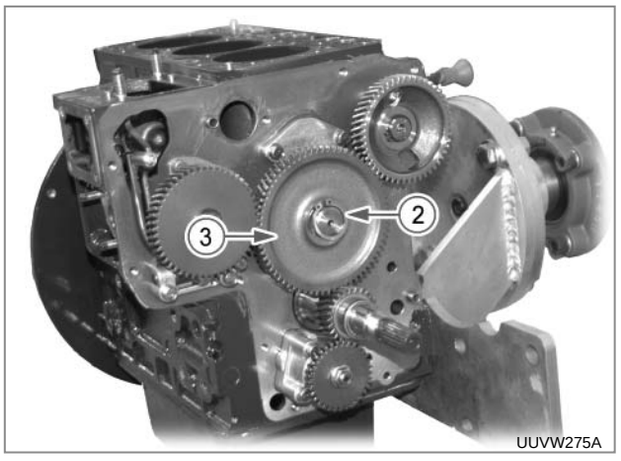
1. Unscrew the crankshaft mounting nut (1), and remove the fan drive pulley (2) using a puller.(29mm)

Mounting nut
tightening torque .....137.3 ~ 156.9 Nm
14.0 ~ 16.0 kgf-m
101.3 ~ 115.7 lb-ft



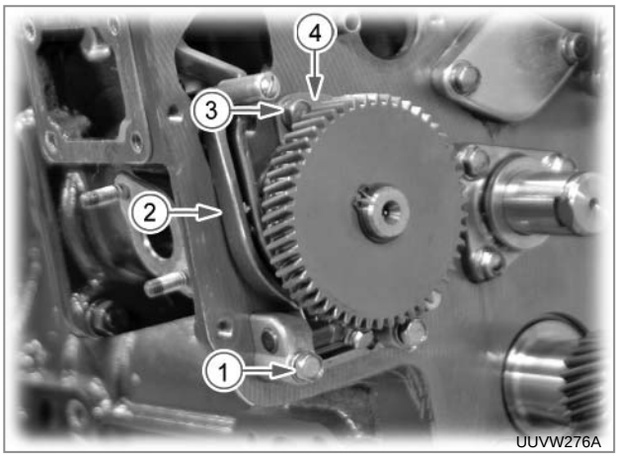




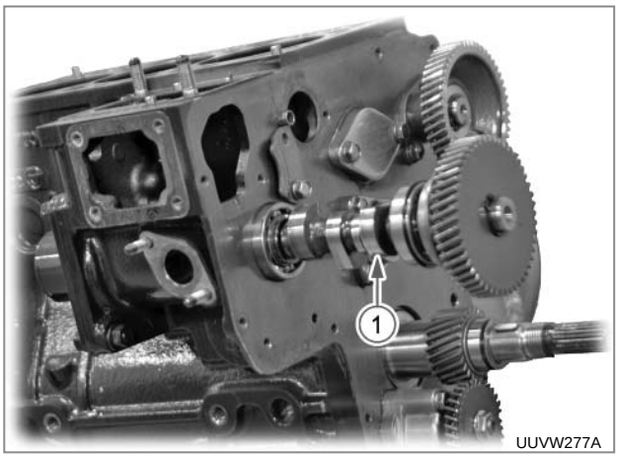


2. Unscrew the 14 gear case mounting bolts (M6, 1) and remove the gear case using the 10 mm socket wrench and T type socket wrench. If necessary, remove the relief valve (2) and engine oil filter (3).

3. Unscrew the two fuel supply pump mounting nuts (M6, 1) to remove the fuel supply pump. Then, pull out the idle gear snap ring (2) and remove the idle gear (3). (10mm)



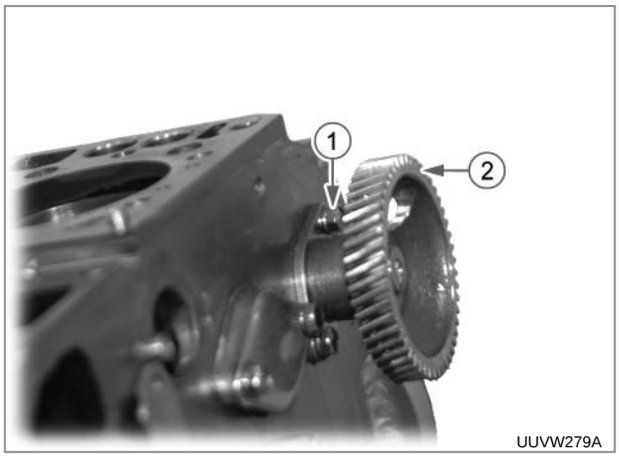
4. Unscrew the two governor fork lever mounting bolts (M6, 1) to remove the fork lever (2). Then, unscrew the two stopper mounting bolts (M6, 3) to remove the stopper (4). (10mm)

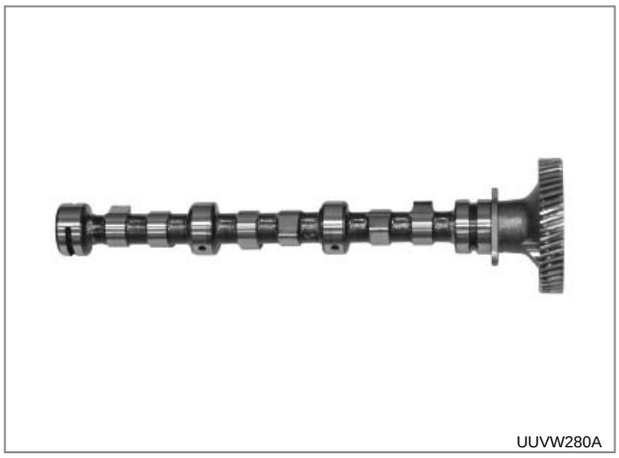


5. Pull out the fuel camshaft assembly (1) as one unit.

6.2.5 VALVE CAMSHAFT

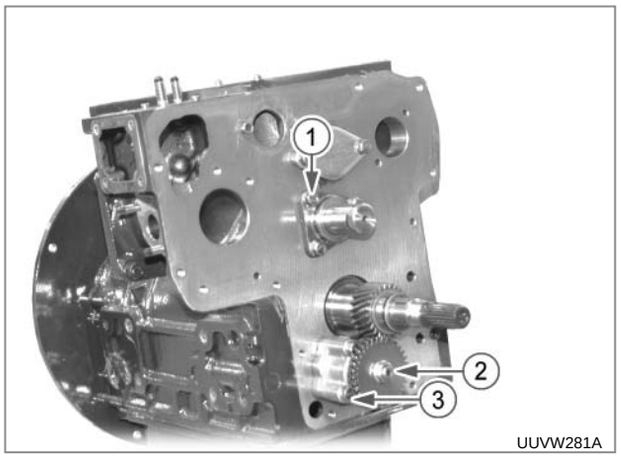
1. Pull out the tappets for each cylinder in order.





2. Unscrew the two camshaft gear stopper mounting bolts (M6, 1) to remove the camshaft assembly (2). (10mm)

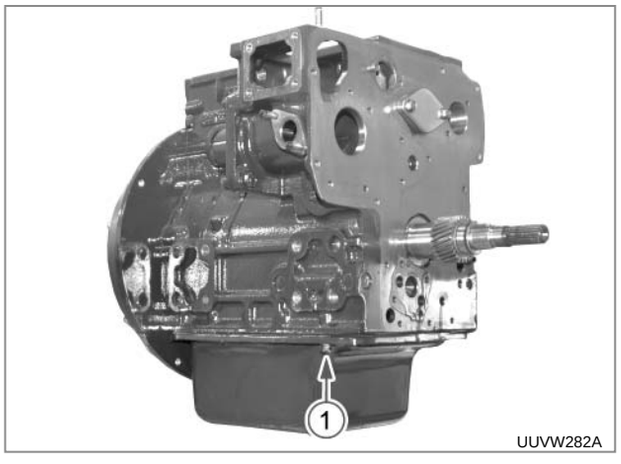
6.2.6 IDLE GEAR SHAFT, OIL PUMP AND OIL PAN



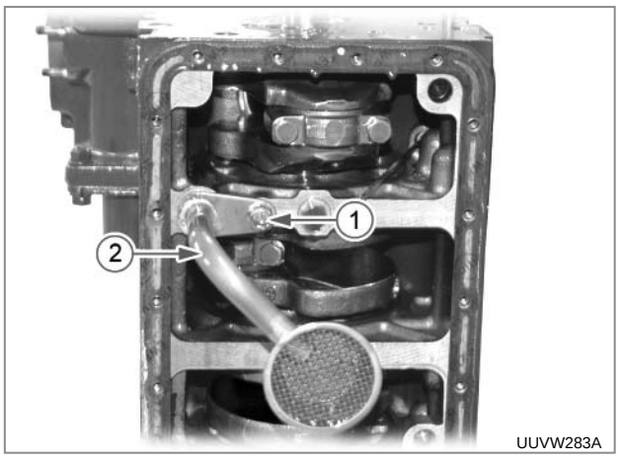
1. Unscrew the three idle gear shaft mounting bolts (M6, 1), one oil pump gear mounting nut (M10, 2) and four oil pump mounting bolts (M6, 3). Then, remove the idle gear shaft, oil pump gear and oil pump in order. (14mm, 10mm)

Idle gear shaft mounting bolt
(M6) tightening torque....7.8 ~ 9.8 Nm
0.8 ~ 1.0 kgf-m
5.7 ~ 7.2 lb-ft

Oil pump mounting bolt
(M6) tightening torque....9.8 ~ 11.8 Nm
1.0 ~ 1.2 kgf-m
7.2 ~ 8.7 lb-ft



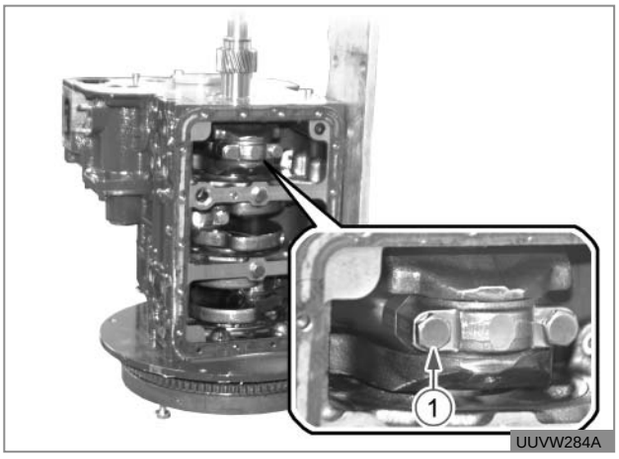
2. Unscrew the 18 oil pan mounting bolts (M6, 1) to remove the oil pan. (10mm)

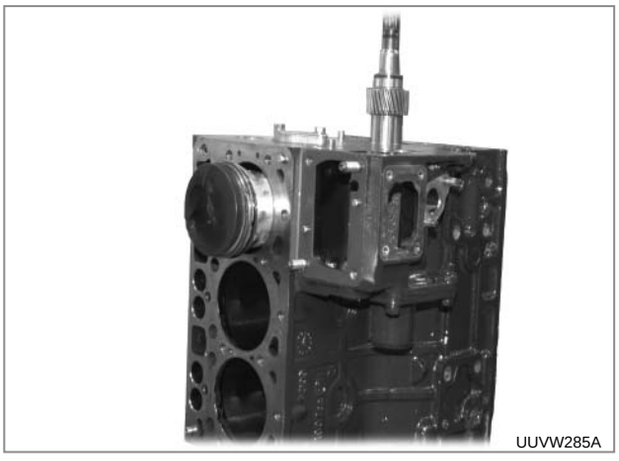


3. Unscrew the one engine oil filter 1 mounting bolt (M8, 1) to remove the engine oil filter 1 (2). (12mm)

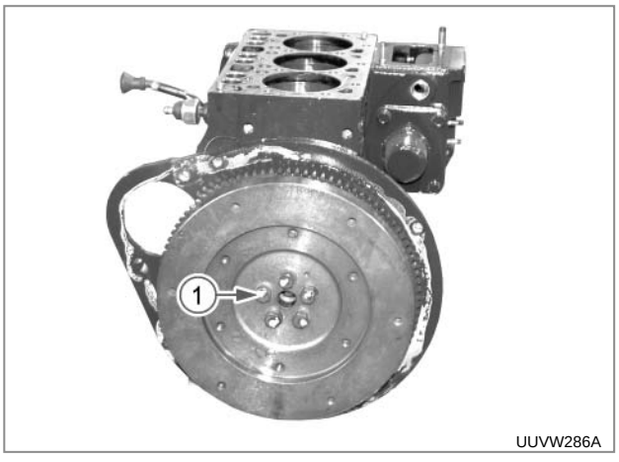
6.2.7 PISTON, FLYWHEEL AND CRANKSHAFT

- **DISASSEMBLY**

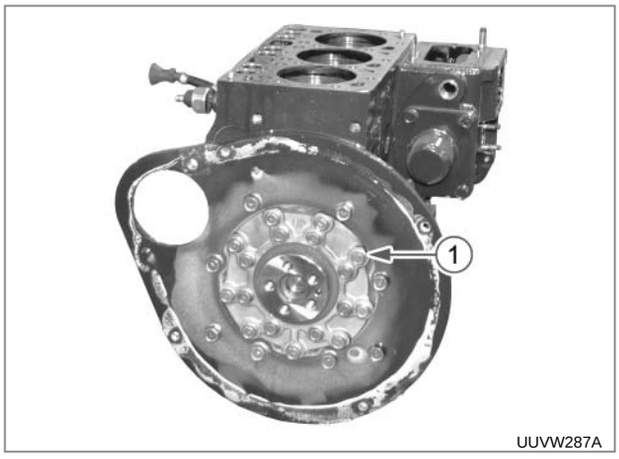




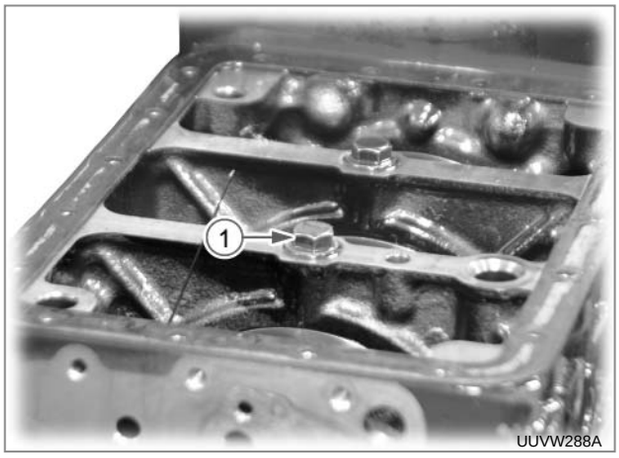
1. Unscrew the connecting rod mounting bolts (1) of the cylinder piston from the oil pan side and push the connecting rod toward the head to pull out the piston assembly. At this time, mark the pistons' numbers according to their corresponding cylinders in order to install them into their original positions later.



2. Unscrew the five flywheel mounting bolts (M10, 1) and pull the flywheel to remove it. (14mm)



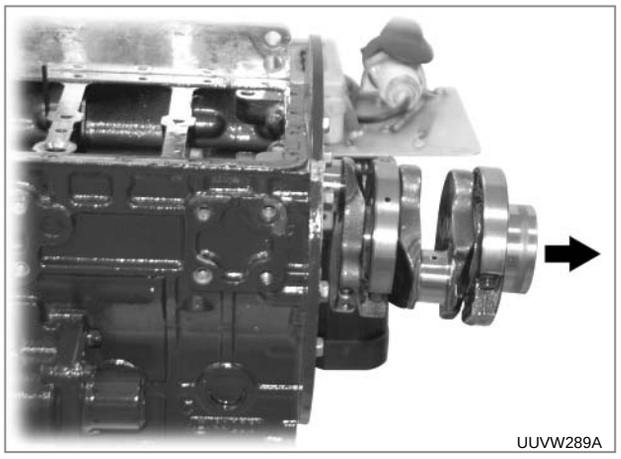
3. Unscrew the 17 main bearing case cover mounting bolts (M8, 1) and remove the main bearing case cover, oil seal, bearing case gasket and bearing case cover gasket in order. For the bearing case cover mounting bolts, unscrew the outer bolts first and then the inner bolts later.

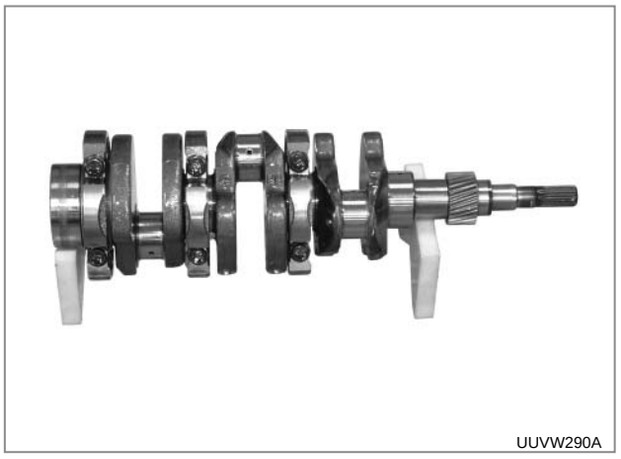


4. Unscrew the two main bearing case bolts (M8,1) tightened to the cylinder block. (13 mm)

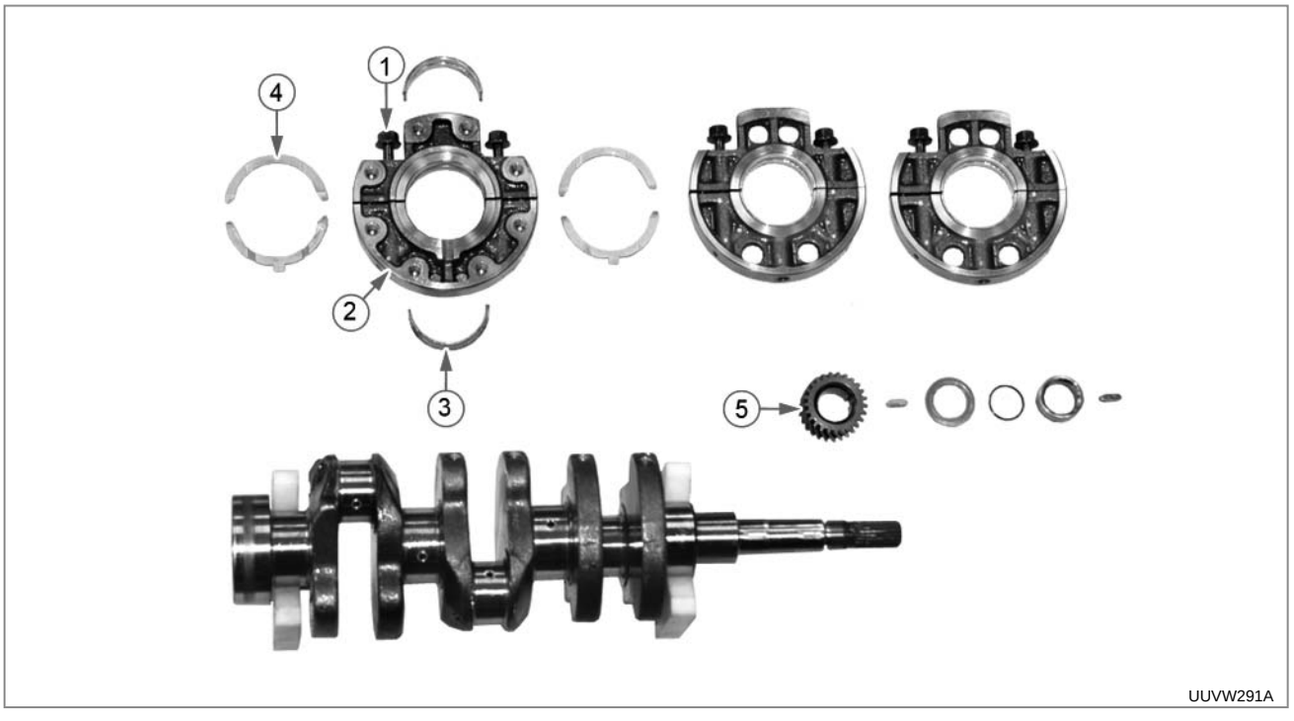
Bolt (M8)

tightening torque.....30 ~ 34 Nm
3.0 ~ 3.5 kgf-m
22 ~ 25 lb-ft


UUVW289A


UUVW290A

5. Tap the crankshaft from its gear side with a rubber hammer to push out the crankshaft assembly to the flywheel side.

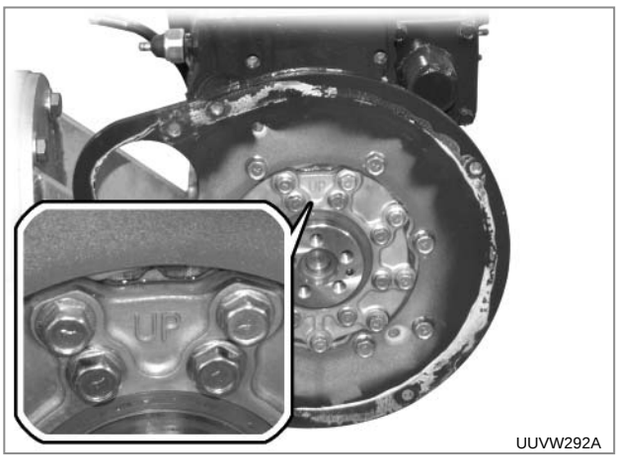


UUVW291A

6. Unscrew the main bearing case bolts 1 (1), and remove the bearing case (2), crankshaft bearing (3) and side bearing (4) in order.
7. Remove the crankshaft gear (5) as necessary. In order to remove the crankshaft gear, pull out the key and remove it using a puller.

- **ASSEMBLY**

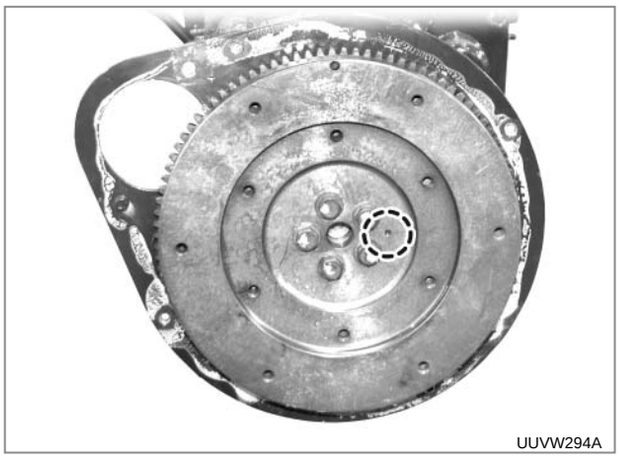
1. Install in the reverse order of removal.



2. When installing the main bearing case cover, make sure that the mark “UP” on it faces the upper side. Also, tighten its outer bolts first and then its inner bolts.

Mounting bolt

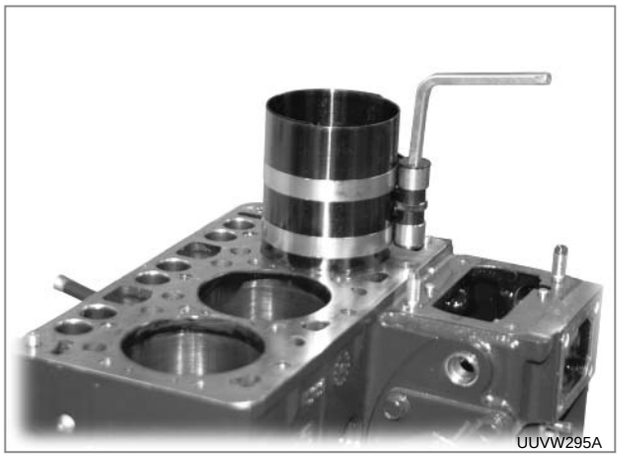
(M8) tightening torque....12.7 ~ 15.7 Nm
1.3 ~ 1.6 kgf-m
9.8 ~ 11.2 lb-ft

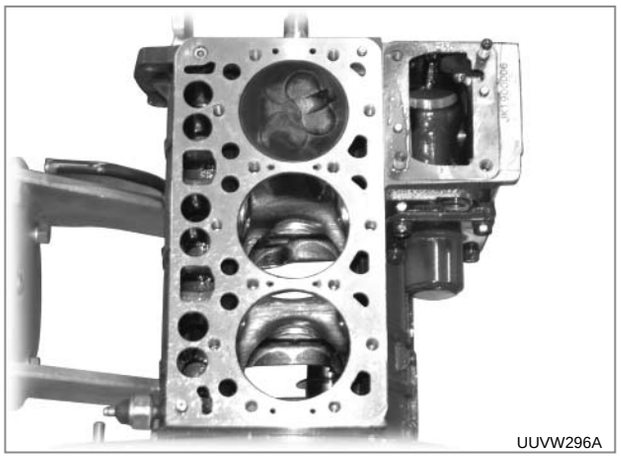


3. When installing the flywheel, align the alignment hole mark of the crankshaft with the alignment hole on the flywheel surface. Also, tighten the flywheel mounting bolts to the specified torque after applying a small amount of oil to them.

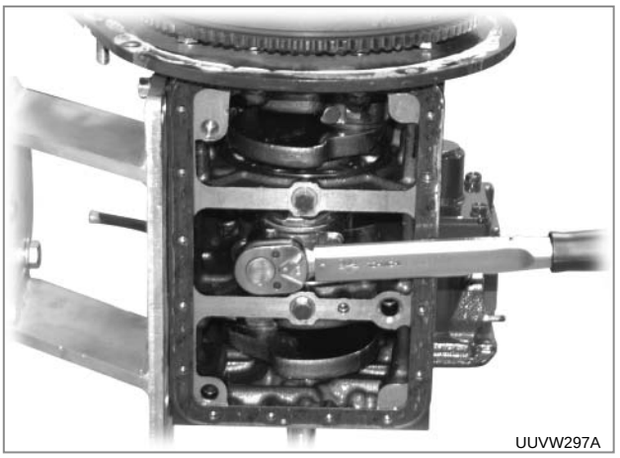
Flywheel bolt

tightening torque.....54.0 ~ 59.0 Nm
5.5 ~ 6.0 kgf-m
40.0 ~ 43.0 lb-ft


UUVW295A


UUVW296A

4. When installing the piston into the cylinder block, begin pushing the connecting rod from the head side into the block, and completely push the piston into the cylinder block after compressing the piston ring using a compressor. Refer to the figure for assembled view.


UUVW297A

5. Apply oil onto the connecting rod cover bolts, and tighten them to the specified torque using a torque wrench.

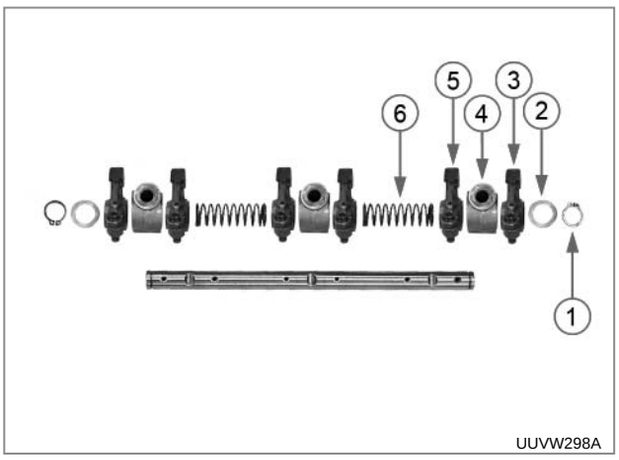
Connecting rod bolt
Specified torque .....26.0 ~ 30.0 Nm
2.7 ~ 3.1 kgf-m
20.0 ~ 22.0 lb-ft

IMPORTANT

- **Mark the cylinder number on the piston and connecting rod to prevent them from interchanging.**
- **Be careful not to damage the chrome-plate area on the piston ring when pressing the piston into the cylinder block.**
- **It is very important that the number carved on the big end of the connecting rod faces the injection pump during installation.**
- **Make sure that the mark caved on the big end of the connecting rod and the arrow mark on the piston face the same direction during installation.**

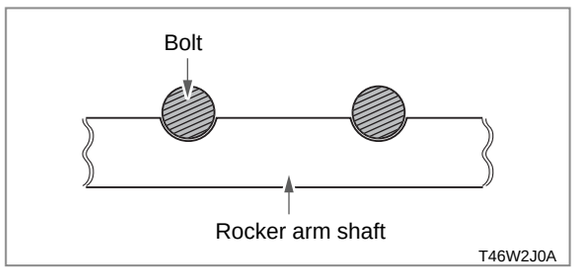
6.3 ENGINE COMPONENT DISASSEMBLY AND ASSEMBLY

6.3.1 ROCKER ARM



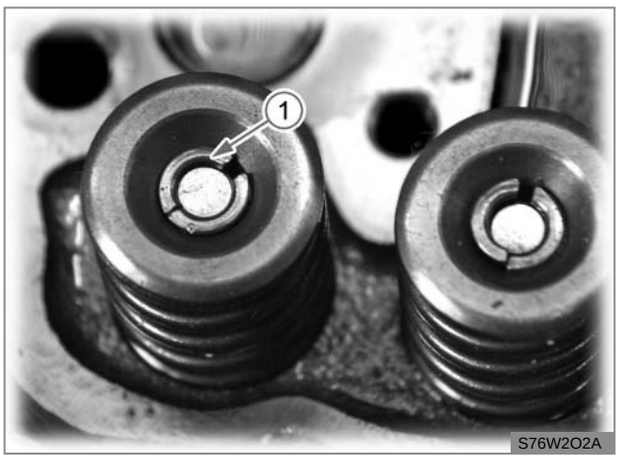
1. Pull out the snap ring (1) at the end from the rocker arm assembly and disassemble the plain washer (2), rocker arm (3), rocker arm support (4), rocker arm (5) and spring (6) in order.
2. Reinstall the rocker arm assembly. And then, adjust the valve clearance.
   (Refer to 5.7.1 Intake and exhaust valves clearance adjustment)

IMPORTANT

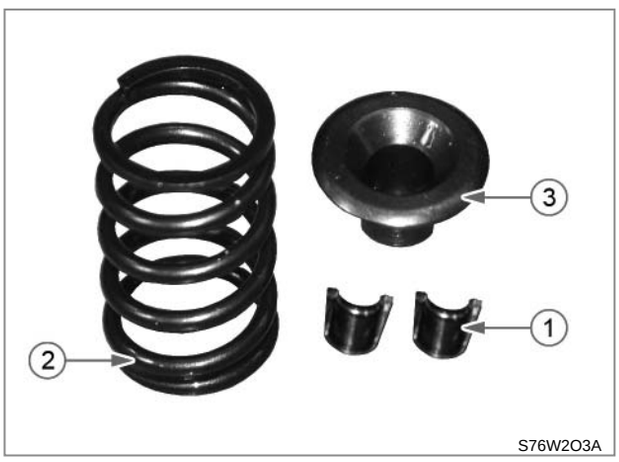


To tighten the rocker arm support bolt, the groove on the rocker arm shaft should face the bolt.

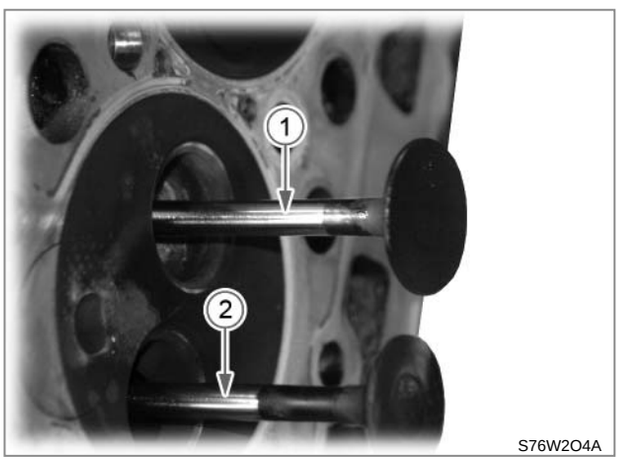
6.3.2 INTAKE AND EXHAUST VALVES



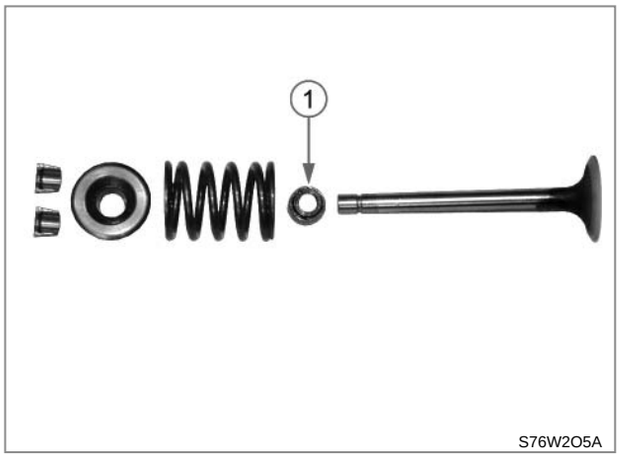
1. Remove the valve collet (1) with screw driver while pushing down the valve spring retainer with a ring spanner.



2. Remove the valve spring (2) and its retainer (3).



3. Push the intake (1) and exhaust valve (2) out from the upper head part.



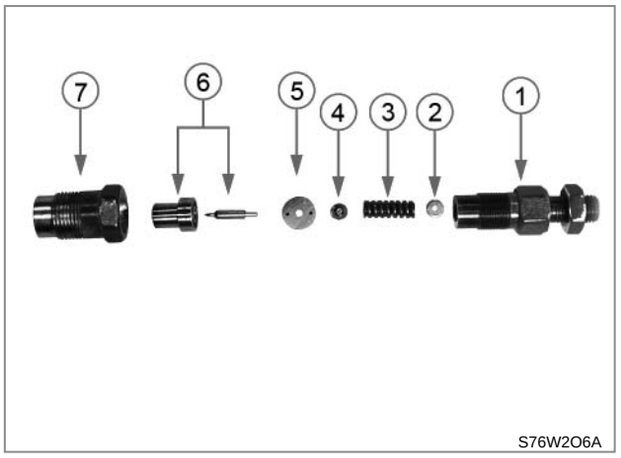
4. Remove the valve stem seal (1).
5. Install in the reverse order of removal.
6. When installing the valve, apply oil to the valve stem and install in the cylinder head.
7. Lubricate the valve and its related parts after installation.

IMPORTANT

- **Do not re-use valve stem seal.**
- **Be careful not to interchange the valves and related components.**
- **Mark the cylinder numbers to the related components to prevent them from interchanging.**

6.3.3 INJECTION NOZZLE

1. Fix the nozzle nut and unscrew it to remove it.



2. Remove the nozzle holder (1), adjusting washer (2), nozzle spring (3), push rod (4), distance piece (5), nozzle (6) and nozzle nut (7) in order.
3. Install in the reverse order of removal.

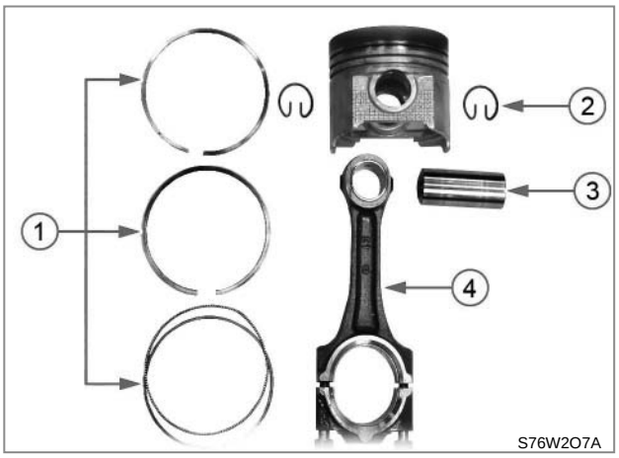
Nozzle holder

tightening torque ..... 49.0 ~ 68.6 Nm
5.0 ~ 7.0 kgf-m
36.1 ~ 50.6 lb-ft

Nozzle nut

tightening torque ..... 29.4 ~ 49.0 Nm
3.0 ~ 5.0 kgf-m
21.7 ~ 36.1 lb-ft

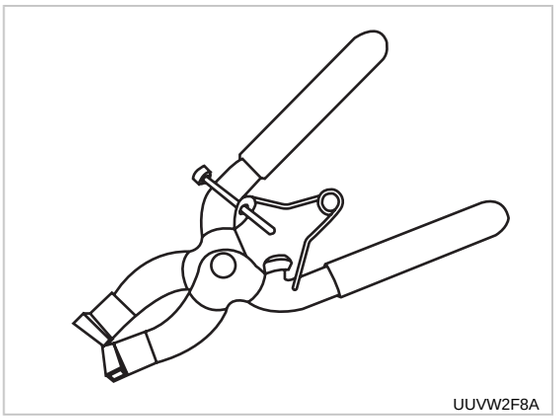
6.3.4 PISTON ASSEMBLY

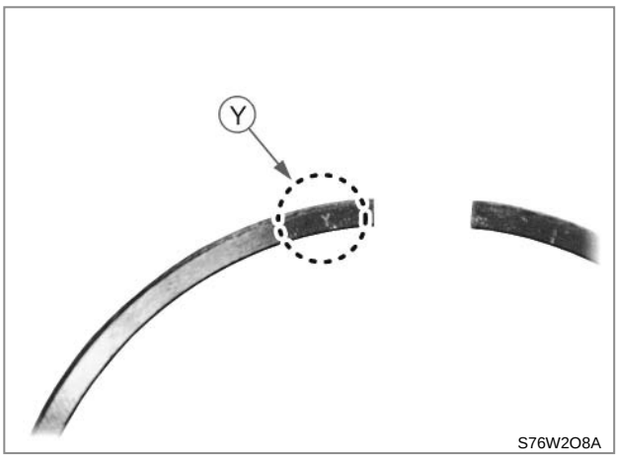


1. Remove the piston rings (1) using a removal tool.
2. Take out the piston pin springs (2) using pliers and remove the piston pin (3).
3. Remove the connecting rod (4) and bushing.
4. Install in the reverse order of removal.
5. After heating the piston to approx. 80~100°C, lubricate and assemble it with the connecting rod.

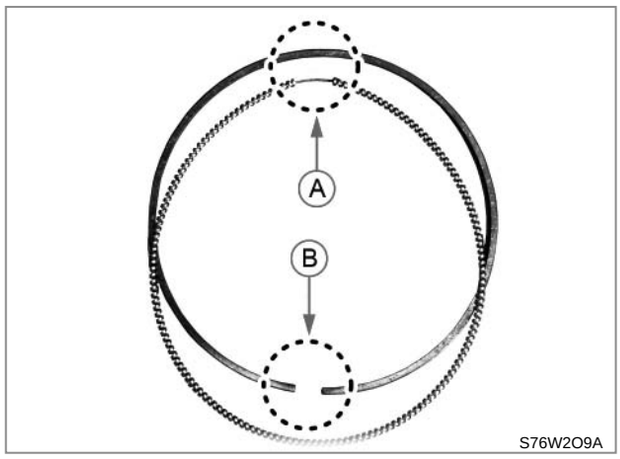
REMARK

- **Piston ring removal tool**

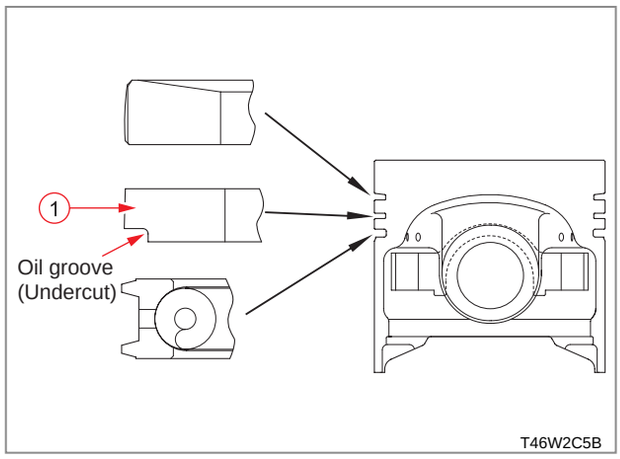




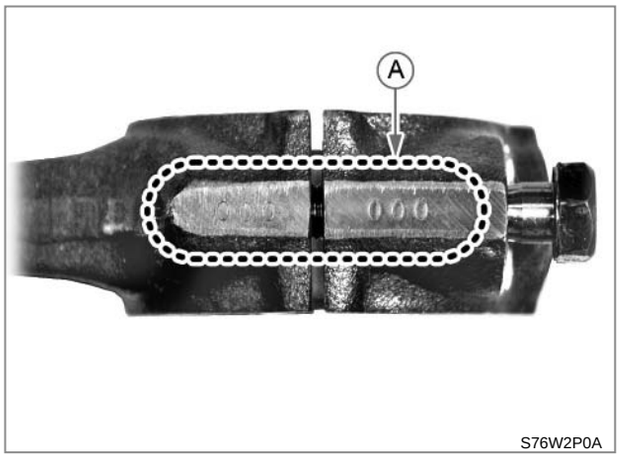
6. Install the top ring with its manufacturer mark (Y) to the top of the piston.

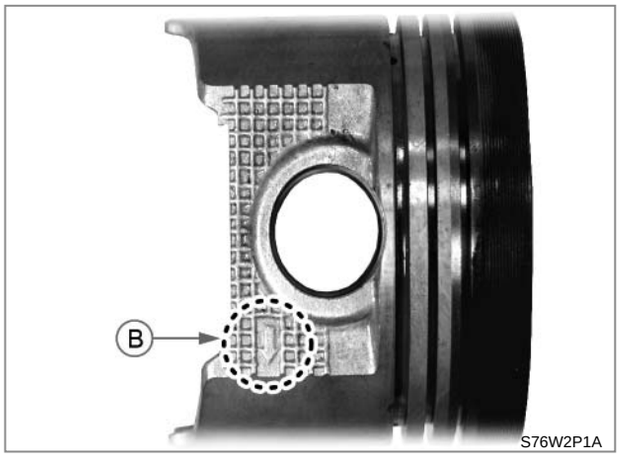


7. The cutout of expander (A) of the oil ring should face the opposite side of the oil ring end gap (B), and the end gaps of the second ring and oil ring should be 120° away from the top ring end gap. When doing so, place the top ring end gap on the opposite side of the combustion chamber.



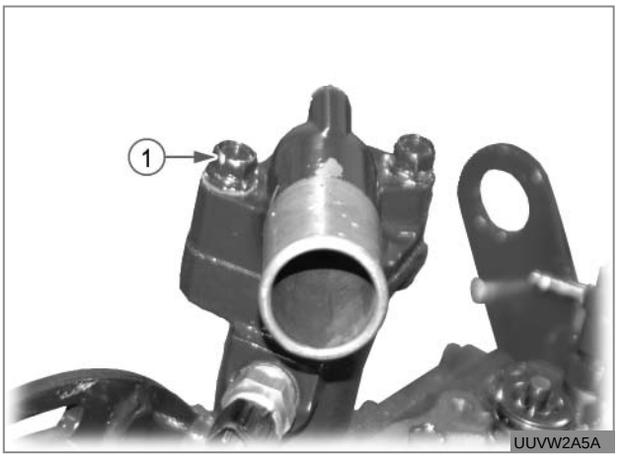
8. Assemble the second ring(1) undercut to be facing down.





9. The mark (A) of the connecting rod on the top should be aligned with the bottom portion. Install the connecting rod with the piston so that it faces the injection pump along with the arrow mark (B) on the piston.

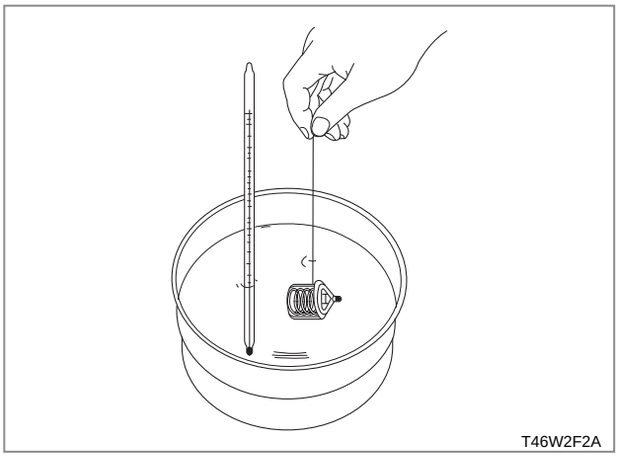
6.3.5 THERMOSTAT



1. Remove the two thermostat cover bolts (M8,1) from the coolant flange.

2. Pull out the thermostat (2).
3. During reassembly, discard the old gasket and clean the gasket mating surface thoroughly. Then, apply Three Bond 1215 or equivalent to the new gasket surface and install the gasket.

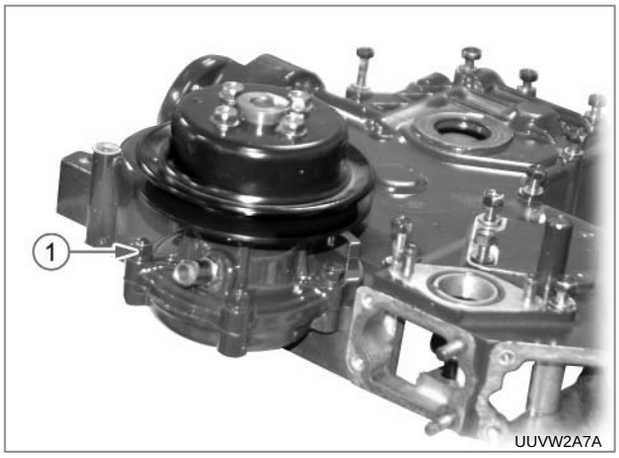
- **OPENING TEMPERATURE OF THERMOSTAT VALVE**


T46W2F2A

1. Suspend the thermostat in the water by a string.
2. While heating the water slowly, read the temperatures when the valve starts to open and when the valve opens for approx. 8 mm(0.315 in.).
3. If the measurements are not within the factory specifications, replace the thermostat.

Opening temperature	Specified value	Initial opening temperature: 71 ± 1.5 °C (159.8 ± 2.7 °F)
		Below 85 °C (185 °F) when opening by 8 mm (0.315 in.)

6.3.6 WATER PUMP



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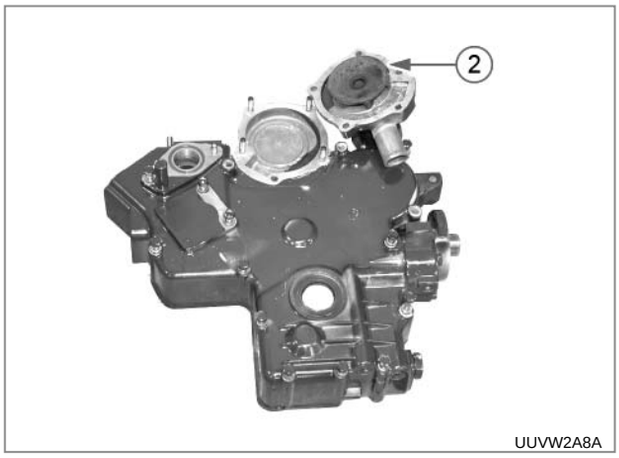

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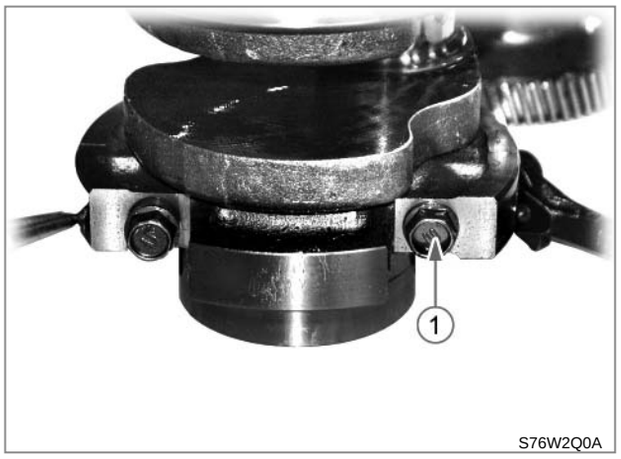
1. Unscrew the four water pump case nuts (M6, 1) tightened to the gear case to remove the water pump case (2).
2. Pull out the fan pulley installation flange with a puller. Then, pull out the water pump bearing, impeller and mechanical seal.
3. Install in the reverse order of removal.
4. If the mechanical seal is removed, replace it with a new one.

⚠ CAUTION

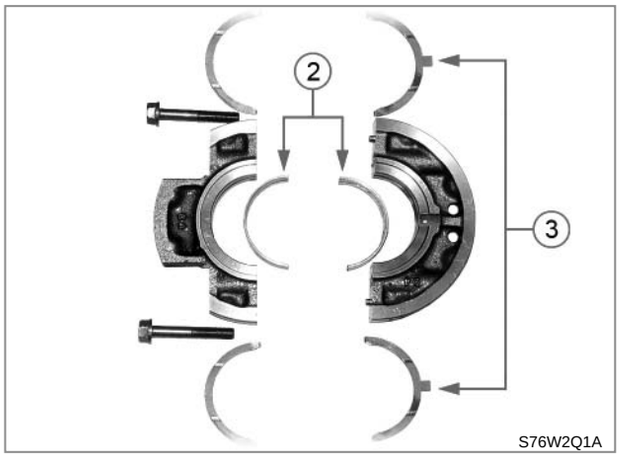
- **The water pump components are firmly pressed in and can be disassembled only with a special tool. Therefore, it is recommended to replace the water pump assembly as a whole unit.**

6.3.7 MAIN BEARING CASE ASSEMBLY

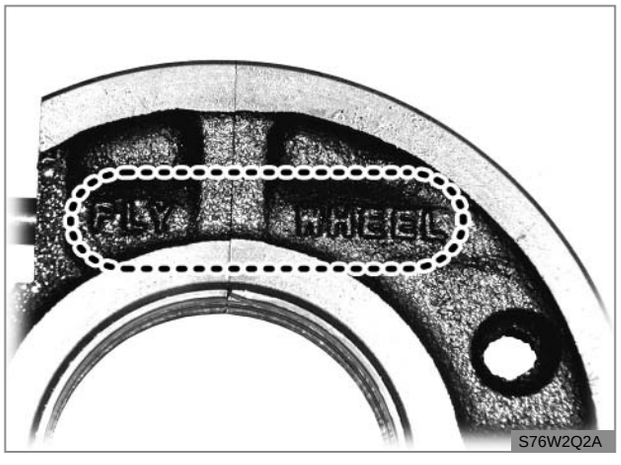


1. Unscrew the bearing case bolts (1) and detach the bearing case.

Bolt tightening torque ....20 ~ 24 Nm
2.0 ~ 2.4 kgf-m
15 ~ 17 lb-ft



2. Remove the crankshaft metals (2) and side metals (3).
3. Install it in the reverse order of removal.



4. The "FLY WHEEL" embossed side should face the flywheel for bearing case assembly. Also, the oil groove of the side bearing should be facing out.

IMPORTANT

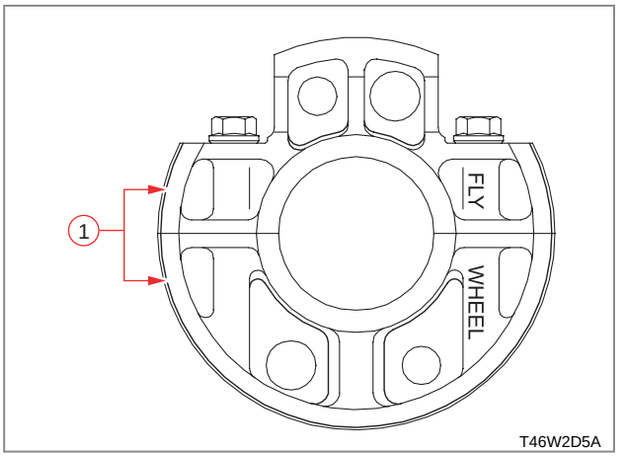
- **If the main bearing case is installed incorrectly, its oil transfer holes are not aligned with the holes of the cylinder block which can cause engine stall.**

5. When installing the main bearing case bolts 1, apply the oil on them and tighten them with a hand until they are not screwed in. Then, tighten them with a torque wrench in several steps.

Main bearing case bolt 1
Specified torque .....20.0 ~ 24.0 Nm
2.0 ~ 2.4 kgf-m
15.0 ~ 17.0 lb-ft

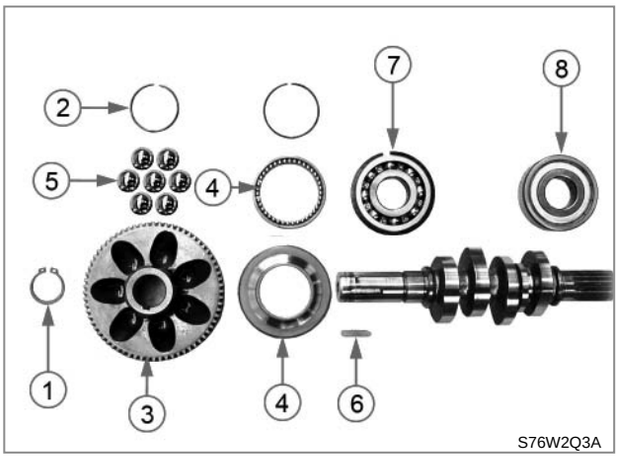
6. Align the main bearing case mounting bolt hole with the hole on the cylinder block. And, apply the sufficient amount of oil to the mounting bolt and tighten it with a hand completely.

Main bearing case mounting bolt 2
Specified torque .....30.0 ~ 34.0 Nm
3.0 ~ 3.5 kgf-m
22.0 ~ 25.0 lb-ft



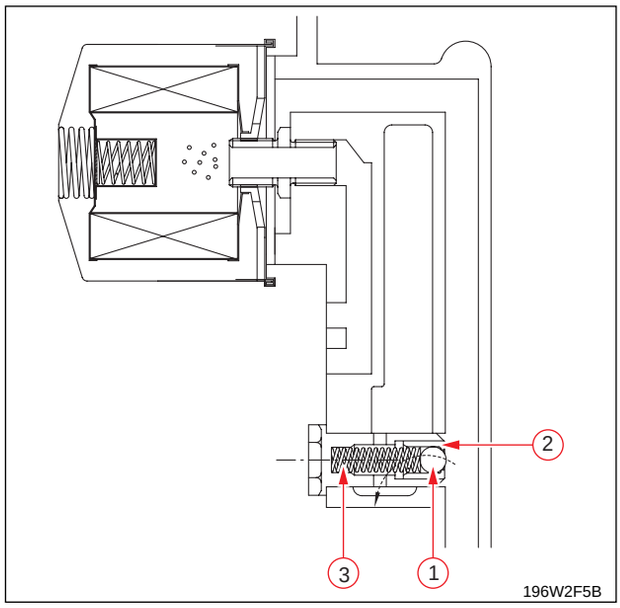
7. The number of lines (1) on the edge indicates the main case number.
   - **The first bearing from the crankcase-1 line**
   - **The second bearing from the crankcase-2 lines**
   - **The third bearing from the crankcase-No line, different in shape**

6.3.8 INJECTION PUMP GEAR ASSEMBLY (FUEL CAMSHAFT GEAR)



1. Pull out the snap ring (1) and remove the injection pump gear assembly. This assembly is forcibly pressed into the shaft, so a special device may be used for its disassembly.
2. Remove the clip (2) to separate the gear (3) and the bearing (4).
3. Take out the ball (5).
4. Take out the key (6) and remove the #6305 bearing (7) and #6305Z bearing (8).
5. Install in the reverse order of removal.
6. When installing the injection pump gear, heat it to approx. 80°C (176°F) and fit it to the camshaft.

6.3.9 ENGINE OIL RELIEF VALVE



(1) Relief valve ball
(2) Relief valve seat
(3) Relief valve spring

1. Remove the relief valve.
2. Check the relief valve for dirt, and the seat (2), spring (3) and ball (1) for damage.
3. If damaged, replace.

REMARK

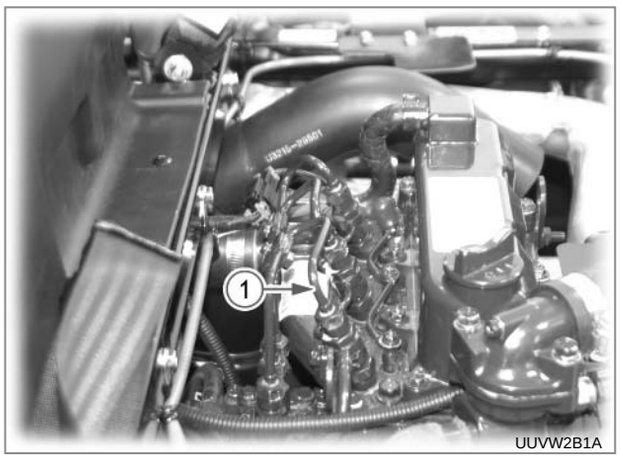
- Install the relief valve cover with the mark ▲up.

Relief valve cover bolt tightening torque ..... 32.4 ~ 36.3 Nm
3.3 ~ 3.7 kgf-m
23.9 ~ 36.8 lb-ft

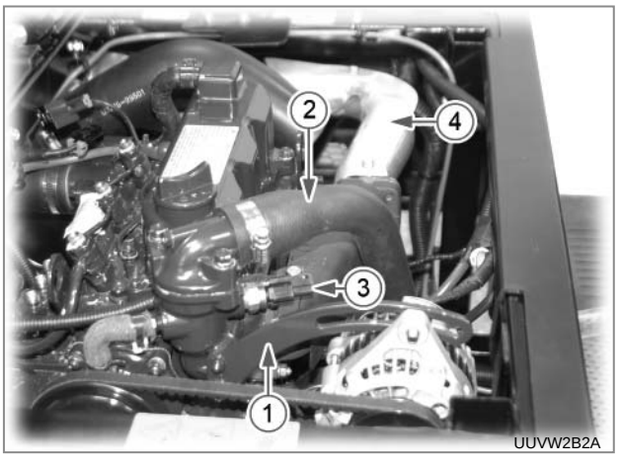
6.4 CYLINDER HEAD GASKET REPLACEMENT

1. Park the vehicle on level ground, apply the parking brake, stop the engine and open the coolant drain cock to drain the coolant. (See 6.1 “Engine assembly removal.”)

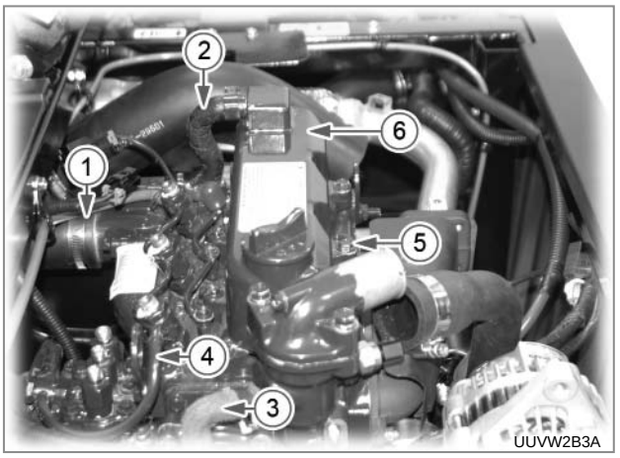
2. Remove the seat (1).



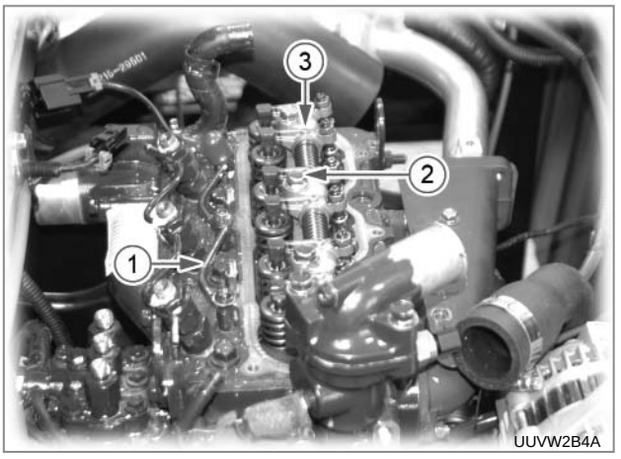
3. Unscrew the high-pressure pipe holder screw to disconnect the high-pressure pipe (1) between the fuel injection pump and injection nozzle. (See 6.2 “Engine component disassembly and assembly.”)



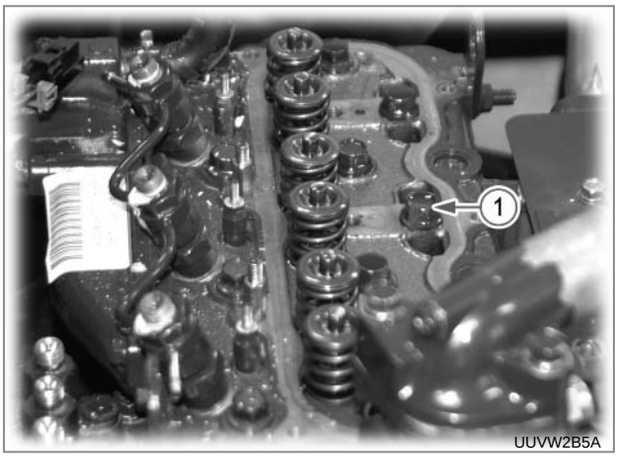
4. Unscrew the alternator bracket mounting bolt to remove the alternator bracket (1). Then, disconnect the coolant hose (2), wiring connector (3) and exhaust pipe (4).



5. Disconnect the intake hose (1), PCV valve hose (2), overflow hose (3) and fuel hose (4). Then, unscrew the cylinder head cover mounting bolts (5) to remove the cylinder head cover assembly (6).

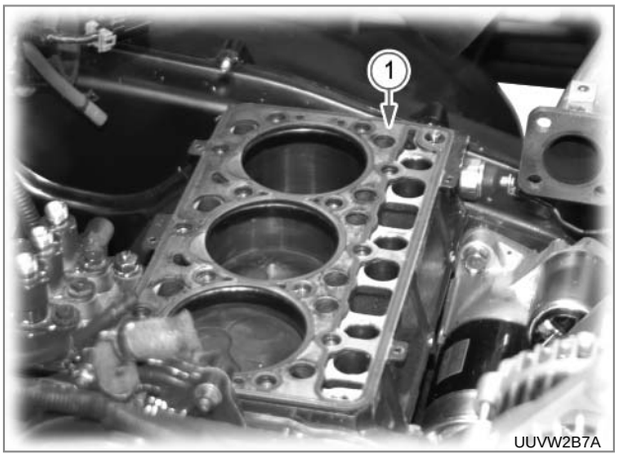


6. Disconnect the glow plug cord (1) and unscrew the rocker arm shaft mounting bolts (2) to remove the rocker arm shaft assembly (3). Then, pull out the push rods in order.



7. Unscrew the cylinder head bolts (1) in the correct removal order. (See 6.2.1 “Cylinder head.”)

8. Remove the cylinder head assembly.



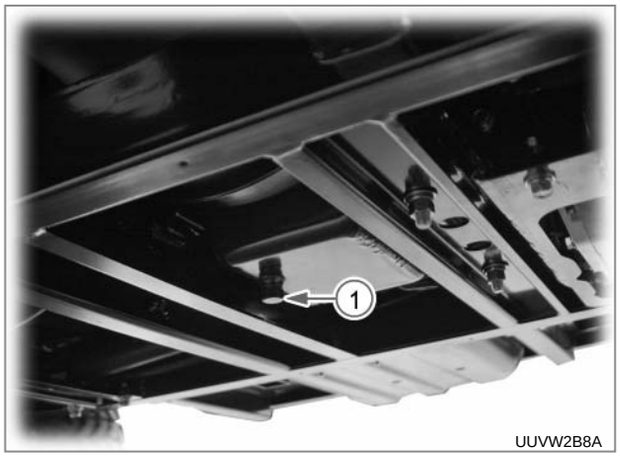
9. Pull out the cylinder head gasket (1) and replace it with a new one.
10. Install in the reverse order of removal.

⚠ CAUTION

- **When installing the engine again, adjust the valve clearance after installing the rocker arm assembly. (See 5.7.1 “Clearance adjustment.”)**
- **For the cylinder head bolt installation, refer to 6.2.1. “Cylinder head.”**

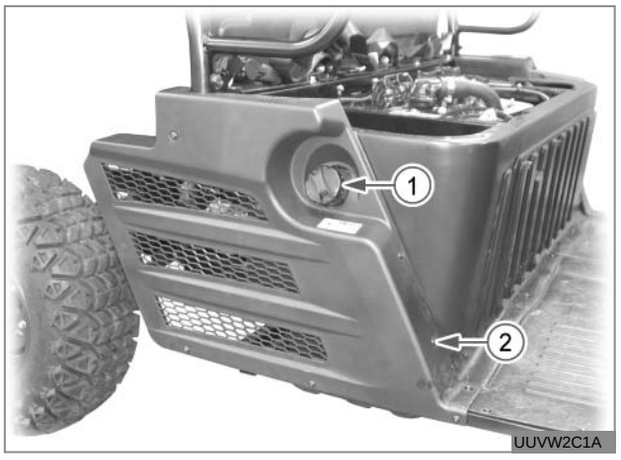
6.5 GEAR CASE DISASSEMBLY AND REASSEMBLY (GEAR CASE GASKET, CRANKSHAFT OIL SEAL AND OIL PUMP REPLACEMENT)

1. Park the vehicle on level ground, apply the parking brake, stop the engine and disconnect the negative battery cable.

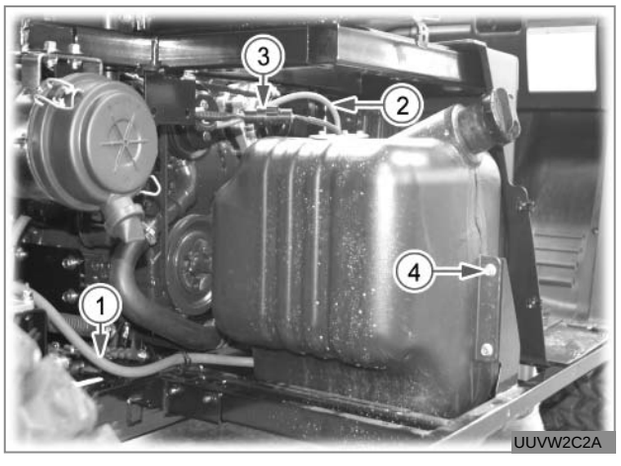


2. Unscrew the drain plug (1) from the bottom of the engine oil pan to drain the engine oil.
3. Open the radiator drain cock to drain the coolant. (See 6.1 “Engine removal.”)

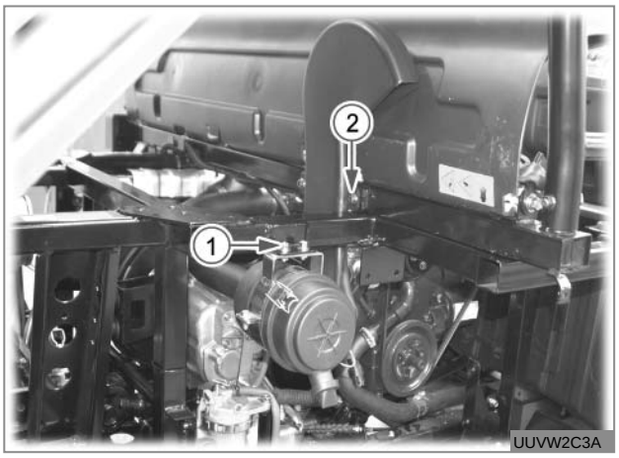
4. Lift and support the cargo bed and remove the seat.



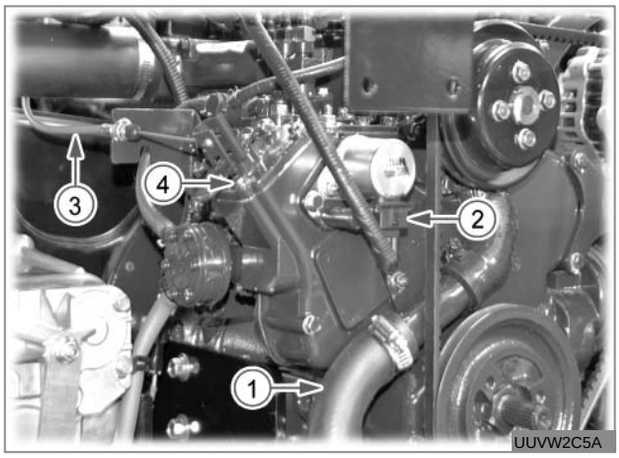
5. Unscrew the fuel tank filler cap (1) as well as the fender (mid, RH) mounting screws (2) to remove the fender (mid, RH).



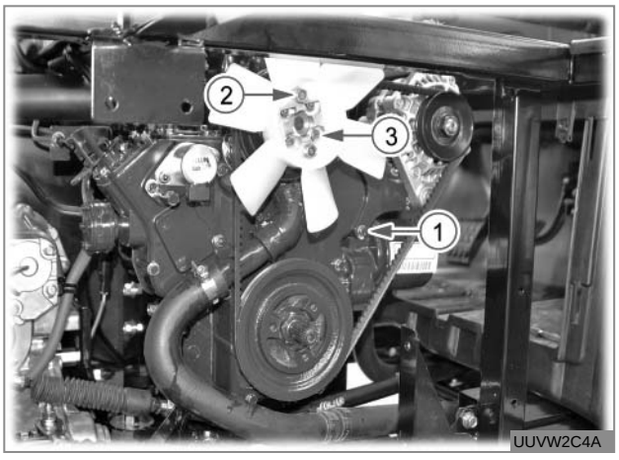
6. Disconnect the fuel supply hose (1) to drain the fuel. Then, disconnect the fuel overflow pipe (2) and fuel sender connector (3) and unscrew the four fuel tank mounting bracket mounting bolts (M8, 4) using the 12 mm spanner to remove the fuel tank.



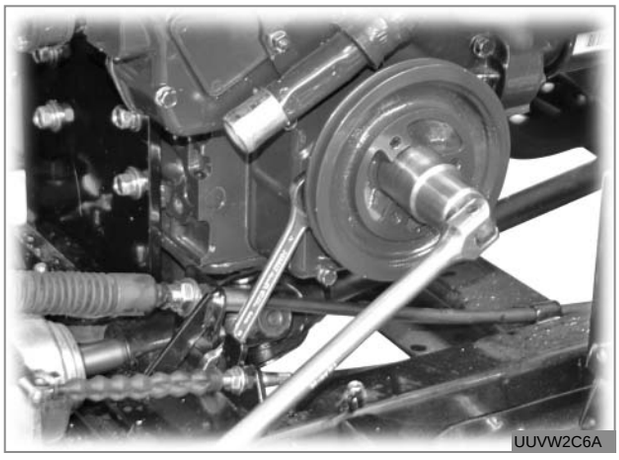
7. Unscrew the two air cleaner mounting bolts (M8, 1) and two intake duct mounting nuts (M8, 2) using the 12 mm spanner to remove the air cleaner assembly.



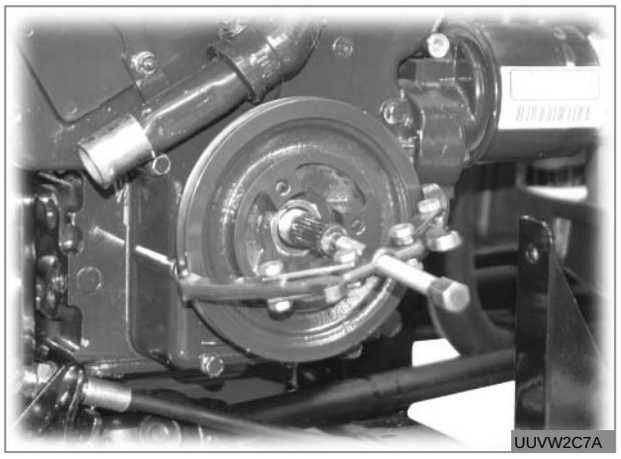
9. Undo the coolant hose band to disconnect the coolant hose (1). Then, disconnect the engine stop solenoid connector (2) and accelerator wire (3) and unscrew the four speed control plate cover mounting bolts and nuts (M6, 4) using the 10 mm spanner to open the cover and disconnect the governor spring. (See 6.2.3 “Speed control plate and governor spring.”)



8. Unscrew the one alternator guide mounting bolt (M8), two gear case bracket mounting bolts (M6, 1), two cooling fan mounting bolts (M8, 2) and four retainer bolts (M6, 3) using the 12 mm spanner (T type) and 10 mm spanner to remove the cooling fan, retainer, alternator and fan belt.



10. Unscrew the crankshaft pulley mounting nut using the 29 mm socket wrench.
    Make sure that the pulley does not rotate by supporting its inner angular part with a jig when unscrewing the pulley mounting nut.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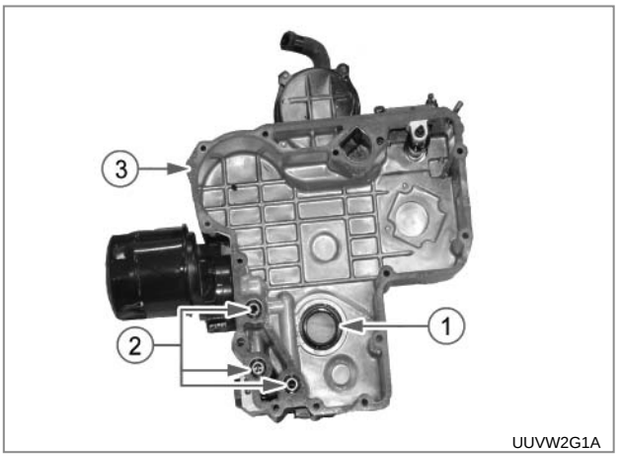
11. Remove the crankshaft pulley using a puller.



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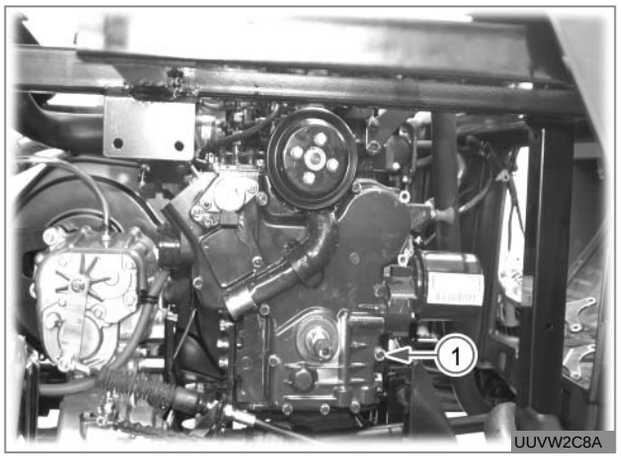
13. Replace the oil seal (1), O-ring (2) and gear case gasket (3) with new ones as necessary. When replacing the gear case gasket, apply Three Bon 1215 or equivalent to the both mating surfaces of the gasket before installation. For the oil seal or O-ring, apply a small amount of grease or oil to its mating surface before installation.



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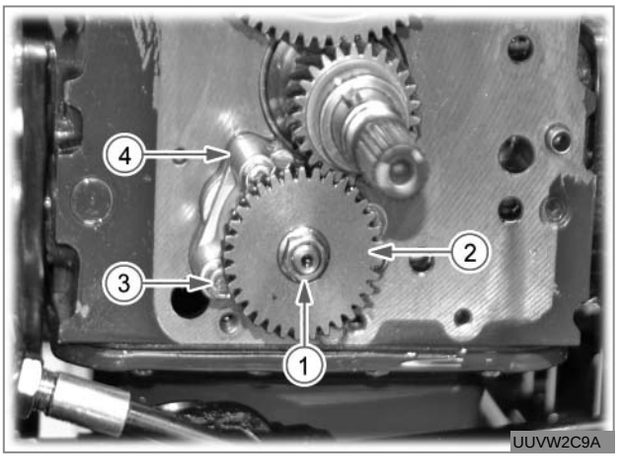
12. Disconnect the coolant return hose and unscrew the 12 gear case mounting bolts (M6, 1) using the 10 mm socket wrench and T type socket wrench to remove the gear case.



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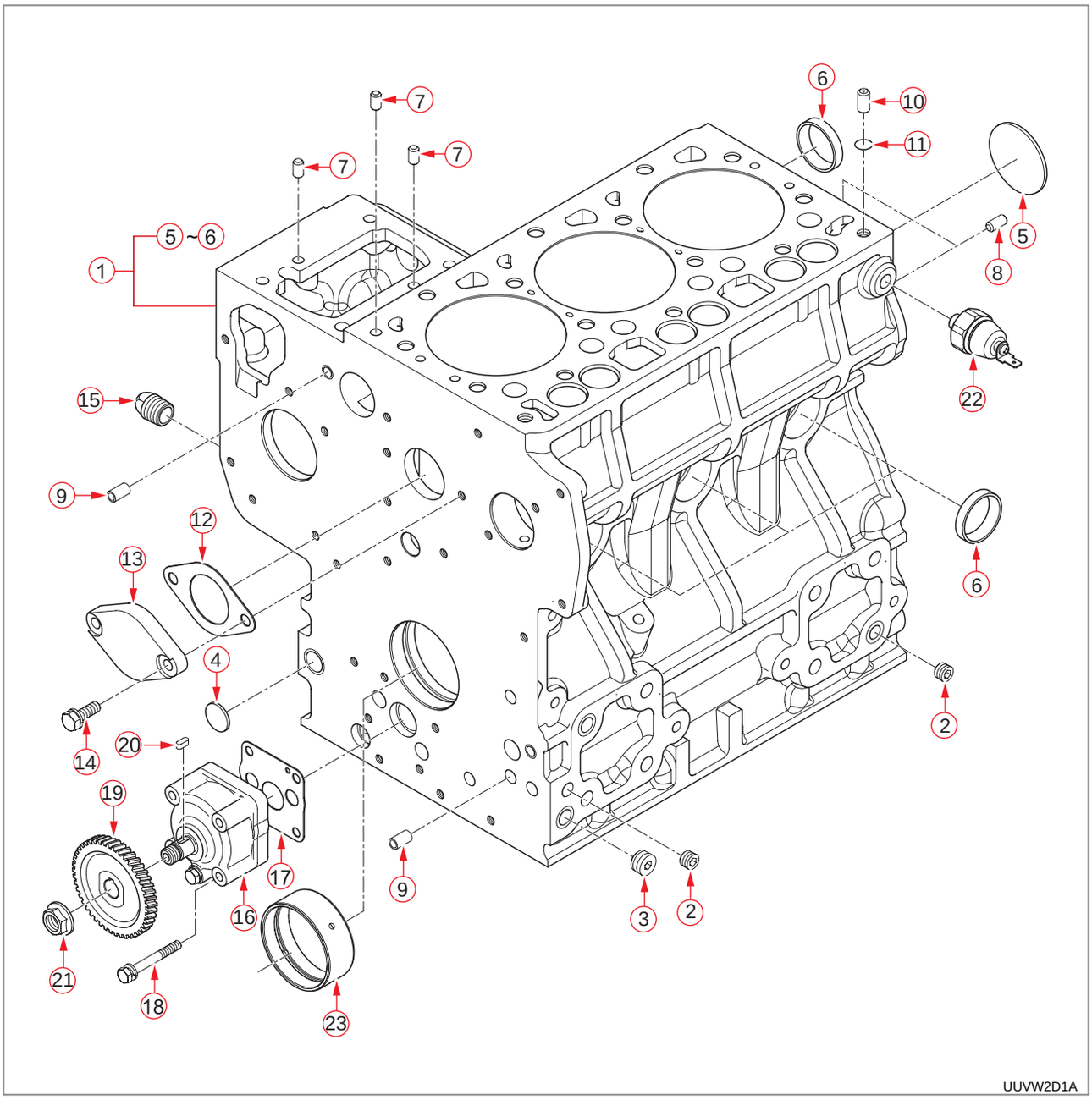
14. If necessary, replace the oil pump (4) by unscrewing the on oil pump gear mounting nut (M10, 1), pulling out the oil pump gear (2) and unscrewing the four oil pump mounting bolts (M6, 3). (See 6.2.6 “Idle gear shaft, oil pump and oil pan.”)
15. For disassembly of other camshaft, fuel camshaft, idle gear, etc., refer to 6.2 "Engine component disassembly and assembly.” Assemble in the reverse order of disassembly.

7. ENGINE EXPLODED VIEW

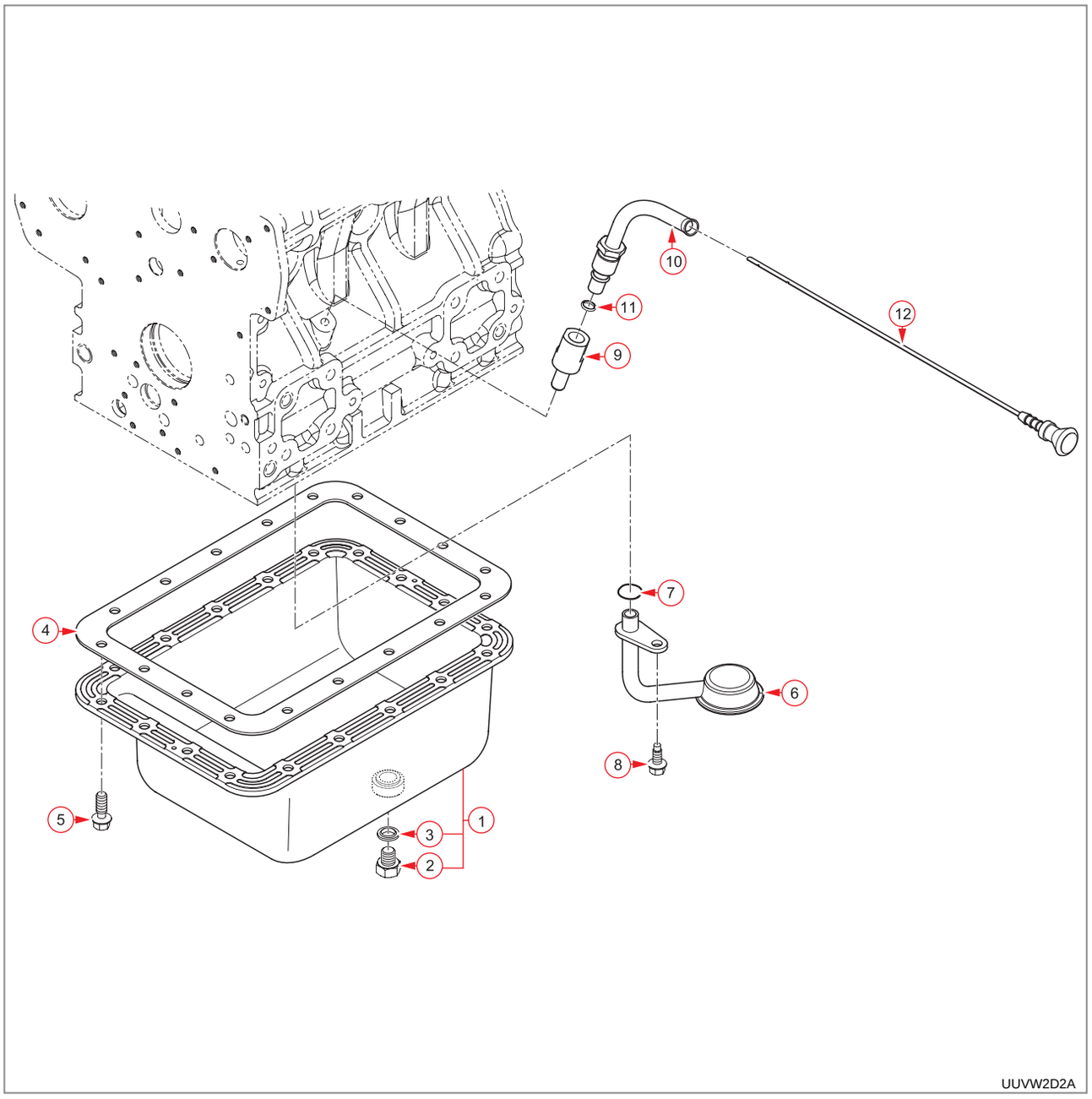
7.1 E010 CYLINDER BLOCK



COMPONENTS

(1) TOTAL CYLINDER BLOCK ASSY
(2) PLUG
(3) PLUG
(4) PLUG
(5) PLUG
(6) PLUG
(7) STRAIGHT PIN
(8) PIN, STRAIGHT
(9) PIN
(10) PIN, PIPE
(11) O RING
(12) COVER
(13) GASKET
(14) BOLT
(15) PLUG
(16) PUMP OIL ASSY
(17) GASKET, OIL PUMP
(18) BOLT
(19) GEAR, OIL PUMP DRIVE
(20) KEY
(21) FLANGE NUT-O/P DRIVE
(22) OIL SWITCH
(23) METAL, CRANKSHAFT

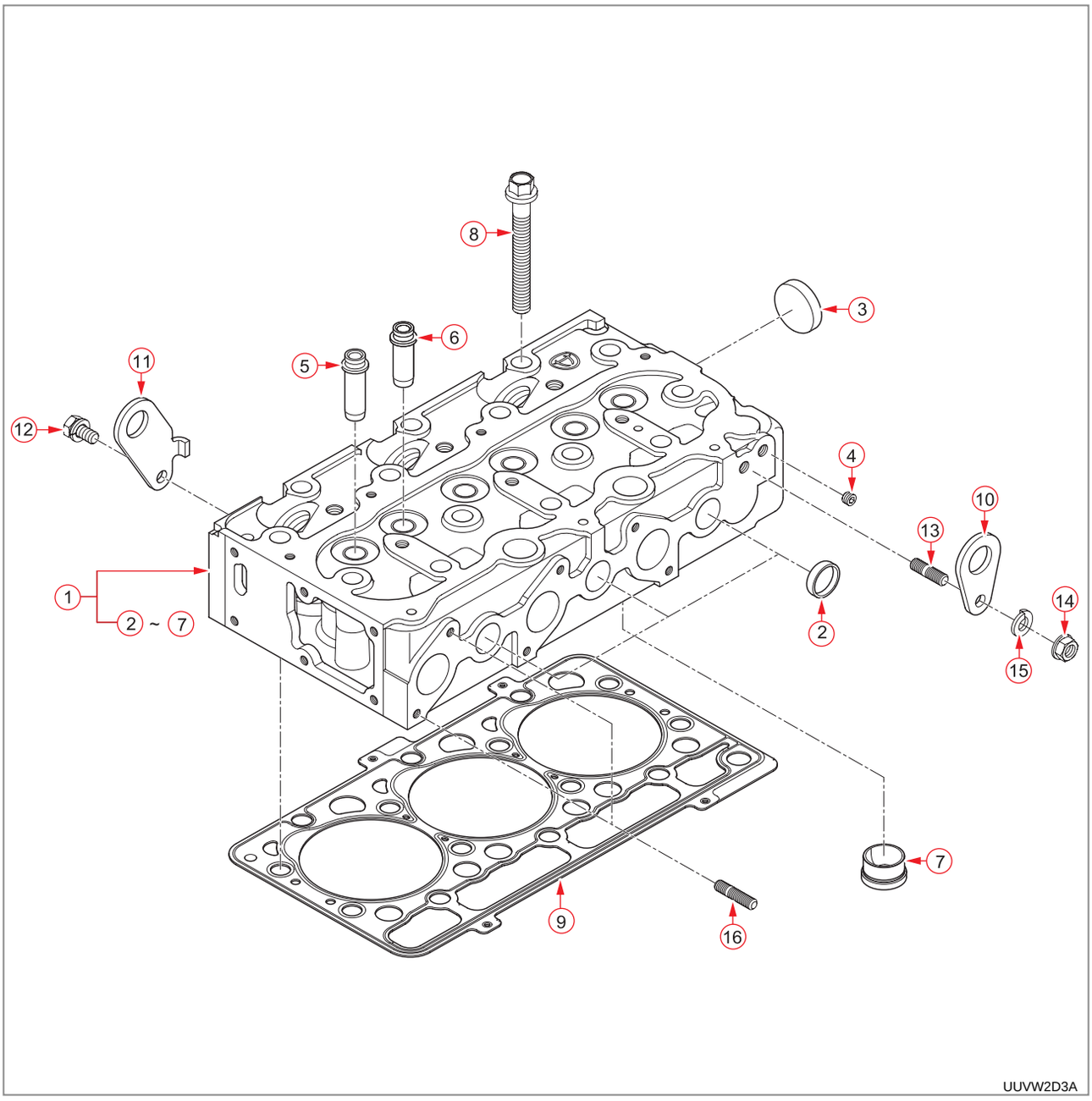
7.2 E020 OIL PAN



COMPONENTS

(1) OIL PAN ASSY
(2) PLUG
(3) WASHER, SEAL
(4) GASKET, OIL PAN
(5) BOLT
(6) FILTER1 OIL
(7) O RING
(8) FLANGE BOLT WITH PIN
(9) GUIDE
(10) GUIDE, OIL GAUGE
(11) PACKING
(12) GAUGE, OIL

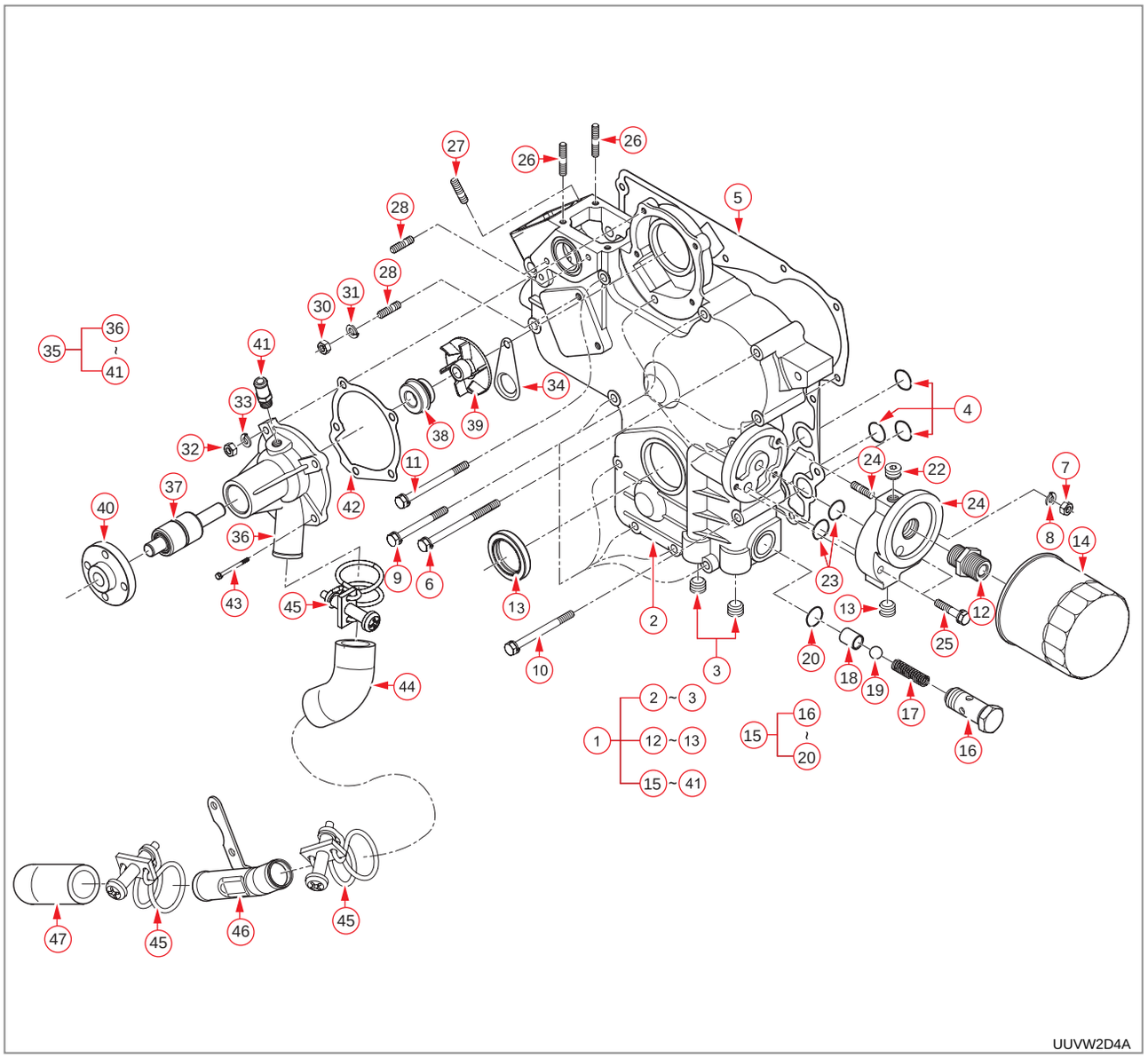
7.3 E030 CYLINDER HEAD



COMPONENTS

(1) TOTAL CYLINDER HEAD ASSY
(2) CAP, SEALING
(3) PLUG
(4) PLUG
(5) GUIDE, INLET VALVE
(6) GUIDE, EXHAUST VALVE
(7) COMBUSTION CHAMBER
(8) BOLT, HEAD
(9) GASKET, HEAD
(10) HOLDER, ENGINE
(11) HOLDER, ENGINE
(12) BOLT
(13) STUD
(14) NUT, FLANGE
(15) WASHER, SPRING
(16) STUD

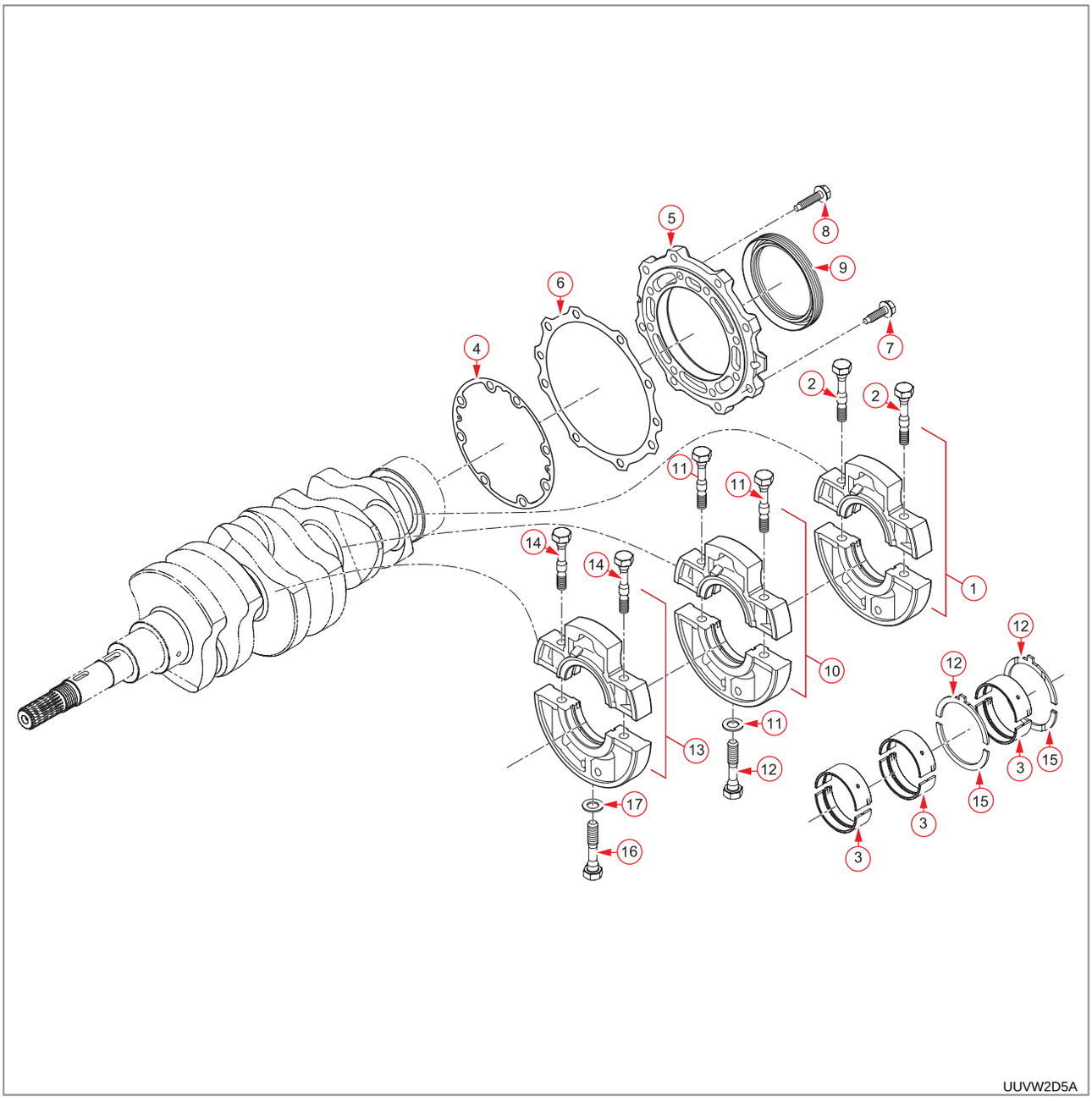
7.4 E040 GEAR CASE



COMPONENTS

(1) GEAR CASE ASSY
(2) GEAR CASE
(3) PLUG
(4) O RING
(5) GASKET, GEAR CASE
(6) BOLT WITH WASHER
(7) NUT
(8) WASHER, SPRING
(9) BOLT
(10) BOLT
(11) BOLT
(12) TUBE, CONNECTING
(13) SEAL, OIL
(14) FILTER, ENGINE OIL
(15) RELIEF VALVE ASSY
(16) BODY
(17) SPRING
(18) SEAT, VALVE
(19) STEEL BALL
(20) O RING
(21) SUPPORT, OIL FILTER
(22) PLUG
(23) O RING
(24) STUD
(25) BOLT
(26) STUD
(27) STUD
(28) BOLT
(29) BOLT
(30) NUT
(31) WASHER, SPRING
(32) NUT
(33) WASHER, SPRING
(34) CLAMP, HOSE
(35) WATER PUMP ASSY
(36) MAIN BODY, WATER PUMP
(37) BEARING
(38) MECHANICAL SEAL ASSY
(39) WATER PUMP IMPELLER
(40) FLANGE, WATER PUMP
(41) HOSE, WATER RETURN
(42) WATER PUMP GASKET
(43) BOLT
(44) HOSE 3, WATER
(45) CLAMP, HOSE
(46) HOSE, WATER
(47) HOSE 2, WATER

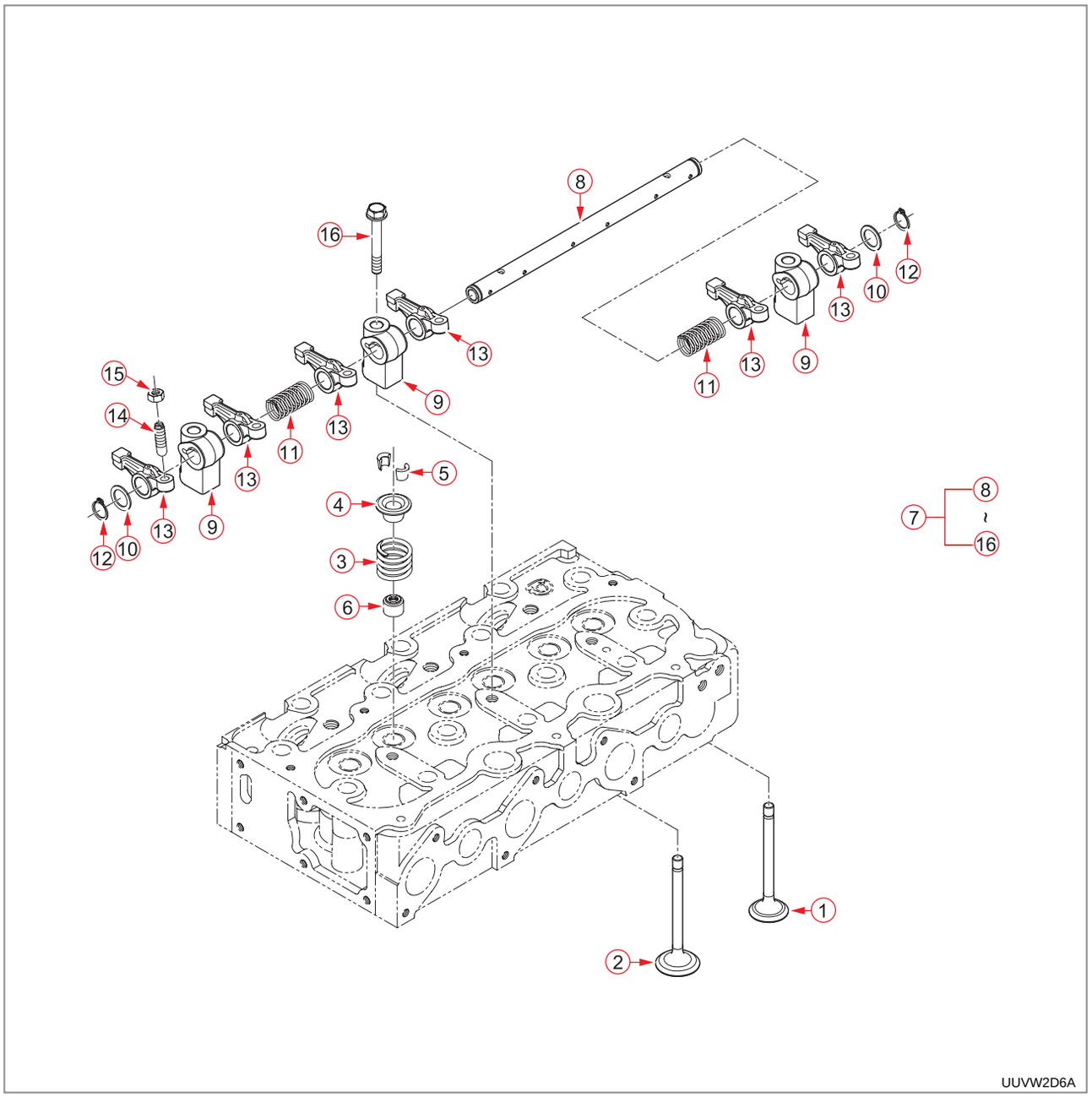
7.5 E050 MAIN BEARING CASE



COMPONENTS

(1) BEARING CASE ASSY
(2) BOLT, BEARING CASE1
(3) METAL, CRANKSHAFT
(4) GASKET, BEARING
(5) COVER, BEARING CASE
(6) GASKET, COVER
(7) BOLT, FLANGE
(8) BOLT, FLANGE
(9) SEAL, OIL
(10) MAIN BEARING 1 CASE ASSY
(11) BOLT, BEARING CASE1
(12) METAL SIDE 1
(13) MAIN BEARING 2 CASE ASSY
(14) BOLT, BEARING CASE1
(15) SIDE METAL2
(16) BOLT, BEARING CASE
(17) WASHER, PLATE

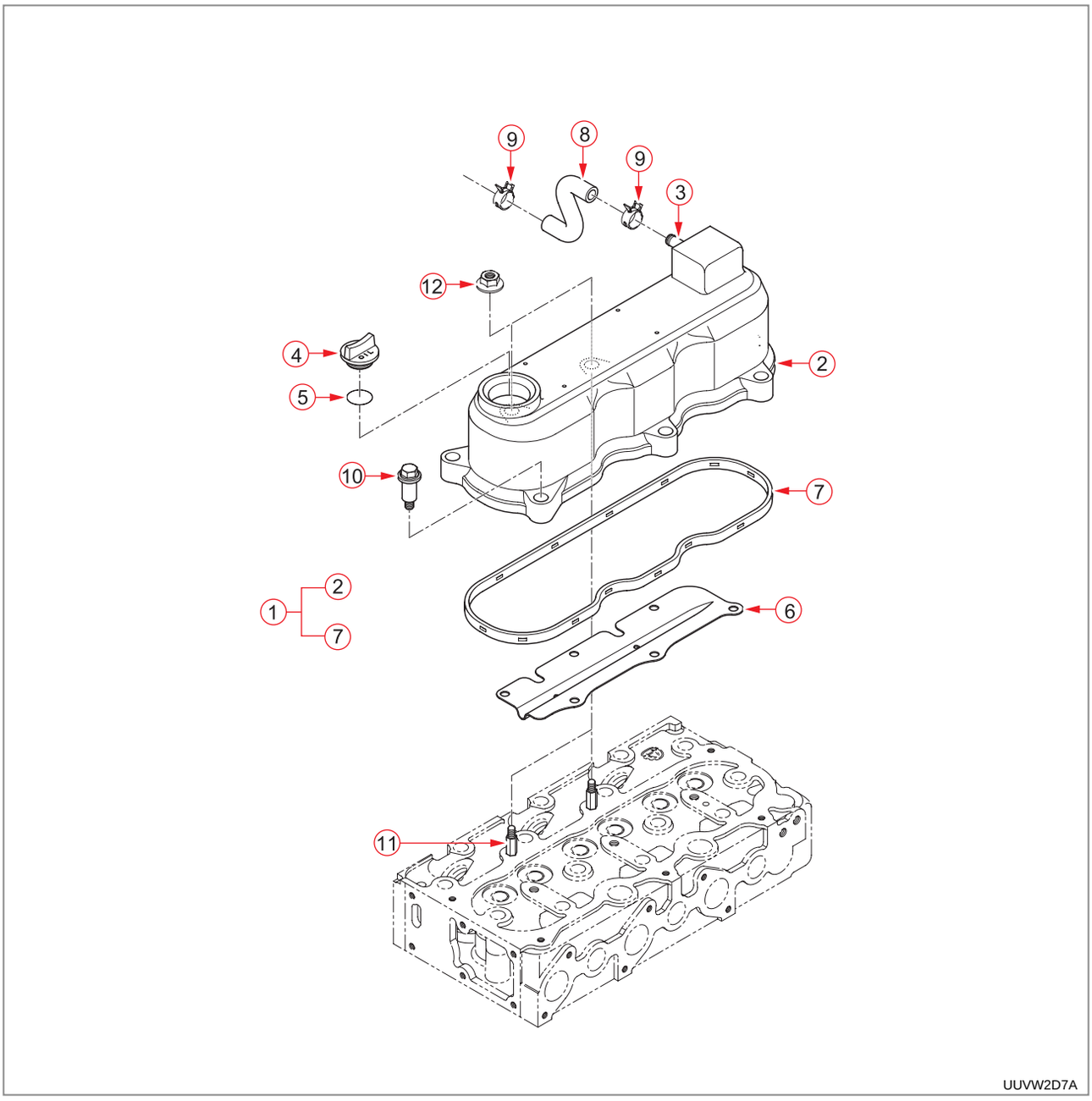
7.6 E080 VALVE ROCKER ARM



COMPONENTS

(1) VALVE, INLET
(2) VALVE, EXHAUST
(3) SPRING, VALVE
(4) RETAINER, VALVE SPRING
(5) COLLET, VALVE SPRING
(6) SEAL, VALVE STEM
(7) ROCKER ARM ALL ASSY
(8) SHAFT, ROCKER ARM
(9) BRACKET, ROCKET ARM
(10) WASHER
(11) SPRING, ROCKER ARM
(12) RING, SNAP
(13) ROCKER ARM
(14) SCREW, ADJUSTING
(15) NUT, ADJUSTING
(16) BOLT, ROCKER ARM SUPPORT

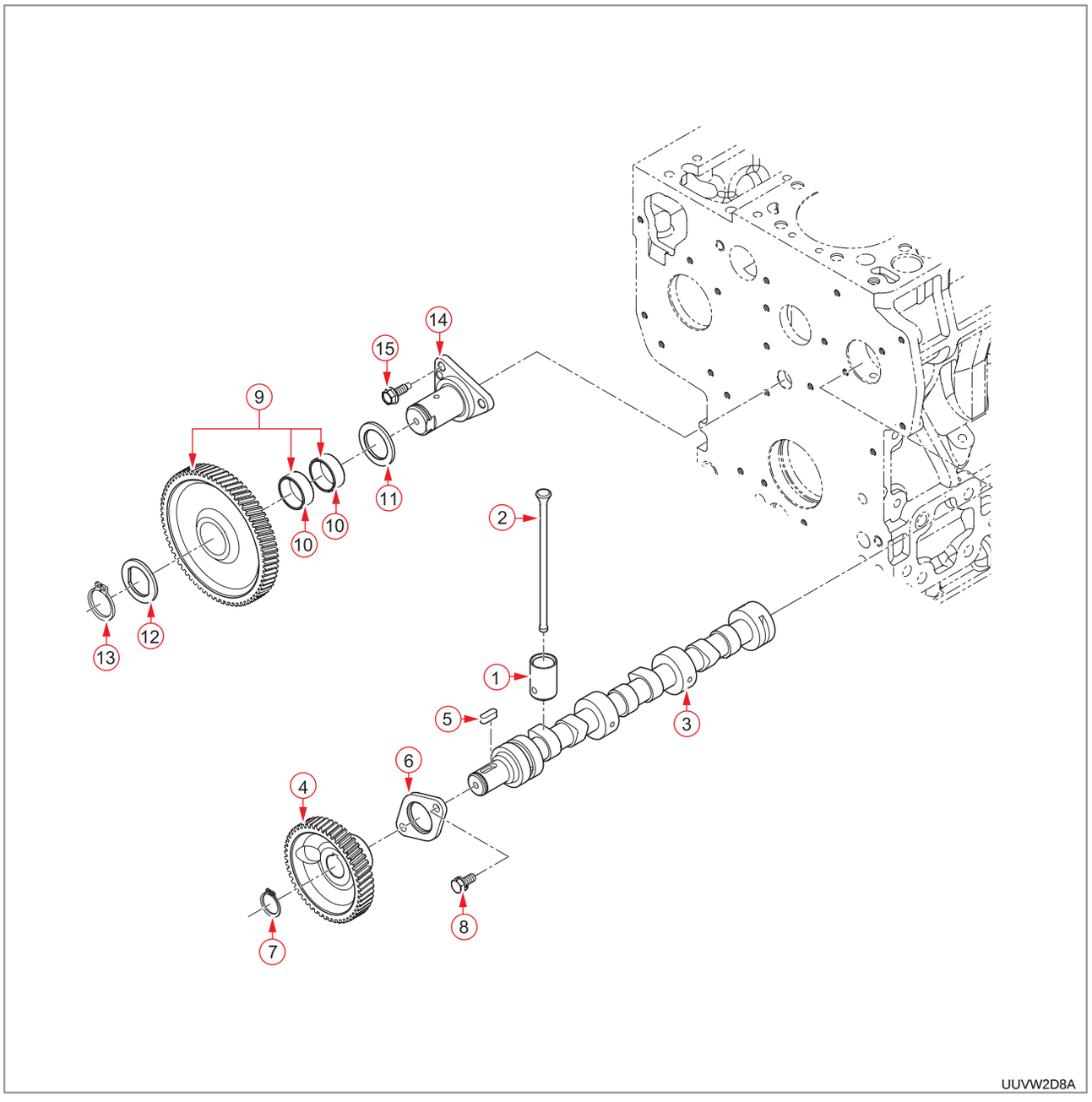
7.7 E090 CYLINDER HEAD COVER



COMPONENTS

(1) CYLINDER HEAD COVER ASSY
(2) COVER, CYLINDER HEAD
(3) CONNECTOR, AIR BREATHER
(4) PLUG, OIL FILLER
(5) O RING
(6) OIL PROTECTOR
(7) GASKET, HEAD COVER
(8) AIR BREATHER
(9) BAND
(10) BOLT, HEAD COVER
(11) STUD
(12) NUT

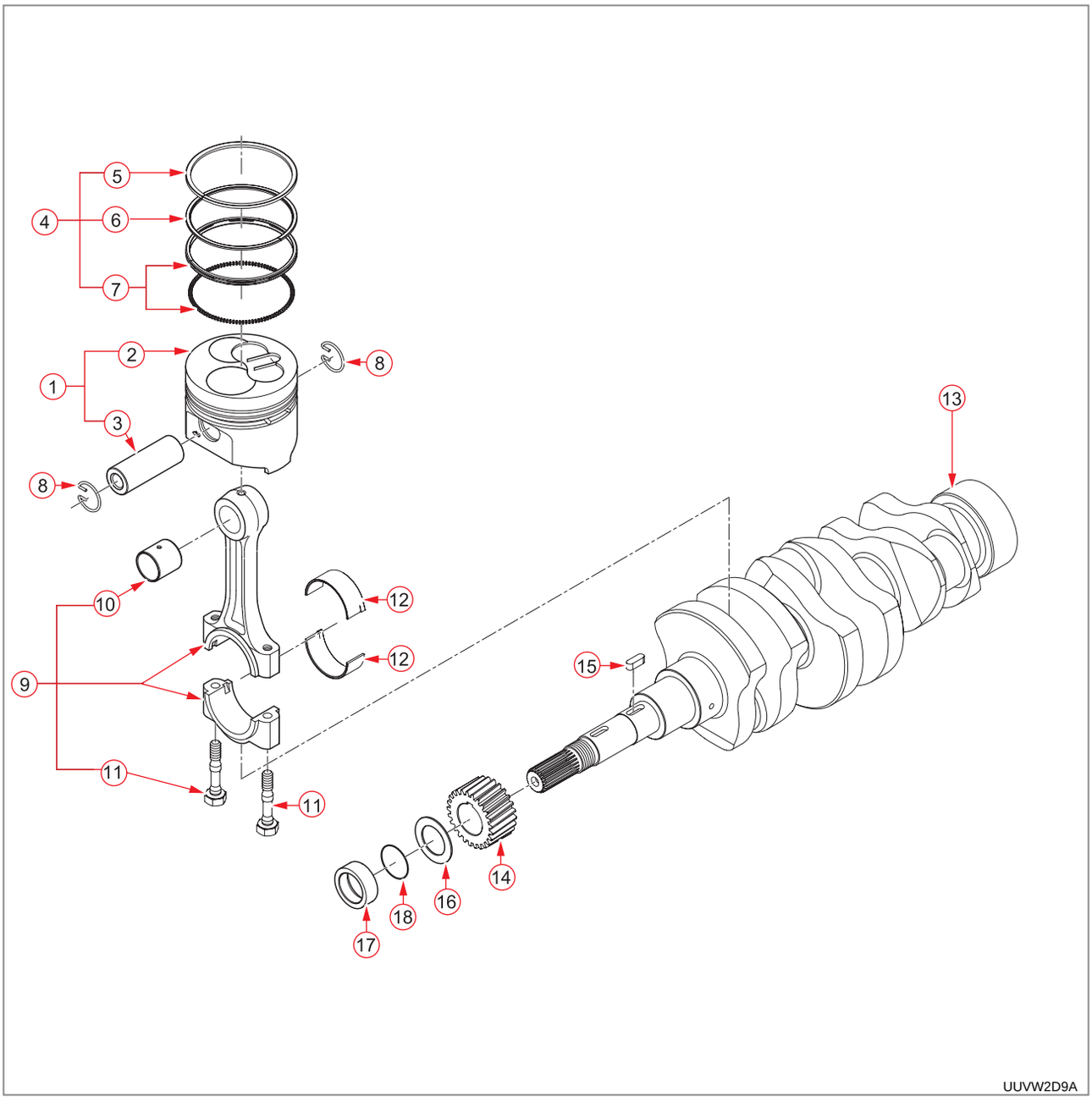
7.8 E100 CAMSHAFT



COMPONENTS

(1) TAPPET
(2) ROD, PUSH
(3) CAMSHAFT ASSY
(4) GEAR, CAMSHAFT
(5) KEY
(6) STOPPER, CAMSHAFT
(7) CIR CLIP, EXTERNAL
(8) BOLT
(9) GEAR IDLE ASSY
(10) BUSH, IDLE GEAR
(11) COLLAR1
(12) COLLAR2
(13) CIR-CLIP
(14) SHAFT GEAR, IDLE
(15) BOLT

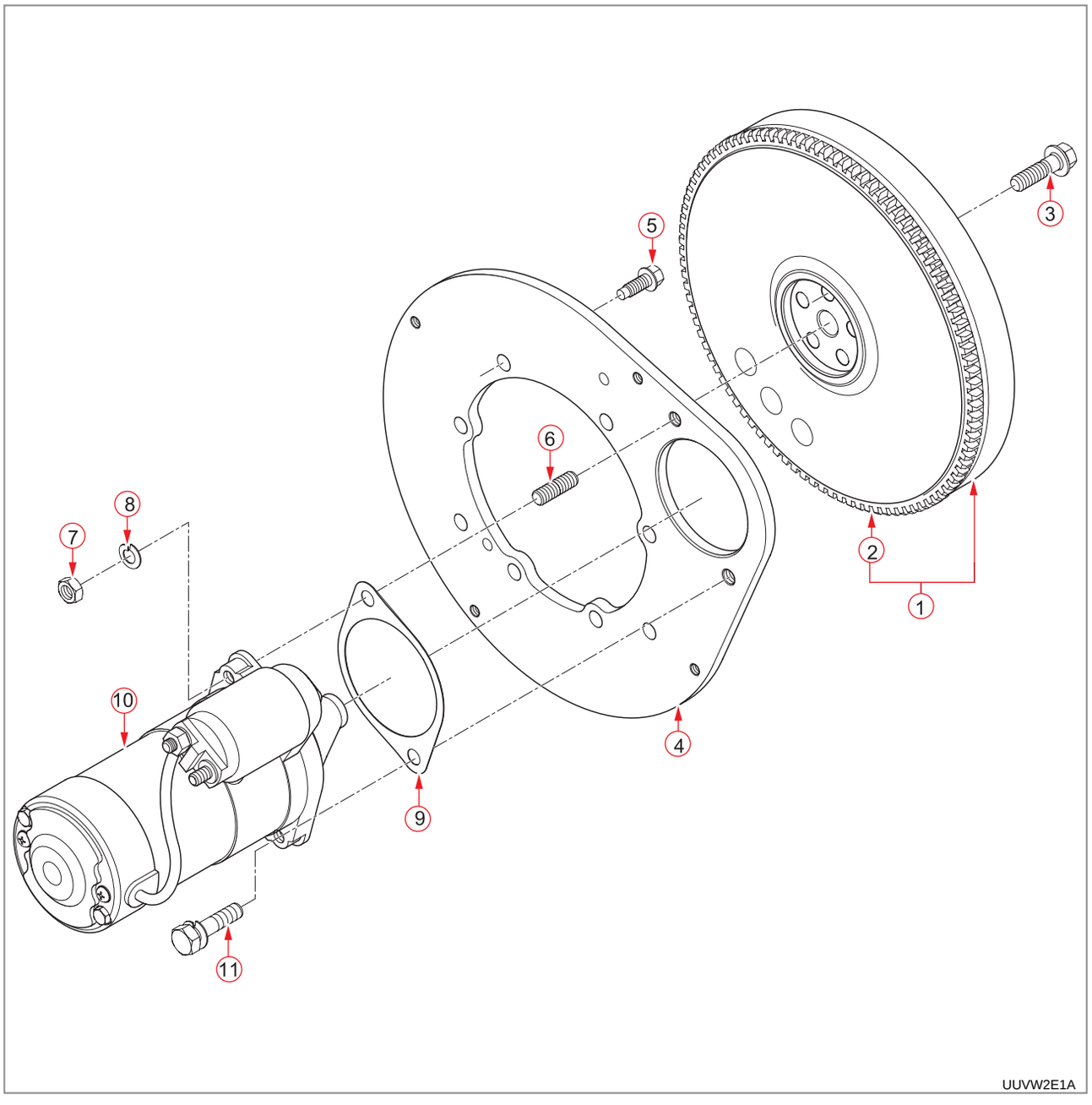
7.9 E110 PISTON & CRANK SHAFT



COMPONENTS

(1) PISTON & PIN ASSY
(2) PISTON
(3) PIN, PISTON
(4) RING, PISTON ASSY
(5) TOP RING
(6) RING 2, PISTON
(7) PISTON OIL RING ASSY
(8) CIR-CLIP
(9) CON ROD ASSEMBLY
(10) BUSH, PISTON PIN
(11) BOLT, ROD
(12) METAL, CRANKPIN
(13) CRANK SHAFT ASSY
(14) GEAR, CRANK SHAFT
(15) KEY
(16) SLINGER, OIL
(17) COLLAR-CRANKSHAFT
(18) O RING

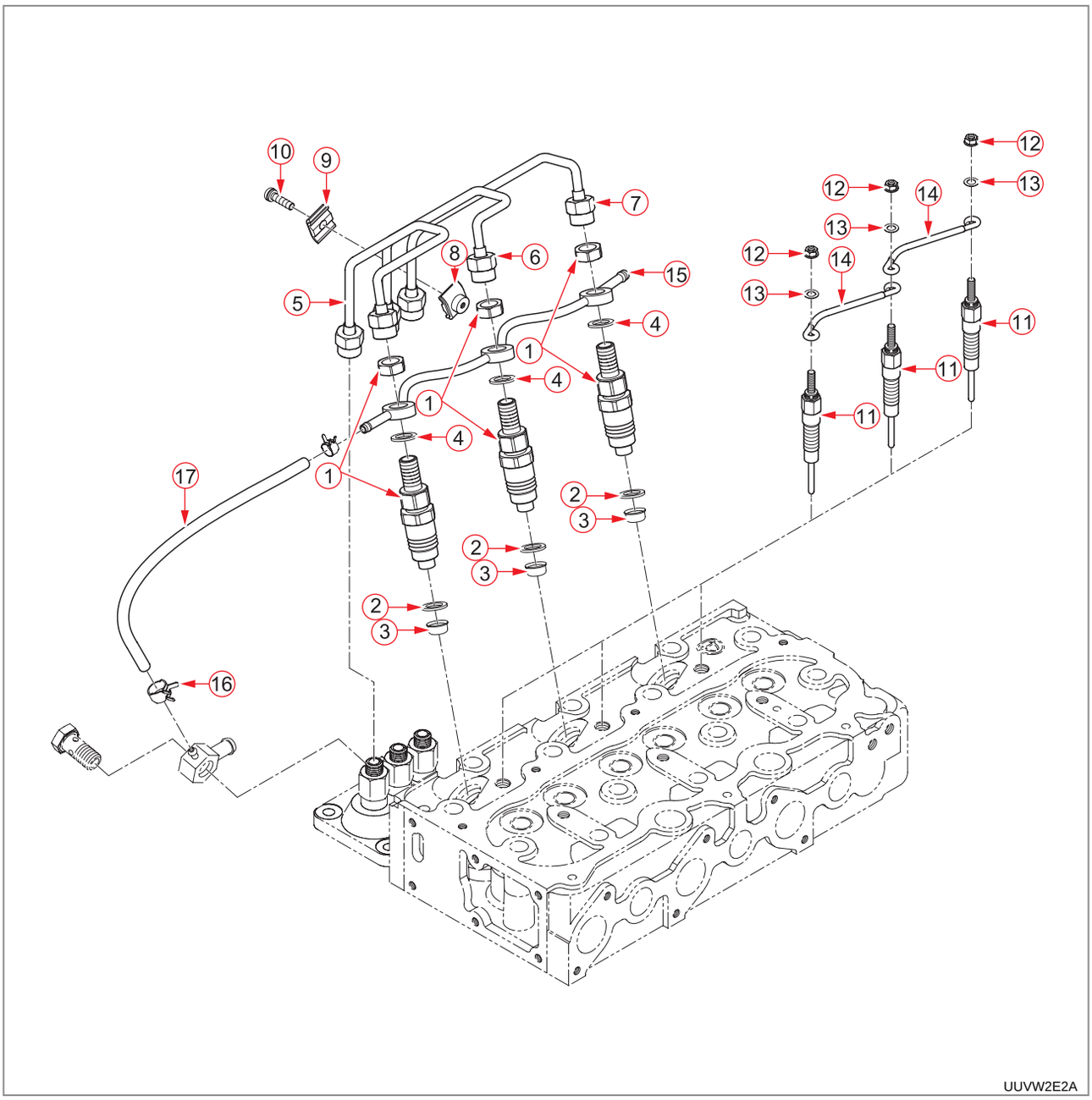
7.10 E120 FLYWHEEL



COMPONENTS

(1) FLYWHEEL ASSY
(2) GEAR, RING
(3) BOLT
(4) PLATE-REAR END
(5) STUD
(6) NUT
(7) WASHER, SPRING
(8) FLANGE BOLT WITH PIN
(9) GASKET
(10) STARTER ASSY
(11) BOLT

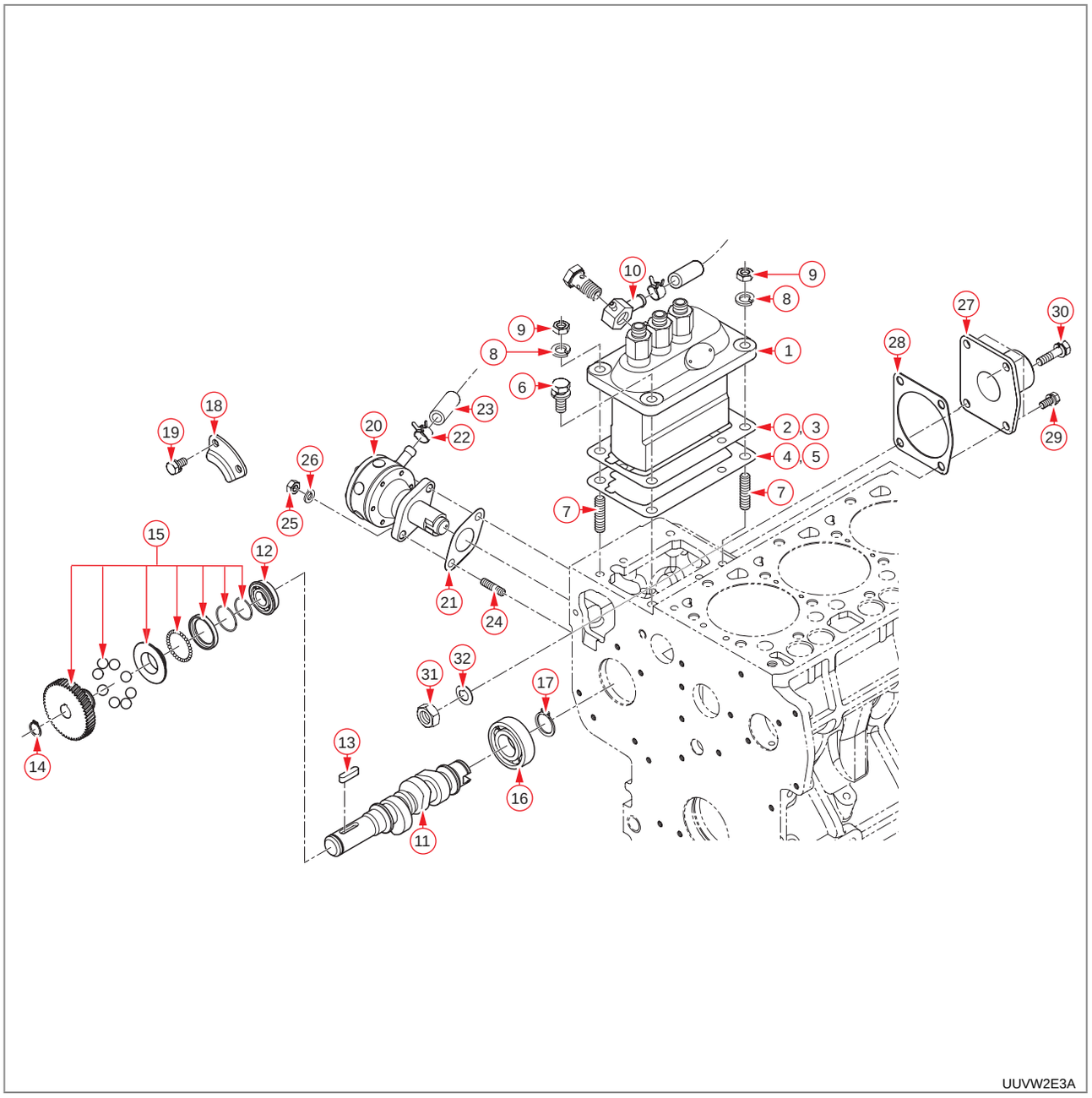
7.11 E130 NOZZLE, HOLDER



COMPONENTS

(1) HOLDER,NOZZLE 1 ASSY
(2) GASKET
(3) HEAT SHIELD
(4) GASKET
(5) TUBE1, INJECTION
(6) TUBE2, INJECTION
(7) TUBE3, INJECTION
(8) CLAMP1, TUBE
(9) CLAMP, TUBE
(10) SCREW
(11) PLUG, GLOW
(12) NUT, FLANGE
(13) PLAIN WASHER
(14) CORD, GLOW PLUG
(15) HOSE, OVER FLOW
(16) BAND
(17) HOSE, FUEL

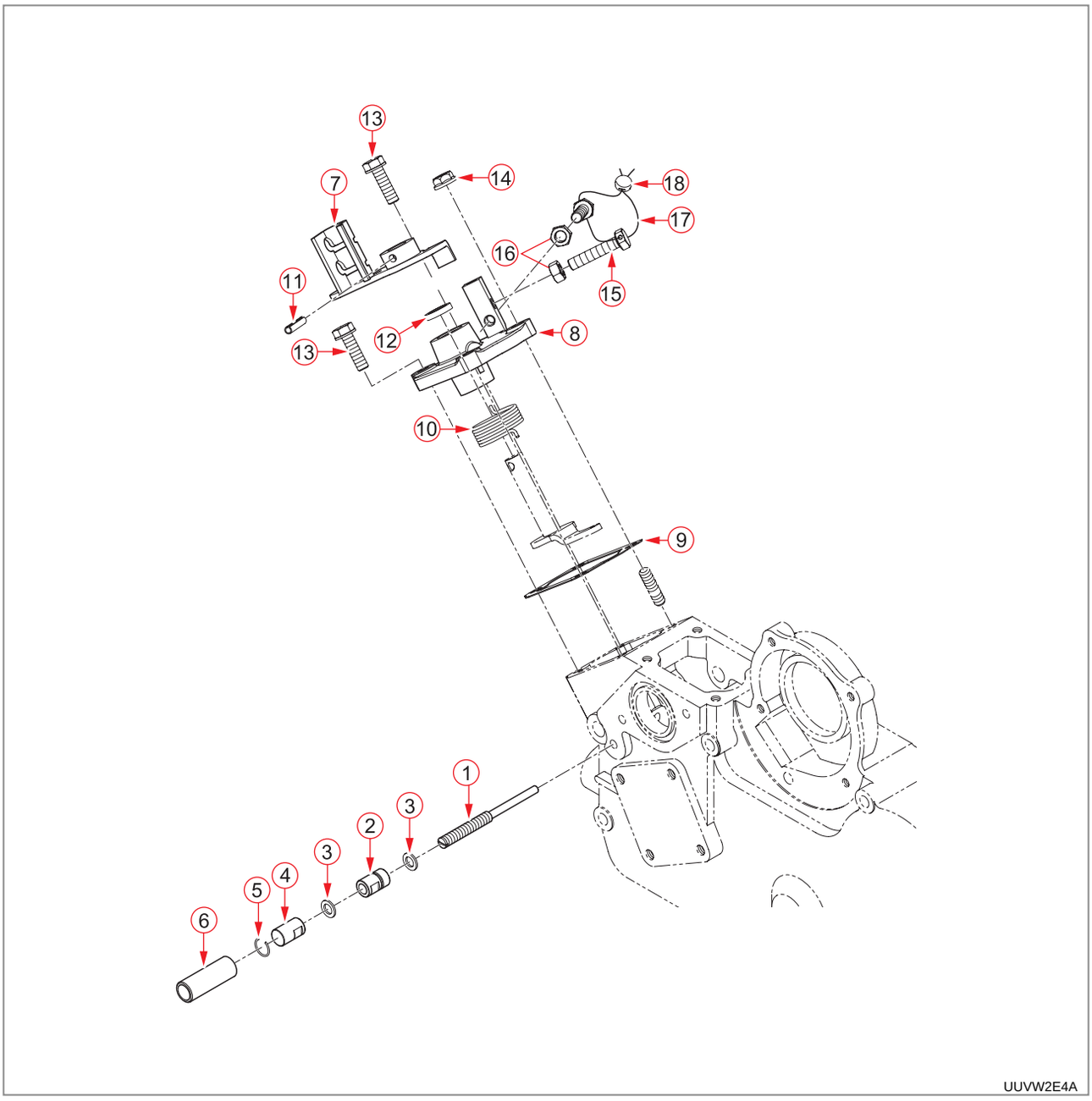
7.12 E140 FUEL CAMSHAFT



COMPONENTS

(1) INJECTION PUMP ASSY
(2) SHIM, INJECTION PUMP
(3) SHIM
(4) SHIM10, INJECTION PUMP
(5) SHIM3, INJECTION PUMP
(6) BOLT
(7) STUD
(8) WASHER, SPRING
(9) NUT
(10) HOSE, FUEL
(11) SHAFT, CAM
(12) BEARING, BALL
(13) KEY
(14) CIR CLIP, EXTERNAL
(15) GOVERNOR SLEEVE ASSY
(16) BEARING(6004C3)
(17) SNAP RING
(18) STOPPER, FUEL CAMSHAFT
(19) BOLT
(20) FUEL PUMP ASSEMBLY
(21) PACKING, FUEL PUMP
(22) CLIP, PIPE
(23) HOSE1, FUEL
(24) STUD
(25) NUT
(26) WASHER, SPRING
(27) COVER, CAMSHAFT
(28) FUEL CAMSHAFT COVER GASKET
(29) BOLT
(30) BOLT
(31) NUT
(32) WASHER, SPRING

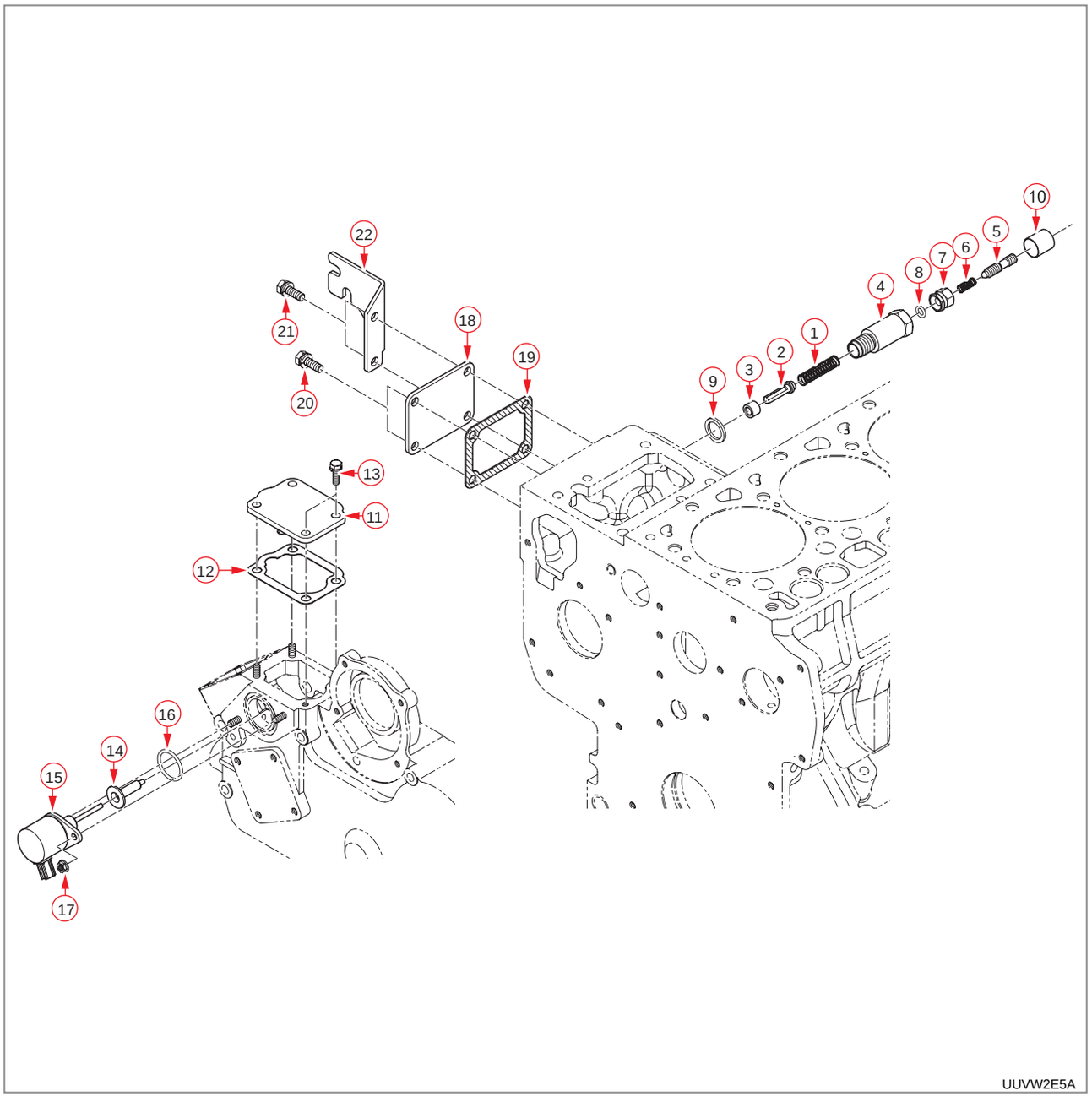
7.13 E150 SPEED CONTROL PLATE



COMPONENTS

(1) ADJUSTING BOLT
(2) NUT
(3) GASKET
(4) NUT, CAP
(5) SNAP RING
(6) CAP
(7) LEVER, SPEED CONTROL
(8) PLATE, SPEED CONTROL
(9) GASKET, SPEED CONTROL PLATE
(10) SPRING
(11) PIN, SPRING
(12) OIL SEAL
(13) BOLT, FLANGE
(14) NUT, FLANGE
(15) SCREW, ADJUSTING
(16) NUT
(17) WIRE
(18) SEALING LEAD

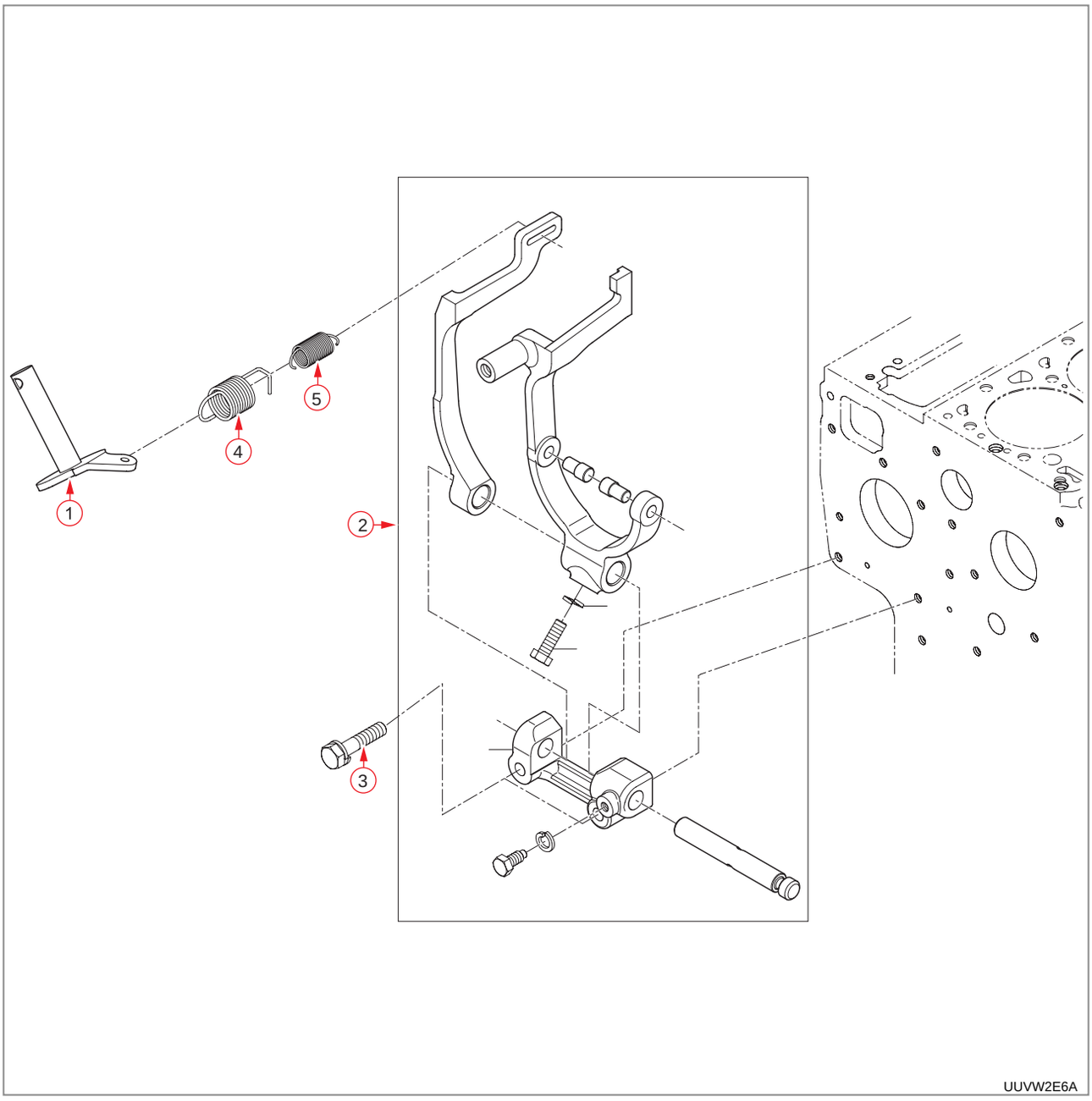
7.14 E160 ENGINE STOP LEVER



COMPONENTS

(1) START SPRING
(2) SHAFT, IDLE ADJUST
(3) BUSH
(4) IDLE ADJUSTMENT BODY
(5) IDEL ADJUSTING BOLT
(6) SPRING / IDLE
(7) NUT
(8) O RING
(9) PACKING
(10) CAP
(11) COVER, ENGINE STOP LEVER
(12) GASKET, SPEED CONTROL PLATE
(13) BOLT, FLANGE
(14) ENGINE STOP SOLENOIDE GUIDE
(15) SOLENOID ASSY
(16) O RING
(17) NUT, FLANGE
(18) COVER,INJECTION PUMP
(19) GASKET
(20) BOLT, FLANGE
(21) BOLT, FLANGE
(22) CABLE BRACKET

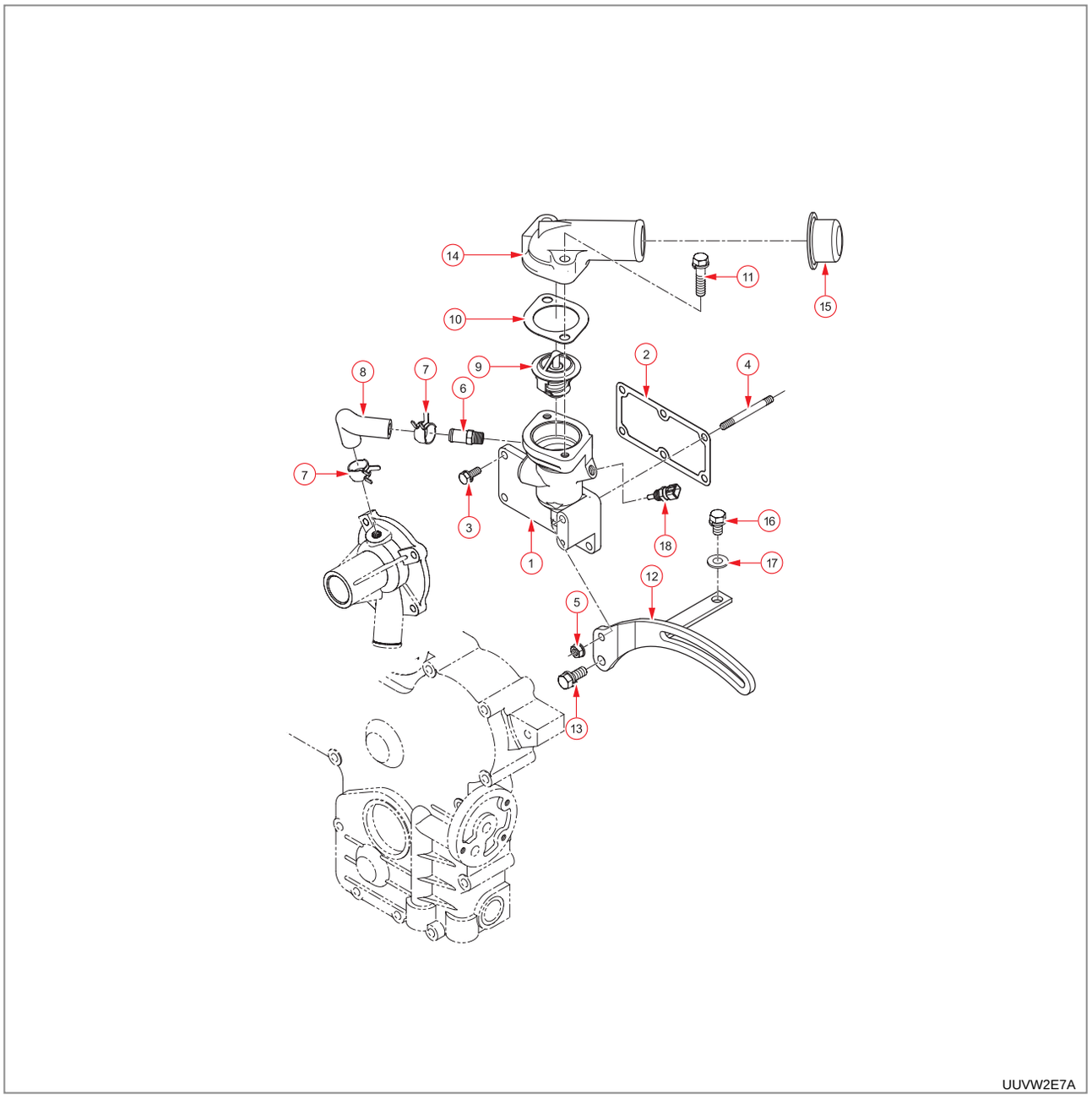
7.15 E170 GOVERNOR



COMPONENTS

(1) GOVERNOR LEVER ASSY
(2) LEVER ASSY
(3) BOLT
(4) SPRING1, GOVERNOR
(5) SPRING, GOVERNOR2

7.16 E190 WATER HOSE



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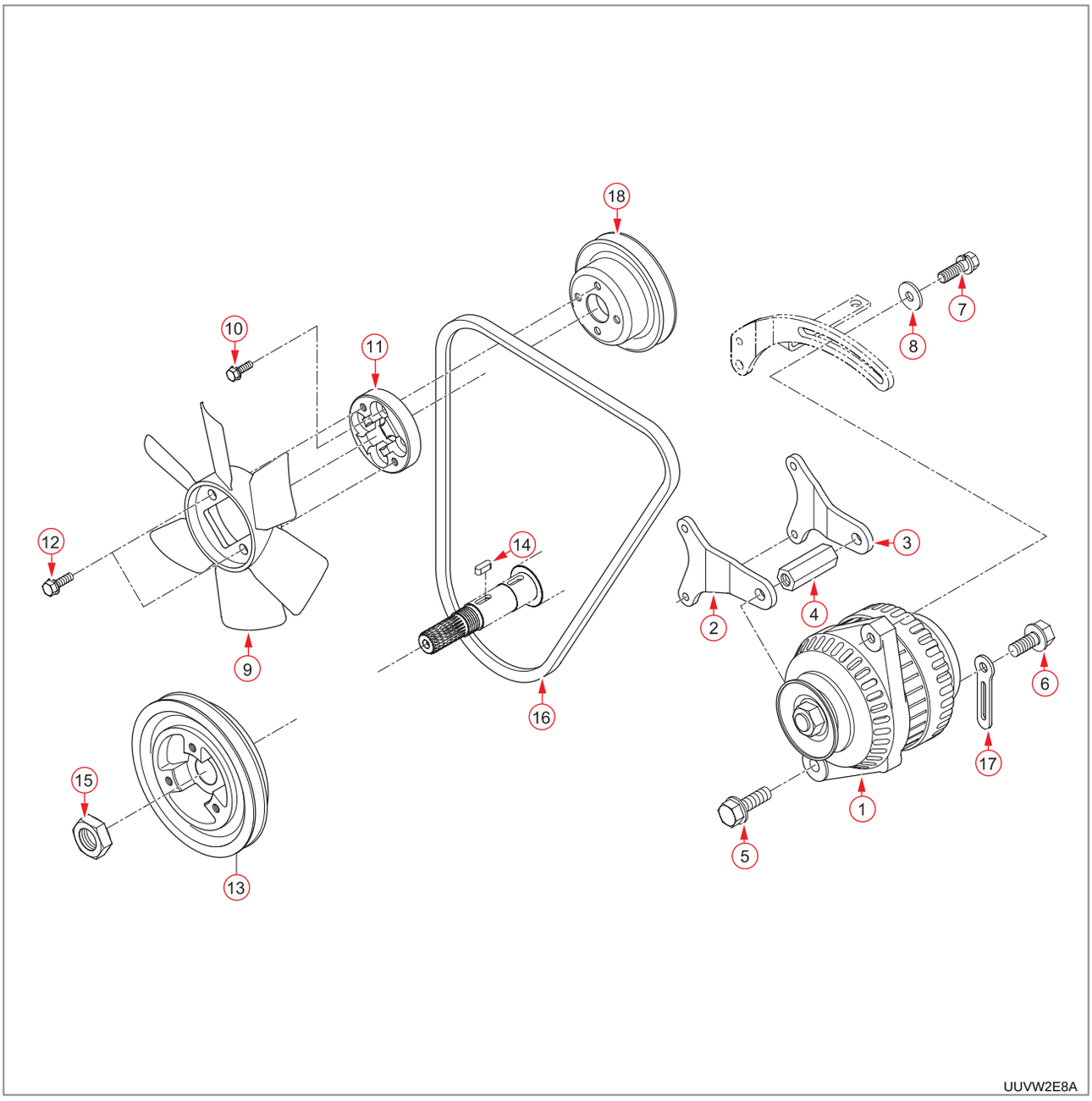
COMPONENTS

(1) FLANGE, WATER
(2) WATER FLANGE GASKET
(3) BOLT
(4) STUD
(5) NUT, FLANGE
(6) HOSE, WATER RETURN
(7) HOSE, WATER PUMP
(8) BAND
(9) THERMOSTAT ASSY
(10) GASKET
(11) BOLT
(12) SUPPORT1, ALTERNATOR
(13) BOLT
(14) THERMOSTAT COVER ASSY
(15) COVER, WATER HOSE
(16) BOLT
(17) WASHER, PLAIN
(18) COOLANT TEMP. SENDER ASSY

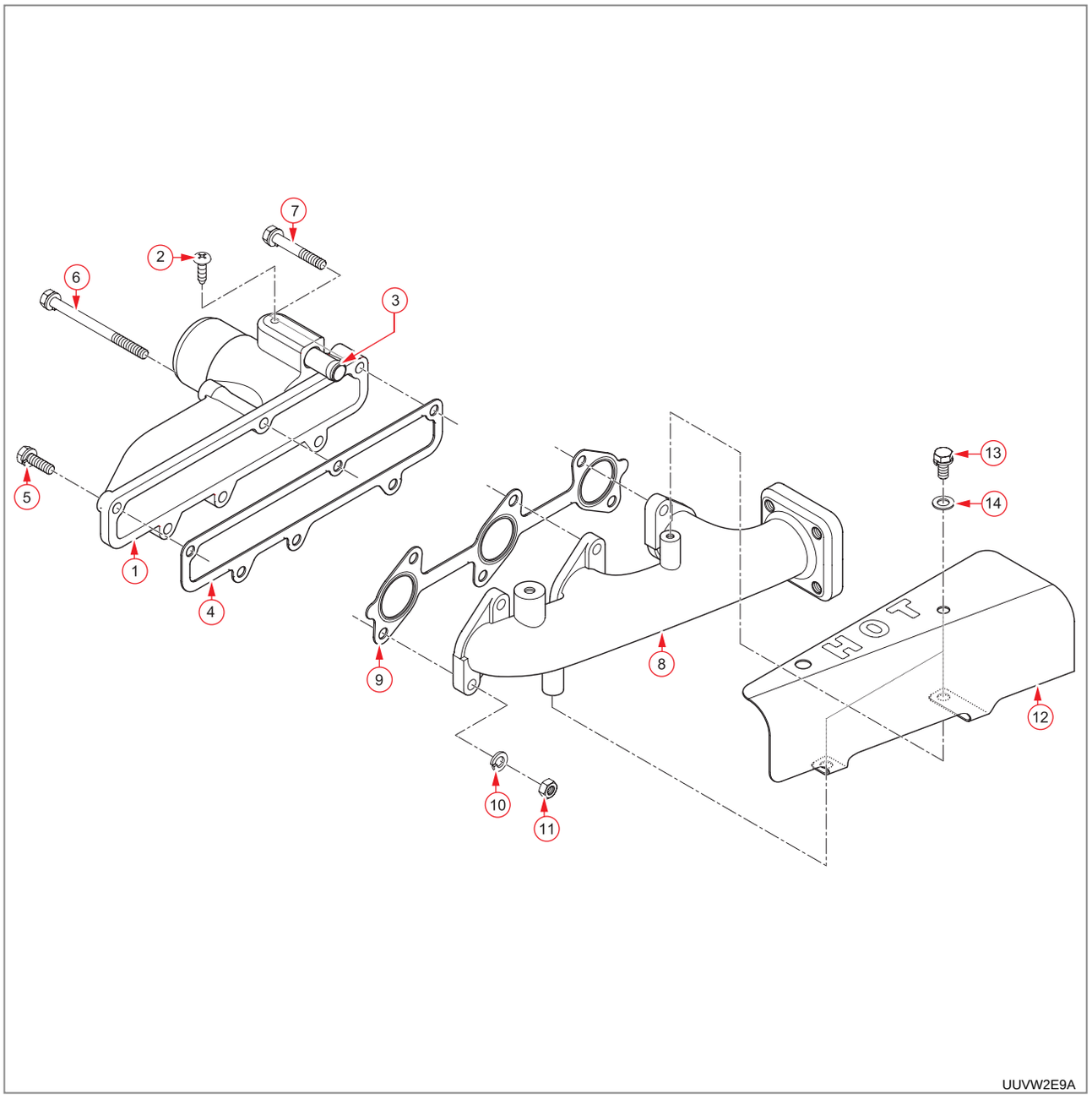
7.17 E200 DYNAMO



COMPONENTS

(1) ALTERNATOR ASSY
(2) SUPPORT2, ANTERNATOR
(3) SUPPORT3, ALTERNATOR
(4) SPACER
(5) BOLT, FLANGE
(6) BOLT, FLANGE
(7) BOLT
(8) WASHER, PLAIN
(9) COOLING FAN
(10) WASHER BOLT
(11) COLLAR,FAN
(12) BOLT, FLANGE
(13) PULLEY, FAN DRIVING
(14) KEY
(15) NUT, CRANKSHAFT
(16) FAN BELT
(17) CLAMP, CORD
(18) PULLEY, FAN

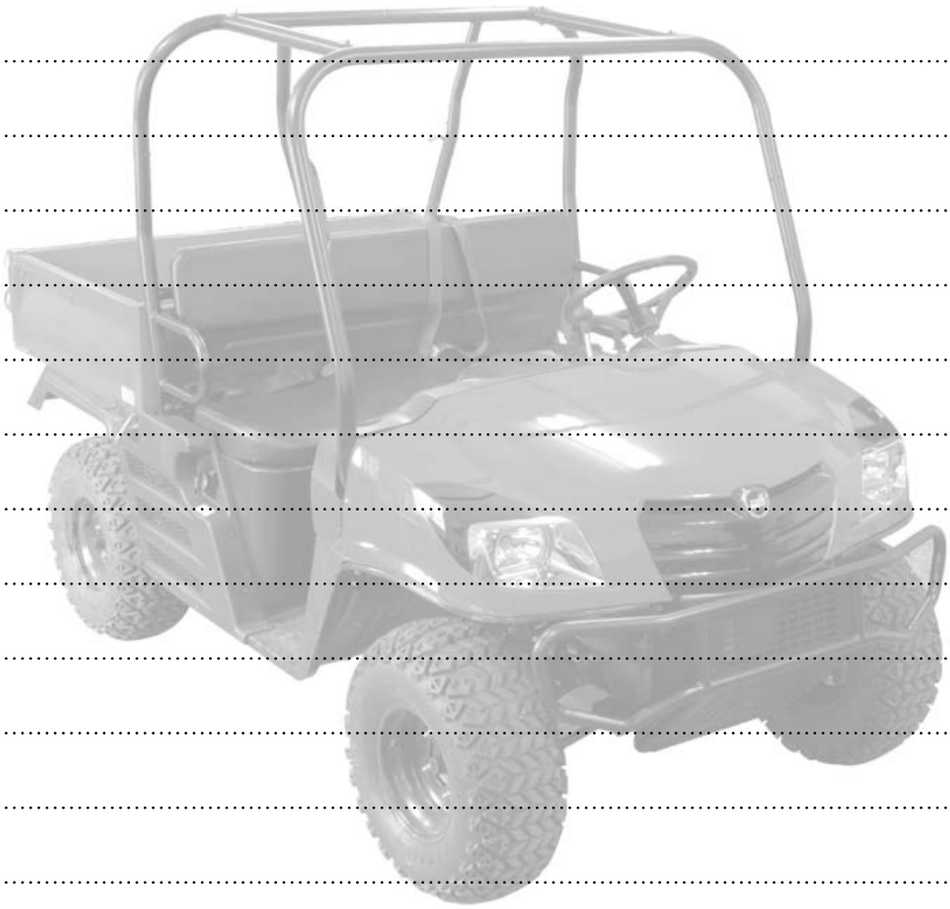
7.18 E220 MAINFOLD



COMPONENTS

(1) MANIFOLD,INLET
(2) BOLT, SCREW
(3) CONNECTOR, AIR BREATHER
(4) GASKET / INLET MANIFOLD
(5) BOLT
(6) BOLT
(7) BOLT
(8) MANIFOLD, EXHAUST
(9) GASKET, EXHAUST MANIFOLD
(10) NUT
(11) WASHER, SPRING
(12) PLATE,HEAT
(13) BOLT
(14) WASHER, PLAIN

MEMO



CVT

CHAPTER 4

TABLE OF CONTENTS

1. SPECIFICATIONS

1.1 GENERAL SPECIFICATIONS

Item		Specification
Type		Constant variable, belt
Pulley speed reduction ratio (drive : driven)		0.68 : 1
Belt width	Specification	29 mm (1.142 in.)
	Allowable limit	24 mm (0.945 in.)
Distance between center of two pulleys (Shaft distance)		327.15 mm (12.8799 in.)
Drive pulley		Centrifugal force reactive type variable pulley
Driven pulley		Spring compression type variable pulley

1.2 TIGHTENING TORQUE

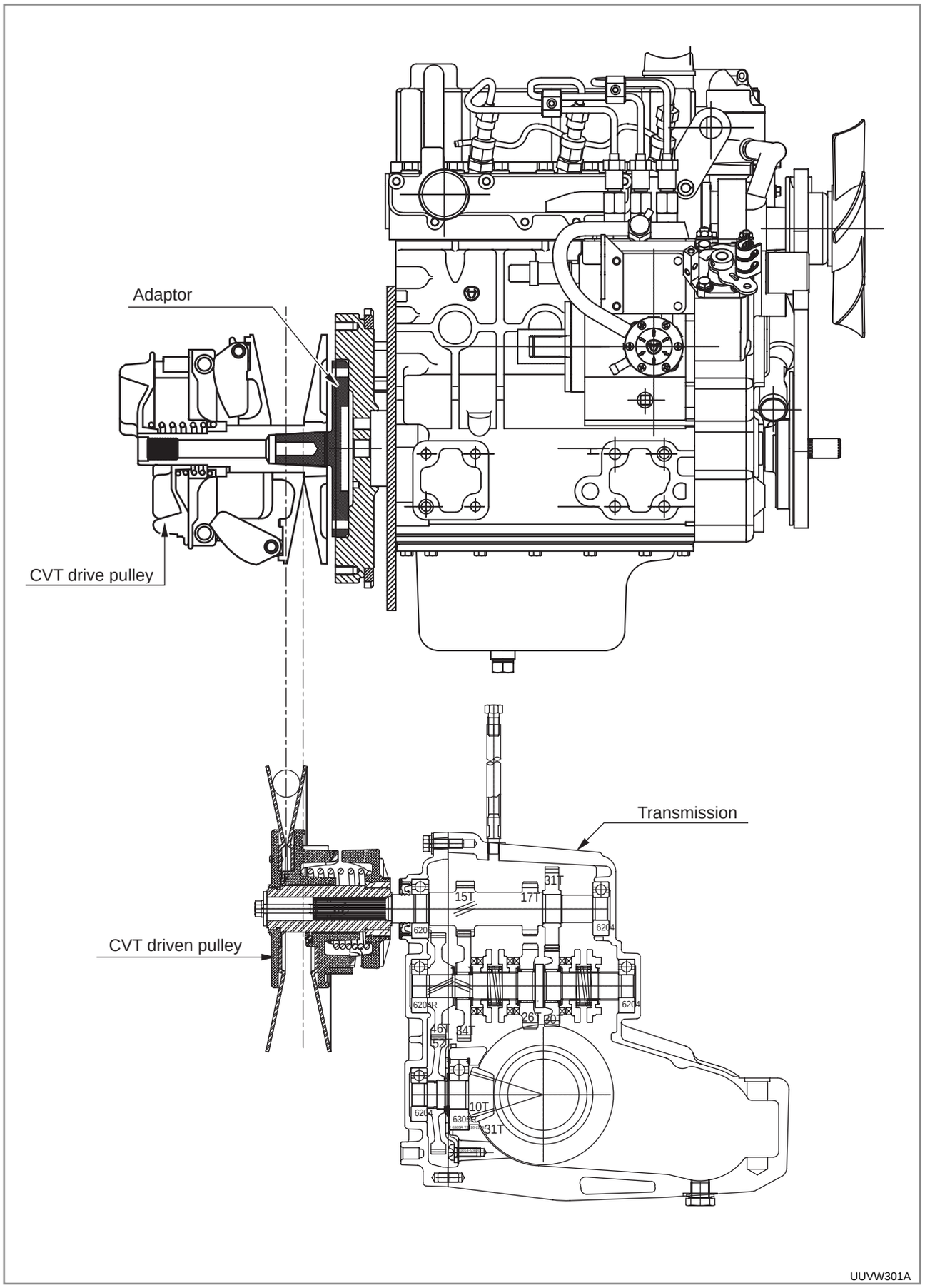
Position	Specification	Tightening torque
CVT drive pulley mounting bolt	-	54.0 Nm 5.5 kgf-m 40.0 lb-ft
CVT driven pulley mounting bolt	M8	24.5 Nm 2.5 kgf-m 18.0 lb-ft

1.3 SEALANT AND ADHESIVE

Applied position	Purpose	Specification
Mating surface of CVT cover and flywheel installation plate to engine	Prevention of water entry	Three Bond 1206D or equivalent
CVT drive/driven pulley mounting bolt	Prevention of looseness	LOCTITE #242 or equivalent

2. STRUCTURE AND OPERATING PRINCIPLE

2.1 STRUCTURE OF CVT (CONTINUOUSLY VARIABLE TRANSMISSION)



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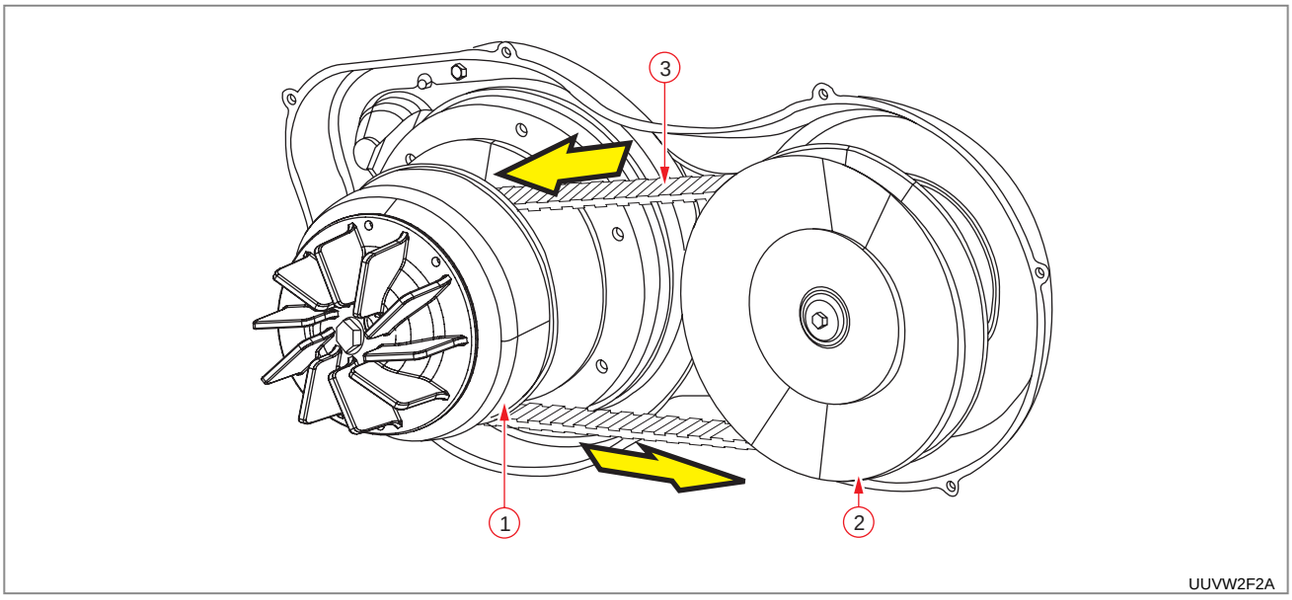
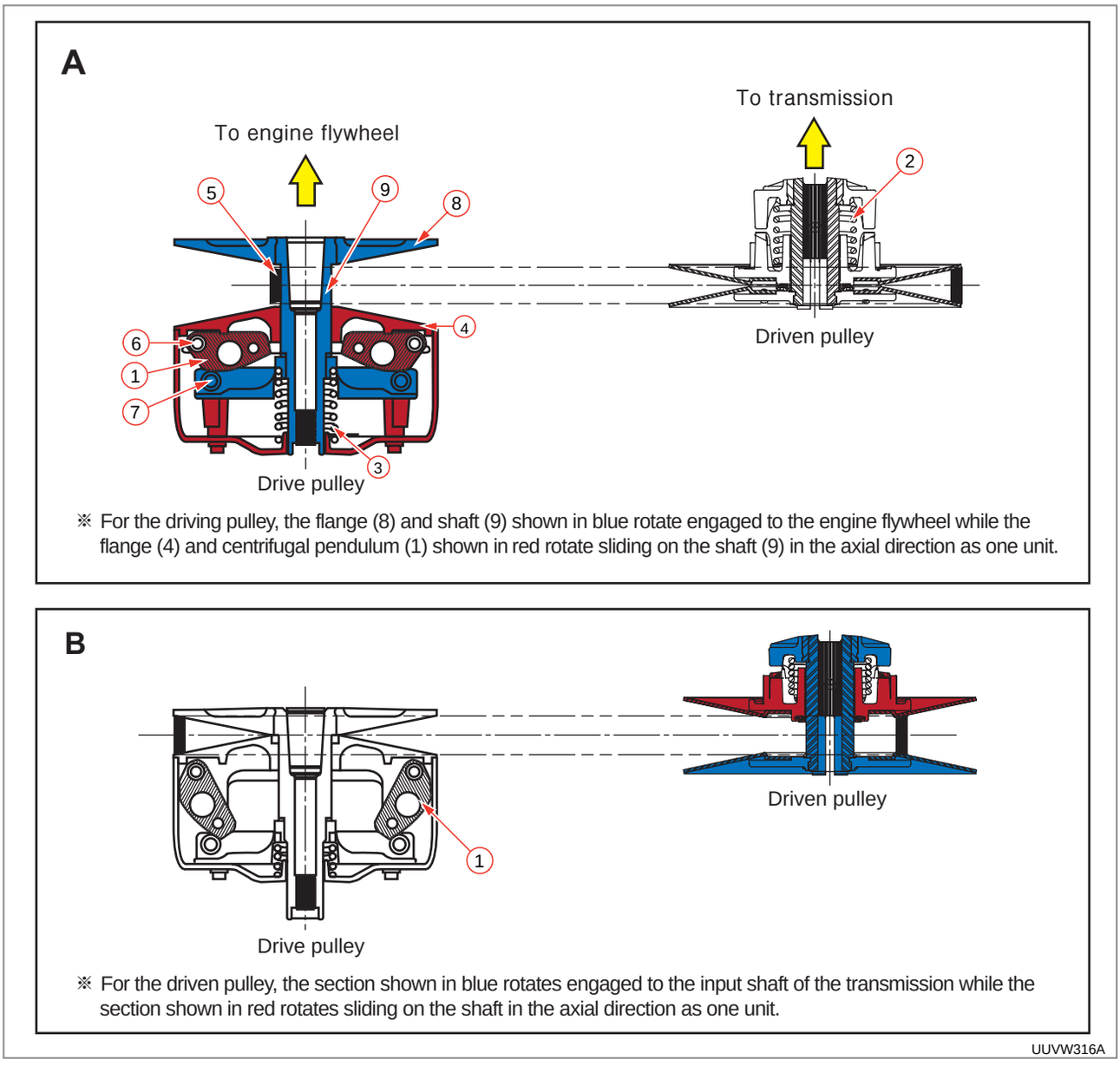
2.2 OPERATING PRINCIPLE



The CVT (Continuously Variable Transmission) equipped in this vehicle has the driving pulley (1) and driven pulley (2) that are connected with the belt (3). This transmission can change steplessly through speed ratios between maximum 3.55:1 and minimum 0.68:1 by changing the effective diameter of the belt for the driving and driven pulleys.

The driving pulley is installed to the flywheel of the engine as shown in the figure (A) on page 4-5, and it is designed in a way that its effective contact diameter against the belt is increased as the centrifugal force is increased by the engine RPM increase. The driven pulley is installed to the input shaft of the transmission and its effective diameter is maintained large by the spring (A2). However, as the belt cannot be extended, increase in the effective diameter of the driving pulley decreases the effective diameter of the driven pulley in inverse proportion. The effective diameter of each pulley is changed as the distance between the inner and outer flanges is changed. For the driving pulley, this distance is changed by the belt tension and centrifugal force of the centrifugal pendulum (A1) attached to the pulley. For the driven pulley, the distance between its flanges is changed by the belt tension and restoring force of the spring (A2) installed to the pulley.



(1) centrifugal pendulum (2) spring (3) returning spring (4) outer flange (5) belt (6) hinge shaft (7) roller (8) inner flange (9) shaft

CVT pulley operation under no load conditions

- Neutral state (A)

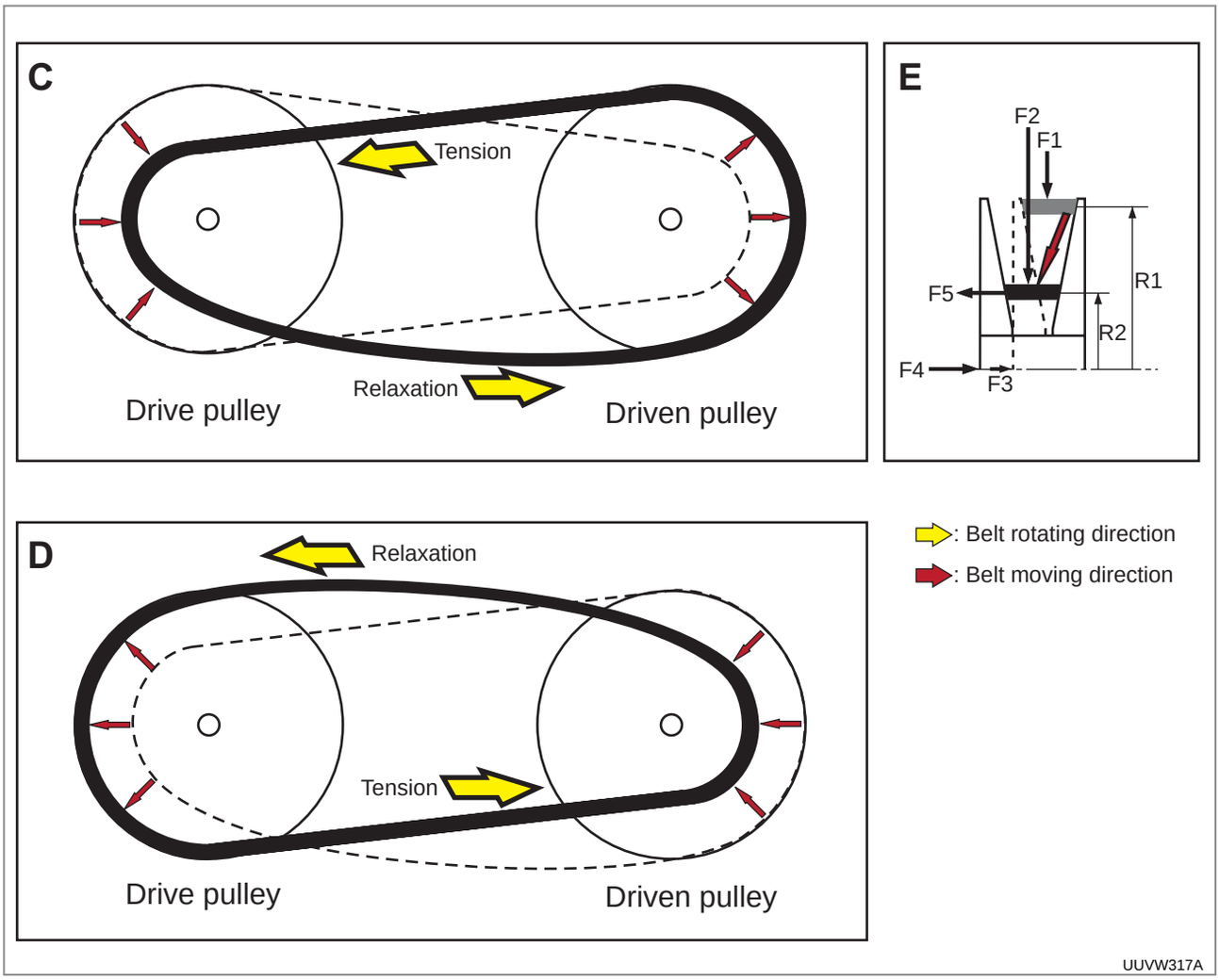
When the engine is running at a low speed below approx. 1300 RPM, the centrifugal force of the centrifugal pendulum (A1) attached to the flywheel of the engine cannot overcome the elastic force of the returning spring (A3). Then, the outer flange (A4) of the driving pulley is continued to be fully extended by the return spring(3) as shown in the figure and the belt (A5) does not contact with the flange of the pulley, resulting in no transmission of the engine power to the driven pulley.

- Engine starting (A)

When the engine speed is increased to a speed over approx. 1300 RPM, the centrifugal pendulum (A1) attached to the driving pulley moves outward pivoting from the hinge shaft (A6), pushing the roller (A7). Then, the reaction from this force moves the outer flange (A4) toward the inner flange (A8) and then the belt (A5) between the flanges is compressed, starting to run.

- Acceleration under no load (B)

When the engine speed is increased further, the centrifugal pendulum (B1) of the driving pulley moves outward further, the flanges on both sides become closer to each other and then the contact point of the belt and flange moves toward the circumference of the pulley. When the engine speed rises to approx. 2200 RPM, the flanges of the driving pulleys become very close to each other and the effective diameter of the belt on the driving pulley side becomes maximum. As the effective belt diameter on the driving pulley side increases and the belt is not extended, the effective belt diameter on the driven pulley side decreases inversely and the flanges on the driven pulley become farther from each other.



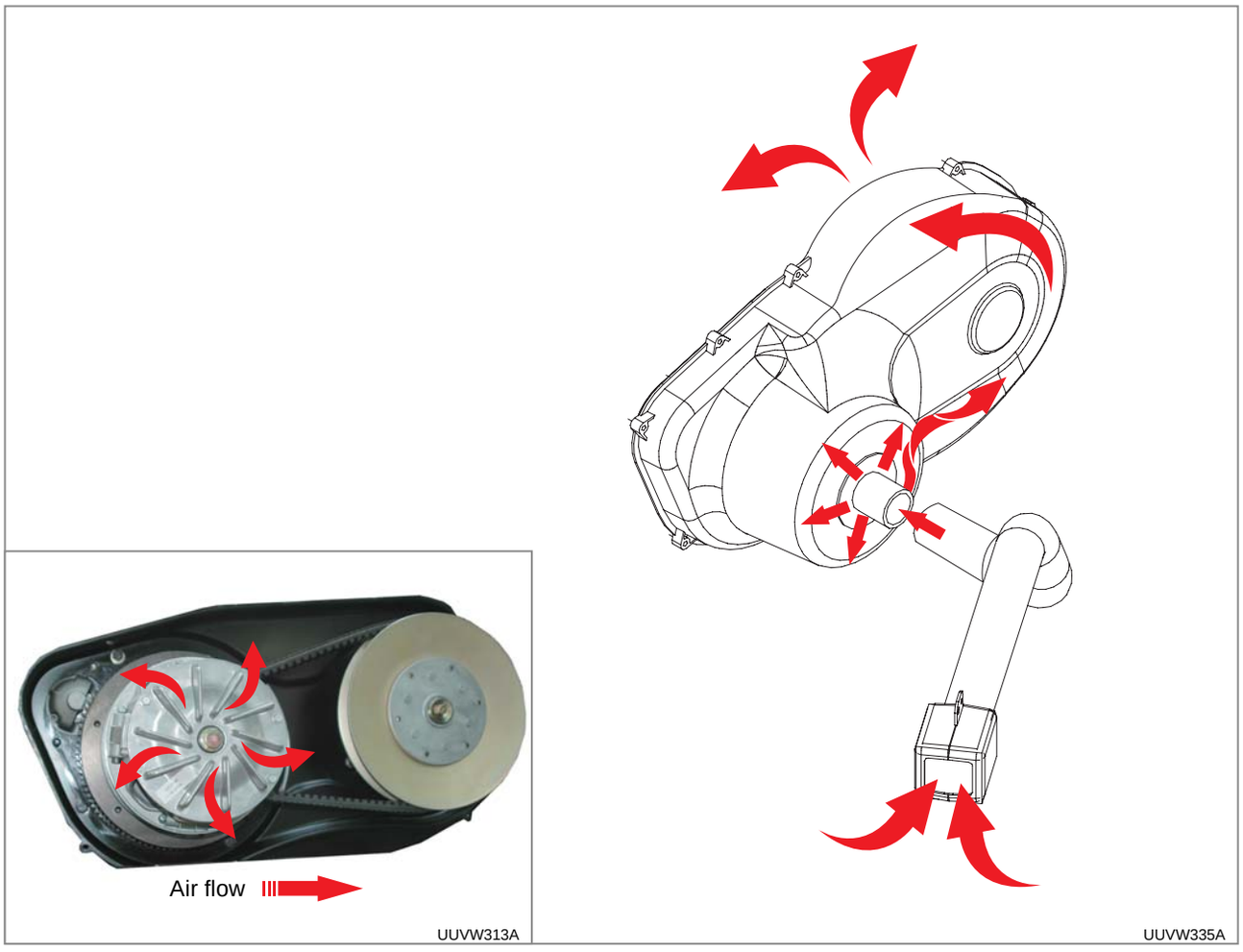
CVT operation under load (example: uphill road) - (C)

When the vehicle starts to drive uphill while driving on the level road with maximum speed, without load, the driven pulley attached to the drive shaft of the transmission has reaction not to turn. Then, as the belt rotates in the direction shown in the figure (C) with an arrow, the tension on the upper side of the belt is increased, affecting the driving pulley. The exploded view of the driving pulley is shown in the figure (E1). When the force of the belt to move toward the center of the pulley by the belt tension is increased from (F1) to (F2), the distance between the flanges of the pulley is increased and the effective diameter of the pulley is decreased from (R1) to (R2). In this state, the force of the pulley flanges to move toward each other by the centrifugal force (or spring force) is increased from (F3) to (F4). As (F4) is balanced with (F5), the horizontal force of (F2), the effective diameter of the belt is not reduced any more, resulting in all force in balance. On the other hand, the effective diameter of the driven pulley is increased as the free length of the belt is increased by reduction in the effective diameter of the driving pulley. As a result, the more the load increases, more the effective diameter of the driving pulley decreases and the more the effective diameter of the driven pulley increases, so this increases the reduction speed ratio, resulting in speed decrease and load resistance increase.

CVT operation under reverse load (example: downhill road) - (D)

When driving from an uphill to a downhill road, the load applied to the wheels is changed then the transmission and engine are driven by the wheels of vehicle. Then, the driven pulley tries to rotate faster than the driving pulley. Therefore, when the belt rotates in the direction shown in the figure (D), the tension on the upper side of the belt decreases and the tension on the lower side of the belt increases. Then, as the lower side of the belt with high tension moves toward the driven pulley, the effective diameter of the driven pulley is decreased as shown in the figure (E), so the effective diameter of the driving pulley is increased by the free length of the belt. As the effective diameter of the driving pulley is increased and the effective diameter of the driven pulley is decreased, this increases the speed ratio and creates driving conditions suitable for a high-speed and low-torque operation.

2.3 PRINCIPLE OF COOLING SYSTEM FOR CVT



The drive pulley is equipped with the cooling fan which rotates in the CVT case to draw ambient air in with the same principle of the centrifugal pump in order to discharge heat generated by friction between the belt and pulley.

As the centrifugal fan rotates and draws air, this air moves toward the end of the fan blades, i.e. toward the circumference of the fan.

Then, the negative pressure is generated on the center of the fan. As the air suction hose of the CVT case is located near the center of the fan as shown in the figure, this negative pressure makes the hose draw ambient air easier. This air cools the CVT pulley and belt and moves toward the driven pulley and outlet hole to be discharged.

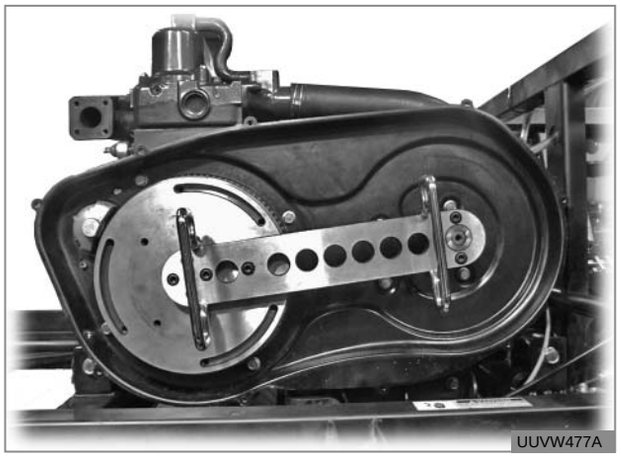
3. TROUBLESHOOTING

Symptom	Cause	Service
Abnormal noise from belt in CVT	• Cracked or abnormally worn belt • Changed distance between shafts	• Visually check and replace the belt. • Adjust it with the shaft dis tance setting jig again.
Slow acceleration / deceleration	• Faulty spring in pulley • Loose belt	• Replace the pulley. • Visually check and replace the belt.
Burning smell or smoke in CVT clutch cover	• Clogged CVT filter • Foreign material accumulated on CVT drive pulley cover fan blades	• Check, clean or replace the CVT filter. • Clean the area around the fan blades of the CVT drive pulley cover.
Max. speed is unachievable	• Worn belt	• Replace the belt (if it is below 25 mm).
Insufficient vehicle power	• Worn belt	• Replace the belt (if it is below 25 mm).
Vehicle cannot move	• Broken belt	• Replace the belt.
Vehicle rattles during acceleration or deceleration	• Insufficient lubrication to sliding parts in CVT pulley except belt and pulley surface	• Grease the part. (Such as roller,shaft,collar, etc.) ※Never grease the belt or inner surface of pulley

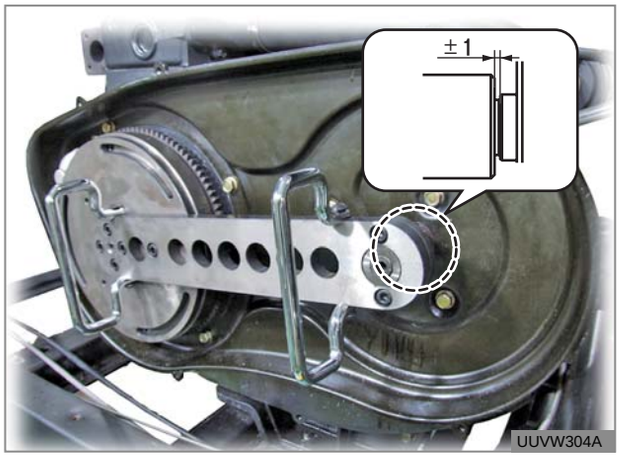
4. INSPECTION AND ADJUSTMENT

4.1 ADJUSTING DISTANCE BETWEEN SHAFTS FOR PULLEYS

When the distance between the shafts and offset values are uncertain during the inspection of the CVT or installation of the engine or gear box, perform the following procedures to measure the distance between shafts and offset value for the engine flywheel and gear box input shaft.



1. Fit the shaft alignment setting jig to the gear box input shaft and the engine flywheel.

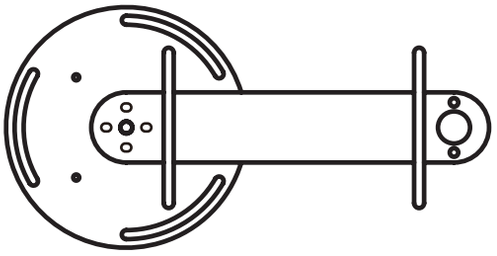


2. Measure the gap between jig and the step on the gear box input shaft as shown in the picture. The gap should be in ± 1mm (0.03937 in.).
3. If everything is OK, tighten the mounting bolts for engine of gear box as needed.
4. For detailed information about adjustment, refer to "5.2 CVT Assembly."

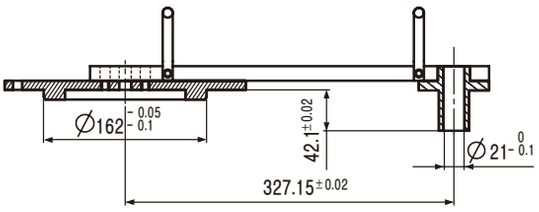
REMARK

- **Shafts & offset measuring jig (without adapter attached)**

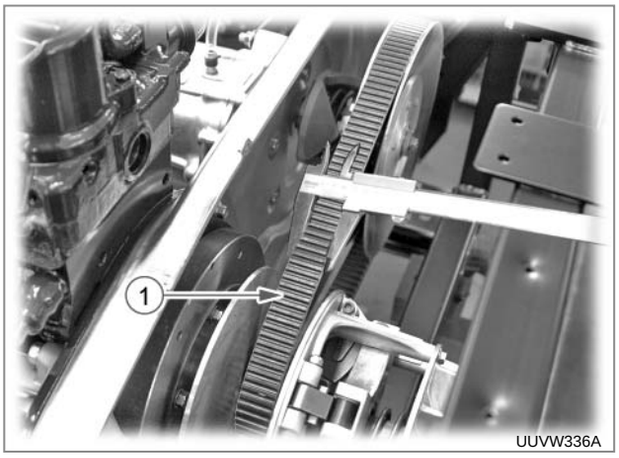
Part number : UCVT-P00



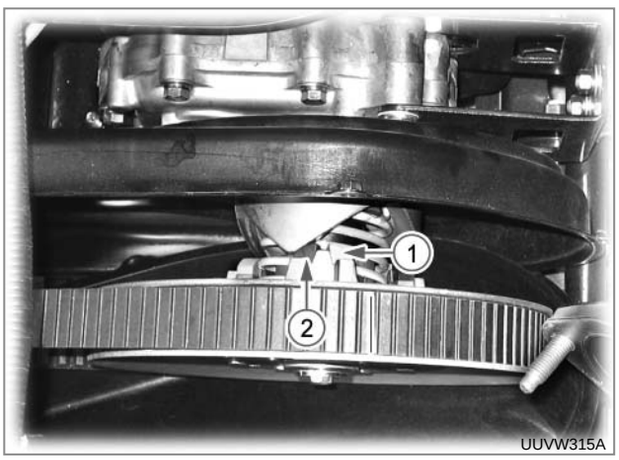
mm.



4.2 CHECK AND REPLACEMENT FOR CVT BELT



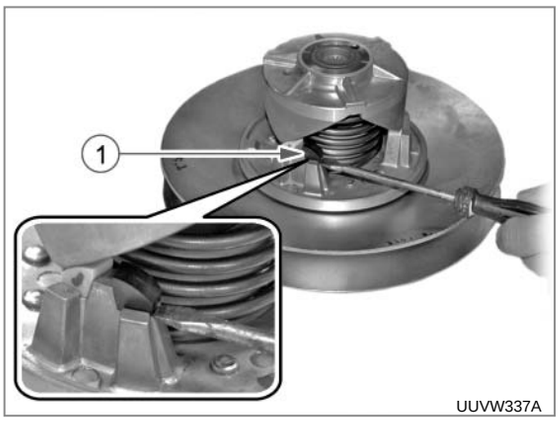
1. Measure the width of the CVT belt(1). Replace it with a new one if it has been used for more than 800 hours or its width is 1 in. (25mm) or less. For replacement, contact your distributor / Dealer.



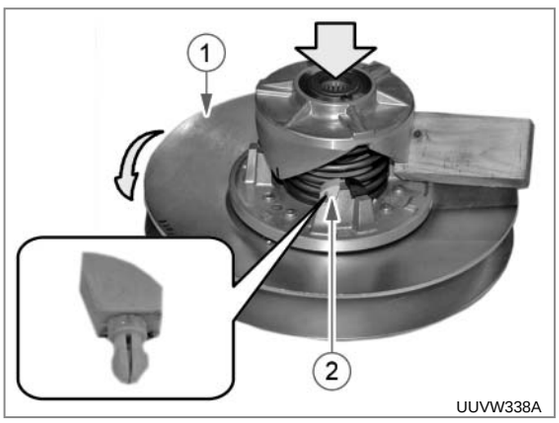
2. Check the CVT driven pulley clutch buttons (1 and 2) for wear. Replace them as necessary.

REMARK

How to change the clutch button



- Insert the tool having the flat end like "-" driver into the gap of the assembly line of clutch button(1) (for stopper: black) and then remove the clutch button upward. In this case, be careful not apply the force too much as the fixing part under the button may be broken.



- For friction (white) clutch button, turn the sliding flange(1) to expose the clutch button(2) while pressing the fixing flange downward and support the wooden block as shown in the picture above.(Recommended to work with a helper).

REMARK

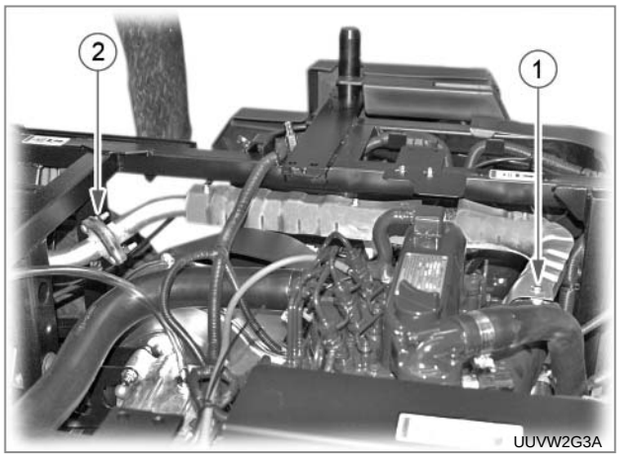
CVT speed reduction ratio

- **The width of a new belt is 29.5 mm (1.161 in.). Its max. speed reduction ratio is 3.55 while its max. speed acceleration ratio is 0.68. Assuming that its width is reduced to 1 in. due to wear, the max. speed reduction and acceleration ratio would be 3.22 and 0.76 respectively. Therefore, the maximun speed would be reduced by 10% and the max. torque at a low speed would be reduced by 9%.**

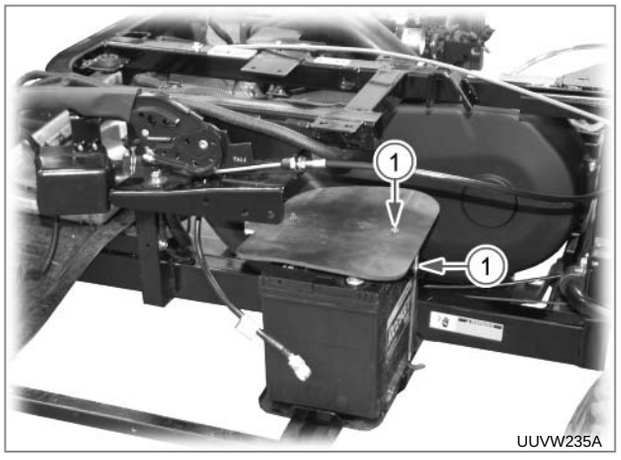
5. DISASSEMBLY, SERVICE AND ASSEMBLY

5.1 CVT DISASSEMBLY

1. Park the vehicle on level ground, apply the parking brake and stop the engine.
2. Lift the rear cargo bed and support it with the support.

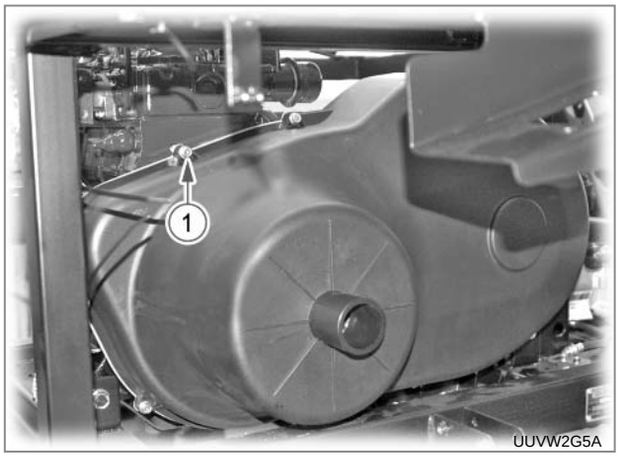


3. Unscrew the heat shield mounting bolts (1) (M6, 4 EA) to remove the heat shield. Then, unscrew the muffler pipe mounting bolts (M8, 4 EA) and muffler pipe mounting nuts (2) (M10, 2 EA) to remove the muffler pipe using 10 mm and 14 mm spanners.

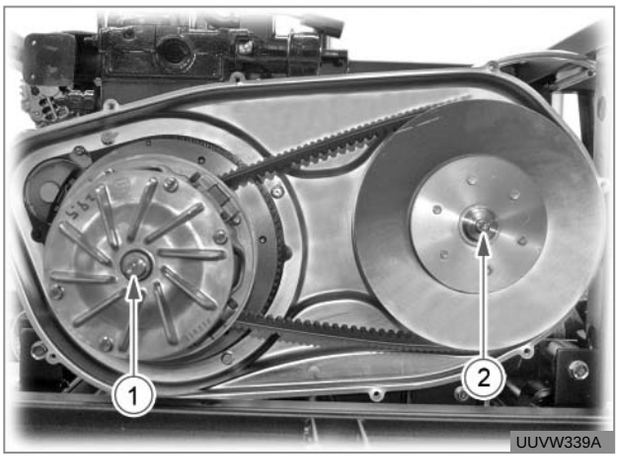


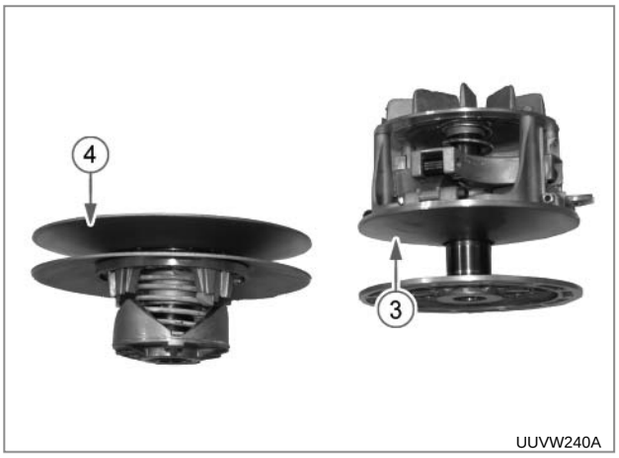
4. Unscrew the battery mounting nuts (1) to remove the battery.

5. Undo the clamps for the CVT case intake hose (1) and disconnect the intake hose.



6. Unscrew the CVT case cover mounting bolts (1) (M6, 9 EA) to remove the CVT case cover.





7. Unscrew the CVT drive pulley mounting bolt (1) and CVT driven pulley mounting bolt (2) and fit the removal tool into the CVT drive pulley bolt hole. Then, turn the tool to remove the CVT drive pulley (3) and belt, and leverage the CVT driven pulley (4) to remove it.

CVT drive pulley mounting bolt tightening torque ..... 54 Nm
5.5 kgf-m
40 lb-ft

CVT driven pulley mounting bolt tightening torque ..... 24.5 Nm
2.5 kgf-m
18.0 lb-ft

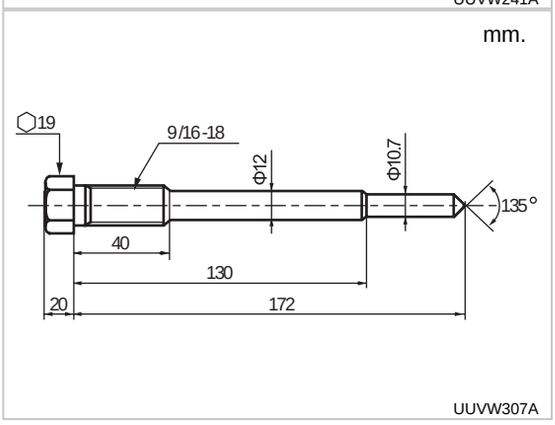
IMPORTANT

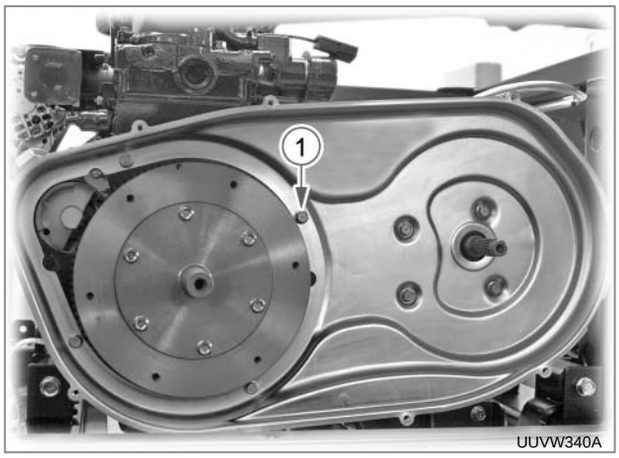
- **Apply LOCTITE #242 or equivalent to the mounting bolts of CVT drive and driven pulleys before installing them.**

REMARK

• REMOVAL TOOL FOR CVT DRIVE PULLEY

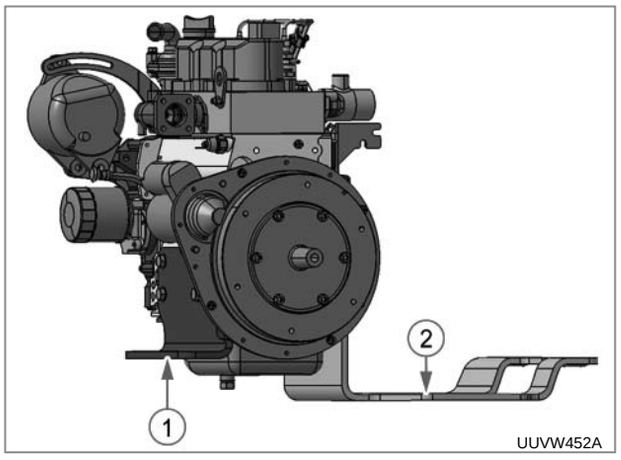
Part number : UCVT-P10



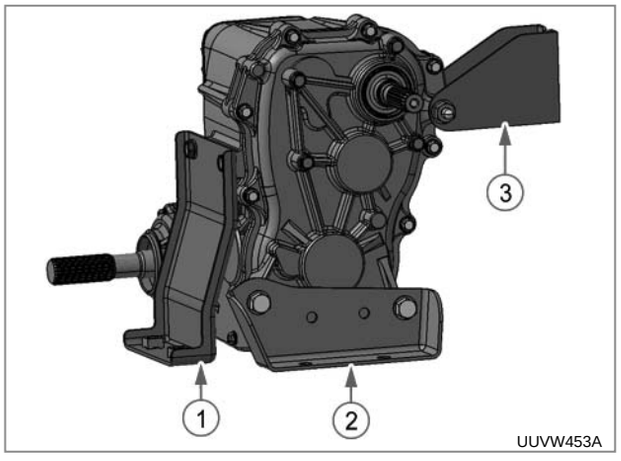


8. Unscrew the CVT internal case mounting bolts (1) (M8, 8 EA) using a 13 mm box wrench and remove the CVT internal case (2).

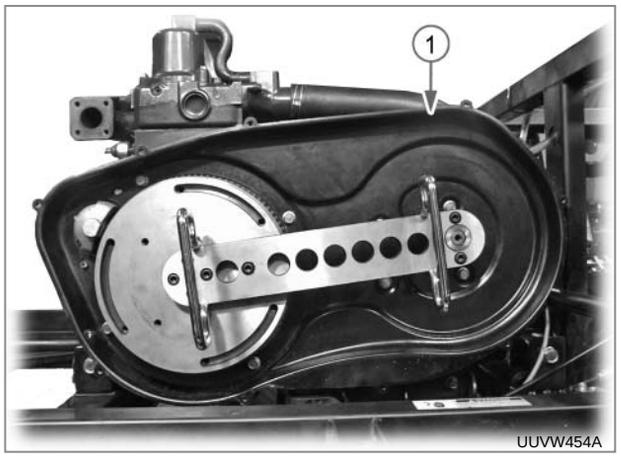
5.2 CVT ASSEMBLY



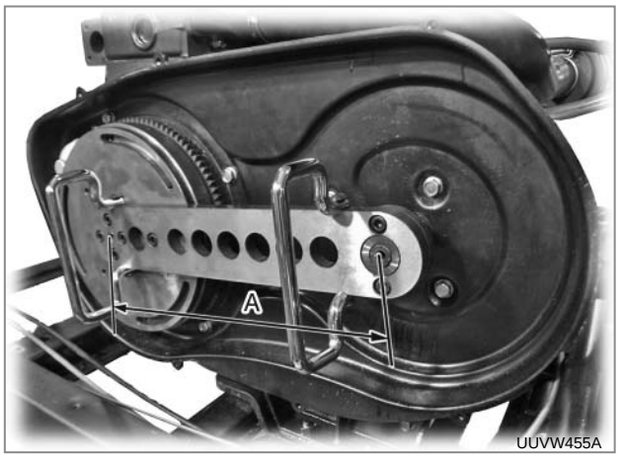
1. Loosen the body mounting bolts of the engine front bracket (1) and engine rear bracket (2).



2. Loosen the mounting bolts of the front mounting bracket (1), side mounting bracket (2) and rear mounting bracket (3) to the CVT assembly.

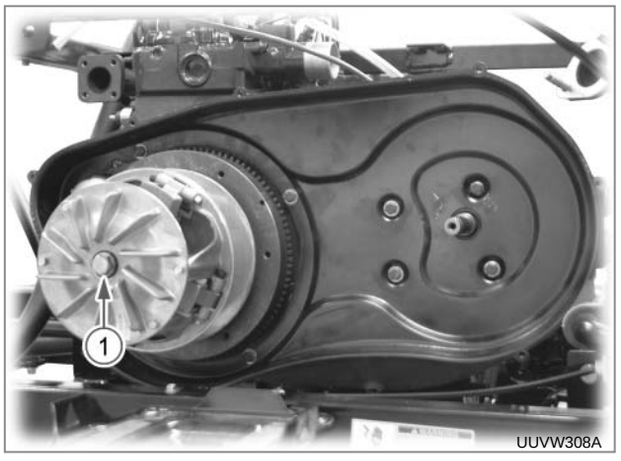


3. Tighten the CVT internal case(1) bolt temporarily and fit the shafts & offset measuring jig to the both shafts.



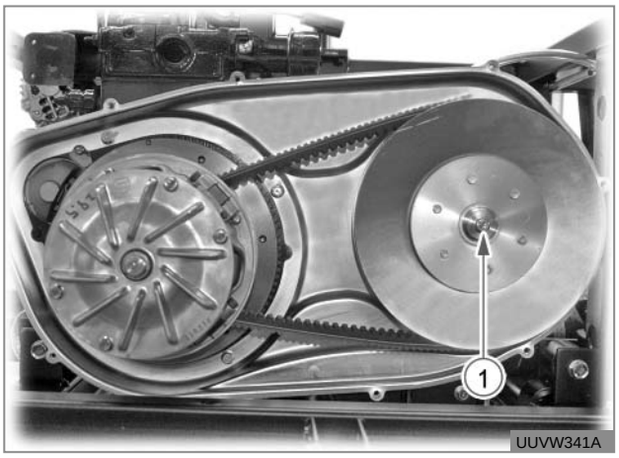
4. Tighten the mounting bolts for the gear box and engine bracket as well as the 8 inner cover mounting bolts. Then, remove the shafts & offset jig. The jig should be removed easily. Otherwise, fit and set the jig to measure the distance again and adjust the mounting location as necessary.

Distance between shafts A: 327 mm (12.88 in)
Engine mounting bolt & gear box(transmission) bolt (M10)
tightening torque ..... 60.9 ~ 70.6 Nm
6.2 ~ 7.2 kgf-m
44.9 ~ 52.0 lb-ft



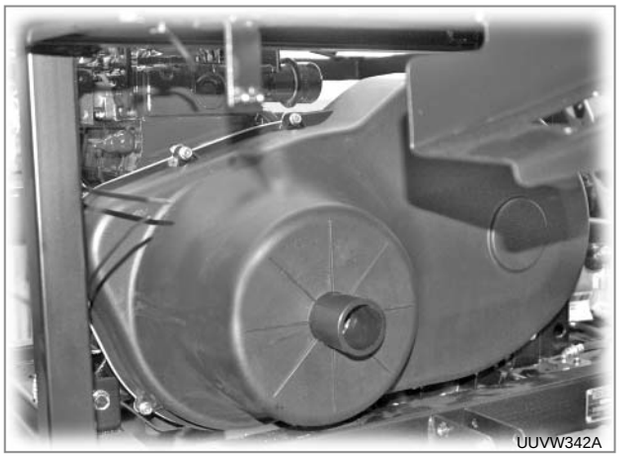
5. Apply LOCTITE #242 or equivalent to the mounting bolt (1) of the CVT drive pulley and tighten it completely.

Drive pulley mounting bolt (1)
tightening torque..... 54.0 Nm
5.5 kgf-m
40.0 lb-ft



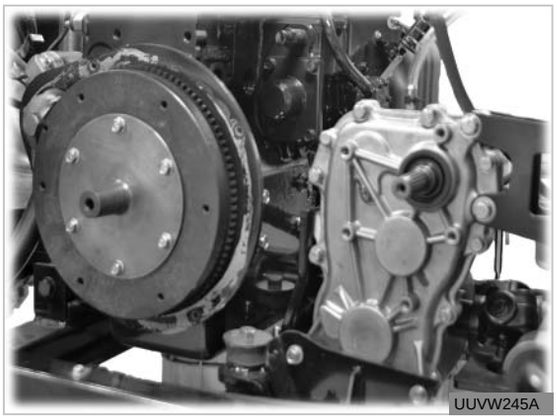
6. Apply LOCTITE #242 or equivalent to the driven pulley mounting bolt and tighten it completely.

Driven pulley mounting bolt (1)
tightening torque .....24.5 Nm
2.5 kgf-m
18.0 lb-ft



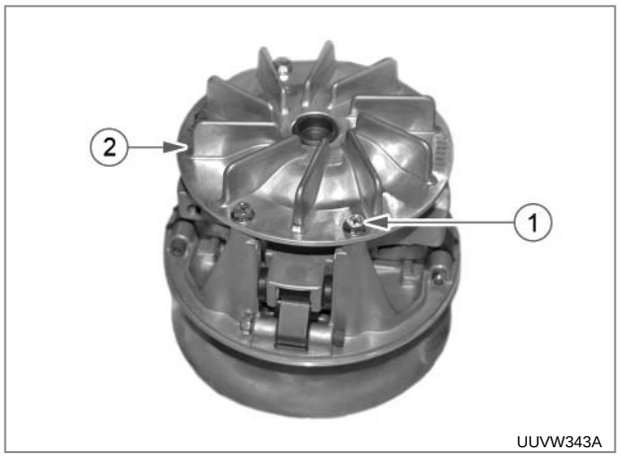
7. Install the outer CVT cover and tighten its mounting bolt.
8. Make sure that all mounting bolts for the engine and CVT are installed properly.

⚠ CAUTION

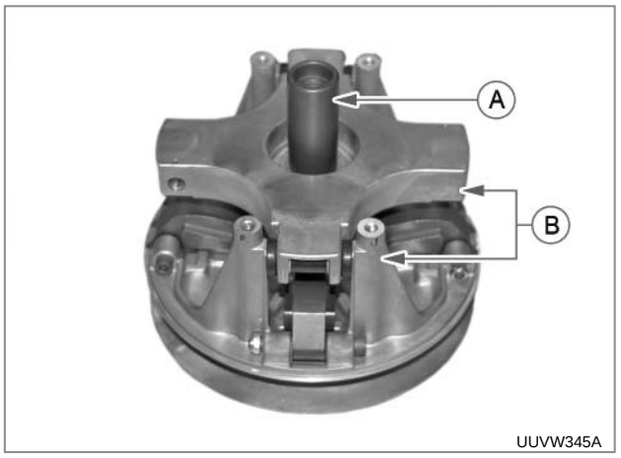


- **When installing the internal CVT cover, remove any Three Bond residual from the mating surface behind the flywheel and apply a sufficient amount of Three Bond 1206D or equivalent to the cover surface before installation to prevent leakage.**

5.3 DRIVE PULLEY ASSEMBLY COMPONENTS DISASSEMBLY AND ASSEMBLY



UUVW343A



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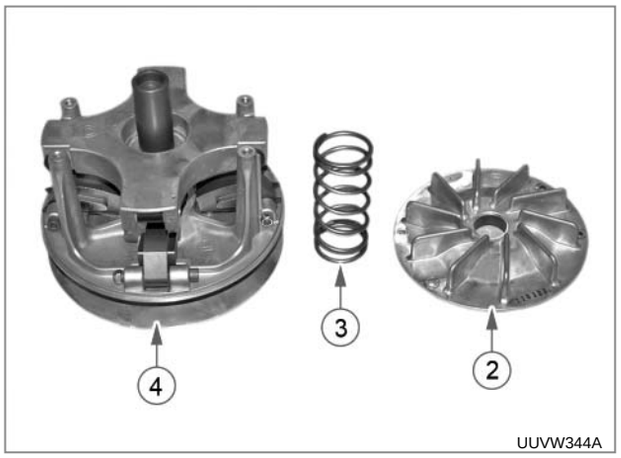
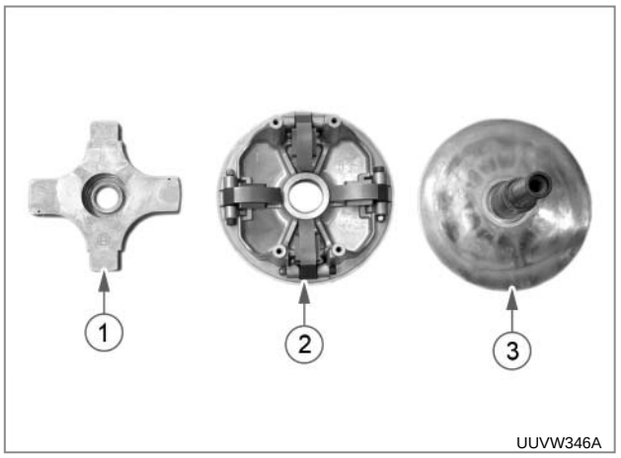


UUVW344A



UUVW346A

1. Unscrew the impeller cover fixing bolt(1) of drive pulley assembly to disassemble the impeller cover(2), pulley body(4) and spring(3).

Fixing bolt

Tightening torque .....8.4 ~ 10.8 Nm
86 ~ 110 kgf-cm
6.2 ~ 7.9 lb-ft

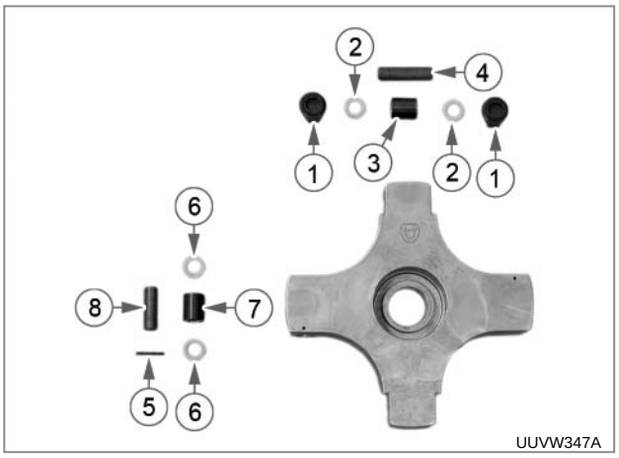
⚠ CAUTION

- **When disassembling the drive pulley assembly, the impeller cover can be pushed up by its internal spring with strong force and you can get injured.**

2. Fix the shaft (A) of fixing pulley assembly and turn the spider assembly part (B) to remove and then remove the spider assembly(1), sliding pulley assembly(2), and fixing pulley assembly(3) in order.

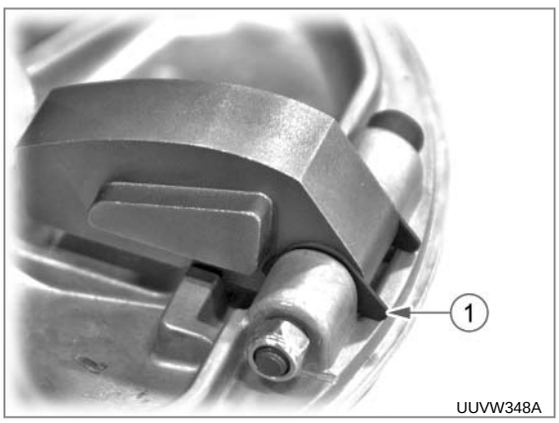
Spider assembly

Tightening torque .....147.0 ~ 166.6 Nm
1500 ~ 1700 kgf-cm
108.0 ~ 122.4 lb-ft

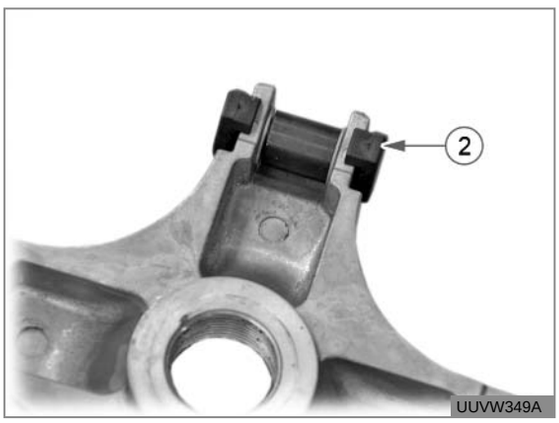


3. Remove the upper and lower covers (1) from the spider assembly, and remove the washers (2), spacer (3) and pin (4) in order. Then, remove the spring pin (5) from its left and right side and remove the washers (6), spacer (7) and pin (8) in order.

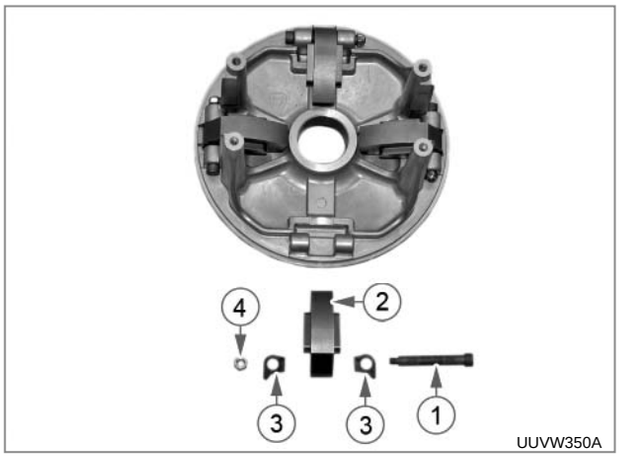
REMARK



- **When reassembling the spider assembly, make sure to set its thrusting part faces downward.**

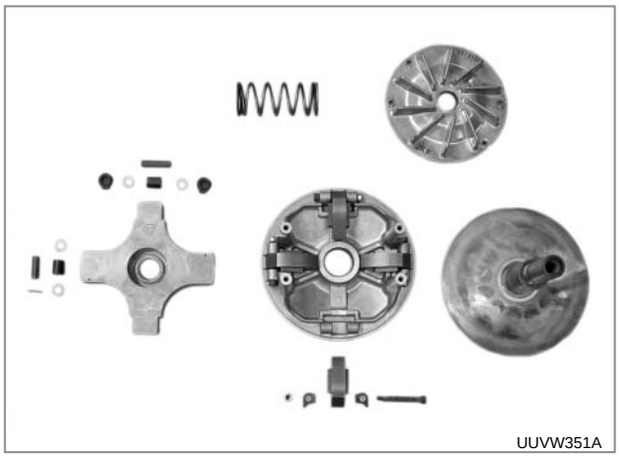


- **The left and right covers (2) should be installed with their protrusive area contacting with the slot on the lower side of the spider body.**



4. Unscrew the centrifugal lever fixing bolt(1) from sliding pulley assembly and remove the centrifugal lever(2), thrust washer(3) and lock nut(4).

Lock nut
tightening torque .....3.9 ~ 5.9 Nm
40 ~ 60 kgf-cm
2.9 ~ 4.3 lb-ft



5. Assemble in the reverse order of disassembly.

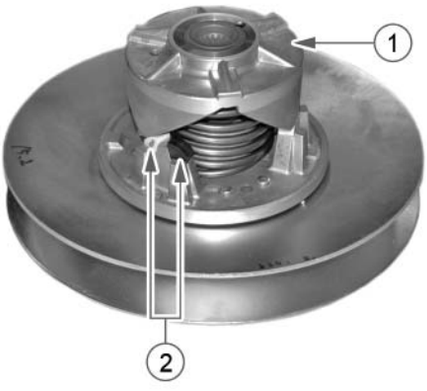
IMPORTANT

- **When reassembling the sliding frange assembly, fit it to its original position with the centrifugal lever assembled in order to maintain the rotating balance of whole drive pulley assembly.**

⚠ CAUTION

1. When reassembling the drive pulley assembly (driving part CVT assembly), tighten the impeller cover bolt to the diagonal direction gradually by turns.
2. Apply the adhesive equivalent LOCTITE #271 to the following screw thread.
   - **Impeller cover mounting bolt**
   - **The shaft of fixing pulley assembly and the attaching area of spider assembly**
   - **Centrifugal lever lock nut**
3. After disassembling the lock nut of centrifugal lever, you should replace it with new one to assemble.

5.4 DRIVEN PULLEY ASSEMBLY COMPONENTS DISASSEMBLY AND ASSEMBLY



UUVW352A

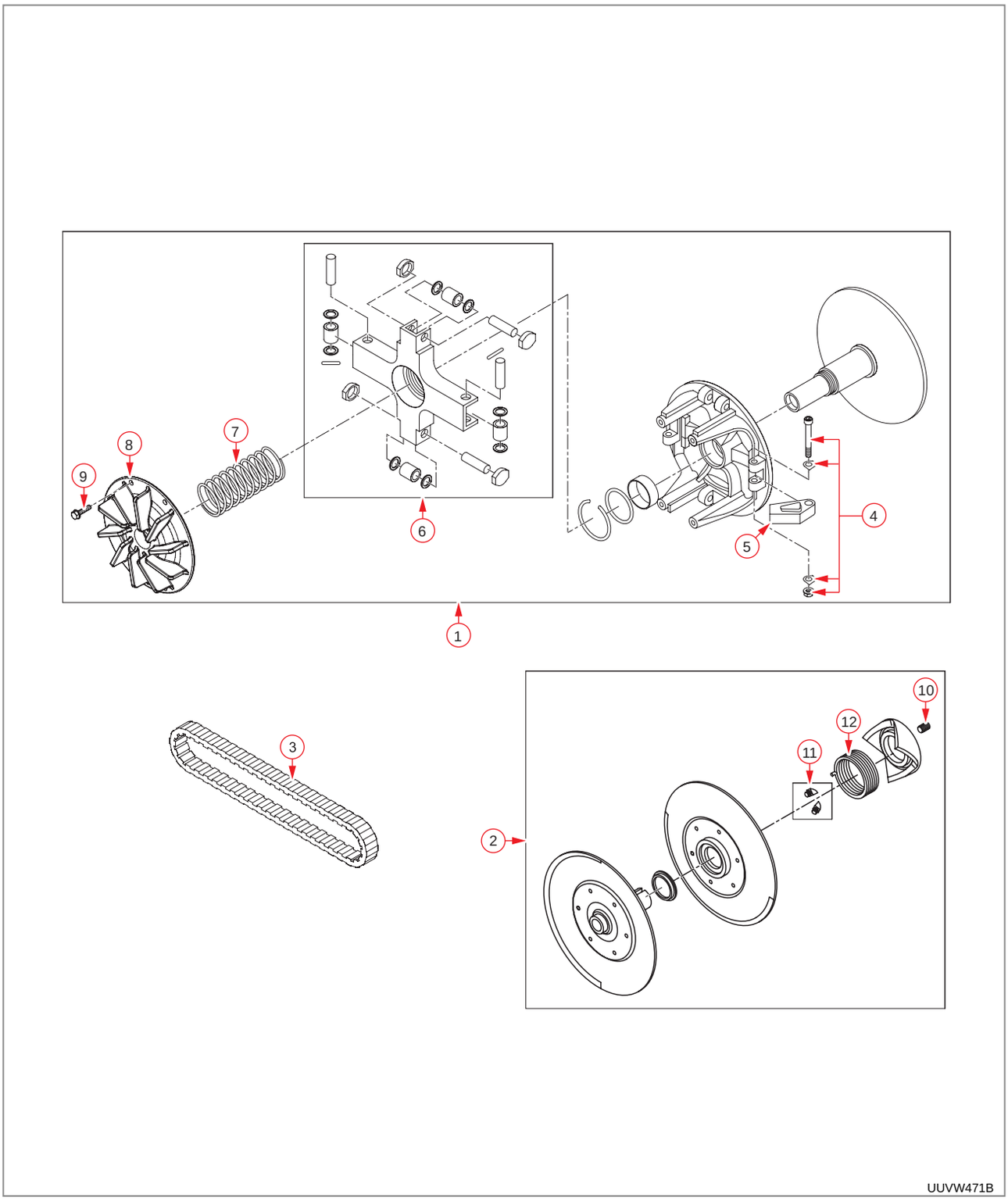
1. As the cam block (1) of the driven pulley is pressed into the mounting flange, the driven pulley cannot be disassembled. If its malfunction or damage is found, the whole driven pulley assembly should be replaced.

REMARK

- **If the clutch button (2) is worn, replace it. Refer to "How to change the clutch button" in section 4.2.**

6. COMPONENTS FOR CVT

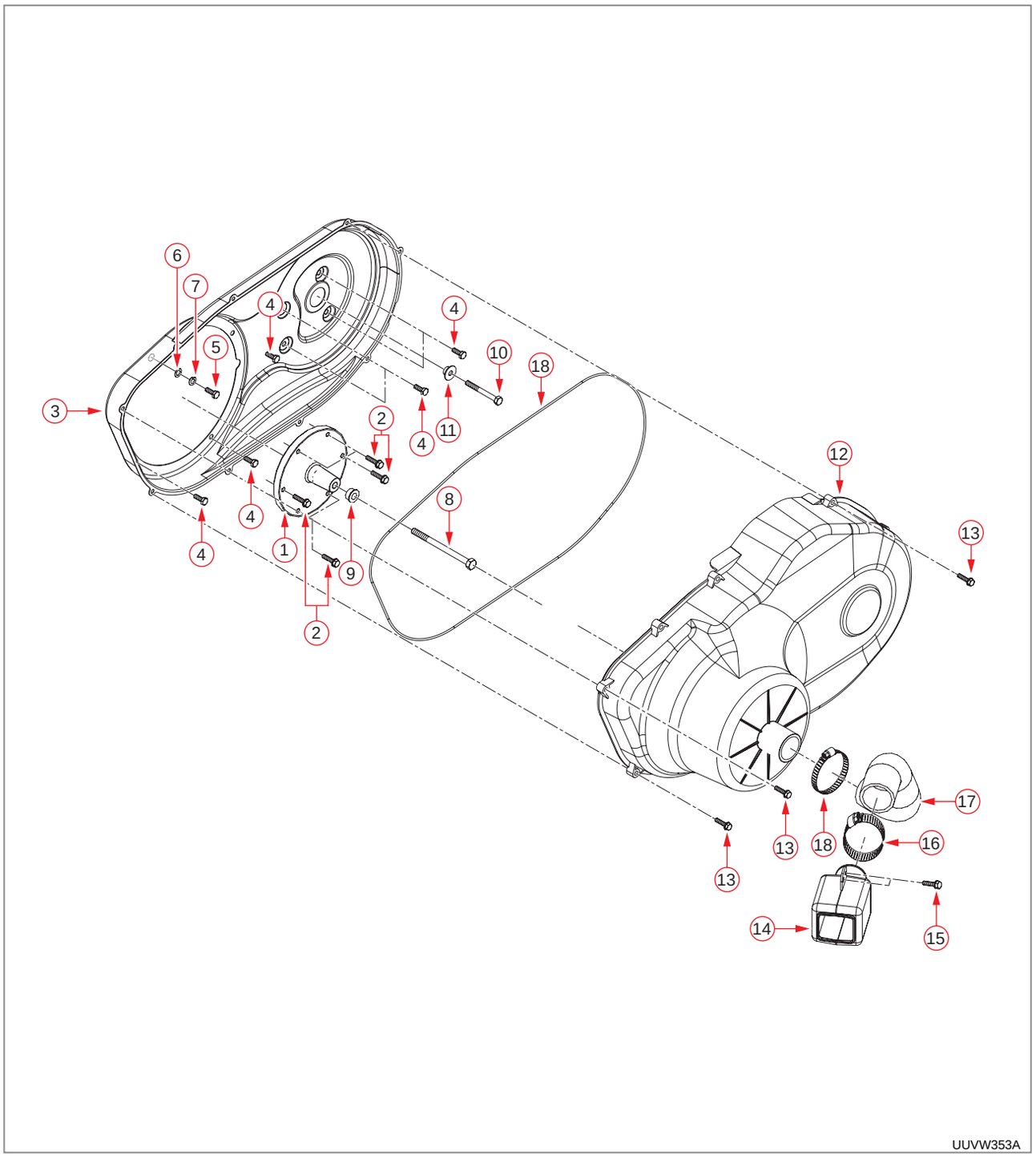
6.1 U060A CVT



COMPONENTS

(1) CVT, PRIMARY
(2) CVT, SECONDARY
(3) BELT, DRIVE
(4) BOLT
(5) ARM. CAM
(6) SPIDER KIT
(7) FRICTION SPRING
(8) FAN
(9) SCREW
(10) SCREW, SET
(11) BUTTON KIT
(12) SPRING

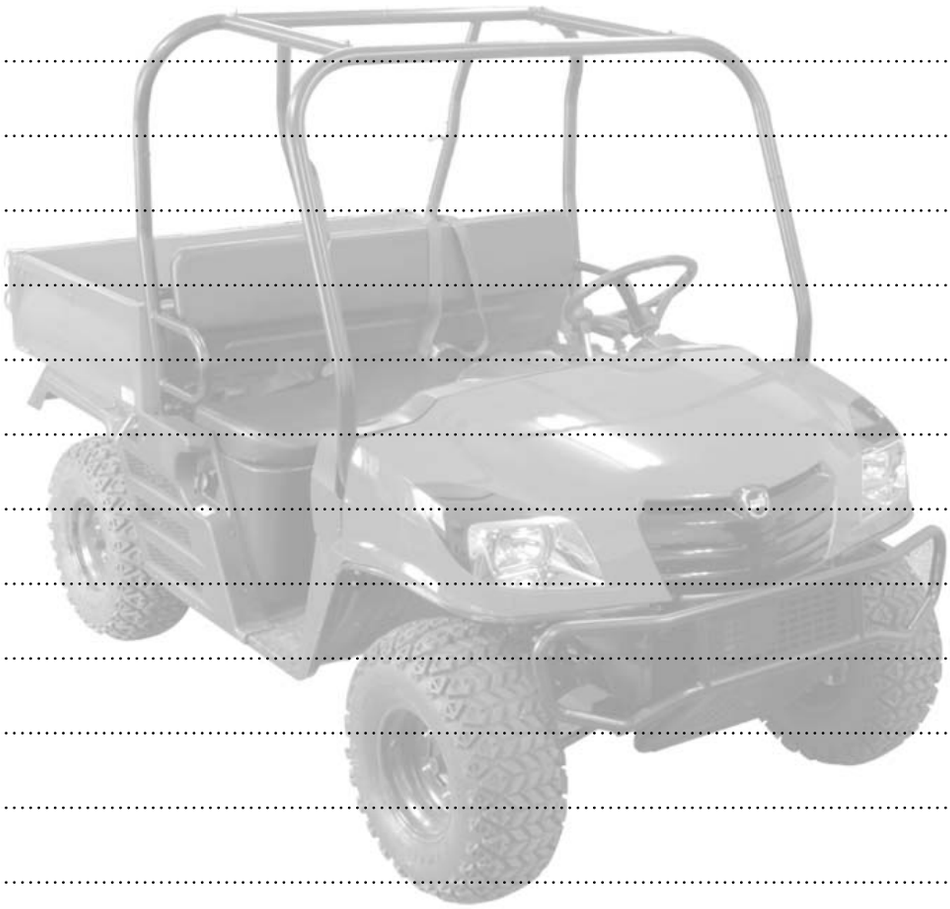
6.2 U0287A CLUTCH COVER



COMPONENTS

(1) ADAPTOR, CVT DRIVE
(2) BOLT, FLANGE
(3) CLUTCH COVER ASSY - INNER
(4) BOLT, FLANGE
(5) BOLT
(6) WASHER, PLAIN
(7) WASHER, SPRING
(8) BOLT, CVT DRIVE
(9) PLUG
(10) BOLT
(11) WASHER
(12) OUTER
(13) BOLT, FLANGE
(14) AIR BAFFLING BOX ASSY
(15) BOLT, FLANGE
(16) CLMAP, HOSE
(17) HOSE, CVT IN
(18) GASKET, CVT COVER

MEMO



TRANSMISSION CHAPTER 5

TABLE OF CONTENTS

1. SPECIFICATIONS

1.1 GENERAL SPECIFICATIONS

Item	Specification
Gears	Low speed, high speed, neutral and reverse
Transmission fluid	0.9 ℓ / 0.24 u.s gal SAE gear oil #90 or DAEDONG UTF55 Shell Donax -TD Exxonmobil Mobilfluid 423 or 424 BP Tractran UTH
Rotating ratio for front/rear wheels	1.008 / 1
Speed for each gear	See tables for forward/reverse driving speeds in chapter 1.
Front wheel drive type	Lever operated, mechanical
Brake	Hydraulic dry caliper discs (FRT/RR)

REMARK

- **Rotating ratio between front and rear wheels on high-speed forward driving**

Rear wheel rotating ratio: $\frac{31}{30} \times \frac{46}{52} \times \frac{10}{31} \times \frac{10}{37} = 0.079695$

Front wheel rotating ratio: $\frac{31}{30} \times \frac{46}{52} \times \frac{22}{19} \times \frac{10}{31} \times \frac{8}{34} = 0.080336$

1.2 TIGHTENING TORQUE

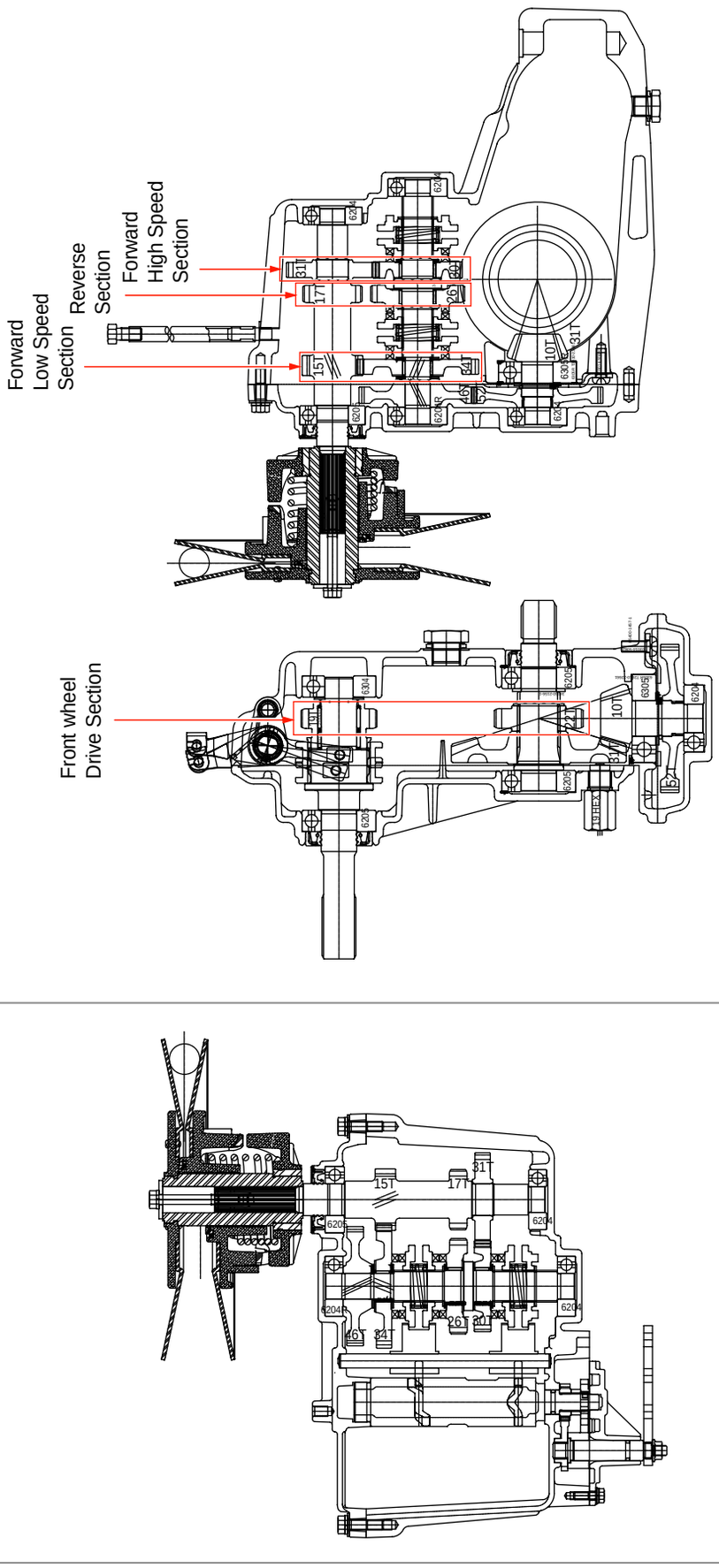
Position	Specification	Tightening torque
Bearing holder for 10 spiral bevel pinion shaft	Screw (M8)	7.8 ~ 15.7 Nm 0.8 ~ 1.6 kgf-m 5.8 ~ 11.5 lb-ft
Transmission case cover	Bolt (M8)	17.6 ~ 20. 6 Nm 1.8 ~ 2.1 kgf-m 13.0 ~ 15.1 lb-ft

1.3 SEALANT AND ADHESIVE

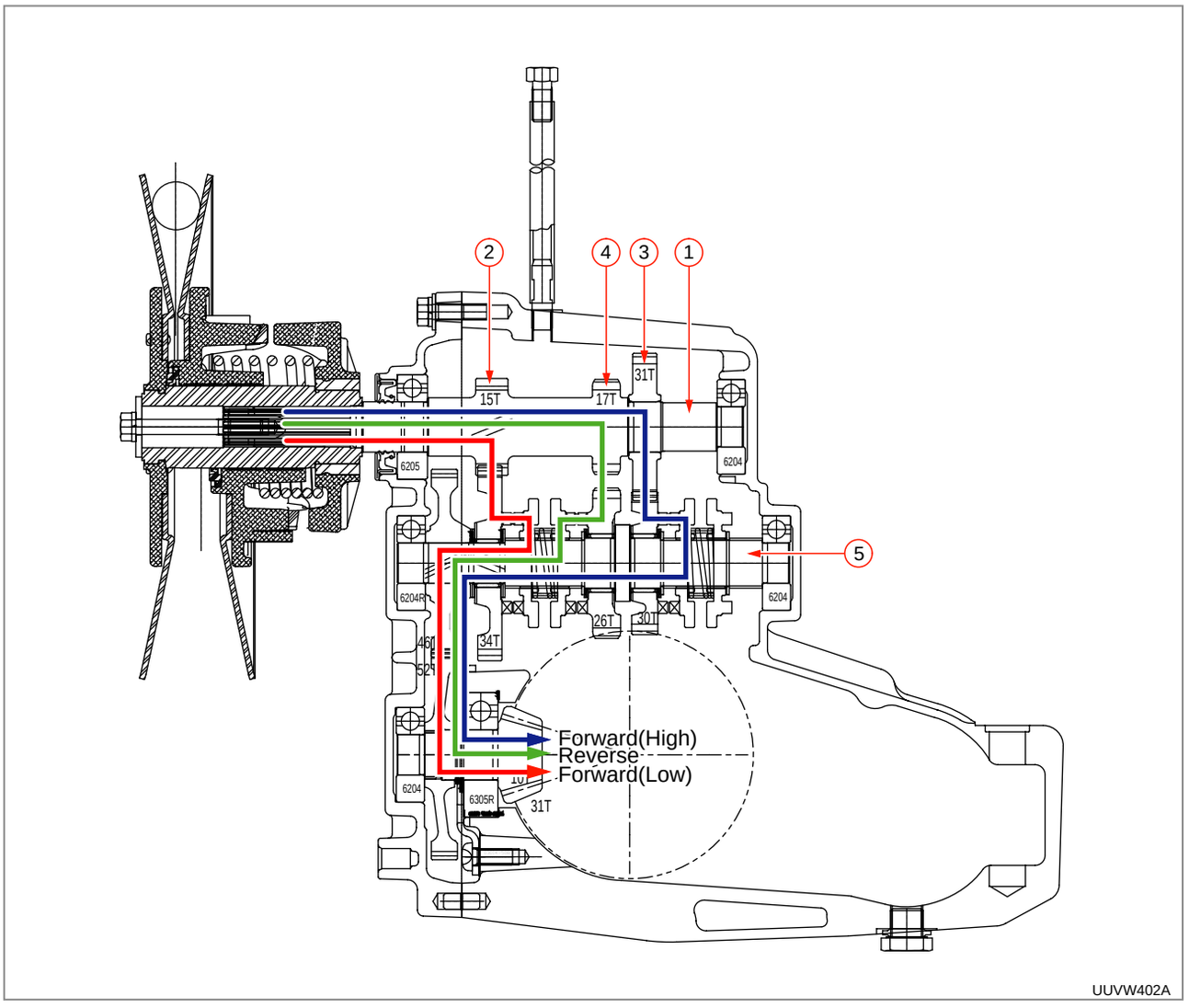
Applied position	Purpose	Specification
Bearing holder mounting screw for 10 spiral bevel pinion shaft	Prevention of looseness	LOCTITE #242 or equivalent
Mating surface of transmission case and cover	Prevention of oil leakage	Three Bond 1206D or equivalent
Mating surface of transmission case and front wheel drive cover	Prevention of oil leakage	Three Bond 1206D or equivalent
Mating surface of transmission case and shift cover	Prevention of oil leakage	Three Bond 1206D or equivalent

2. STRUCTURE AND OPERATING PRINCIPLE

2.1 TRANSMISSION STRUCTURE



2.2 SPEED CONTROL SYSTEM



The shaft 1 (1), which is the CVT driven shaft, is equipped with and rotates with the 15 gear (2), 17 sprocket (4) and 31 gear (3). These gears rotate engaging with the 34 gear, 26 sprocket and 30 gear which are equipped to the shaft 2 (5) that is the countershaft of the shaft 1.

However, the gears or sprocket of the shaft 2 do not transfer power in the neutral state as they slide on the needle bearing.

When the low-speed gear is connected, the 34 gear of the shaft 2 is bound to the shaft by the dog type fork and the low-speed is achieved by the 15 gear of the shaft 1 and the 34 gear of the shaft 2. The high-speed is achieved by the 31 gear of the shaft 1 and the 30 gear of the shaft 2. For reverse driving, as the 17 sprocket of the shaft 1 and the 26 sprocket of the shaft 2 are connected by the silence chain, the rotating direction of the shaft 2 becomes reverse to the one when the gear is engaged to achieve the reverse driving.

LOW-SPEED FORWARD DRIVING

Shaft 1 (driven shaft) → 15 gear → 34 gear → Dog clutch → Shaft 2 → 46 gear → 52 gear → 10 bevel pinion shaft → 31 bevel gear

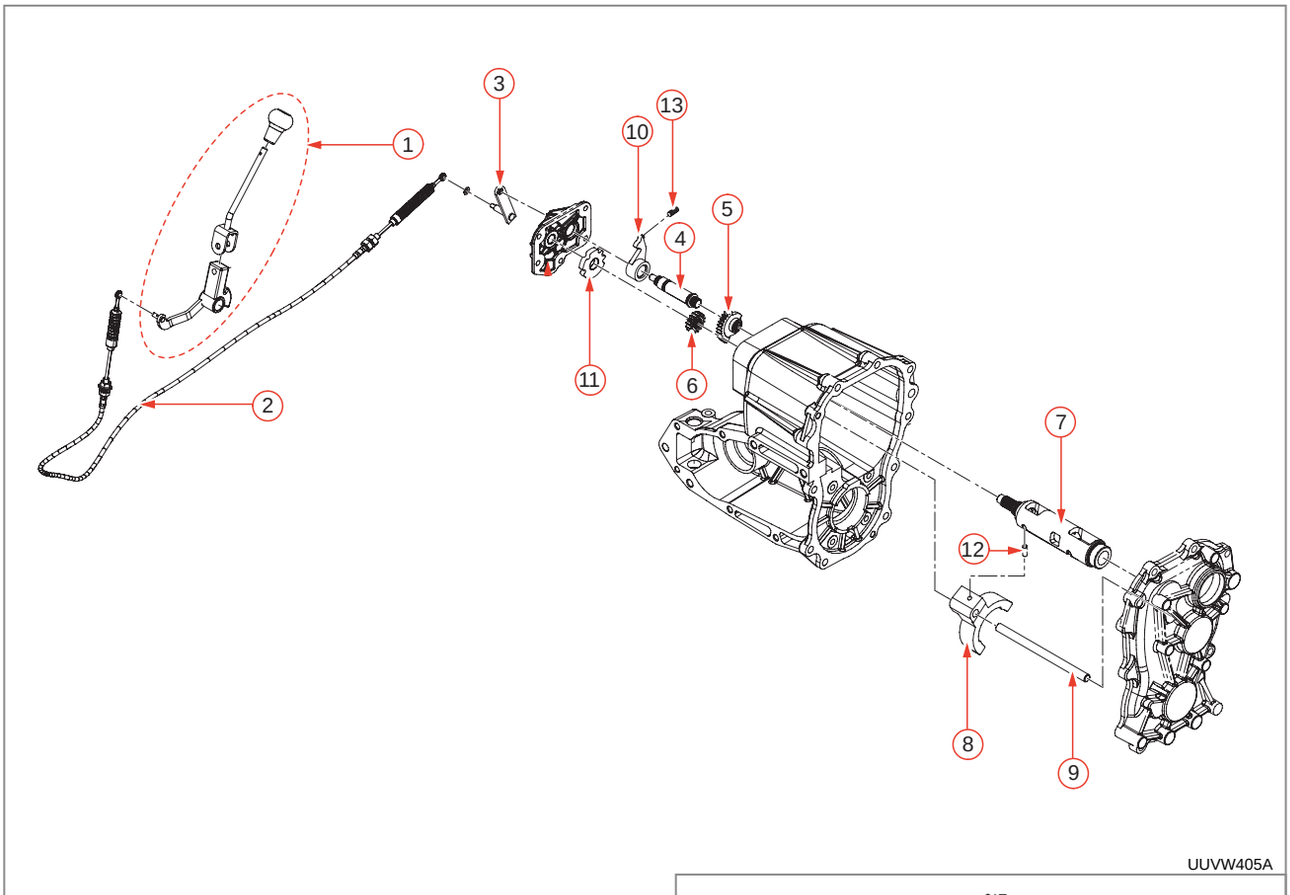
HIGH-SPEED FORWARD DRIVING

Shaft 1 (driven shaft) → 31 gear → 30 gear → Dog clutch → Shaft 2 → 46 gear → 52 gear → 10 bevel pinion shaft → 31 bevel gear

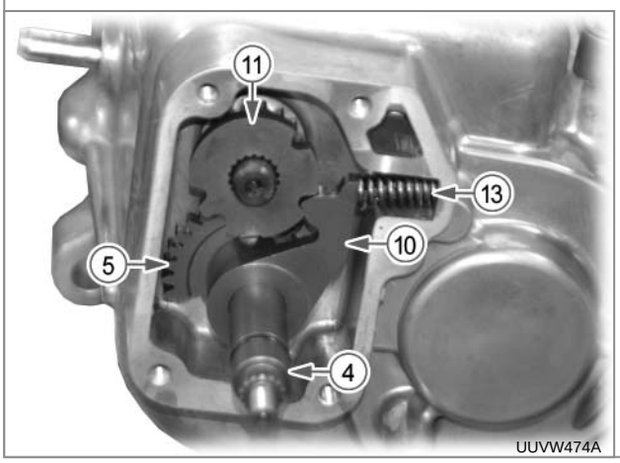
REVERSE DRIVING

Shaft 1 (driven shaft) → 17 sprocket → 26 sprocket → Dog clutch → Shaft 2 → 46 gear → 52 gear → 10 bevel pinion shaft → 31 bevel gear

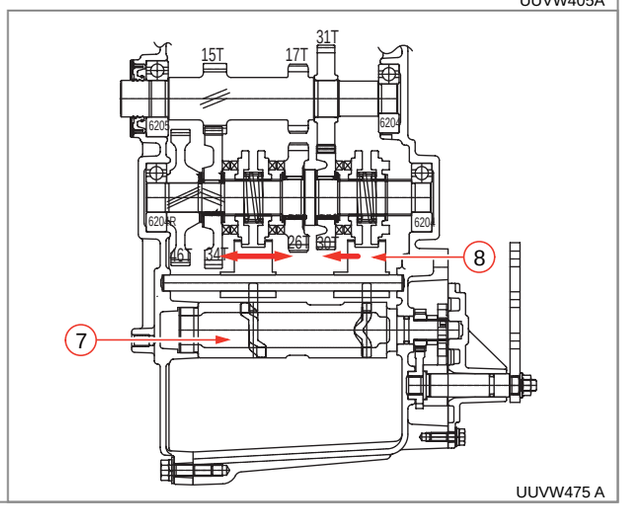
2.3 SHIFT SYSTEM



UUVW405A



UUVW474A

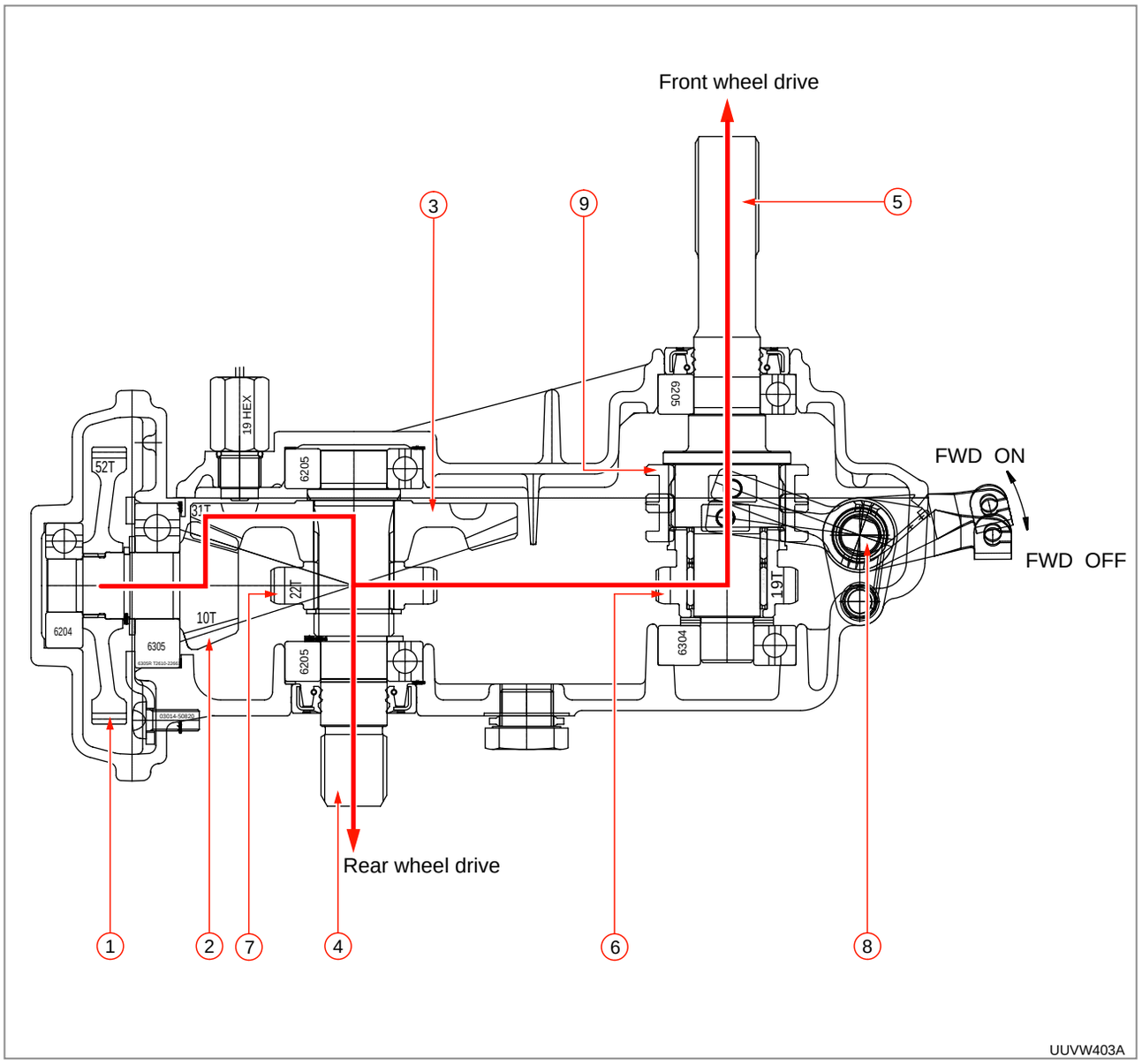


UUVW475 A

The shift system of this transmission is equipped with the fork rod (9) and shift drum (7). When the shift lever (1) is moved, shift arm (3) and shift arm shaft (4) are rotated by the cable (2) and the 13 gear (half-moon shaped) (5) at the end of the shift arm shaft rotates the 16 gear (6) installed to the end of the shift drum to rotate the shift drum. The fork 1 and 2 (8) are designed to slide on the fork rod. Each fork is equipped with the fork pin (12) which is bound to the groove of the shift drum. As the shift drum rotates, the fork pin fixed to the groove of the shift drum moves left or right and the fork slides on the fork rod to shift the gear.

The detent disc (11) is installed to the splined section at the end of the shift drum while the detent arm (10) is designed to pivot on the shift arm shaft as a hinge point. The detent arm is supported by the detent spring (13) and its protrusion is to be fit to the groove of the detent disc. Therefore, the turning angle of the shift drum is restricted by the detent disc so each gear can be maintained securely without being disengaged.

2.4 WHEEL DRIVE SYSTEM



The 46 gear is installed to the countershaft (shaft 2) of the speed control system and it drives the 52 gear (1) which then drives the 31 bevel gear (3) through the 10 spiral bevel pinion (2) in order to drive the rear axle drive shaft (4). The spiral bevel pinion and bevel gear are equipped in order to change the angle of shaft by 90˚.

The front axle drive shaft (5) receives power from the rear axle drive shaft (4) through the silence chain. Unlike the 22 sprocket (7) of the rear axle drive shaft, the 19 sprocket (6) of the front axle drive shaft (5) slides on the needle bearing and no power is delivered before the front wheel drive is activated. When the front wheel drive lever is shifted, the front wheel drive shift arm (8) moves the fork (9) to engage the front wheel drive shaft and 19 sprocket in order to transfer power to the front wheels.

FRONT WHEEL DRIVE

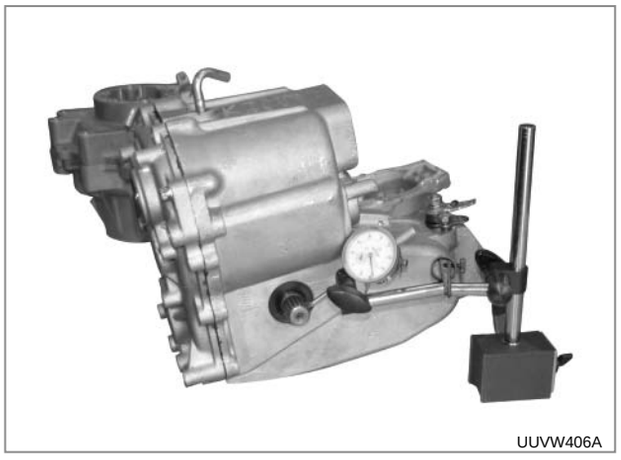
52 gear → 10 bevel pinion shaft → 31 bevel gear → Rear wheel drive shaft → 22 sprocket → 19 sprocket → Front wheel drive shaft

3. TROUBLESHOOTING

Symptom	Cause	Service
Oil leakage	• Excessive oil • Loose bolt • Damaged oil seal, O-ring or gasket • Cracked transmission housing	• Adjust the oil level. • Retighten the bolt. • Replace the damaged parts. • Replace the damaged parts.
Abnormal noise	• Insufficient oil • Improper gear backlash • Worn gear • Worn bearing • Improper gear engagement • Damaged silence chain	• Add oil. • Adjust the backlash or replace the related part. • Replace • Replace • Replace (It's not serviceable)
Gear disengaged	• Worn or bent shift fork • Loose detent spring	• Replace • Replace
Difficult gear shift	• Loose or improperly adjusted cable • Worn or bent shift fork or shift arm • Worn or deformed shift lever	• Adjust or replace the cable. • Repair or replace the related parts. • Replace the shift lever.

4. INSPECTION AND ADJUSTMENT

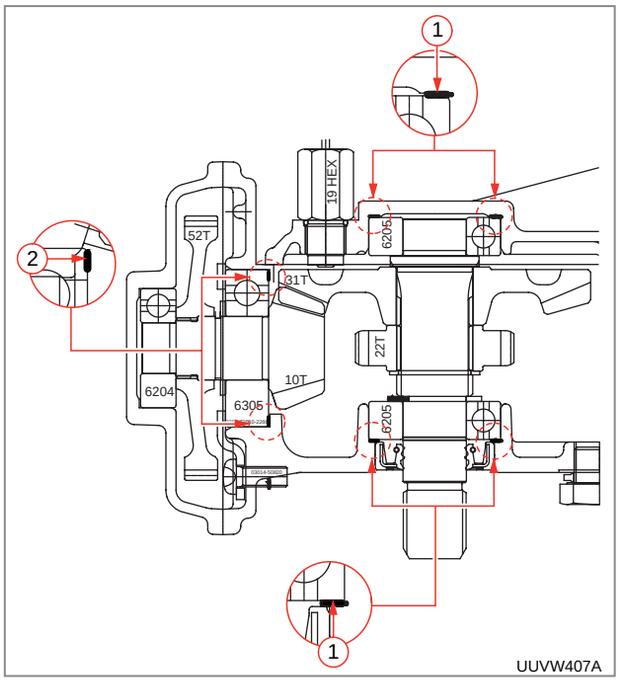
4.1 BACKLASH OF 10 SPIRAL BEVEL PINION SHAFT AND 31 BEVEL GEAR


UUVW406A

1. Set the rear wheel drive shaft as it is installed to the 10 spiral bevel pinion shaft and 31 bevel gear as shown in the figure.
2. Install the dial gauge to the rear wheel drive shaft so that it contacts the splined section of the shaft lightly.
3. Measure the backlash while rotating the rear wheel drive shaft with a hand gently back and forth.

   Standard backlash on the gear teeth contacted:
   0.2 ~ 0.3 mm (0.0079 ~ 0.0118 in.)

   Back lash on the spline :
   0.04 ~ 0.07 mm (0.0016 ~ 0.0028 in.)

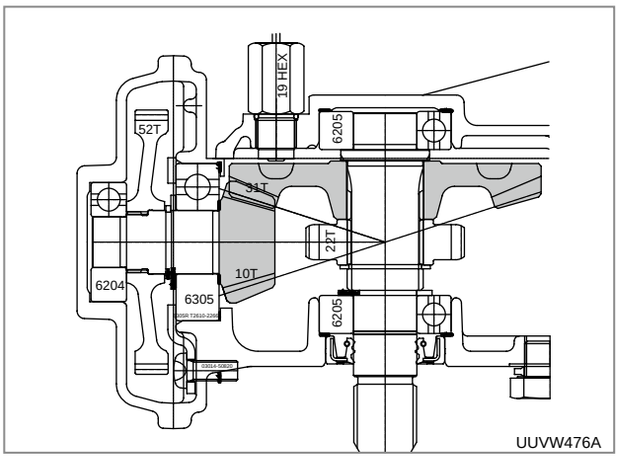


UUVW407A

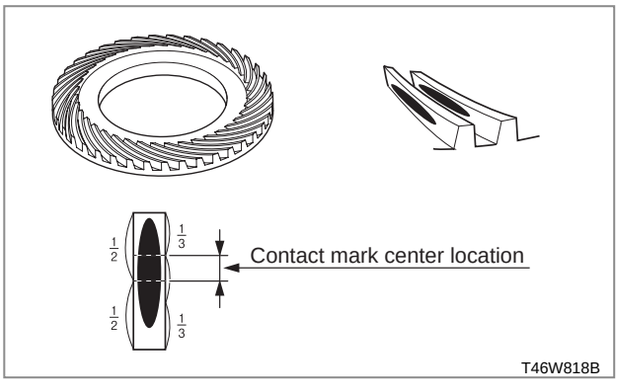
4. If the 31 bevel gear should be moved to adjust the backlash, adjust the shim (1). If the 10 spiral bevel pinion shaft should be moved, adjust the shim (2).

   Type of shim (1) : 0.1 mm (0.00394 in.)
   0.2 mm (0.00787 in.)
   0.3 mm (0.01181 in.)
   Type of shim (2) : 0.1 mm (0.00394 in.)
   0.2 mm (0.00787 in.)
   0.5 mm (0.01968 in.)
5. If the shim is adjusted, measure the tooth contact amount. The tooth contact amount does not need to be measured if it is not necessary to adjust the shim.

4.2 TOOTH CONTACT OF SPIRAL BEVEL GEAR

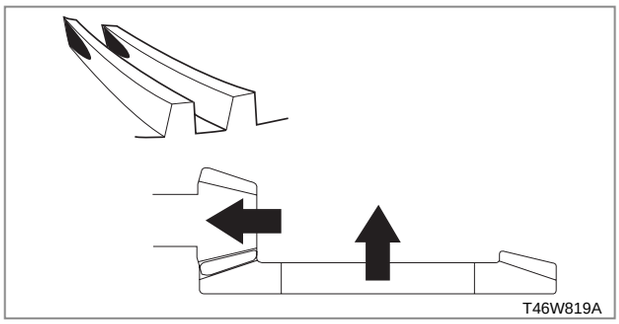


1. Remove the 10 spiral bevel pinion shaft and 31 spiral bevel gear, and clean the teeth thoroughly.
2. Coat all the teeth of the pinion shaft with contact grease. Then, install the shaft.
3. Turn the bevel gear shaft for approx. 5 rounds and check the contact area by a contact mark on the spiral bevel gear teeth.



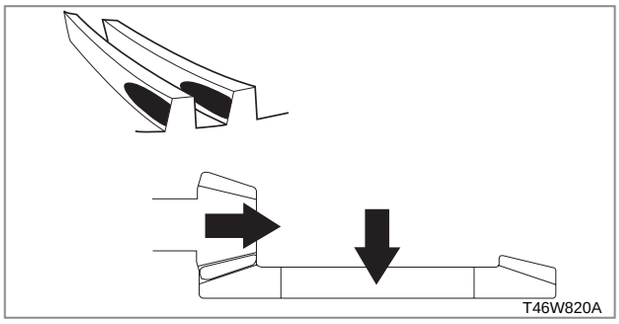
The contact area should be over 35 % of the entire teeth area and the center of the contact mark should be close to the center of the pinion in height. Also, the center of the contact mark should be located in between the 1/3 spot from the toe of the teeth and center of the teeth in length.

A. TOE CONTACT



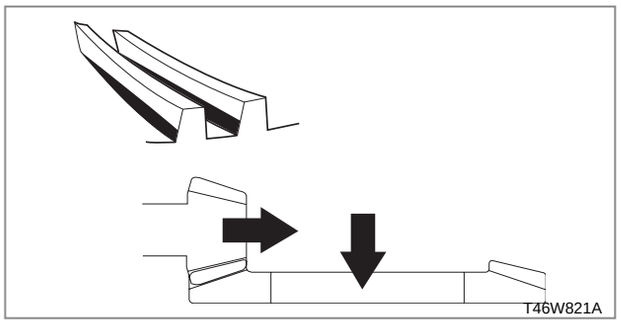
If the center of the contact mark is too close to the toe of the tooth, push back the pinion shaft and push in the ring gear to the pinion direction so that the back lash is maintained. Then, measure the backlash.

B. HEEL CONTACT



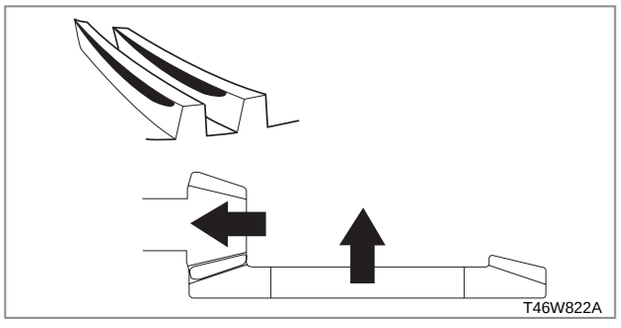
If the contact mark is close to the heel of the ring gear teeth, push the pinion shaft toward the ring gear and push the ring gear away from the pinion so that the backlash is maintained. Then, measure the backlash.

C. DEEP CONTACT



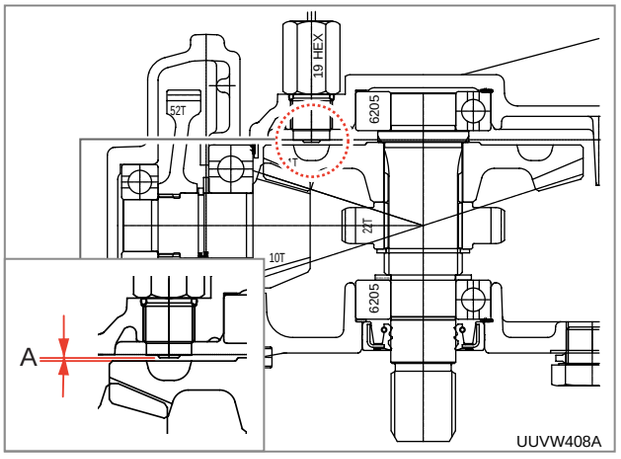
If the contact mark is on the bottom of the ring gear teeth, push the ring gear away from the pinion and push the pinion into the ring gear (if necessary) to maintain the backlash. Then, measure the backlash.

D. TIP CONTACT



If the contact mark is on the tip of the ring gear teeth, pull the ring gear toward the pinion and pull out the pinion from the ring gear (if necessary) to maintain the backlash. Then, measure the backlash.

4.3 AIR GAP OF VEHICLE SPEED SENSOR

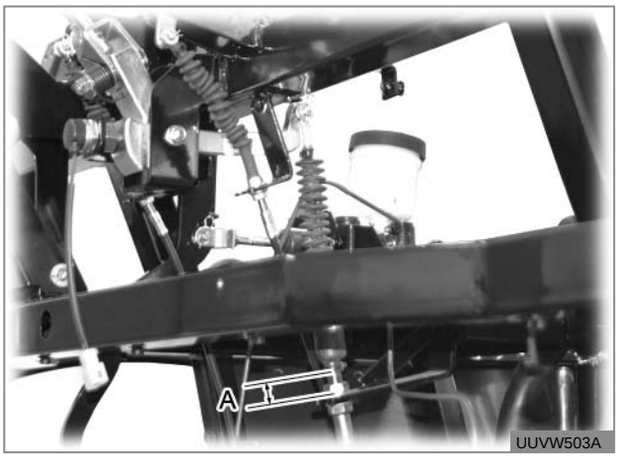


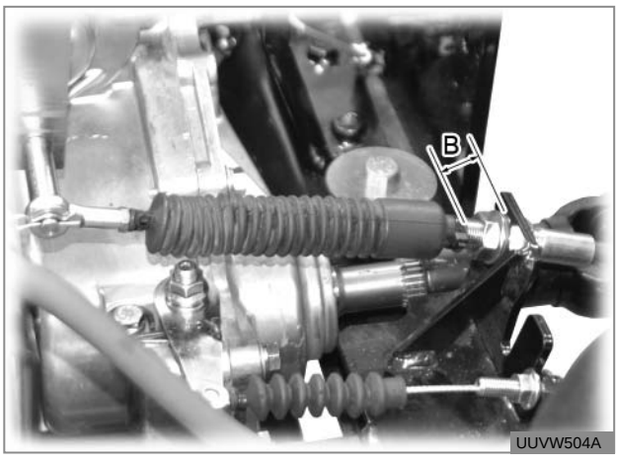
1. During assembly, make sure that the air gap between the end of the vehicle speed sensor and the 31 bevel gear of the transmission is within 1 mm (0.039 in.).

IMPORTANT

- **Do not impact the vehicle speed sensor; it is sensitive to impact.**

4.4 SHIFT CABLE LENGTH

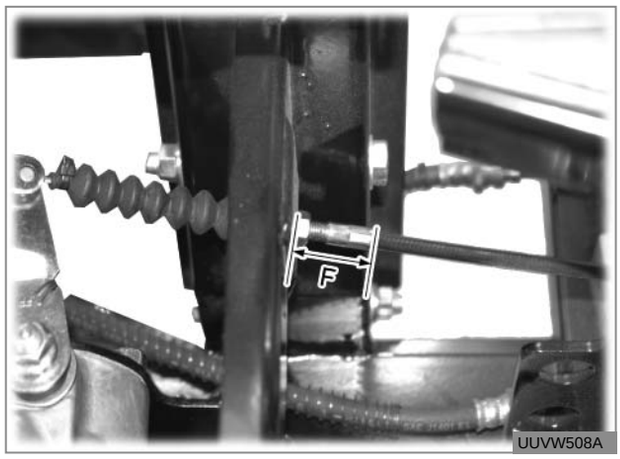




1. Put the shift lever to the "N" position. Then, adjust the length of the section A of the gear selector cable using the nut on the adjusting screw at its lever side mounting section.
   Set length for section A: 40 mm (1.575 in.)
2. Put the shift lever to the "N" position. Then, adjust the length of the section B using the nut on the adjusting screw at the mounting section on the shift arm side.

   To adjust the set length for the section B, set the shift lever in the neutral state on the transmission case side, pull the cable gently to fit it into the mounting bracket, and then adjust the cable length so that the lever can be moved to each gear position freely. Then, tighten the mounting nut.

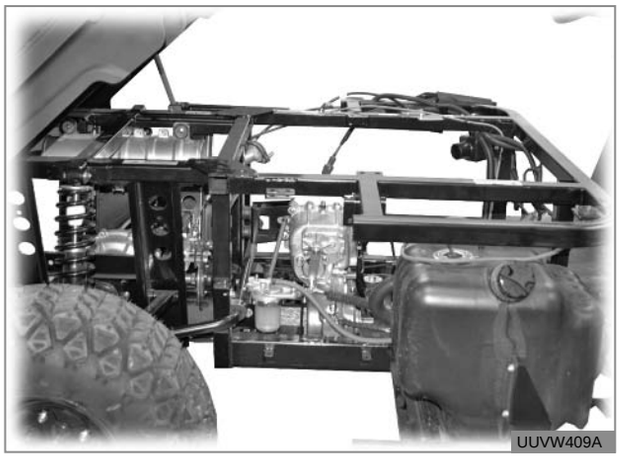
4.5 FRONT WHEEL DRIVE CABLE LENGTH



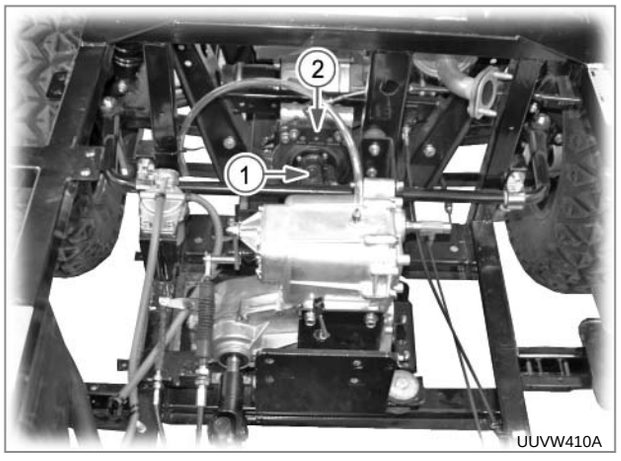
1. Set the differential lock lever to the "UNLOCK" position. Then, adjust the differential lock cable length to the bracket with the nut on the adjusting screw from its mounting sections on both sides.
   Set length for section E: 40 mm (1.575 in.)
2. To adjust the set length for the section F, set the differential lever in the "UNLOCK" position on the rear axle case side, pull the cable gently to fit it into the mounting bracket, and then adjust the cable length so that the lever can be moved to the "LOCK" position freely. Then, tighten the mounting nut.

5. DISASSEMBLY, SERVICE AND ASSEMBLY

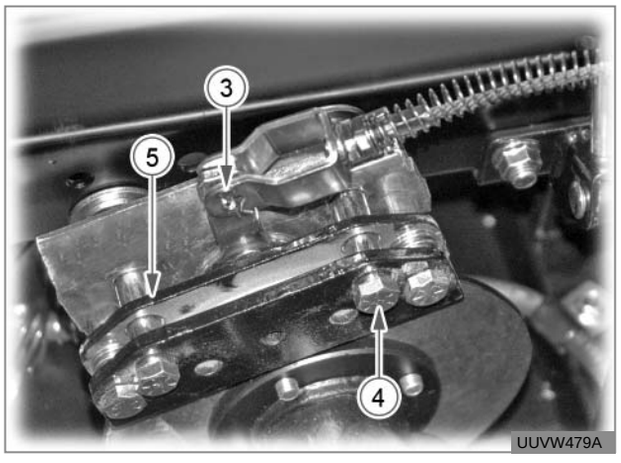
5.1 TRANSMISSION REMOVAL


UUVW409A

1. Park the vehicle on firm and level ground, stop the engine and apply the parking brake. Then, raise the cargo bed and support it.
2. Remove the CVT. (Refer to chapter 4, "CVT disassembly.")



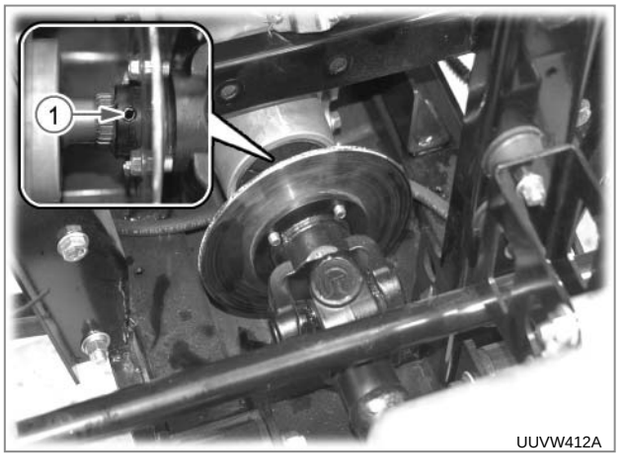
UUVW410A



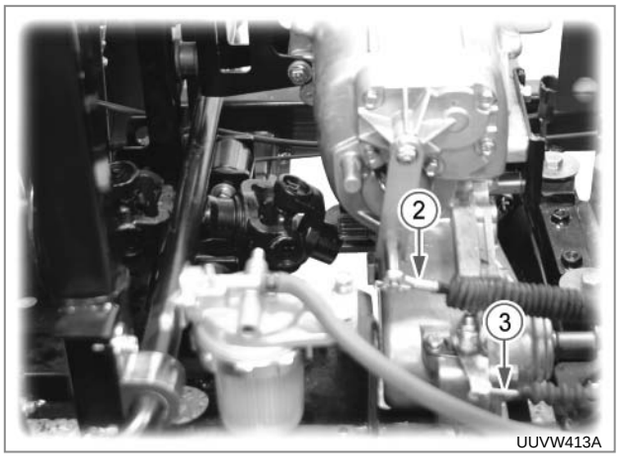
UUVW479A

3. To remove the rear propeller shaft (1), remove the parking brake caliper assembly (2) first.

   Pull out the parking brake cable connecting snap pin (3) and unscrew the caliper mounting bolts (4) (M10, 2 EA) using the 14 mm socket wrench to disconnect the cable and separate the caliper assembly (5).

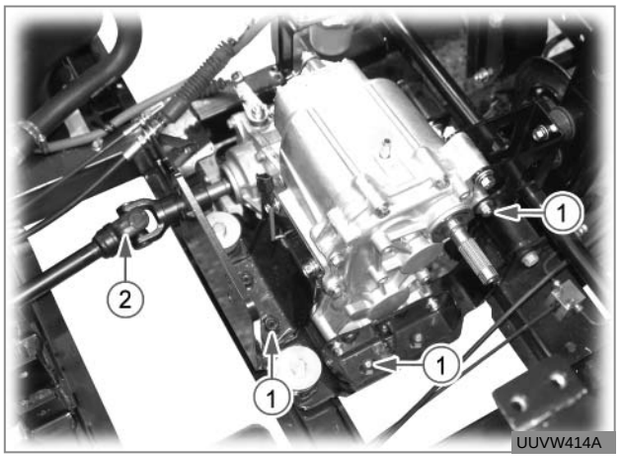


UUVW412A



UUVW413A

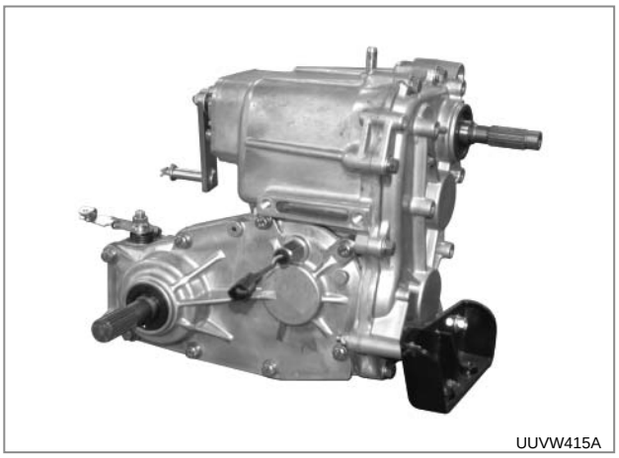
4. Pull out the mounting spring pin (1) and pull the rear propeller shaft to the rear to separate it from the transmission case. Then, disconnect the main shift cable (2) and front wheel drive cable (3).

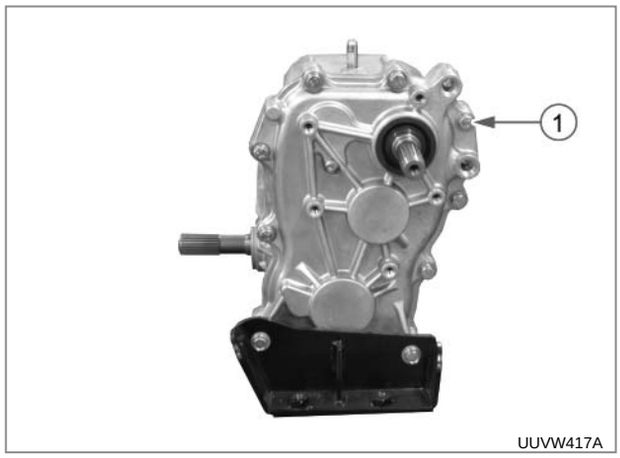


UUVW414A

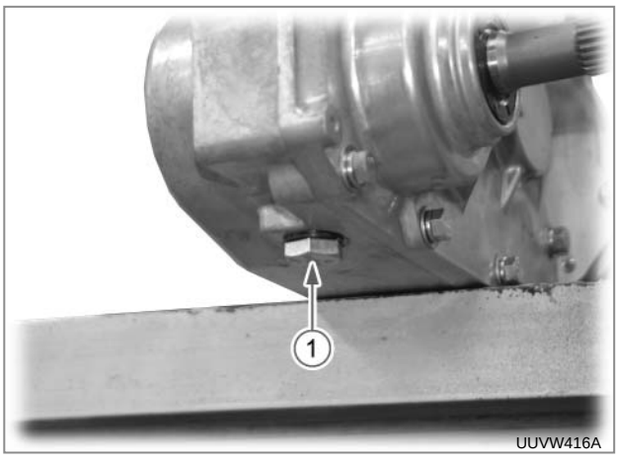
5. Unscrew the transmission case mounting bolts (1) (M10, 6 EA) and pull the transmission case to the rear to separate the front propeller shaft (2). Then, lift the transmission case assembly to remove it.

5.2 TRANSMISSION COMPONENTS DISASSEMBLY AND ASSEMBLY


UUVW415A



UUVW417A



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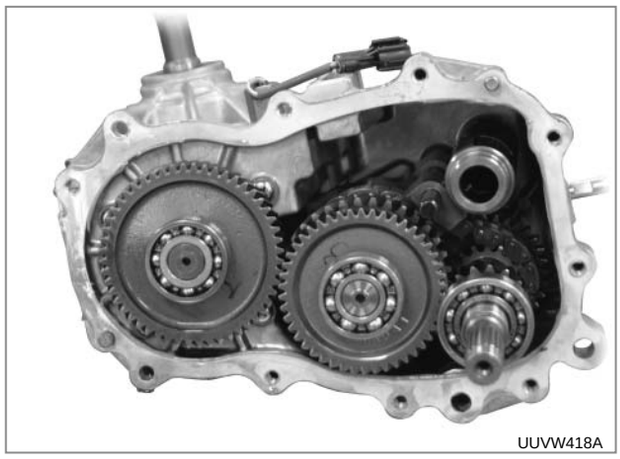
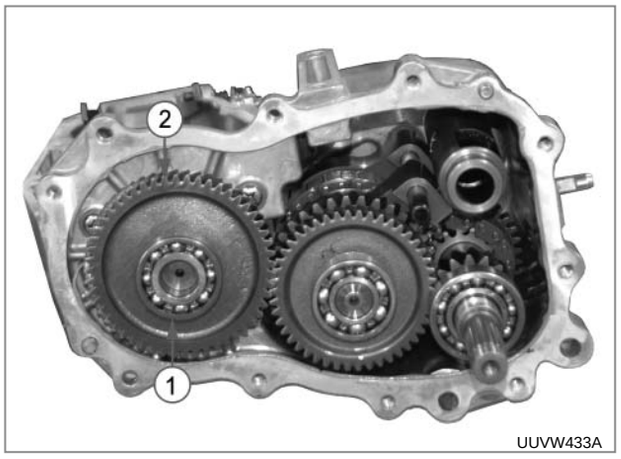
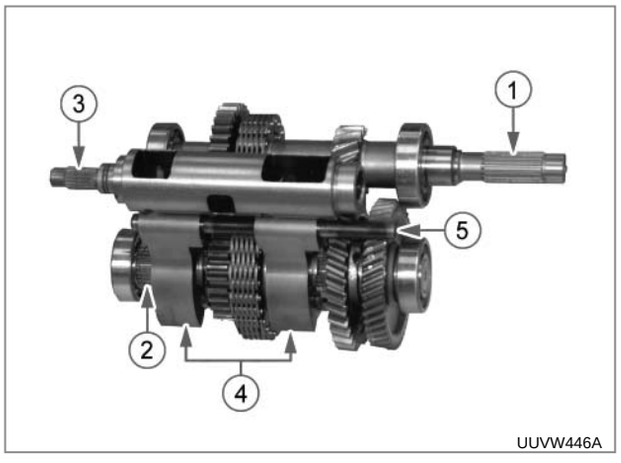

UUVW418A

1. Set the transmission case assembly in a stable place and undo the drain plug (1) with the 22 mm socket wrench to drain the transmission fluid.

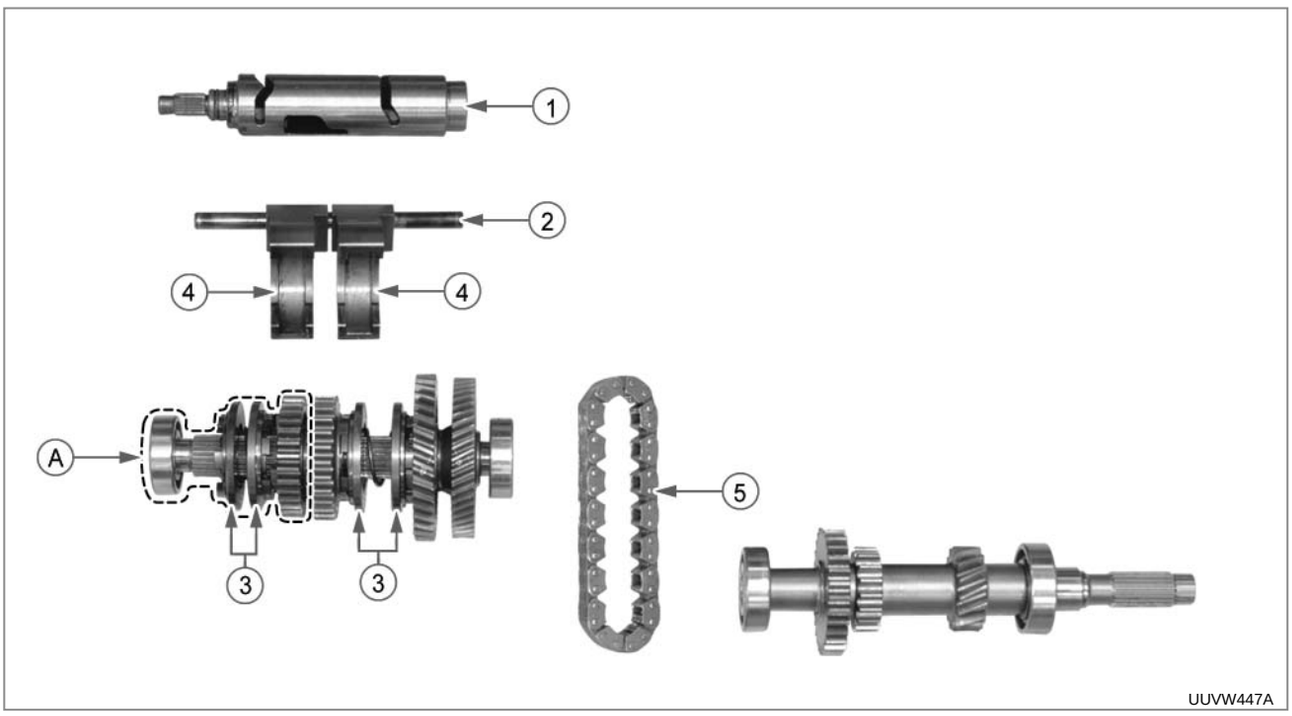
2. Unscrew the transmission case cover mounting bolts (1) (M8, 10 EA) using the 12 mm socket wrench to remove the transmission case cover.



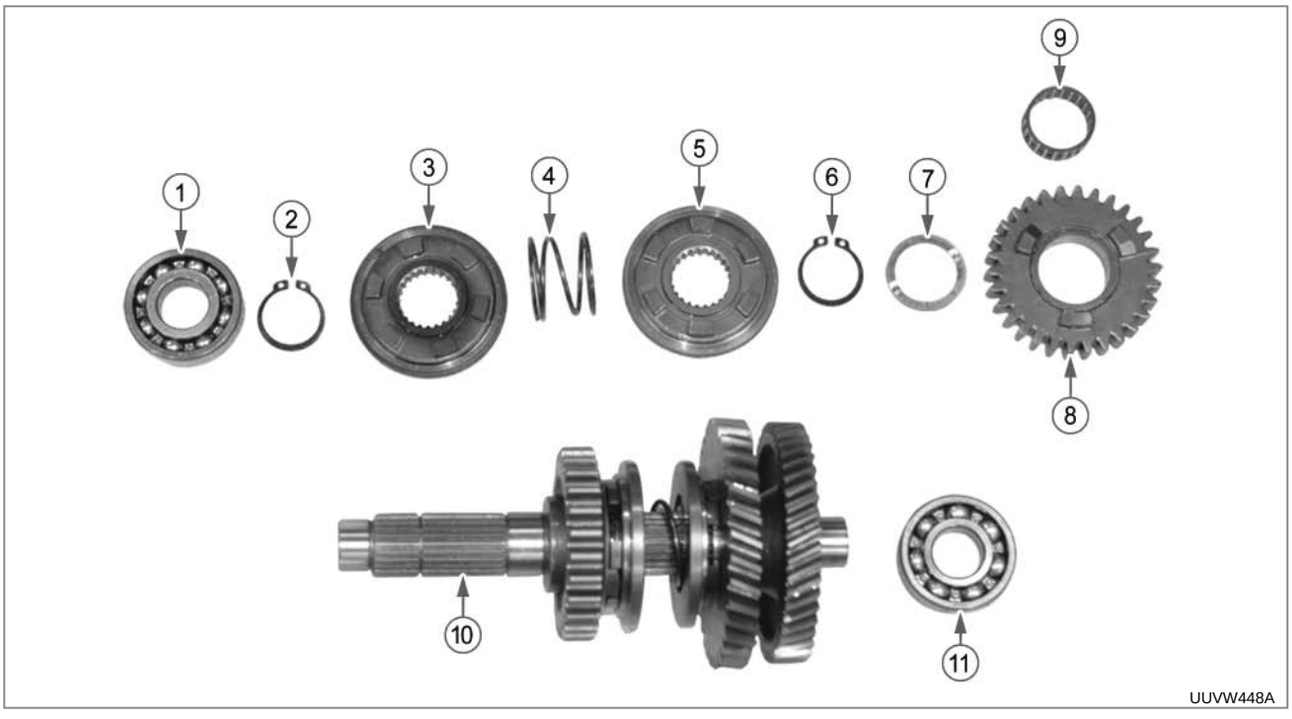
3. Remove the ball bearing (1) from the spiral bevel pinion shaft on the transmission cover side to remove the 52 gear (2).



4. On the transmission case cover side, pull the drive shaft (1), driven shaft (2), shift guide lever (3), fork (4) and fork rod (5) to the front of the case to remove them as an assembly.

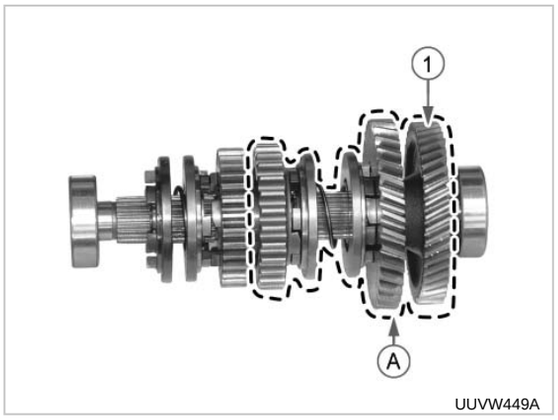


5. Disconnect the shift guide lever (1) and pull out the fork rod (2). Then, remove the forks (4) while setting the clutch dogs (3) on both sides adhered together.
6. Remove the driven shaft 30 gear assembly (A). Then, remove the silent chain (18 links) (5).

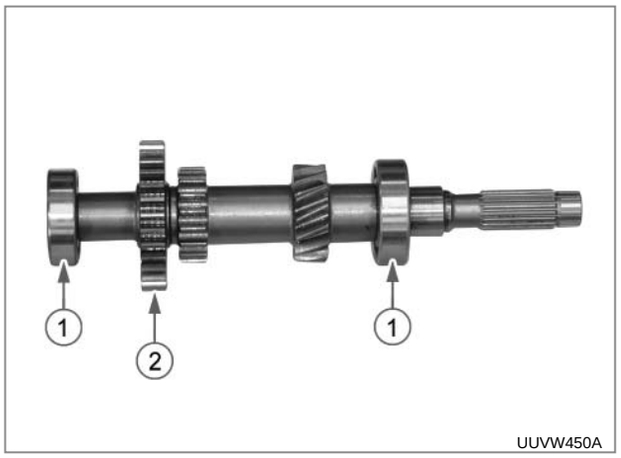


7. Disassemble the driven shaft assembly; remove the ball bearing (1), snap ring (2), clutch dog (3), spring (4), clutch dog (5), snap ring (6), thrust collar (7), 30 gear (8), needle bearing (9), driven shaft (10) and ball bearing (11) in order.

REMARK



- **The 46 gear (1) (A) cannot be removed from the driven shaft assembly; it is shrink-fitted with heat.**



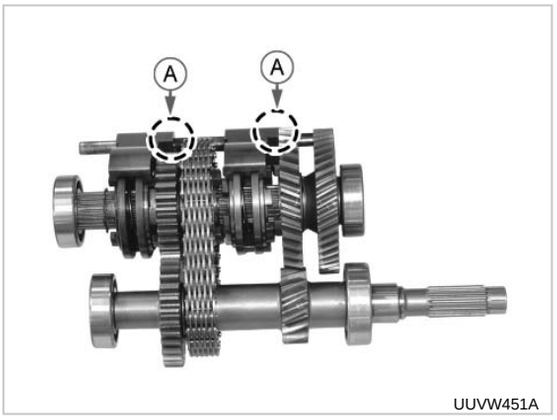
8. Remove the ball bearings (1) from the drive shaft assembly on both sides.

REMARK

- **The 31 gear (2) cannot be removed from the drive shaft assembly; it is shrink-fitted with heat.**

9. Assemble in the reverse order of disassembly.

CAUTION

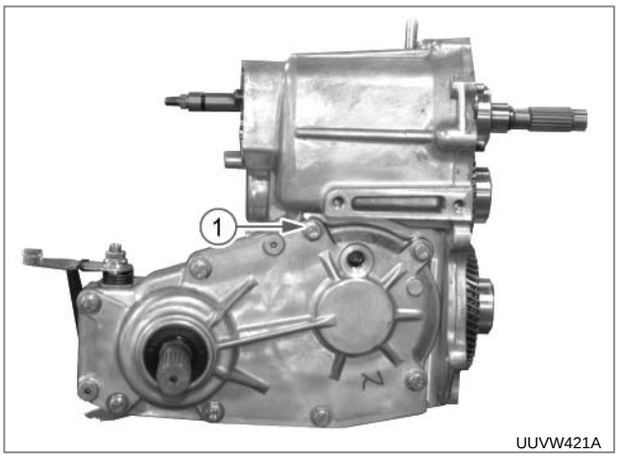


- **When installing the fork, its longer bosses (A) should be in the splined direction.**

IMPORTANT

- **When installing the cover, front wheel drive cover and shift cover to the transmission case, clean their mating surfaces thoroughly and apply liquid gasket (Three Bond 1206D or equivalent) to them in advance.**

5.3 AXLE DRIVE SHAFT DISASSEMBLY AND ASSEMBLY



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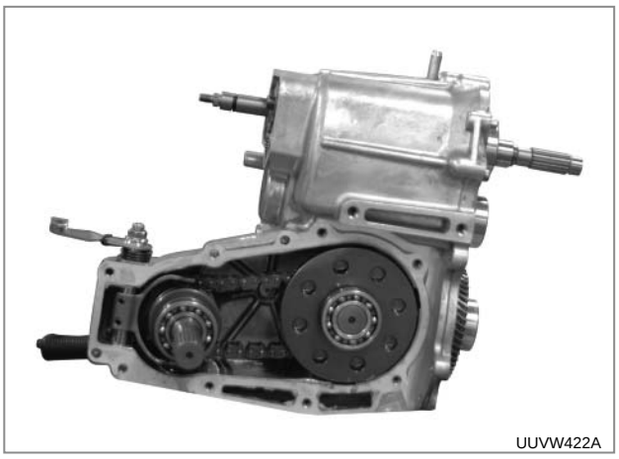

UUVW422A

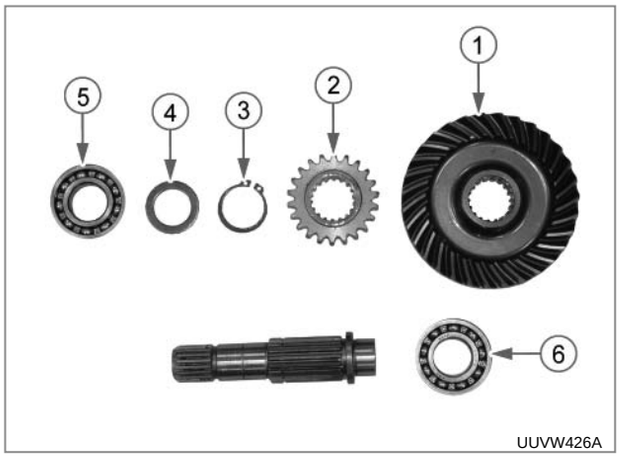

UUVW425A

1. Unscrew the front wheel drive cover mounting bolts (1), (M8, 8 EA) using the 12 mm socket wrench to remove the front wheel drive cover.


UUVW423A

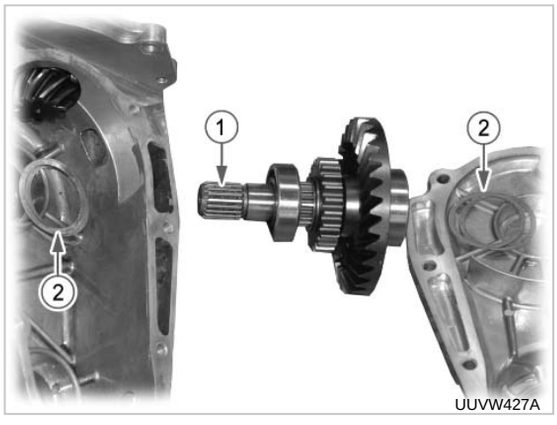
2. Remove the front wheel drive shaft and rear wheel drive shaft together while pulling the front wheel drive lock fork upward.

3. Disconnect the silent chain and disassemble the rear wheel drive shaft and front wheel drive shaft.

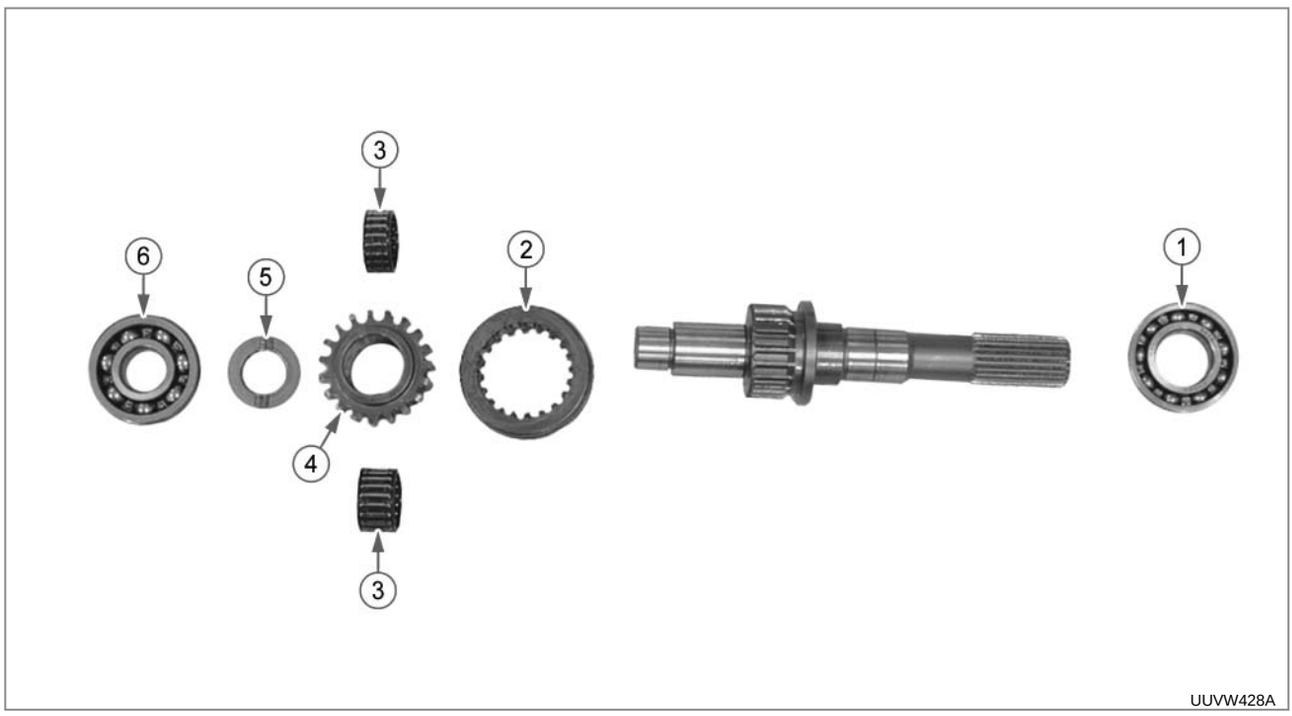


4. When assembling the rear wheel drive shaft, fit the 31 bevel gear (1), 22 sprocket (2), snap ring (3), spacer (4) and ball bearing (5) to the splined side of the rear wheel drive shaft. Then, tap in the ball bearing (6) from the other side.

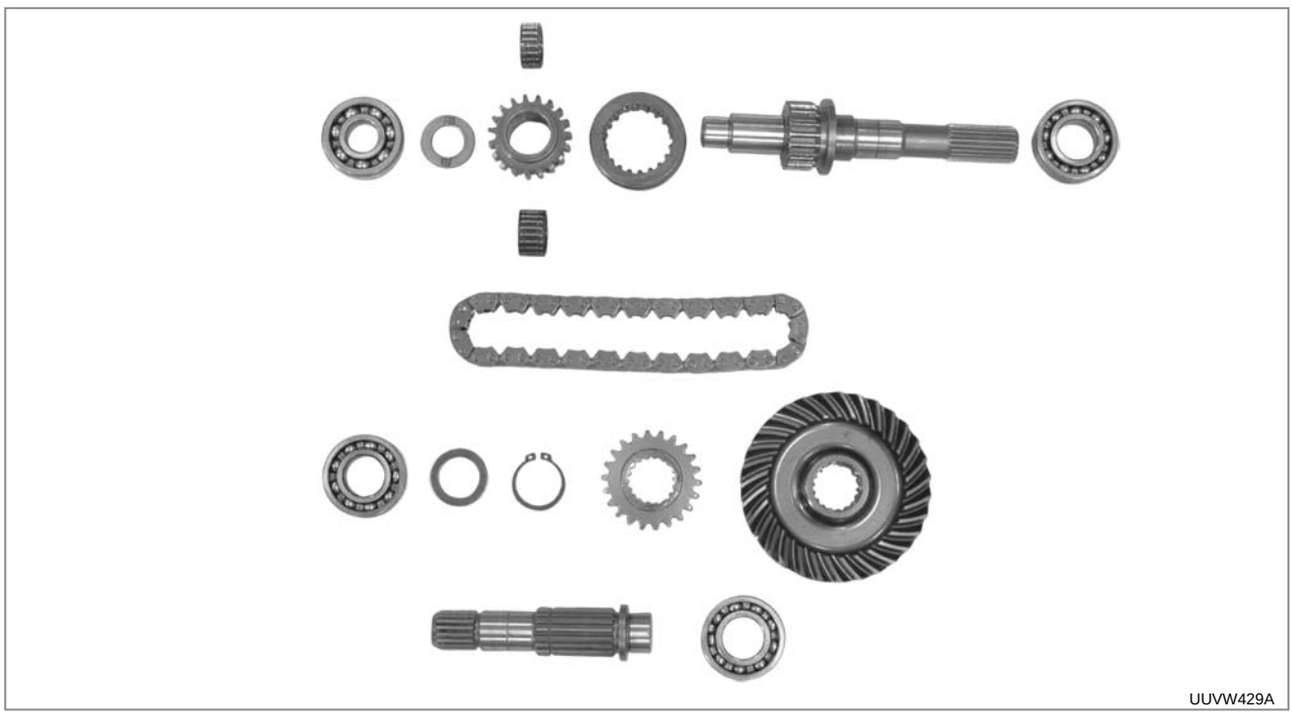
⚠ CAUTION



- **When disassembling the rear wheel drive shaft (1), keep the adjusting shims (2) on the case side in a safe place. When assembling the shaft, make sure to insert the shims, in the cover in the ball bearing mounting area.**

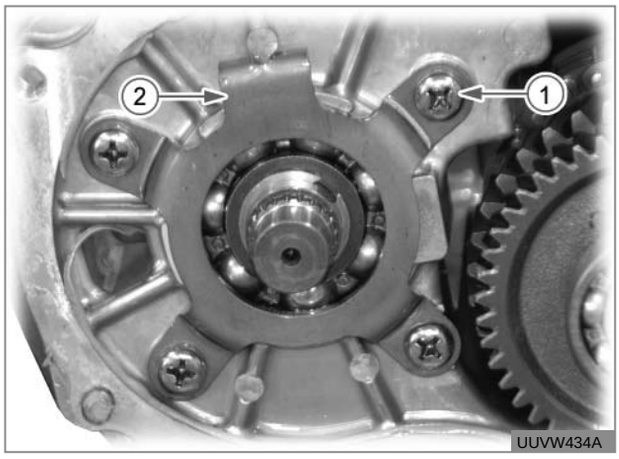


UUVW428A



UUVW429A

5. When assembling the front wheel drive shaft, tap in the ball bearing (1) to the splined side. Then, fit the fork (2), needle bearing (3), needle bearing (3), 19 sprocket (4), thrust washer (5) and ball bearing (6) to the other side in order.

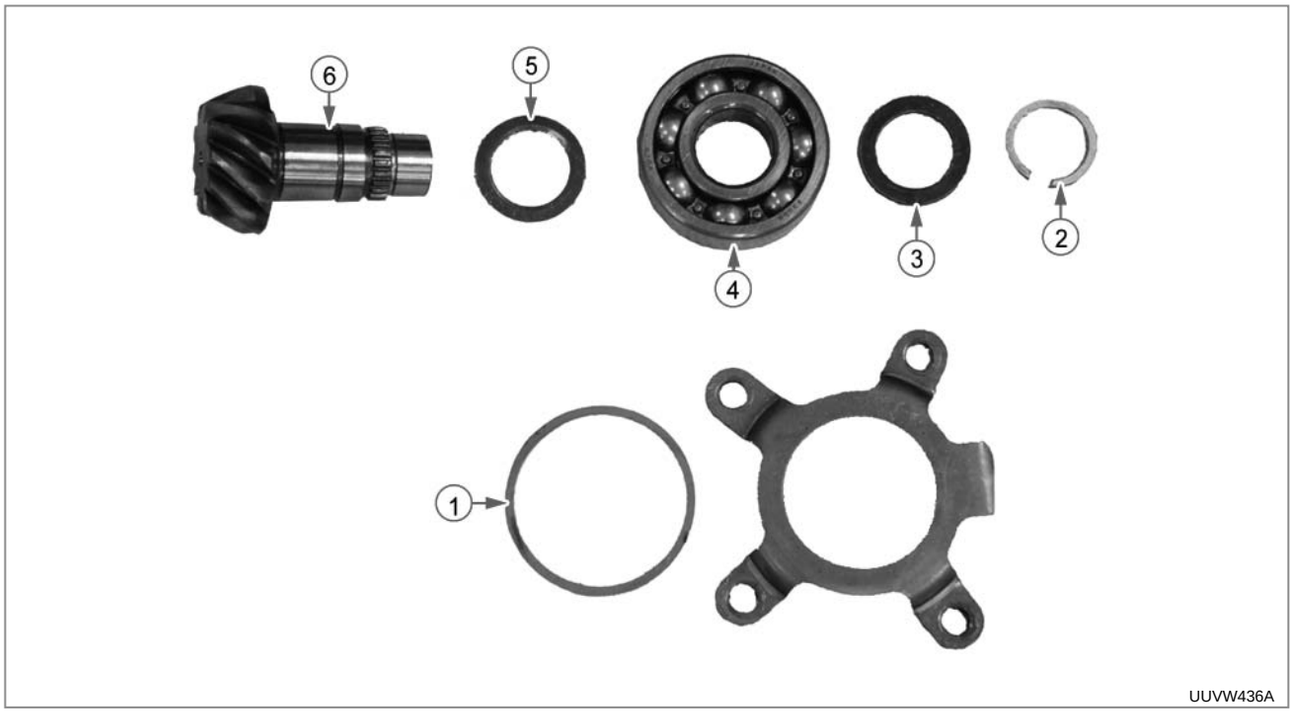


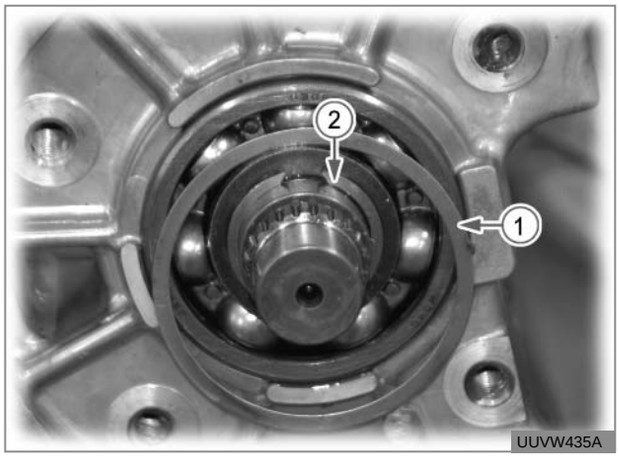
6. Unscrew the ball bearing holder mounting screws (1) (M8, 4 EA) to remove the holder (2).

Mounting screw (M8)
tightening torque .....7.8 ~ 15.7 Nm
0.8 ~ 1.6 kgf-m
5.8 ~ 11.5 lb-ft

⚠ CAUTION

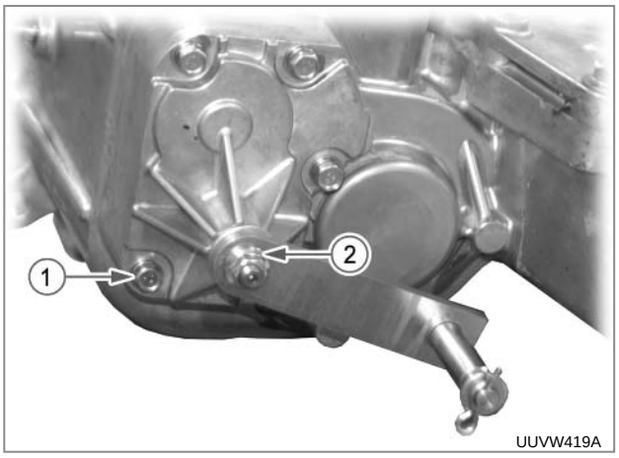
- **When installing the ball bearing holder mounting screws, apply LOCTITE #242 or equivalent to their threads in advance.**

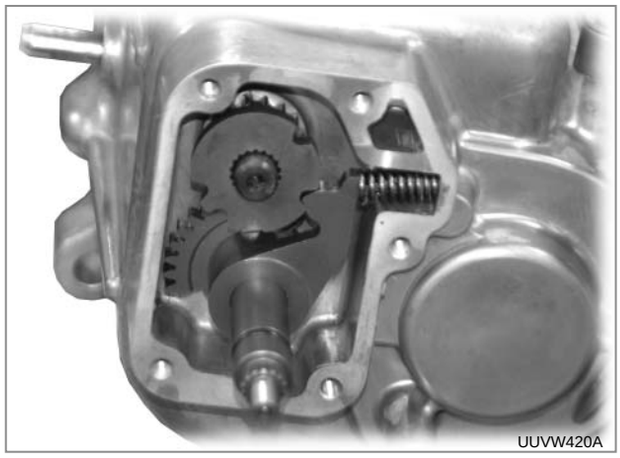




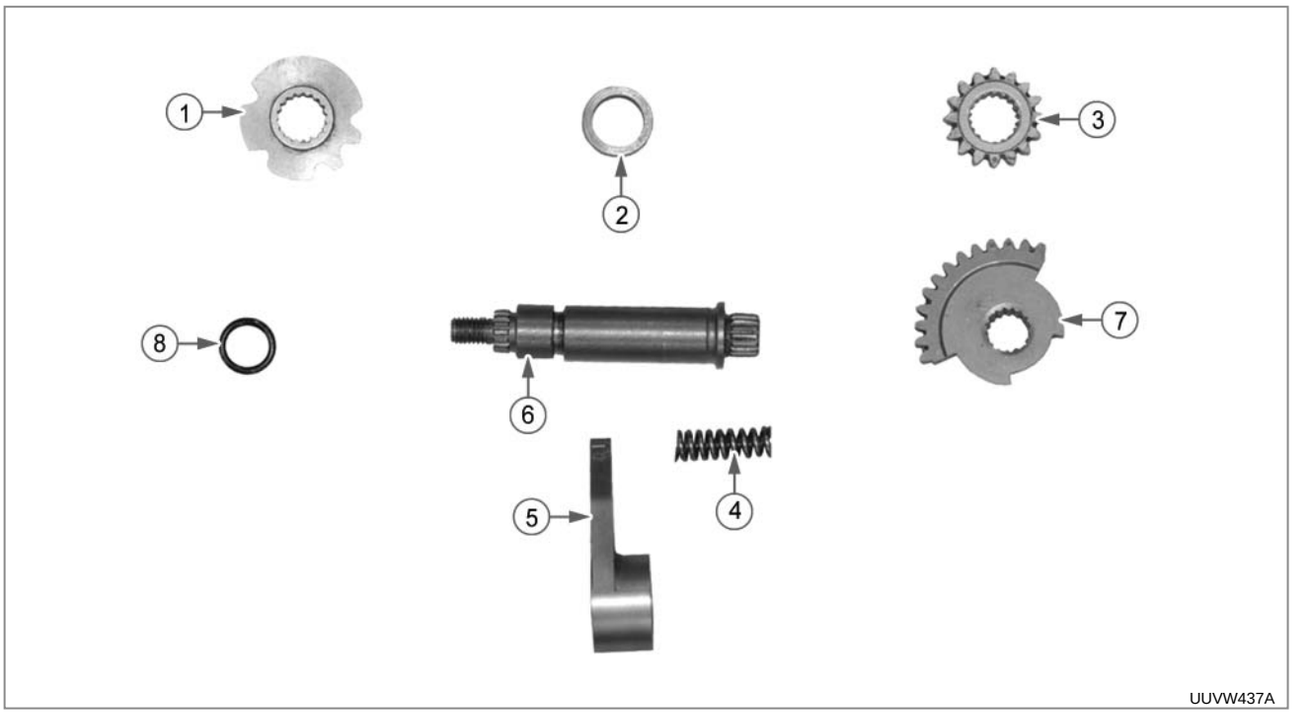
7. Remove the adjusting shim (1) and tap out the spiral bevel pinion shaft assembly from inside the case outward. Then, remove the snap ring (2), spacer (3), ball bearing (4), adjusting shim (5) and spiral bevel pinion shaft (6) in order.

5.4 GEAR SHIFT SYSTEM DISASSEMBLY AND ASSEMBLY

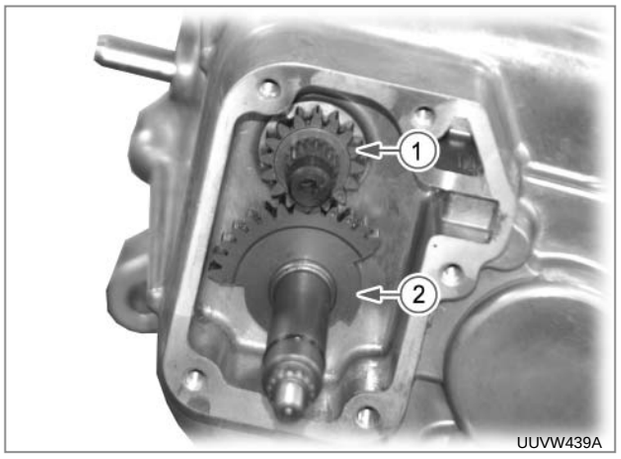




1. Unscrew the shift cover mounting bolts (1) (M6, 5 EA) and shift lever mounting nut (2) (M8, 1 EA) using the 10 mm and 12 mm spanners and socket wrenches to remove the shift cover.

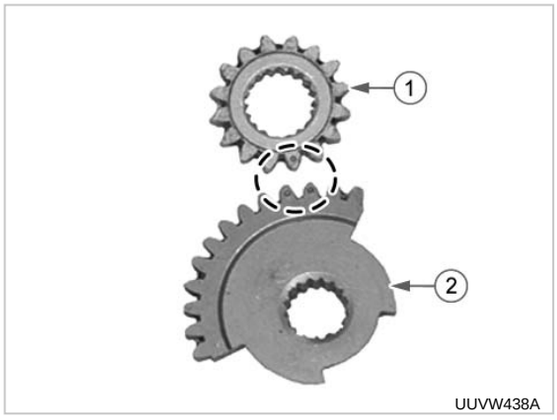


2. Remove the shift disc (1), spacer (2), 16 gear (3), spring (4), lock arm (5), shaft (6), 33 gear (7) and O-ring (8) from the shift cover side.

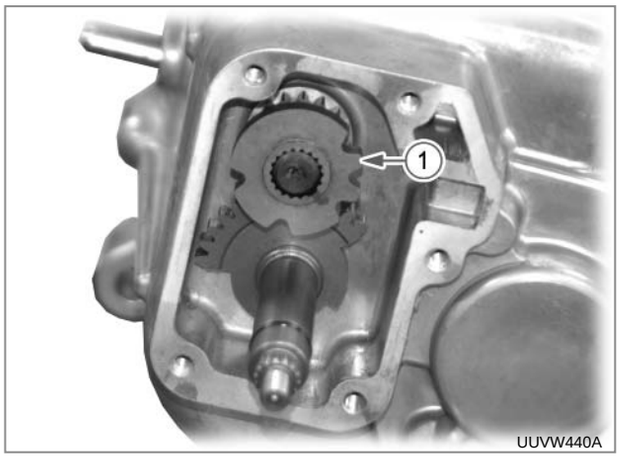


3. When reassembling these components, insert the 16 gear (1) to the shift guide lever and set the 33 gear (2) to the shaft with the gear boss toward the case so that the marks are aligned.

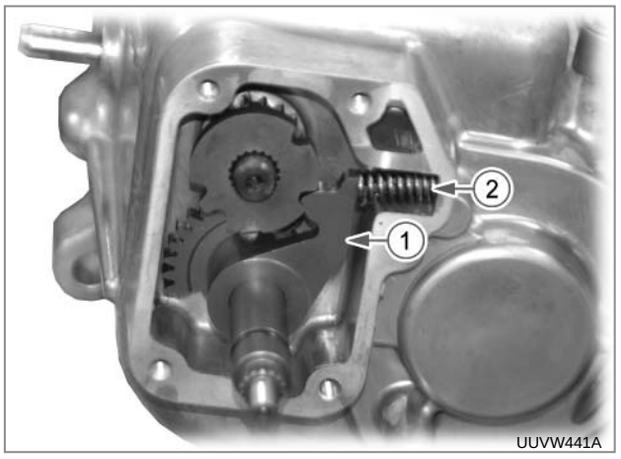
⚠ CAUTION



- **When installing the 16 gear (1) and 33 gear (2), make sure that the marks on their surfaces are aligned.**

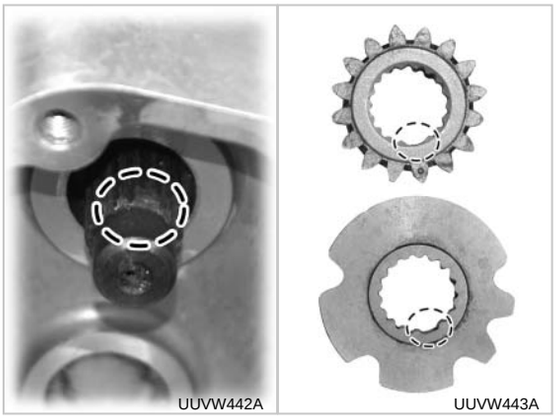


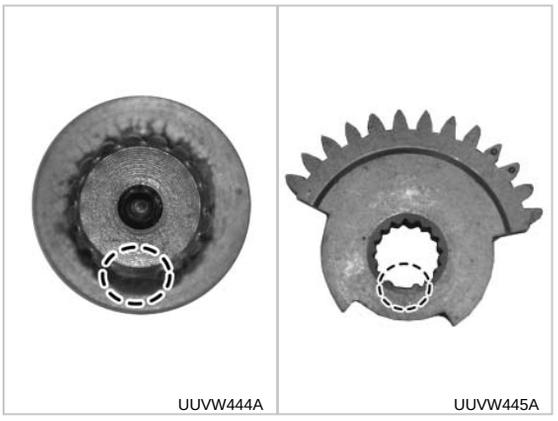
4. Fit the spacer to the shift guide lever. Then, fit the shift disc (1).



5. Install the lock arm (1) and spring (2) to the shaft.
6. Apply a sufficient amount of grease to the shift gear installing area before installing the shift cover.

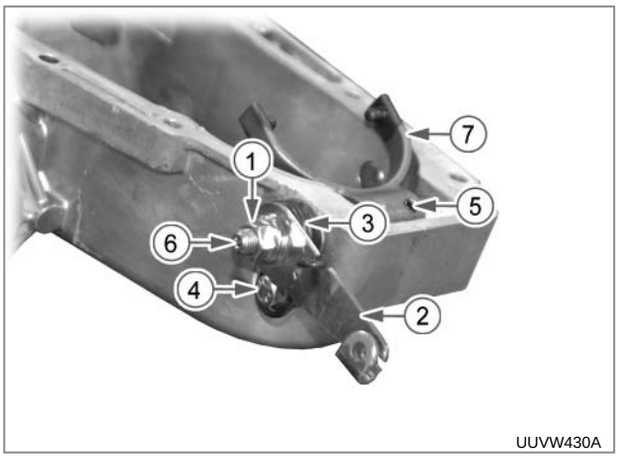
! IMPORTANT



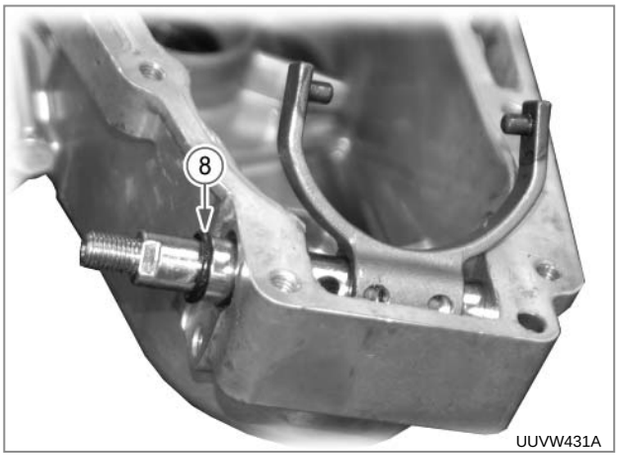


- **When installing the 46 gear and shift disc to the shift guide lever or installing the 33 gear to the shaft, make sure to align the serration alignment section.**

5.5 FRONT WHEEL DRIVE SYSTEM DISASSEMBLY AND ASSEMBLY



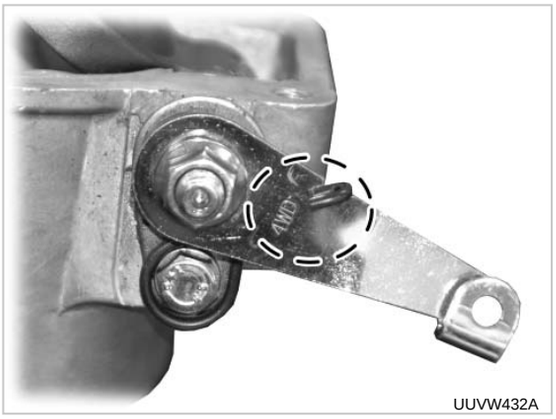
UUVW430A



UUVW431A

1. When necessary, remove the shift arm (6) and front wheel drive lock fork (7) by unscrewing the front wheel drive lever mounting nut (1) (M10, 1 EA), removing the shift arm (2) and spring (3) and then pulling out the lock plate mounting bolt (4) and shift arm spring pin (5). .
   Make sure not to miss the O-ring (8) and check its status. If it is damaged, replace it with a new one. Be sure to inspect the O-ring (8). Replace it with a new one if damaging. And apply a small amount of lubricant to it before installing.

REMARK

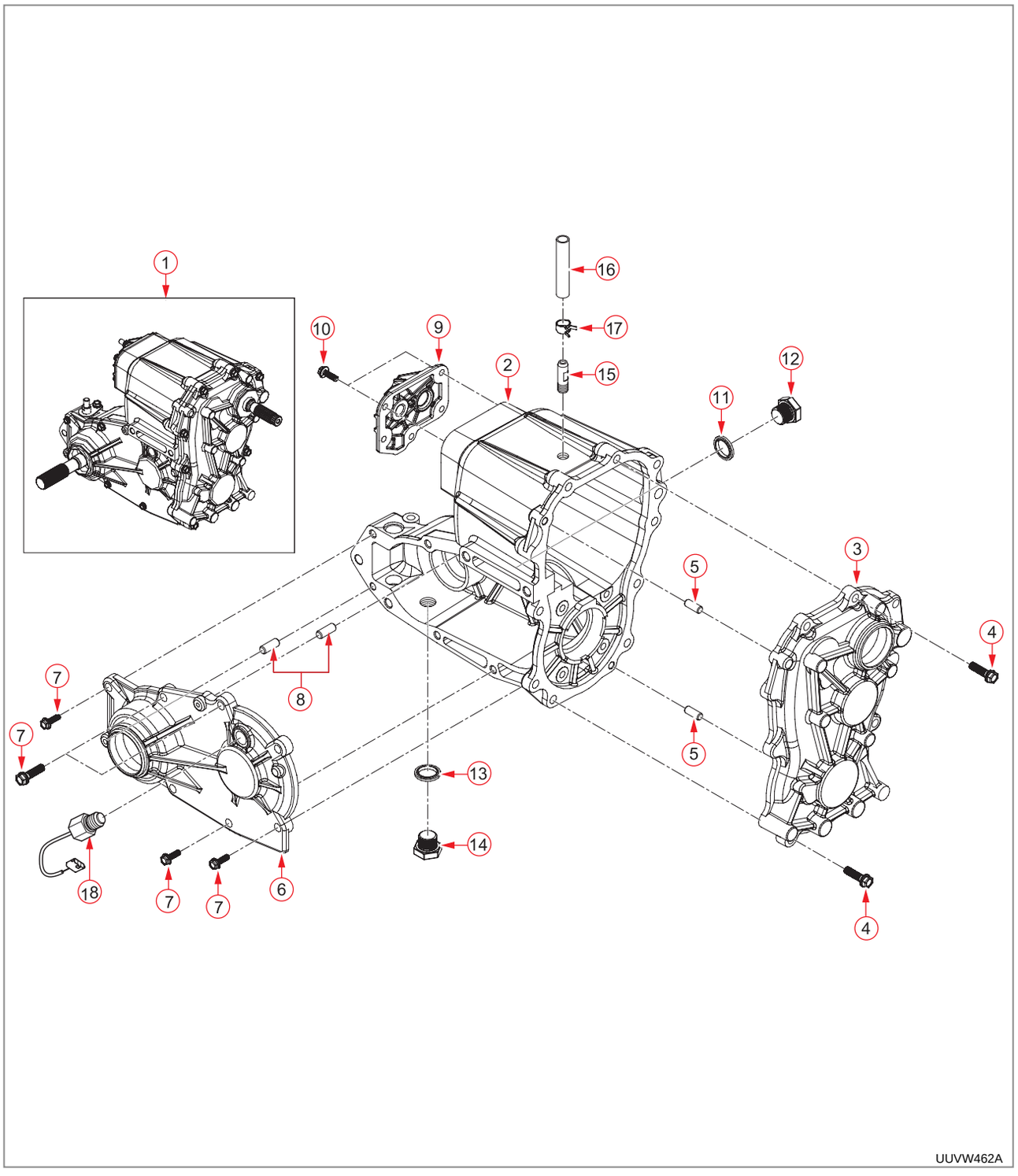


UUVW432A

- **When installing the front wheel drive lever and spring, make sure the mark "4WD" and spring hook groove face upward.**

6. COMPONENTS

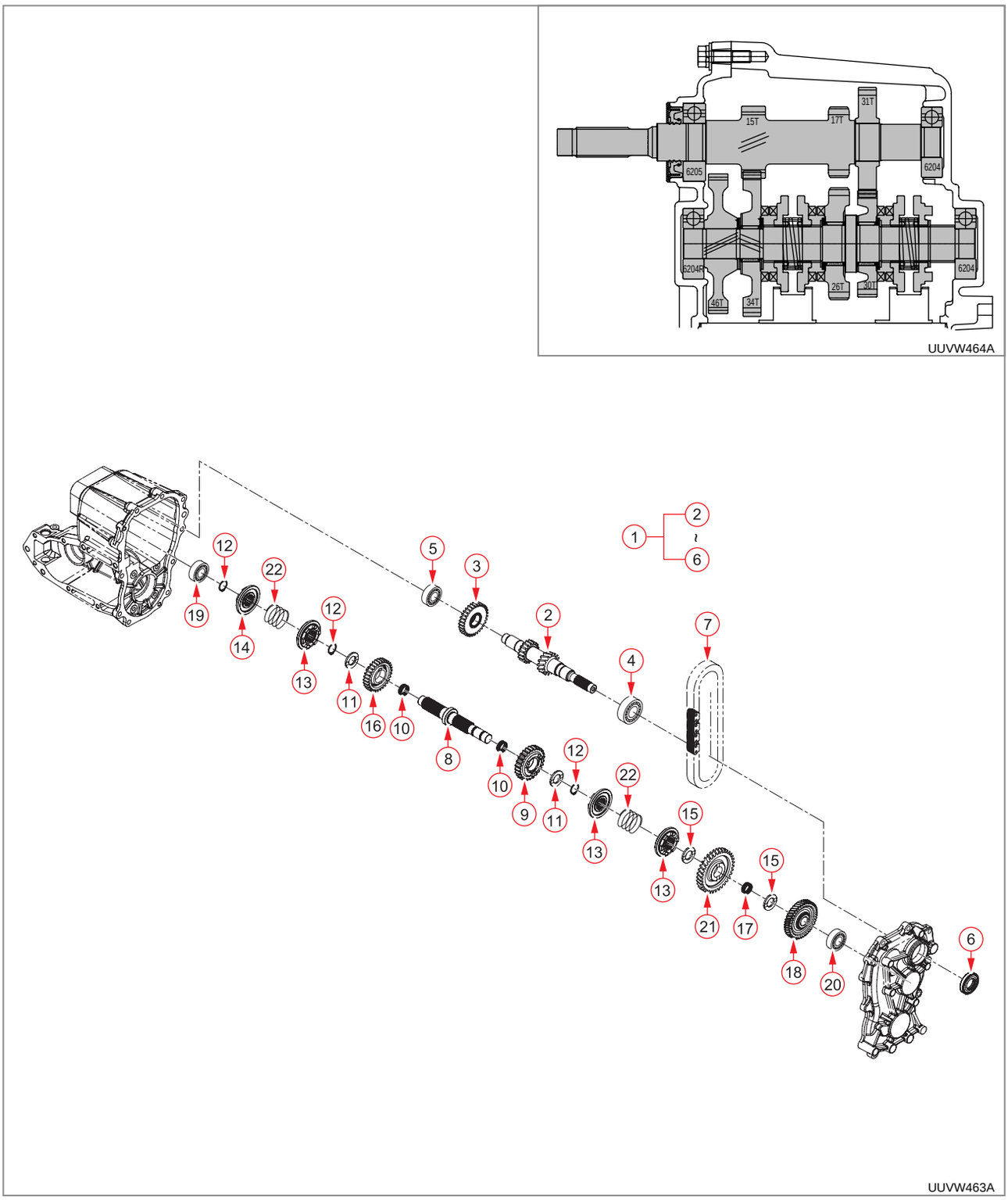
6.1 U120A TRANSMISSION CASE



COMPONENTS

(1) TRANMISSION ASSY
(2) MISSION CASE
(3) COVER, TRANSMISSION CASE
(4) BOLT
(5) PIN, STRAIGHT
(6) COVER, FRONT AXLE DRIVE
(7) BOLT
(8) PIN, STRAIGHT
(9) COVER, SHIFT
(10) BOLT
(11) WASHER, SEAL
(12) PLUG
(13) WASHER, SEAL
(14) PLUG
(15) CONNECTOR, AIR BREATHER
(16) HOSE, OVER FLOW
(17) CLIP, PIPE
(18) PICK UP SENSOR

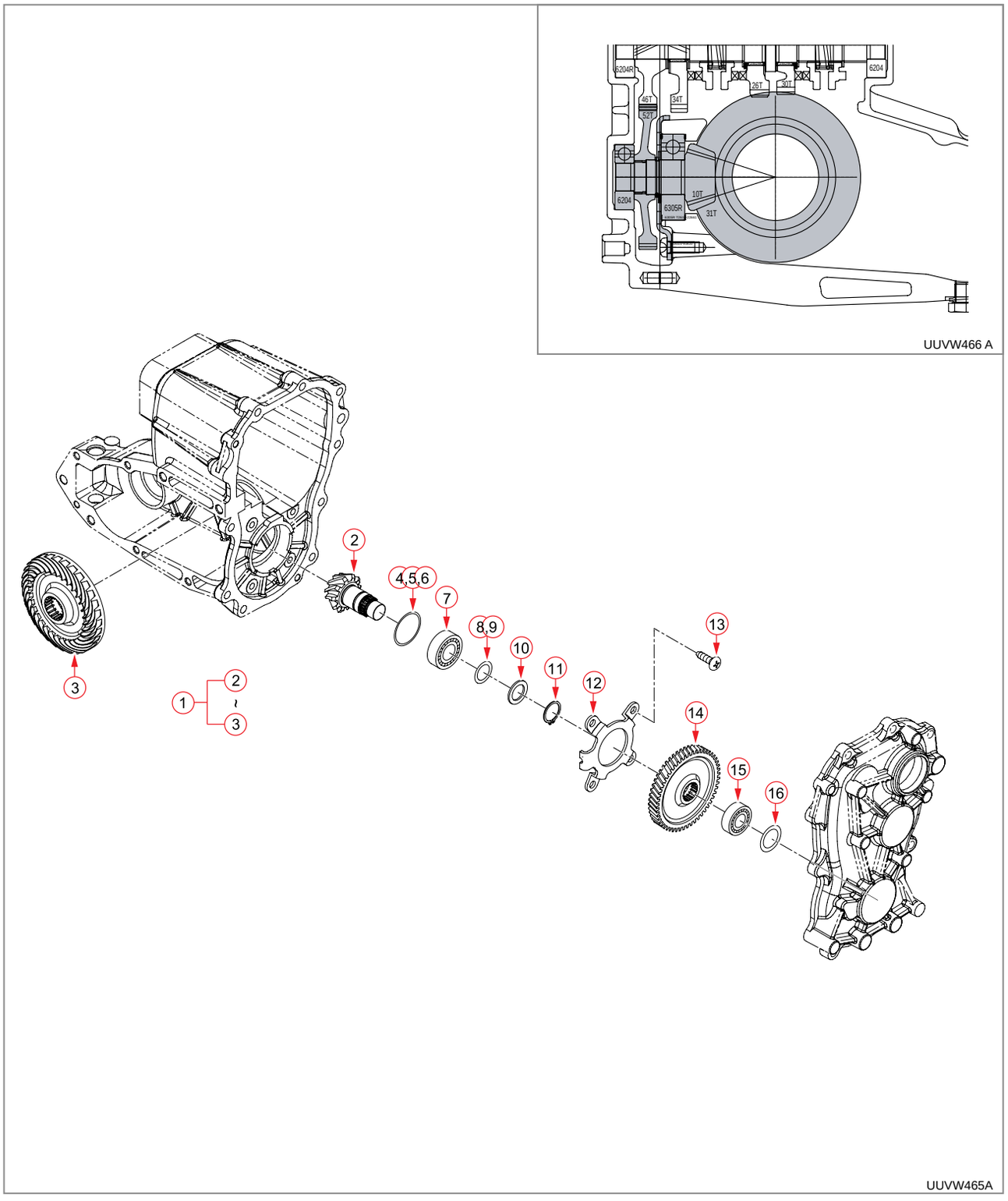
6.2 U130A SHAFT 1



COMPONENTS

(1) SHAFT
(2) SHAFT
(3) GEAR 31
(4) BEARING, BALL
(5) BEARING, BALL
(6) OIL SEAL(25*47*10.5)
(7) SILENT CHAIN, 36
(8) SHAFT
(9) 26T, SPROCKET
(10) BEARING, NEEDLE
(11) COLLAR, THRUST
(12) SNAP RING
(13) CLUTCH DOG
(14) CLUTCH DOG
(15) COLLAR, THRUST
(16) GEAR 30
(17) BEARING, NEEDLE
(18) GEAR 46
(19) BEARING, BALL
(20) BEARING, BALL
(21) GEAR34
(22) SPRING CLUTCH

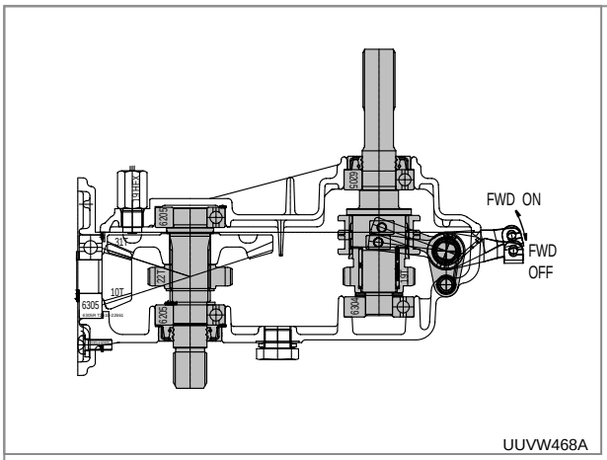
6.3 U140A BEVEL PINION GEAR



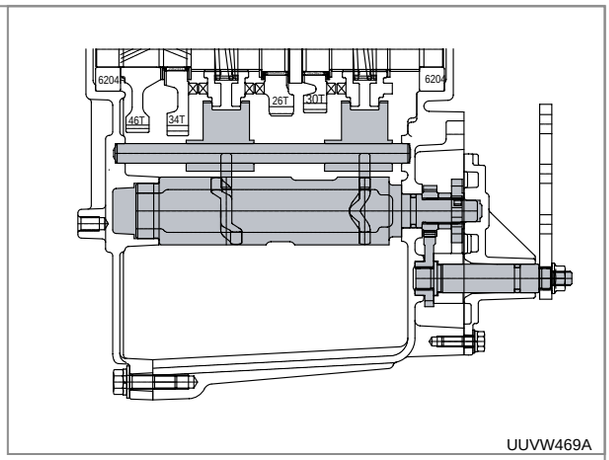
COMPONENTS

(1) SPIRAL BEVEL GEAR ASSEMBLY
(2) SHAFT, 10 BEVEL PINION
(3) BEVEL GEAR, 31
(4) SHIM
(5) SHIM
(6) SHIM
(7) BEARING, BALL
(8) SHIM 0.1
(9) SHIM 0.2
(10) COLLAR
(11) RING, SNAP
(12) WINNOW BEARING HOLDER
(13) GEAR 52
(14) SCREW
(15) BEARING,BALL
(16) SHIM, 0.1

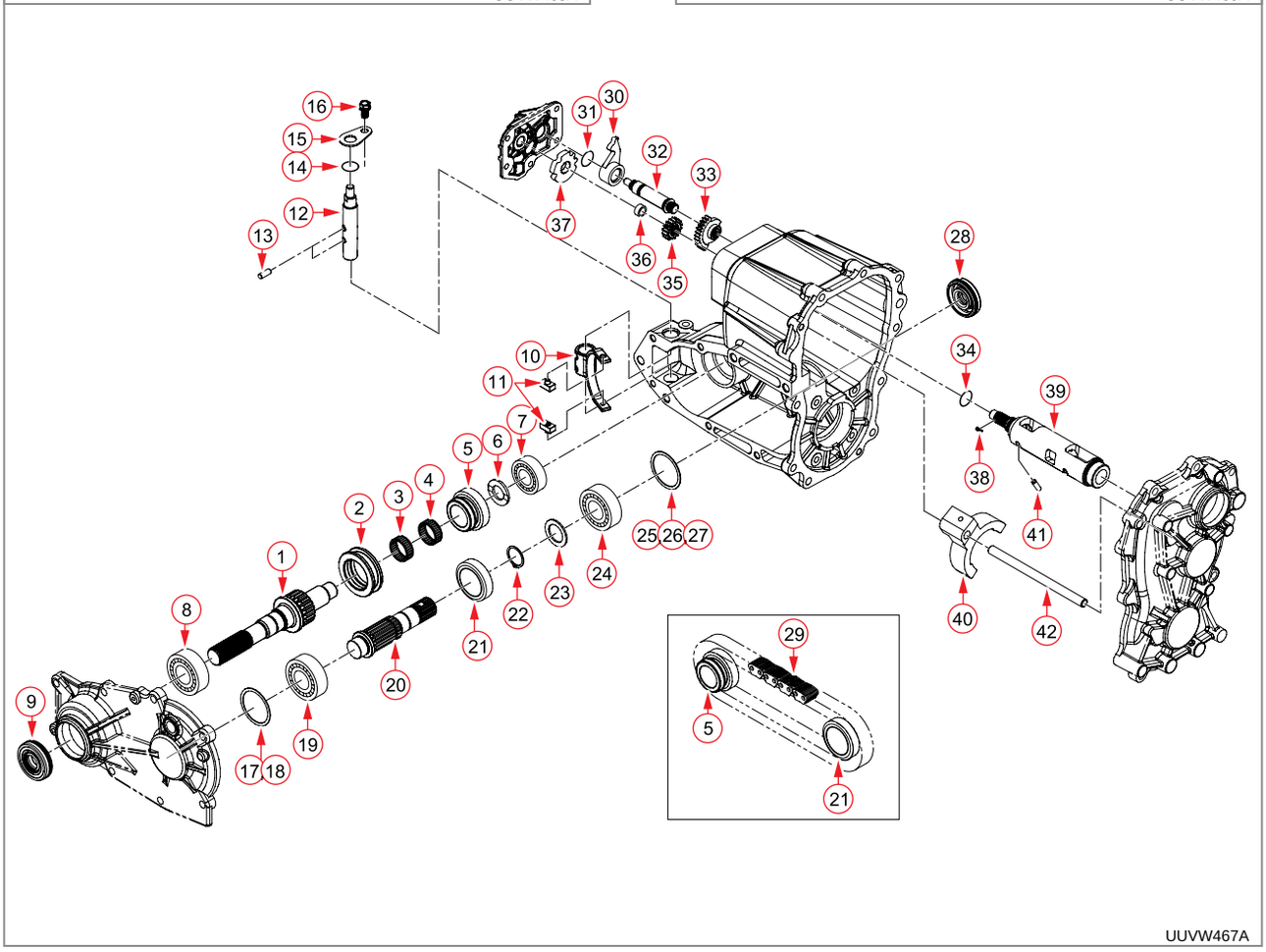
6.4 U150A SHAFT 2



UUVW468A



UUVW469A

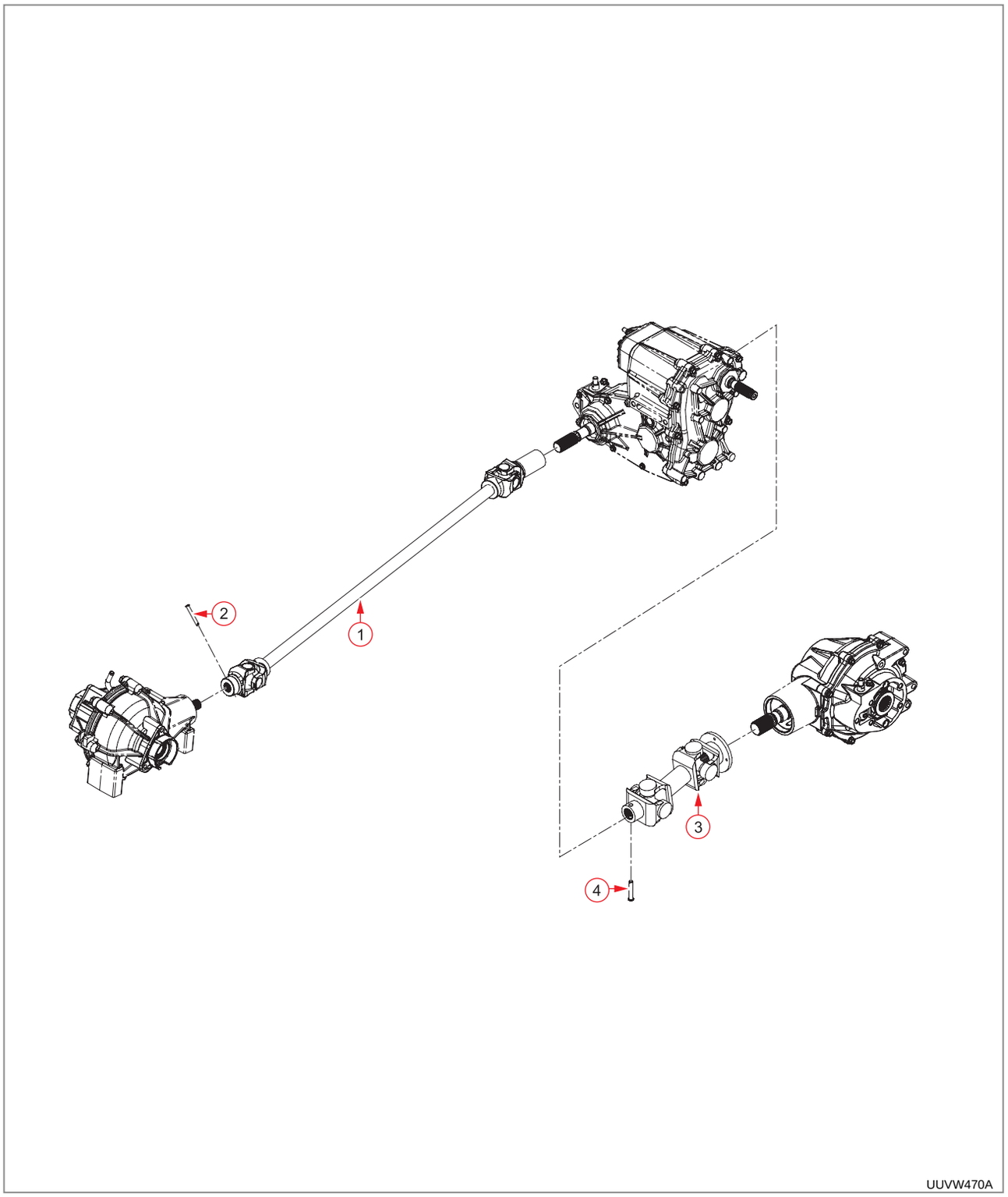


UUVW467A

COMPONENTS

(1) SHAFT, FRONT DRIVE
(2) SHIFT, FRONT DRIVE
(3) BEARING, NEEDLE
(4) BEARING, NEEDLE
(5) 19T, SPROCKET
(6) COLLAR
(7) BEARING, BALL
(8) BEARING, BALL
(9) OIL SEAL(25*47*10)
(10) FORK,FRONT DRIVING LOCK
(11) GUIDE, SHIFT
(12) ARM, SHIFT(FRONT)
(13) PIN, SPRING
(14) O RING
(15) PLATE, LOCK
(16) BOLT
(17) SHIM, 0.2
(18) SHIM, 0.3
(19) BEARING,BALL
(20) SHAFT, REAR DRIVE
(21) 22T, SPROCKET
(22) CIR CLIP, EXTERNAL
(23) COLLAR
(24) BEARING, BALL
(25) SHIM, 0.1
(26) SHIM, 0.2
(27) SHIM, 0.3
(28) OIL SEAL(25*47*10)
(29) SILENT CHAIN, 50
(30) ARM, LOCK
(31) O RING
(32) SHAFT
(33) GEAR 33
(34) O RING
(35) GEAR 16
(36) SPACER
(37) DISC, SHIFT
(38) FRICTION SPRING
(39) LEVER, GUIDE S-CHANGE
(40) FORK
(41) PIN,KNOCK
(42) ROD, FORK

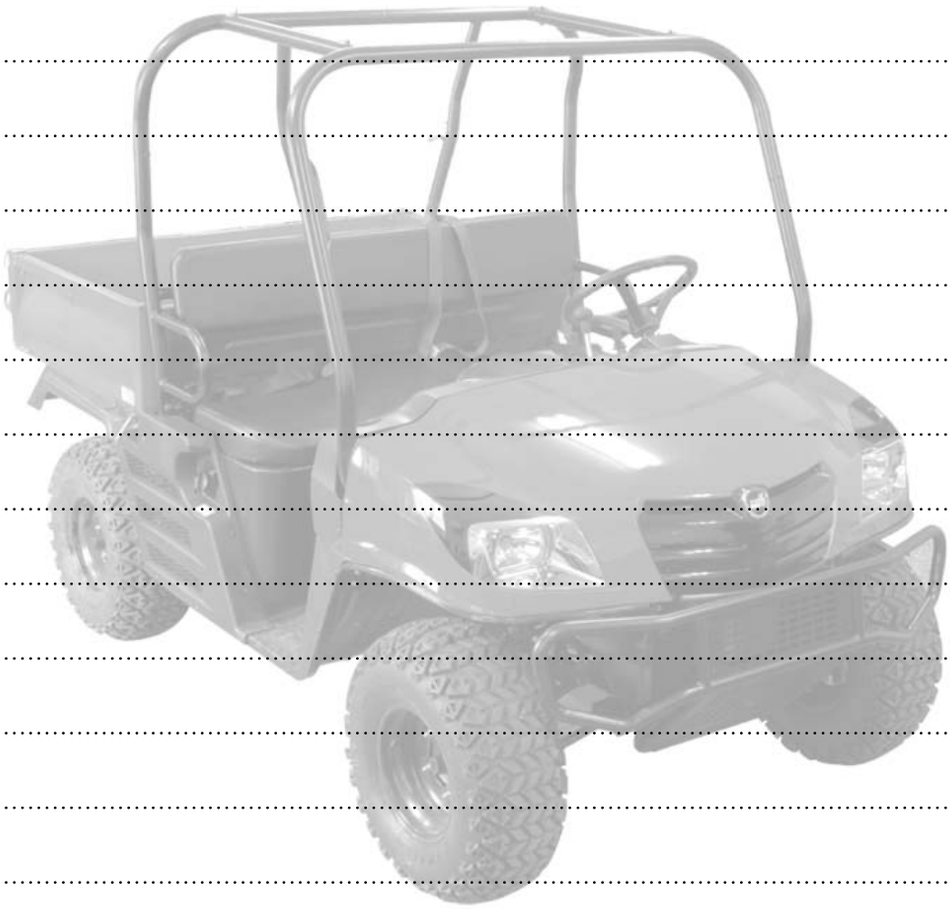
6.5 U160A PROPELLER SHAFT



COMPONENTS

(1) PROPELLER SHAFT ASSY, FR
(2) PIN, SPRING
(3) PROPELLER SHAFT ASSY, RR
(4) PIN, SPRING

MEMO



CHASSIS

CHAPTER 6

TABLE OF CONTENTS

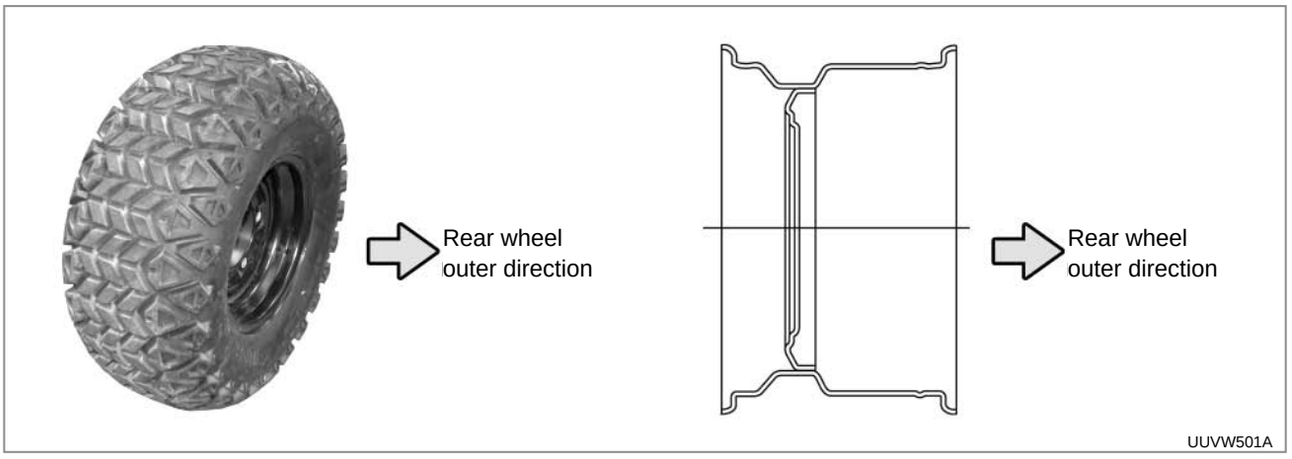
1. SPECIFICATIONS

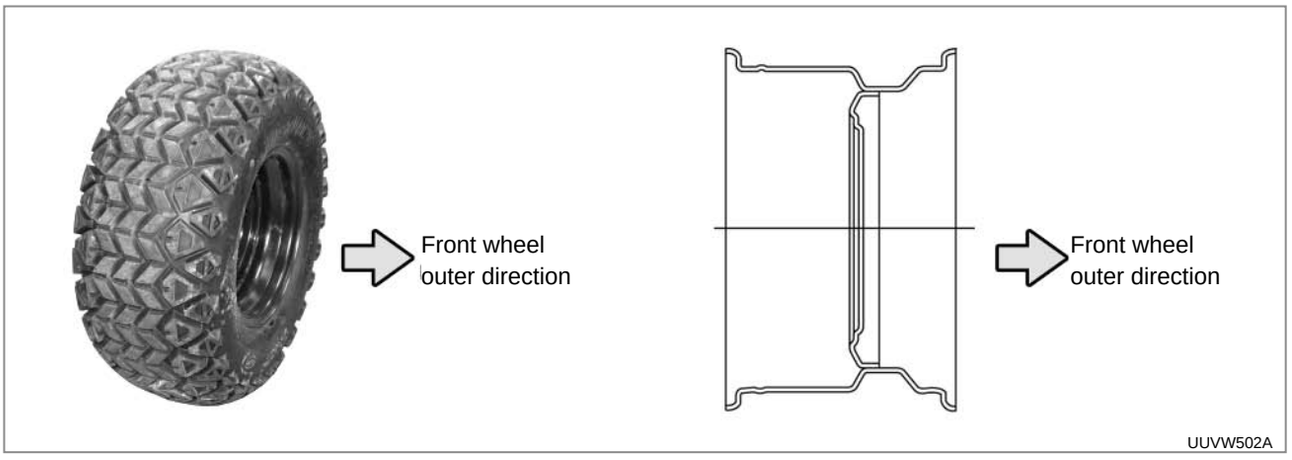
1.1 TIRE

Item	Standard		Specification
Standard tire inflation pressure	Front	25 x 10 - 12 (6PR)	12 psi (0.84 kgf/cm², 82.7 kPa)
	Rear	25 x 11 -12 (6PR)	18 psi (1.26 kgf/cm², 124.0 kPa)
Wheel nut tightening torque	Front	Flange nut (M10)	39.2 ~ 45.1 Nm 4.0 ~ 4.6 kgf-m 28.8 ~ 331 lb-ft
	Rear	Flange nut (M10)	

2. INSPECTION AND ADJUSTMENT

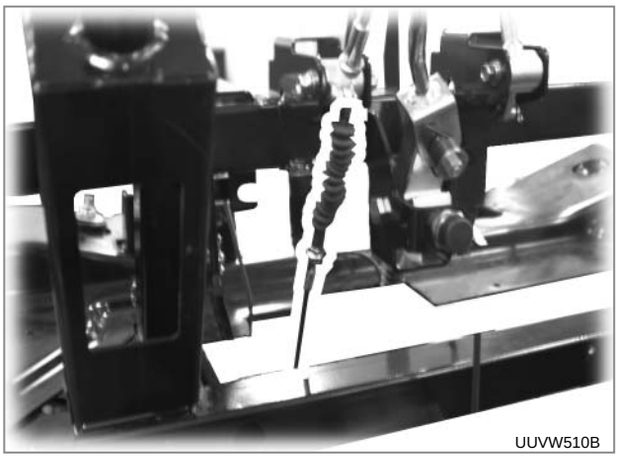
2.1 INSTALLATION DIRECTION OF FRONT/REAR TIRES

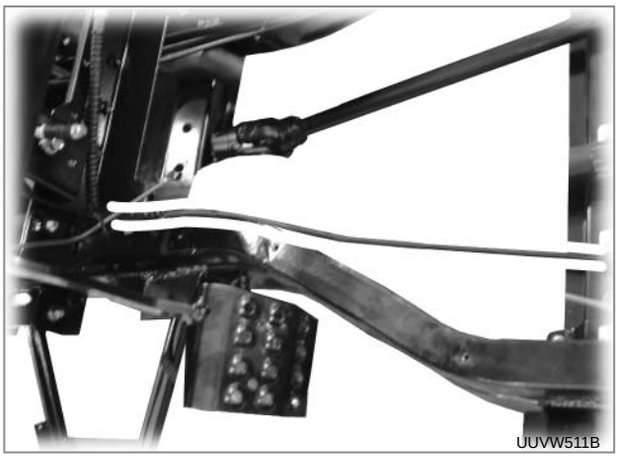




2.2 ROUTES FOR VARIOUS CABLES

2.2.1 DIFFERENTIAL LOCK CABLE


UUVW510B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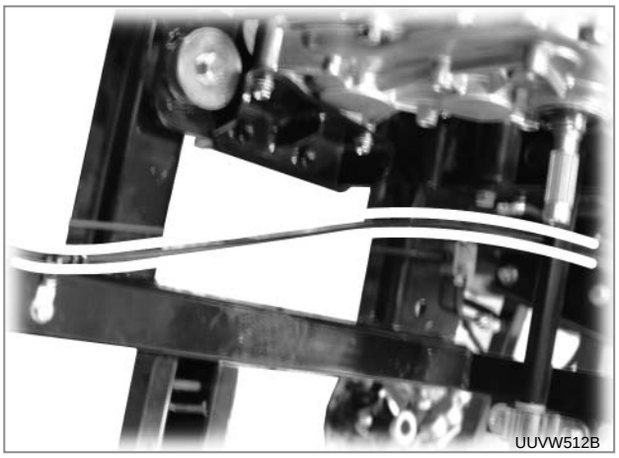
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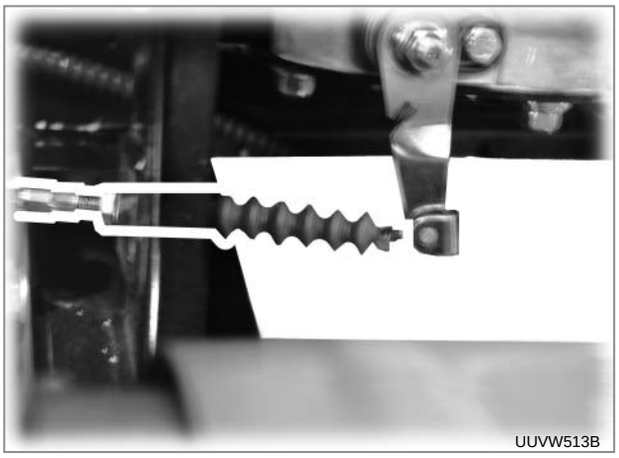
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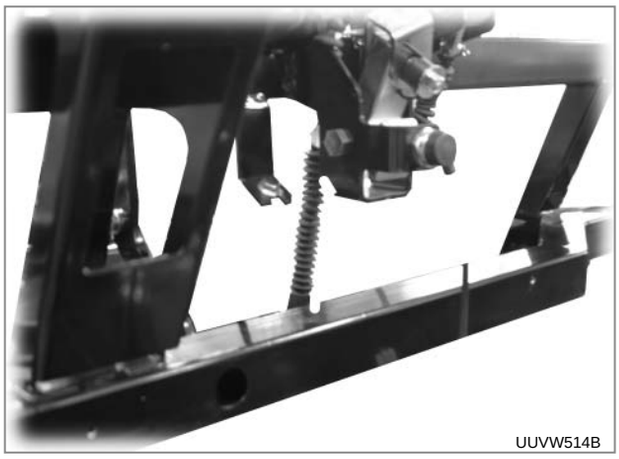
2.2.2 SHIFT SELECTOR CABLE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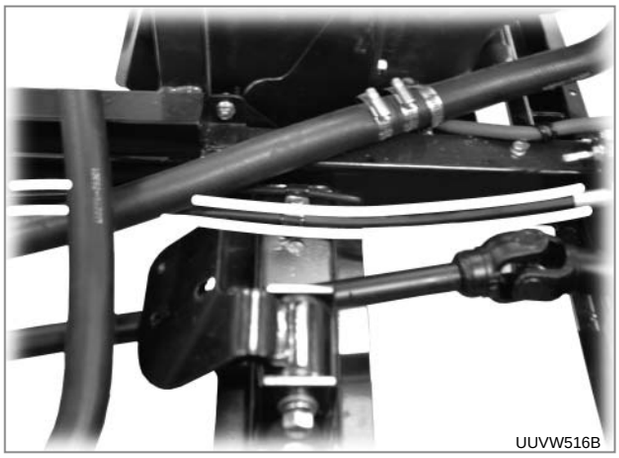
UUVW515B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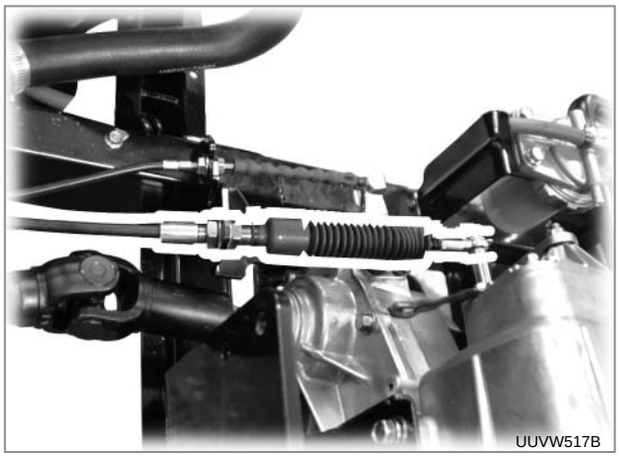
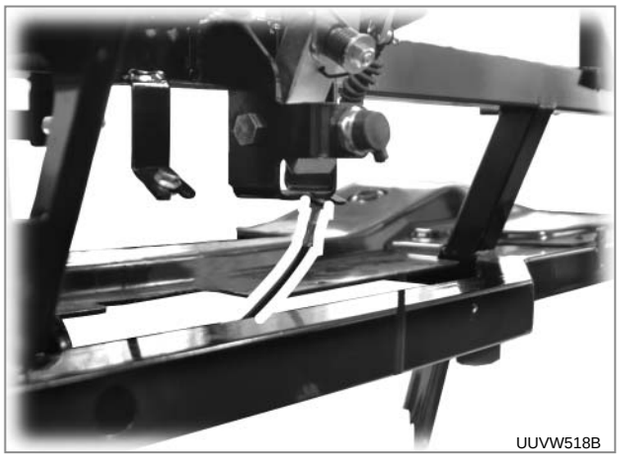

UUVW517B

2.2.3 FRONT WHEEL DRIVE CABLE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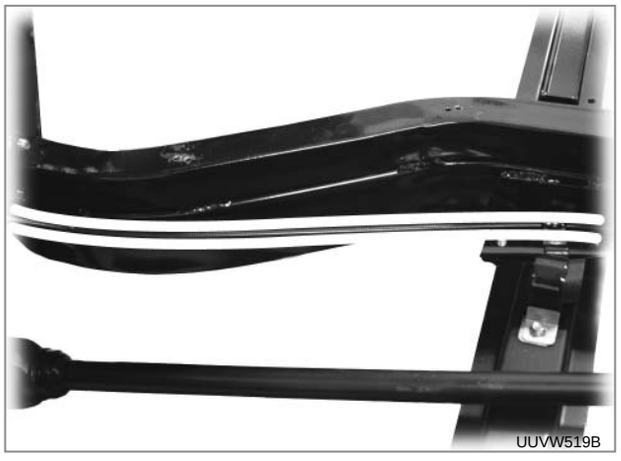
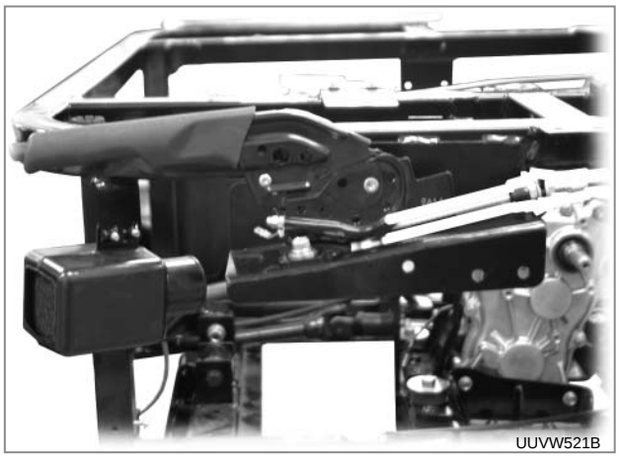

UUVW519B


UUVW520B

2.2.4 PARKING BRAKE CABLE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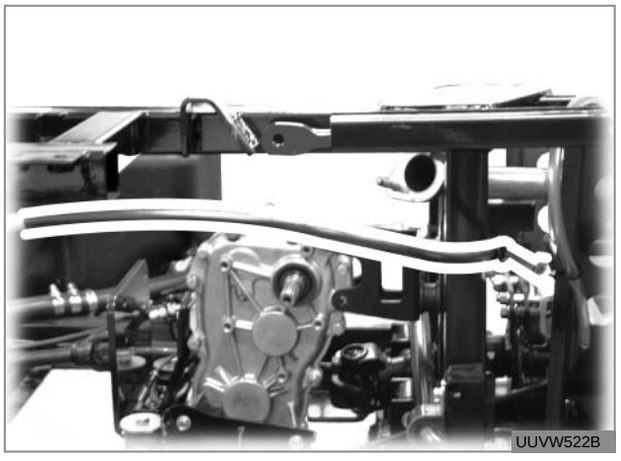
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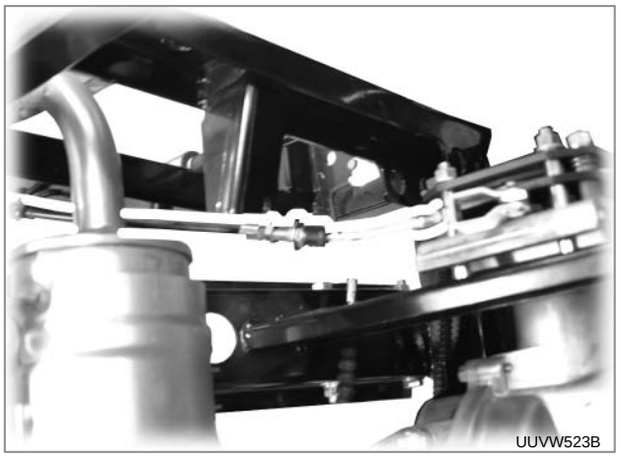
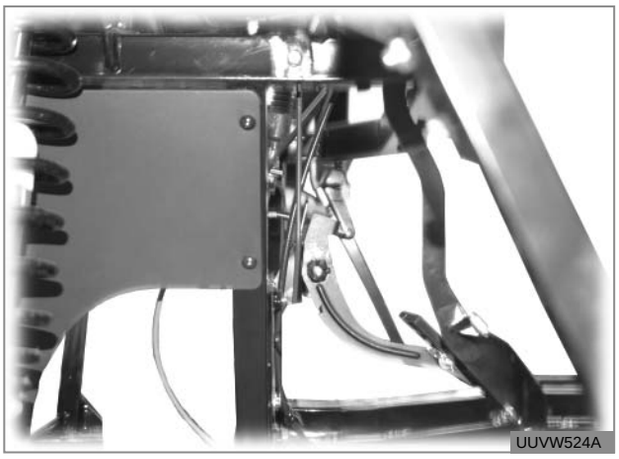
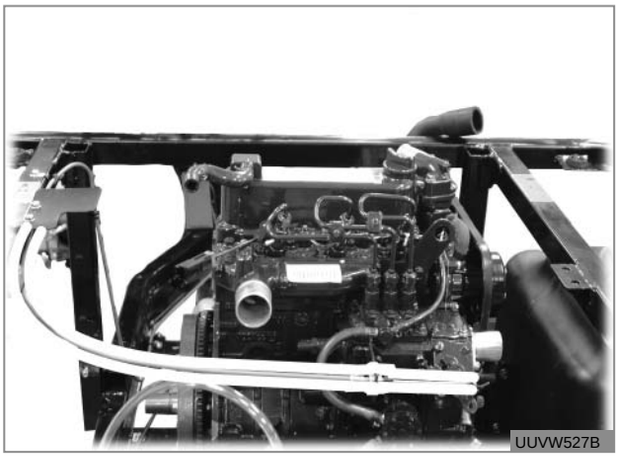

UUVW523B

2.2.5 ACCELERATOR PEDAL CABLE


UUVW524A


UUVW526B


UUVW527B

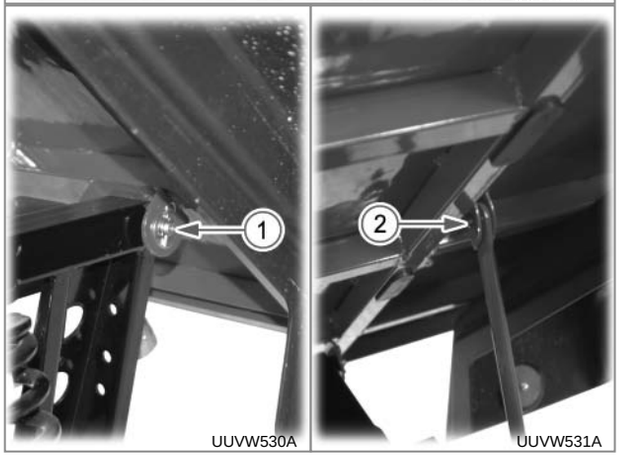
3. DISASSEMBLY, SERVICE AND ASSEMBLY

3.1 CARGO BED REMOVAL


UUVW528A

1. Park the vehicle on level ground, apply the parking brake and stop the engine.


UUVW2G6A



UUVW530A UUVW531A

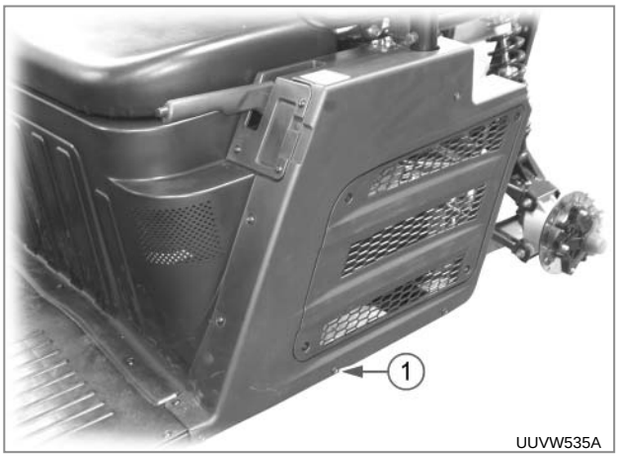
2. Lift the cargo bed and remove the mounting pins (1) from both sides. Then, pull out the cargo bed support pole connecting pin (2) and remove the gas cylinder fixing bolt(3) to remove the cargo bed.

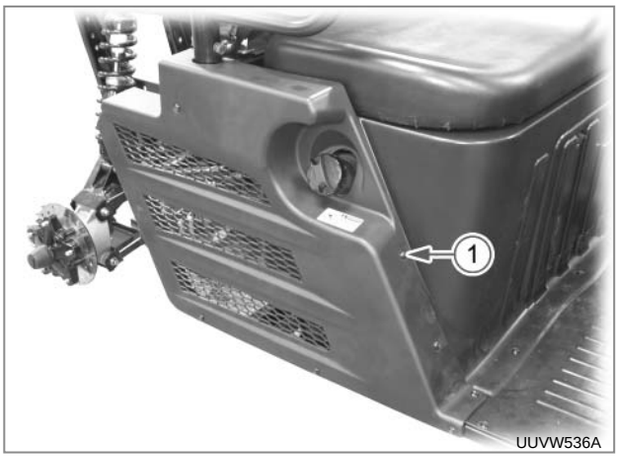
⚠ CAUTION

- **As the cargo bed is heavy, it should be removed by more than 1 person. Also, take precaution not to drop it and injure yourself.**
- **The cargo bed should be removed using a hoist or crane.**

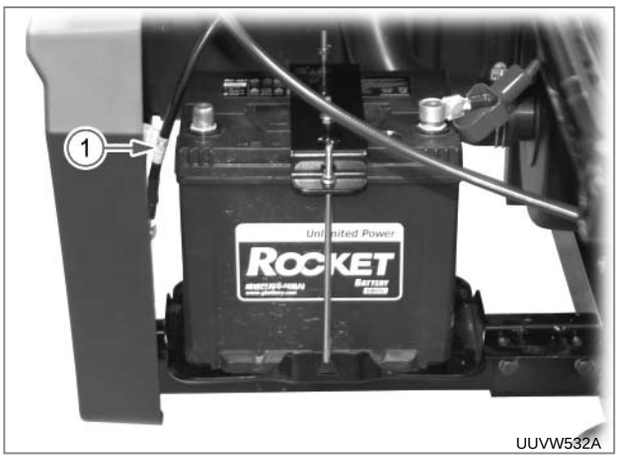
3.2 SEAT AND FENDER REMOVAL

1. Unscrew the wheel lug nuts to remove the front and rear wheels.

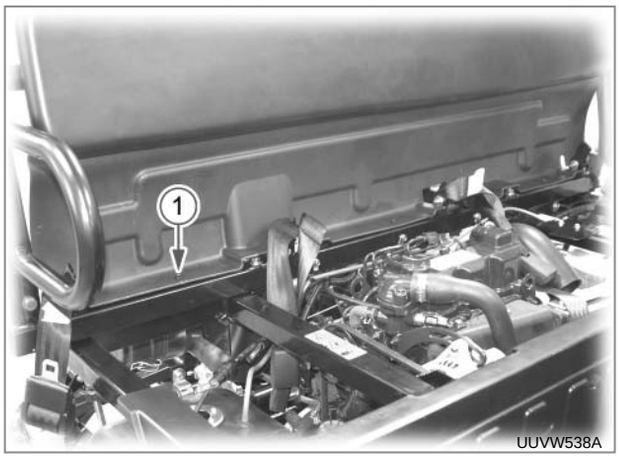


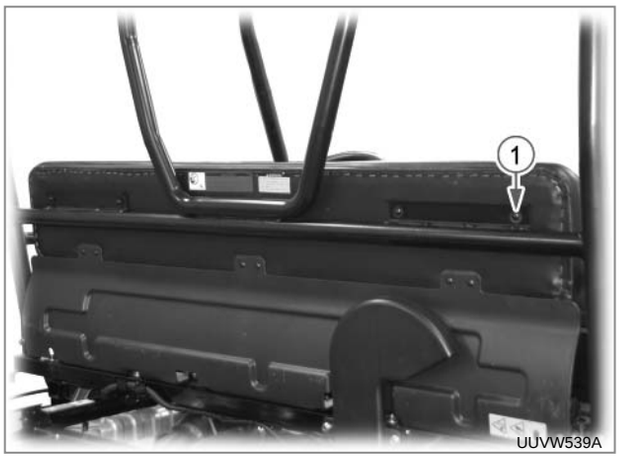


2. Unscrew the left and right cover mounting screws (1) for the middle fender to remove the covers.



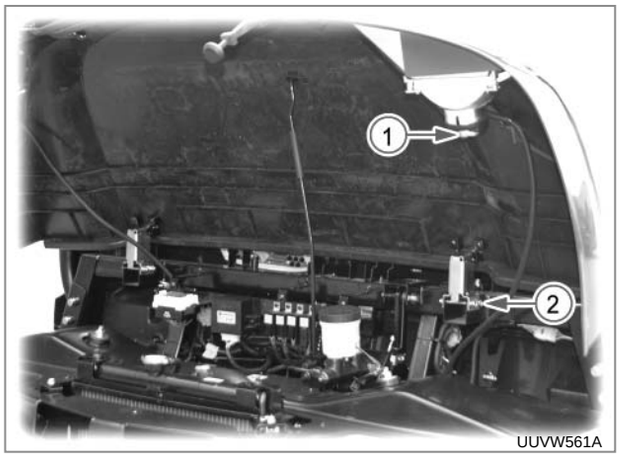
3. Remove the battery cover and disconnect the negative battery cable (1).



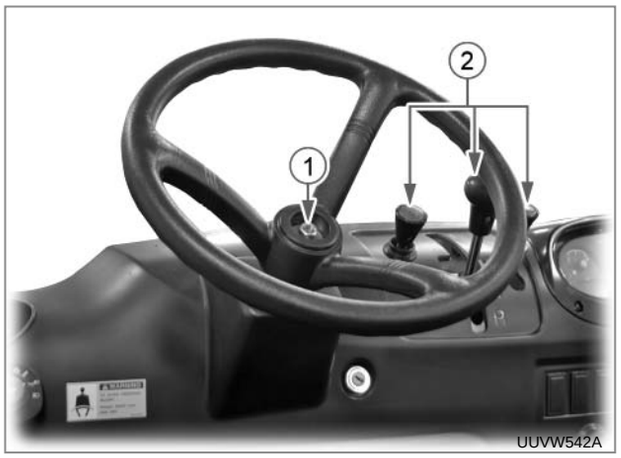


4. Remove the seat by pulling it up in the front. Then, unscrew the seatback assembly mounting screws (1) to remove the seatback assembly.

3.3 HOOD, PANEL, FLOOR AND RADIATOR REMOVAL

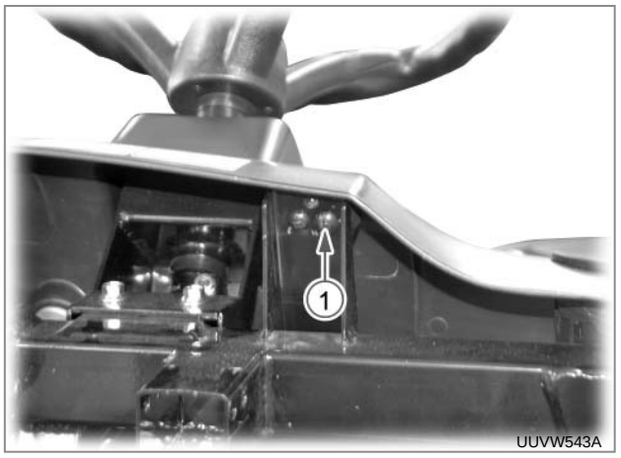


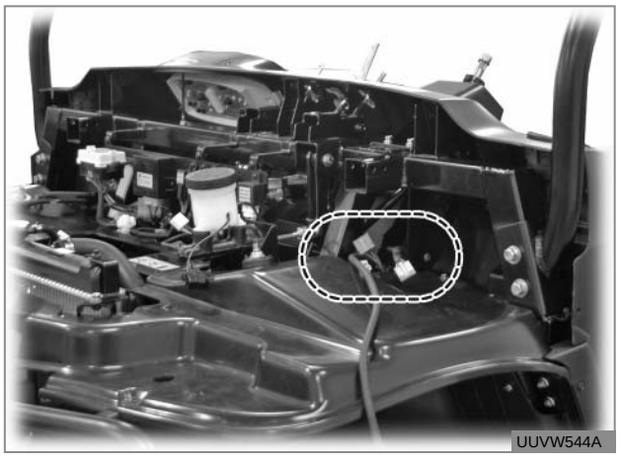
1. Disconnect the headlamp connector (1) and unscrew the hood mounting bolts (2) on the left and right to remove the hood.



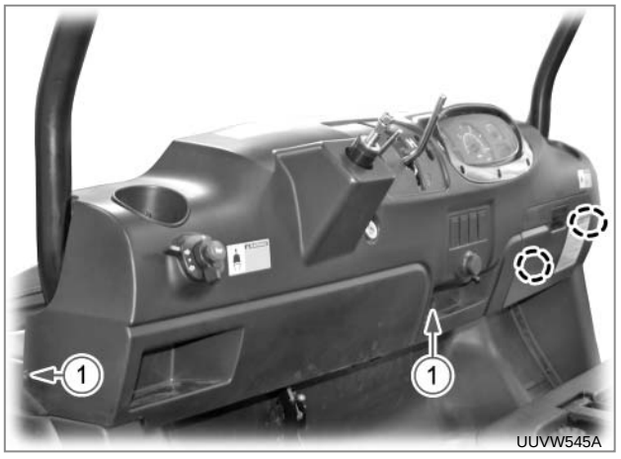
2. Remove the steering wheel cover and unscrew the mounting nut (1) to remove the steering wheel. The unscrew the grip mounting screws to remove the grips (2) for the shift levers.

- **Steering wheel mounting nut tightening torque ..... 48.0 ~ 55.9 Nm (4.90 ~ 5.7 kgf-m, 35.3 ~ 41.0 lb-ft)**

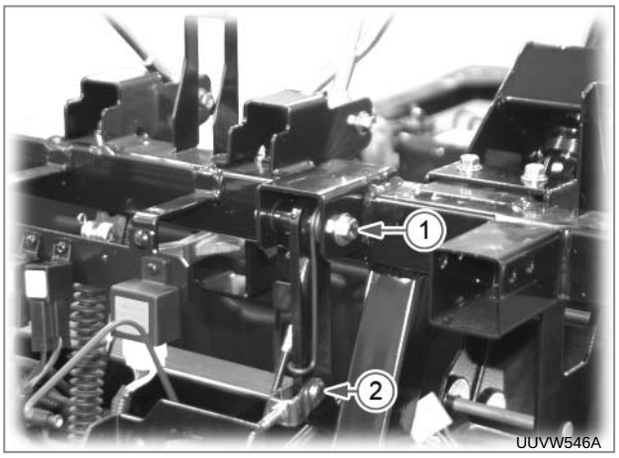


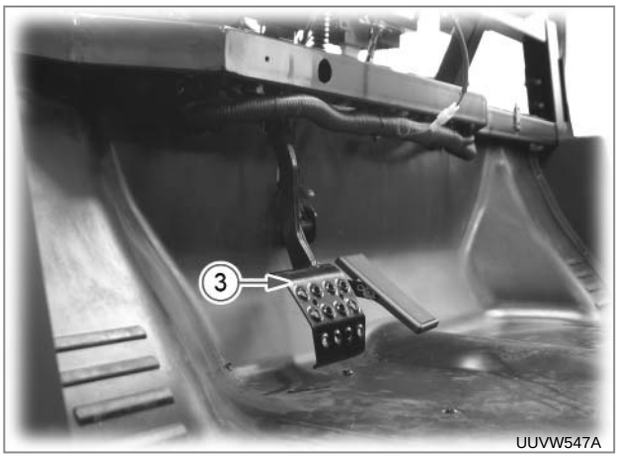


3. Unscrew the panel mounting screws (1) (LH/RH) from the hood side. Then, disconnect the connectors for the instrument cluster, power take-off socket, ignition key and combination switch.

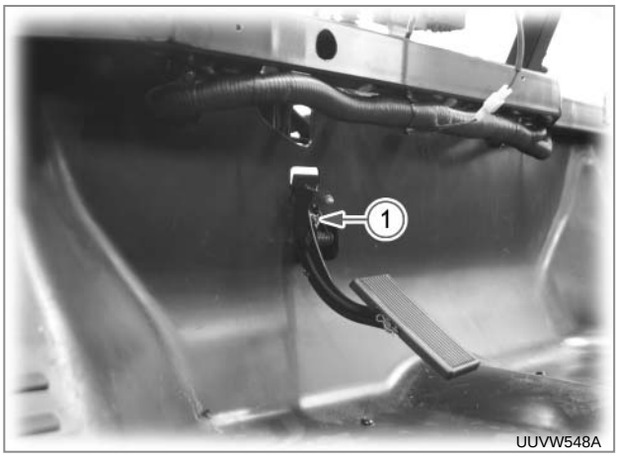


4. Unscrew the panel mounting screws (1, 4 EA) from the seat side and pull the panel up to remove it.

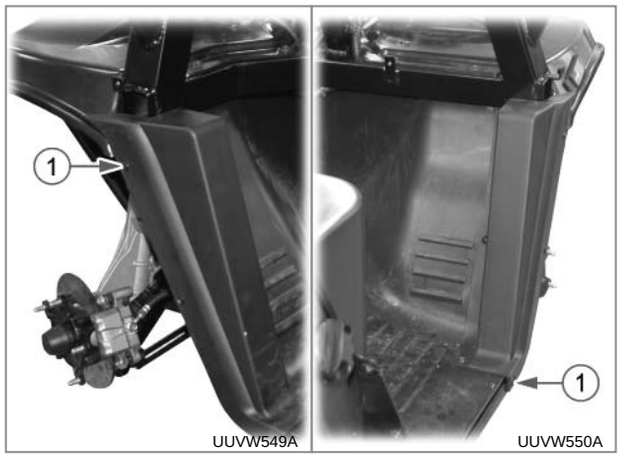




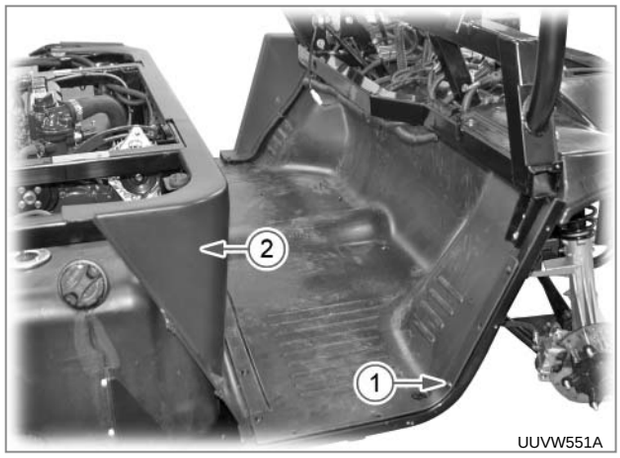
5. Unscrew the brake pedal hinge mounting bolt (1) and pull out the rod connecting pin (2). Then, remove the brake pedal (3) through the hole.



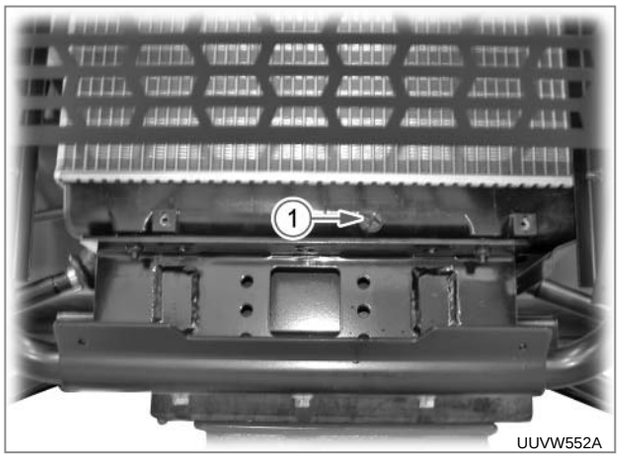
6. Unscrew the accelerator pedal mounting bolt (1) to remove the accelerator pedal assembly.



7. Unscrew the left and right cover mounting screws (1) for the middle fender to remove the covers (LH/RH).



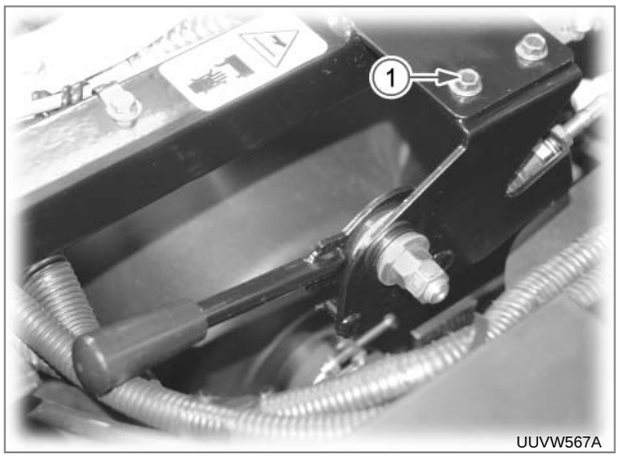
8. Unscrew the main floor assembly mounting screws (1) (FRT/RR), and press and pull the bottom of the main floor to remove the rear main floor (2).



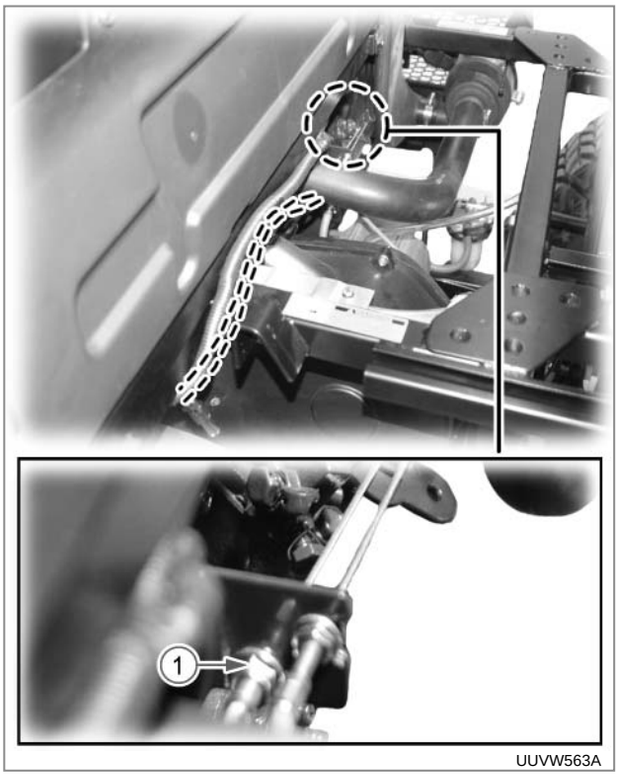
9. If necessary, unscrew the front grill (lower) mounting screw and open the drain cock (1) to drain the coolant. Then, disconnect the coolant hose and electric motor connector and unscrew the radiator mounting bolts (2) to remove the radiator assembly.
10. Assemble in the reverse order of disassembly.

3.4 HAND THROTTLE DISASSEMBLY

1. Remove the seat(1). Lift the cargo bed and secure it.

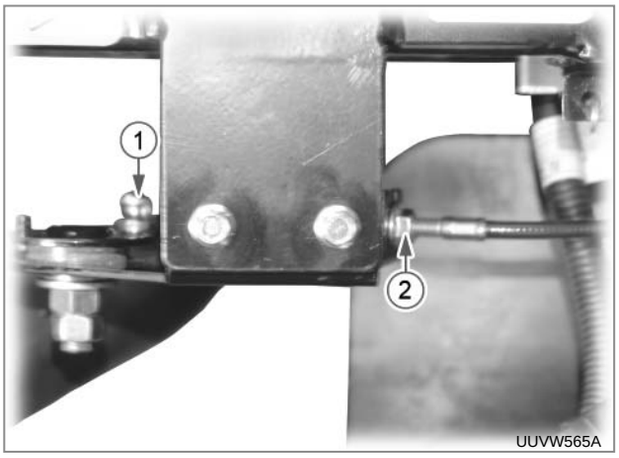


2. Unscrew the mounting bolts (1) for the accelerator lever bracket on the bottom frame of the seat in order to remove the lever assembly and bracket.



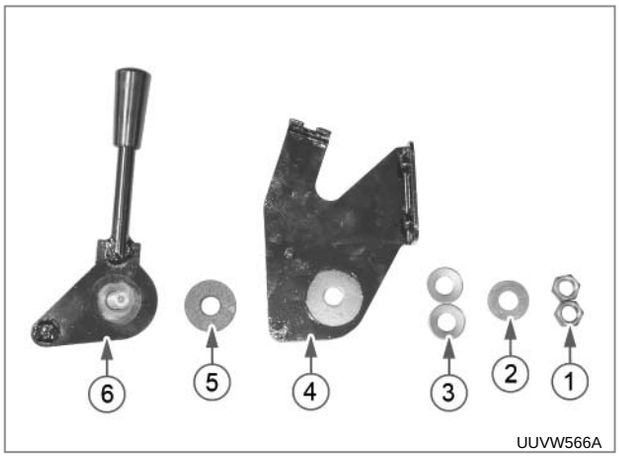
UUVW563A

3. Unscrew the speed control lever bracket adjusting nut (1) on the engine side and disconnect the cable.



UUVW565A

4. Pull out the cable mounting snap pin (1) on the accelerator lever side and unscrew the cable adjusting nut (2) from the bracket to disconnect the cable.

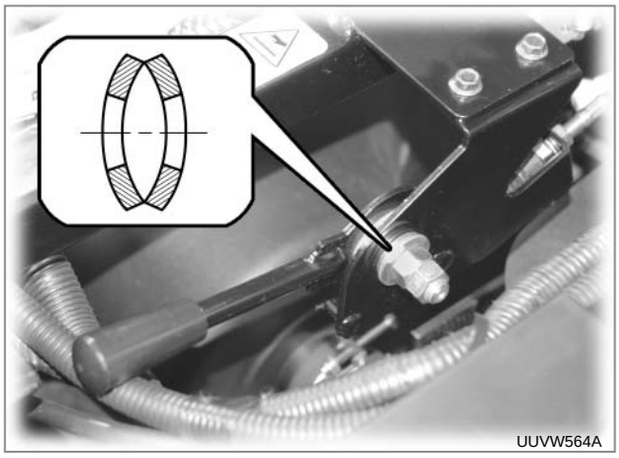


UUVW566A

5. Unscrew the accelerator lever mounting double nut and remove the nut (1), plain washer (2), plate spring (3), bracket (4), brake lining (5) and accelerator lever (6).
6. Assemble in reverse order of disassembly.

IMPORTANT

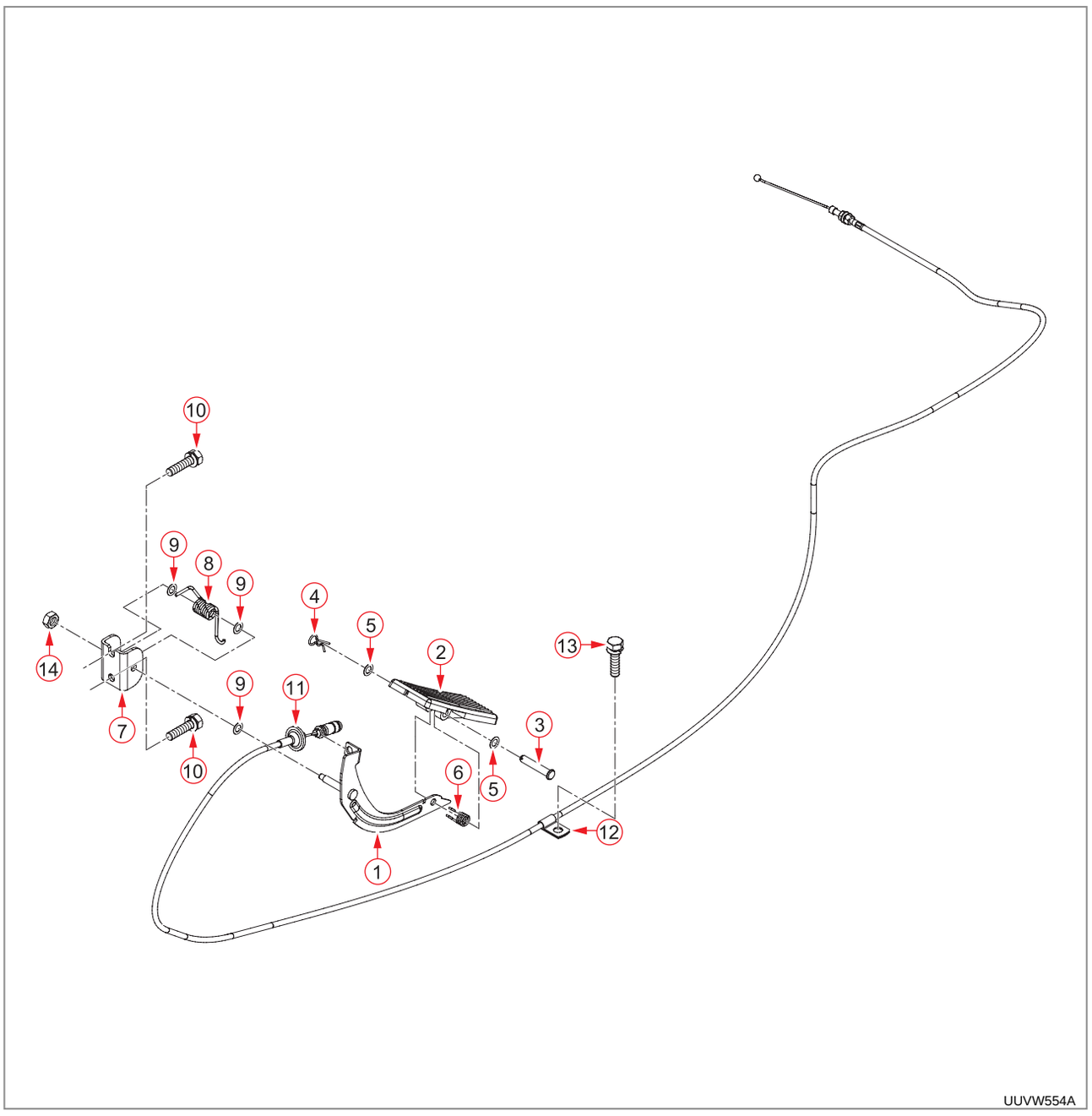
- **To adjust the cable length, lower the accelerator lever to the lowest position of the guide and fit its cable end on the engine side to the speed control lever groove. Then, install the cable to the speed control lever bracket, pulling it gently with the speed control lever not pulled up, and tighten the adjusting nut to secure it.**


UUVW564A

7. When installing the accelerator lever to the bracket, make sure to install the plate springs facing each other (convex side outward) and tighten the double nut to secure them.

4. COMPONENTS

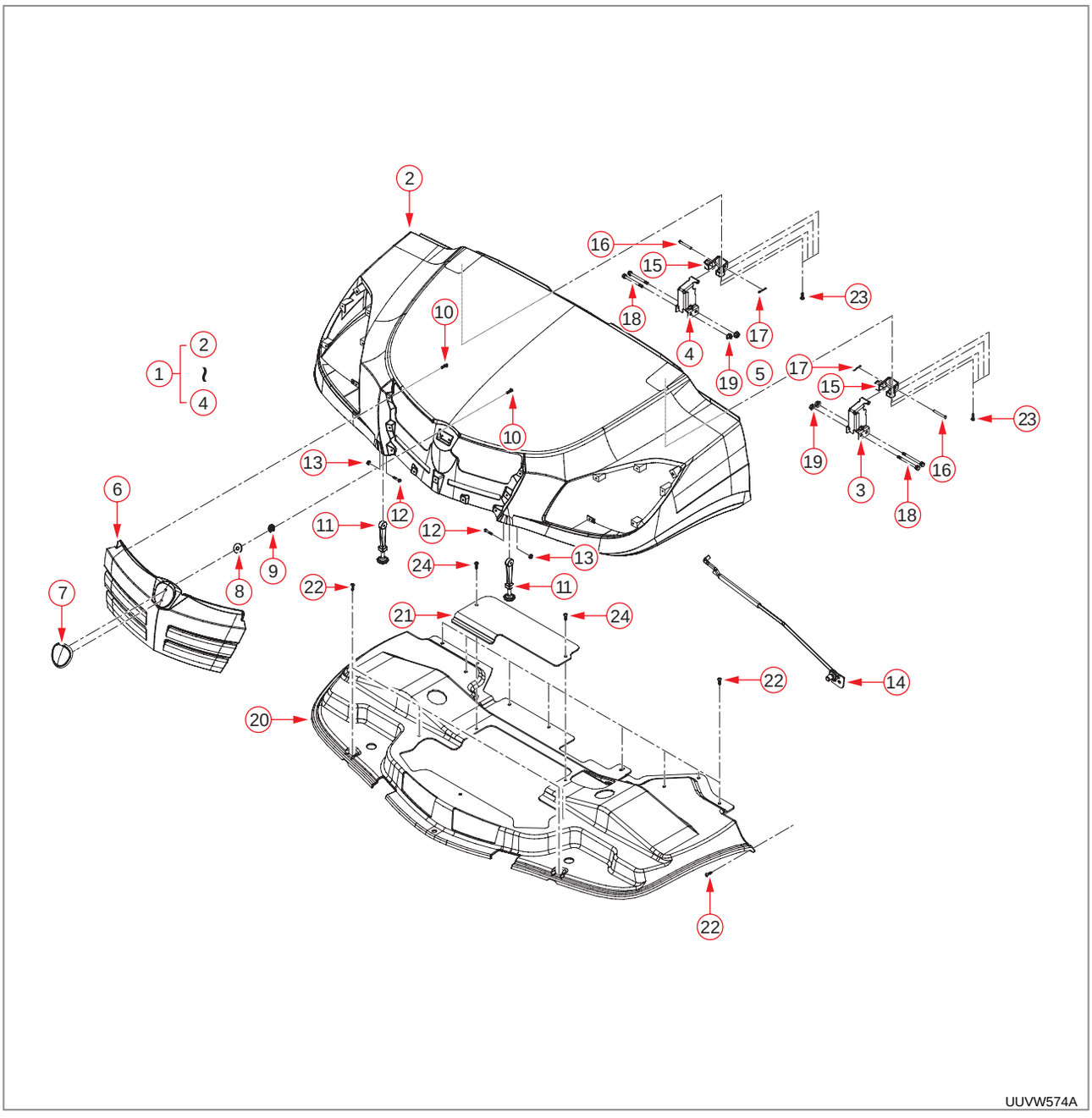
4.1 U030A ACCELERATOR PEDAL



COMPONENTS

(1) ARM ASSY, ACCEL PEDAL
(2) FOOT, ACCEL PEDAL
(3) PIN, HEAD
(4) PIN, SNAP
(5) WASHER, PLAIN
(6) SPRING, ACCEL PEDAL
(7) BRKT, ACCEL PEDAL MTG
(8) SPRING
(9) WASHER, PLAIN
(10) BOLT, FLANGE
(11) ACCEL PEDAL CABLE
(12) CLAMP
(13) BOLT, FLANGE
(14) LOCK NUT

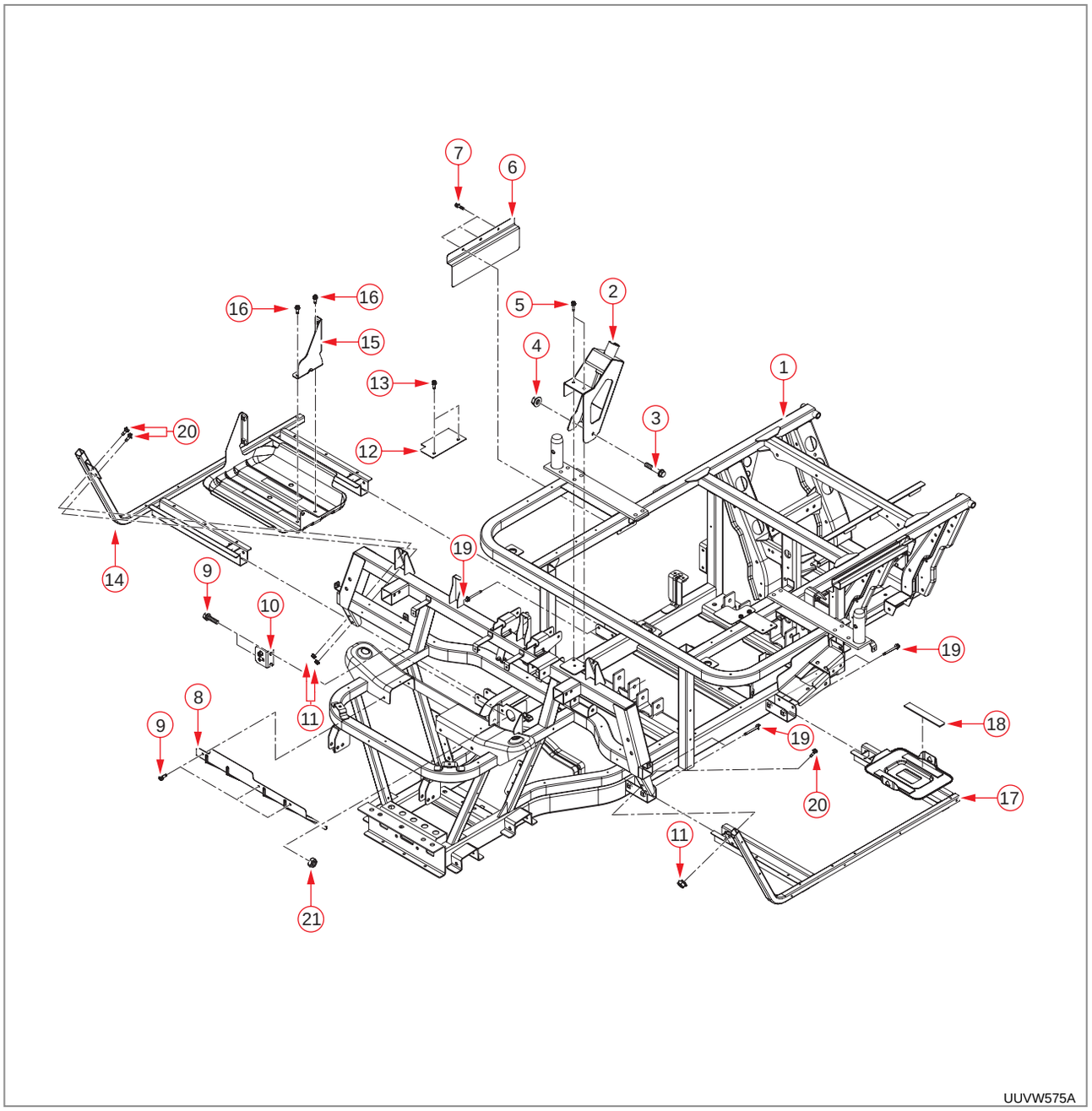
4.2 U0912A HOOD



COMPONENTS

(1) HOOD ASSY(GREEN)
(2) HOOD(GREEN)
(3) HOOD HINGE LH ASSY
(4) HOOD HINGE RH ASSY
(5) TAPPING SCREW
(6) GRILL ASSY
(7) EMBLEM
(8) PLATE, RUBBER
(9) PLATE, FIXED
(10) TAPPING SCREW
(11) STRAP,HOOD LATCH
(12) BOLT, FLANGE
(13) NUT, FLANGE
(14) ASSY SUPPORT
(15) HOOD HINGE BRKT
(16) JOINT PIN
(17) PIN, SPLIT
(18) BOLT, WASHER
(19) NUT, FLANGE
(20) HOOD LINER
(21) COVER, HOOD LINER
(22) SCREW (BLACK)
(23) FLANGE BOLT
(24) SCREW (BLACK)

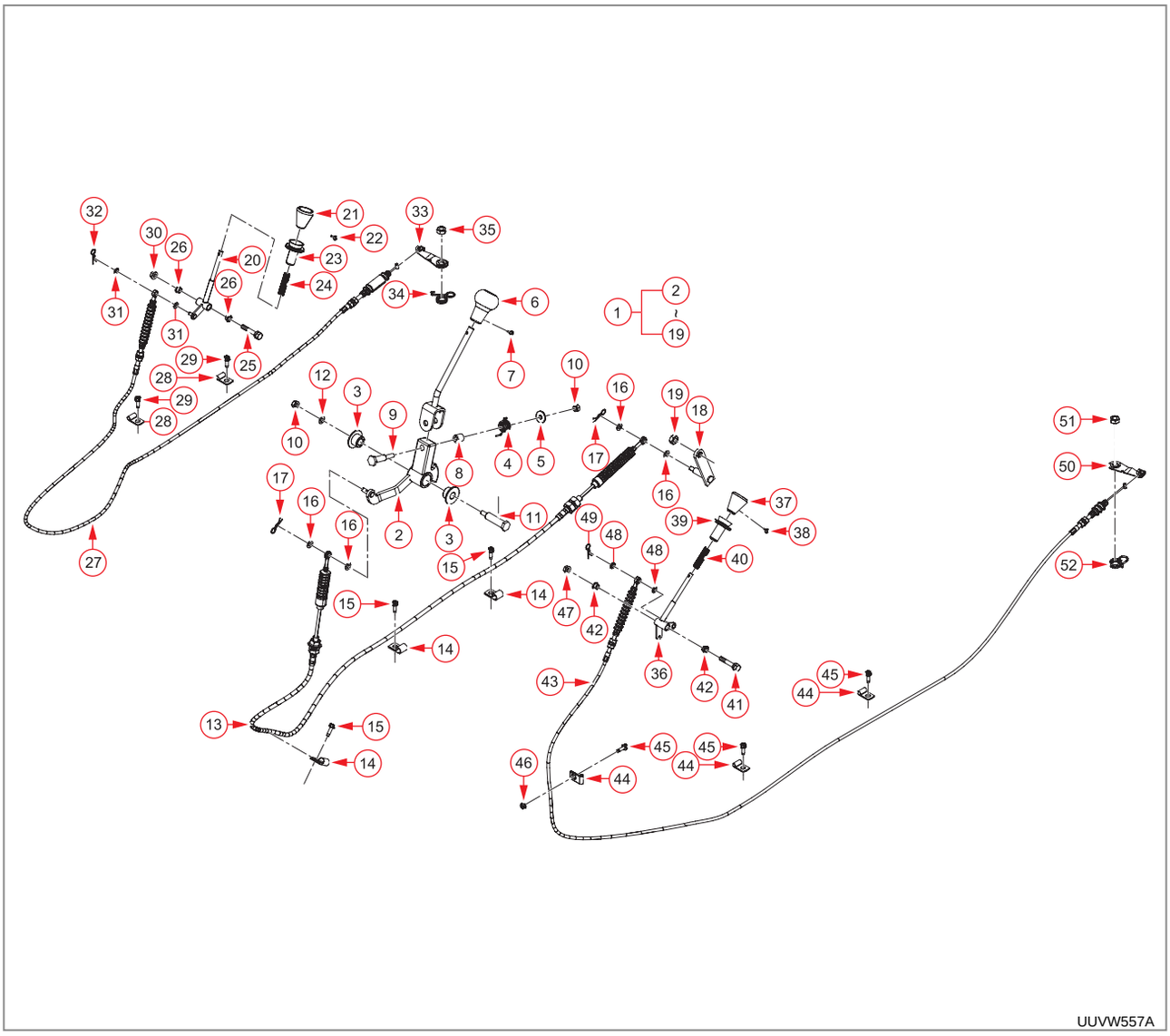
4.3 U0200A STRUCTURE



COMPONENTS

(1) STRUCTURE ASSY
(2) STEERING COVER ASSY
(3) BOLT
(4) NUT, FLANGE
(5) BOLT, FLANGE
(6) COVER, COOLING FAN
(7) SCREW (BLACK)
(8) HEAT-PROTECTOR BRKT
(9) SCREW (BLACK)
(10) STAY ROD BRKT
(11) NUT, FLANGE
(12) NOISE PLATE
(13) BOLT, FLANGE
(14) SUPPORT FLOOR FRAME ASSY RH
(15) BRACKET-FUEL TANK ASSY, LH
(16) FLANGE BOLT
(17) SUPPORT FLOOR FRAME ASSY LH
(18) RUBBER, CUSHION
(19) BOLT
(20) BOLT, WASHER
(21) NUT, FLANGE

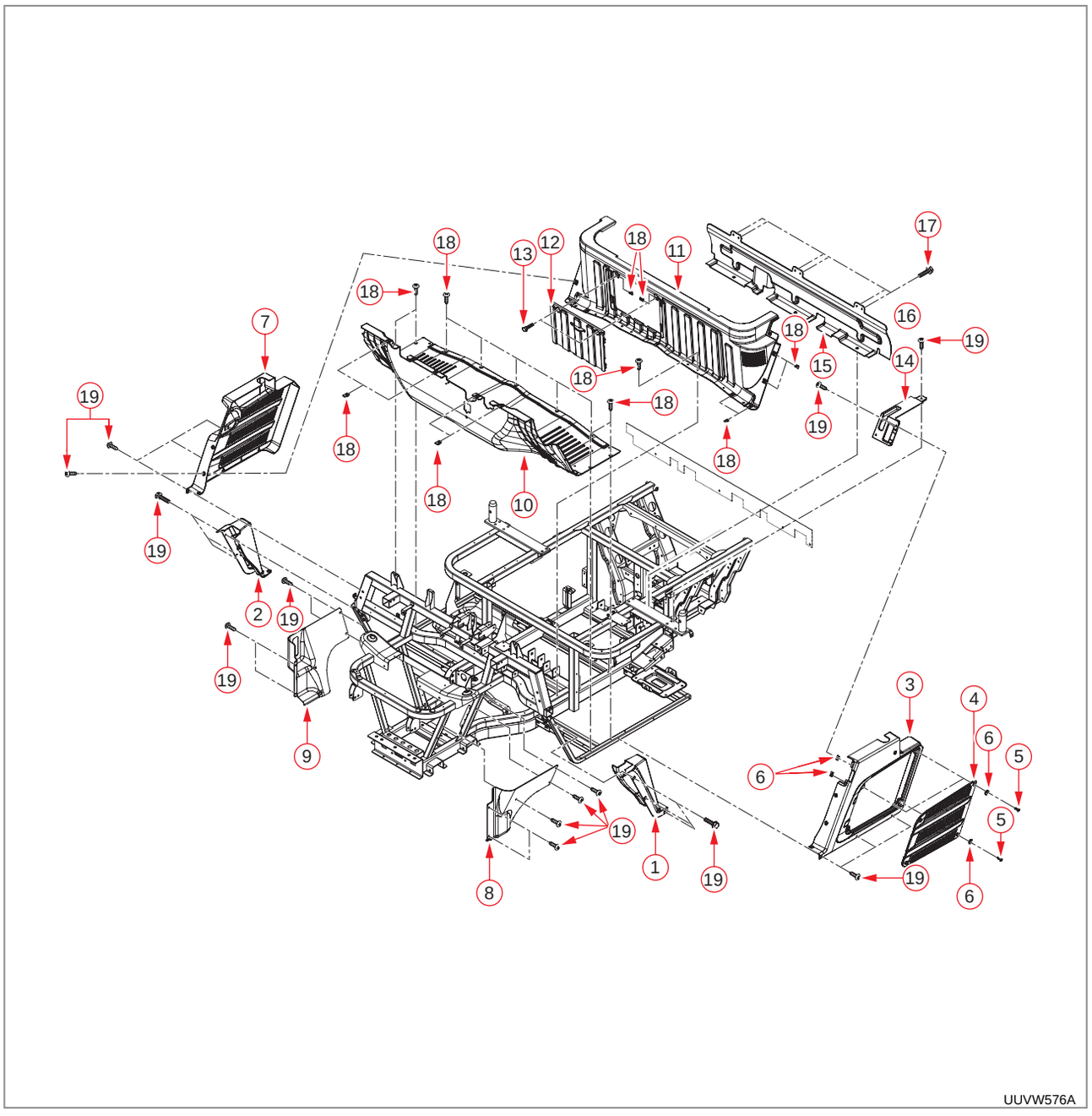
4.4 U630A LEVER



COMPONENTS

(1) SELECTOR SHIFT LEVER ASSY
(2) LOWER ARM ASSY, SELECTOR
(3) BUSHING, SHIFT LEVER
(4) SPRING, SHIFT LEVER RETURN
(5) WASHER, SHIFT LEVER
(6) GRIP
(7) SCREW
(8) SPACER, SELECTOR
(9) BOLT, SELECTOR BRACKET
(10) NUT
(11) BOLT, SHIFT BRACKET
(12) WASHER, PLAIN
(13) GEAR SELECTOR CABLE ASSY
(14) CLAMP
(15) BOLT, FLANGE
(16) WASHER, PLAIN
(17) PIN, SNAP
(18) SELECTOR SHIFT LEVER ASSY
(19) NUT
(20) 4WD LEVER ASSY
(21) GRIP
(22) BOLT,SCREW
(23) TUBE, LOCK LEVER
(24) SPRING, ROD
(25) PIN,HEAD
(26) BUSH
(27) 4WD CABLE ASSY
(28) CLAMP
(29) BOLT, FLANGE
(30) PIN, SNAP
(31) WASHER, PLAIN
(32) PIN, SNAP
(33) 4WD LEVER ASSY
(34) SPRING
(35) NUT
(36) DIFF LEVER ASSY
(37) KNOB ASSY, DIFF LOCK
(38) BOLT, SCREW
(39) TUBE, LOCK LEVER
(40) SPRING, ROD
(41) SPRING, DIFF LOCK RETURN
(42) PIN,HEAD
(43) BUSH
(44) DIFF LOCK CABLE ASSY
(45) CLAMP
(46) BOLT, FLANGE
(47) NUT, FLANGE
(48) PIN, SNAP
(49) WASHER, PLAIN
(50) PIN, SNAP
(51) DIFF LEVER ASSY
(52) NUT
(53) SPRING

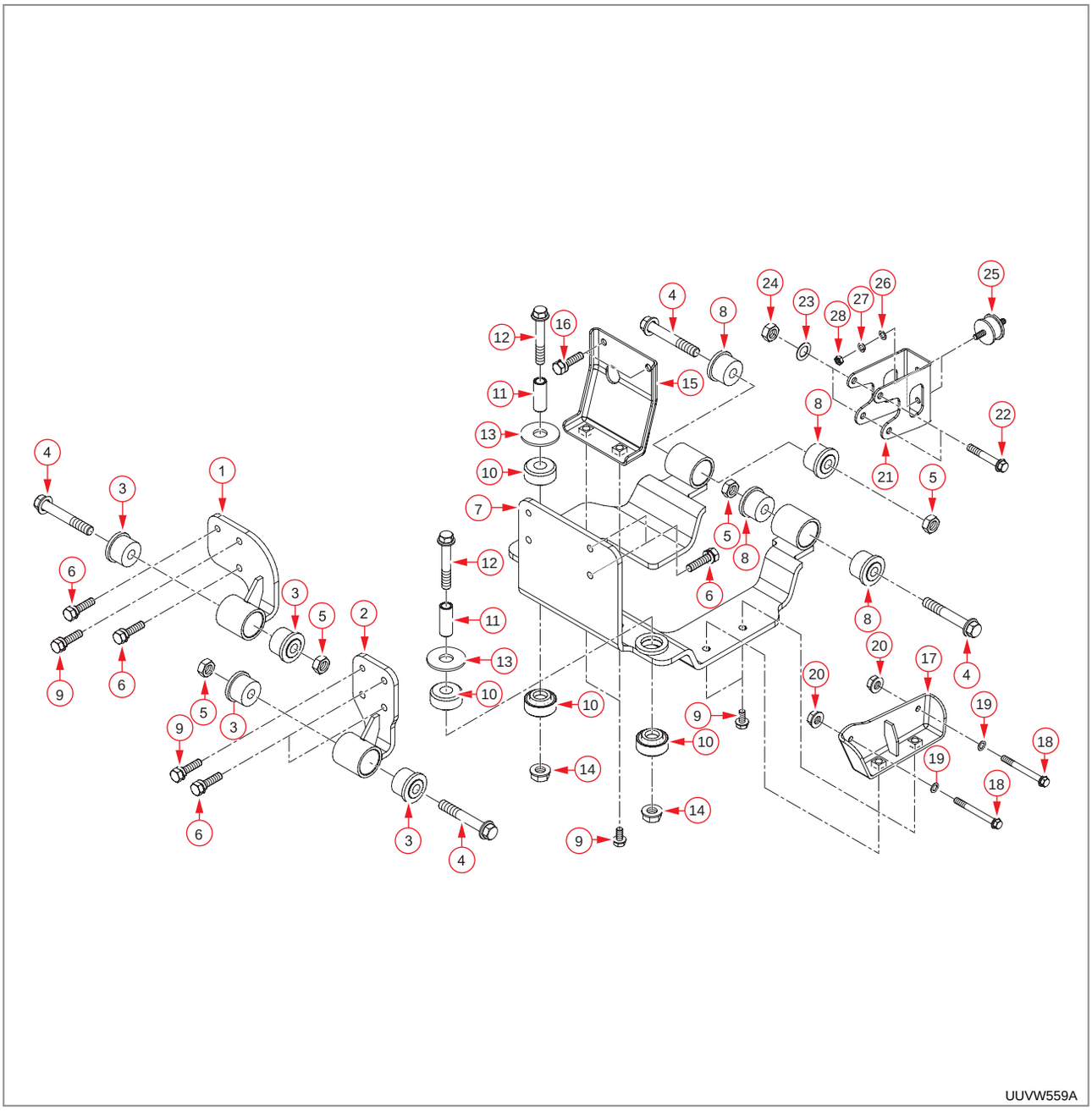
4.5 U0900A MOLDING



COMPONENTS

(1) FENDER, FR LH
(2) FENDER, FR RH
(3) FENDER MIDDLE OUTER, LH
(4) COVER, BATTERY
(5) SCREW
(6) NUT, SPRING
(7) FENDER MIDDLE OUTER, RH
(8) PANEL WHEEL WELL, LH
(9) PANEL WHEEL WELL, RH
(10) MAIN FLOOR ASSY FR
(11) NUT, SPRING
(12) MAIN FLOOR ASSY RR
(13) NUT, SPRING
(14) FLOOR REAR, LH
(15) OIL CHECK COVER ASSY
(16) BOLT
(17) PARKING LEVER COVER
(18) COVER, SEAT BACK RR
(19) BOLT, FLANGE
(20) SCREW

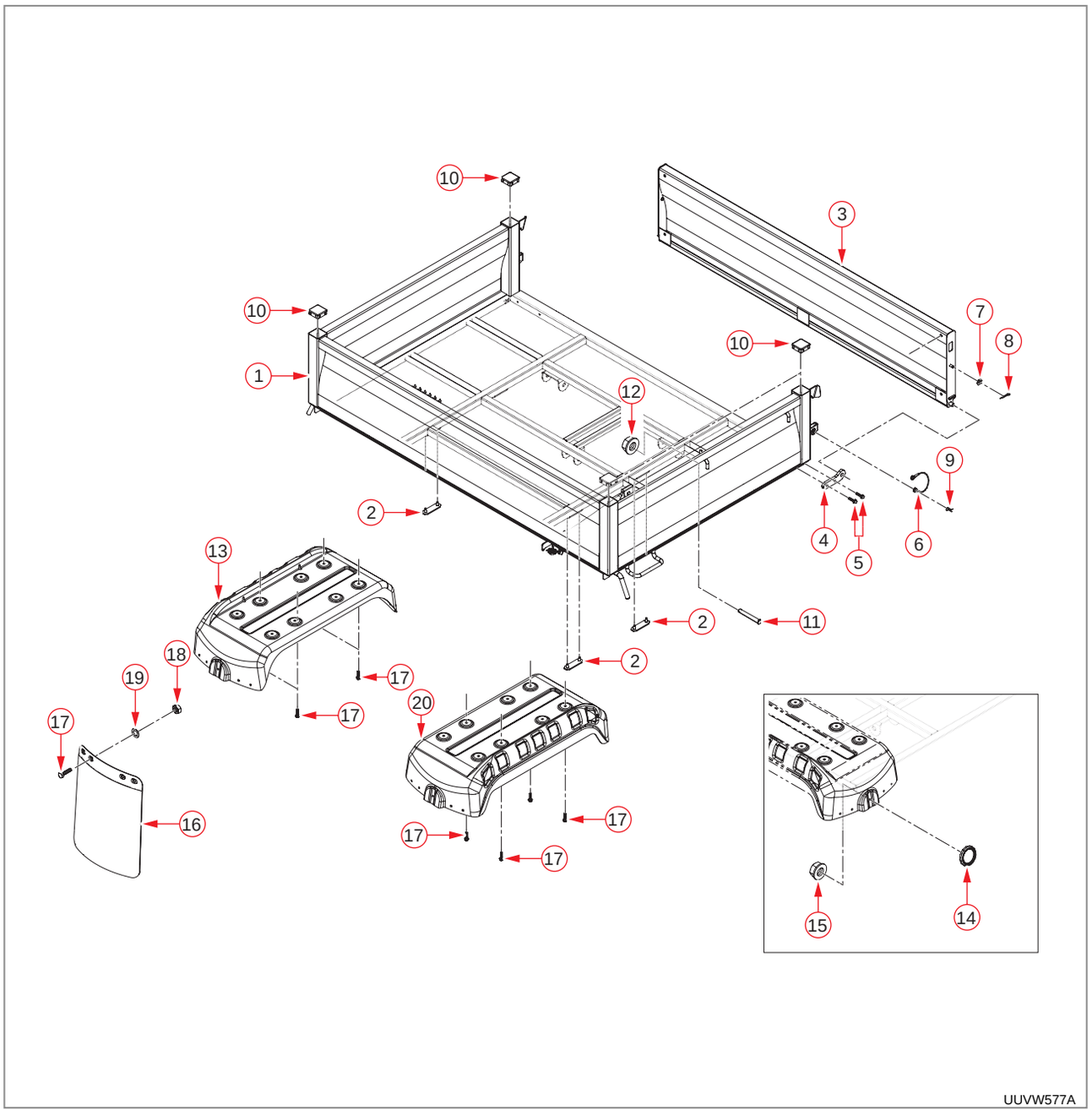
4.6 U670A ENGINE MOUNTING



COMPONENTS

(1) ENGINE MOUNTING FRONT BRACKET ASSY
(2) ENGINE MOUNTING FRONT BRACKET ASSY
(3) DAMPER, ROLL MOUNTING
(4) REAMER BOLT, FLANGE
(5) NUT
(6) BOLT
(7) ENGINE MOUNTING FRONT BRACKET ASSY
(8) DAMPER, ROLL MOUNTING
(9) BOLT
(10) DAMPER ASS'Y-ENG. MOUNTING
(11) BUSH
(12) BOLT
(13) WASHER
(14) FLANGE NUT
(15) TM MOUNTING BRACKET ASSY, FR
(16) WASHER BOLT
(17) BRACKET, TM MOUNTING REAR
(18) BOLT
(19) WASHER, PLAIN
(20) NUT, FLANGE
(21) BRACKET, TM MOUNTING REAR
(22) BOLT
(23) WASHER, PLAIN
(24) NUT
(25) MOUNTING RUBBER
(26) WASHER, PLAIN
(27) WASHER, SPRING
(28) NUT

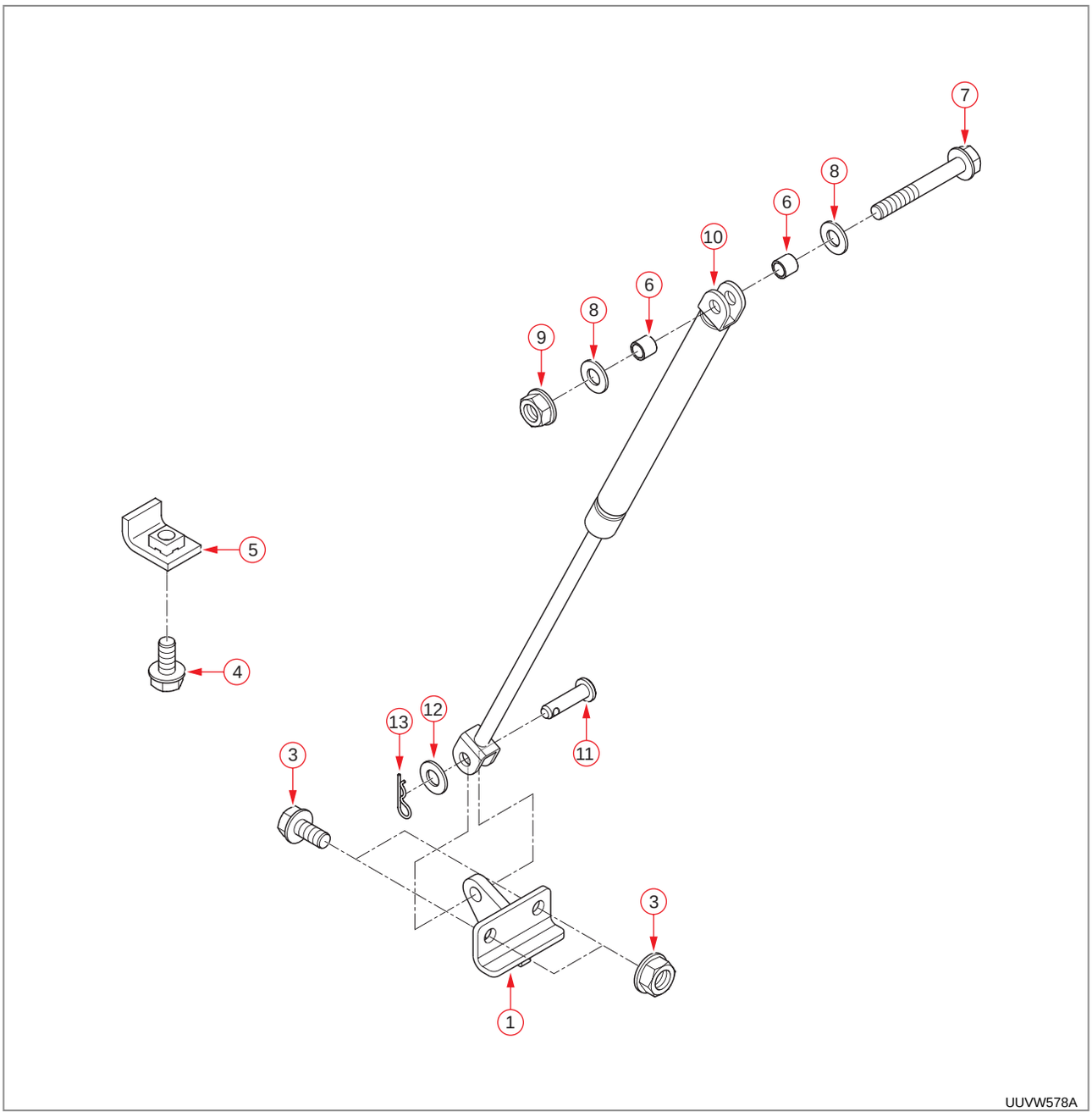
4.7 U0922A DECK



COMPONENTS

(1) DECK ASSY(BLACK)
(2) DECK UNDER BUMPER
(3) TAILGATE ASSY(BLACK)
(4) TAILGATE HINGE BRACKET(BLACK)
(5) BOLT, WASHER
(6) STOP ROPE
(7) REAMER BOLT WASHER
(8) PIN, SPLIT
(9) PIN, SNAP
(10) DECK POLE COVER
(11) REAMER BOLT, FLANGE
(12) NUT
(13) FENDER REAR ASSY(RH)
(14) ASS'Y REFLECTOR
(15) NUT, FLANGE
(16) FENDER
(17) FLANGE BOLT
(18) FLANGE NUT
(19) WASHER
(20) FENDER REAR ASSY(LH)

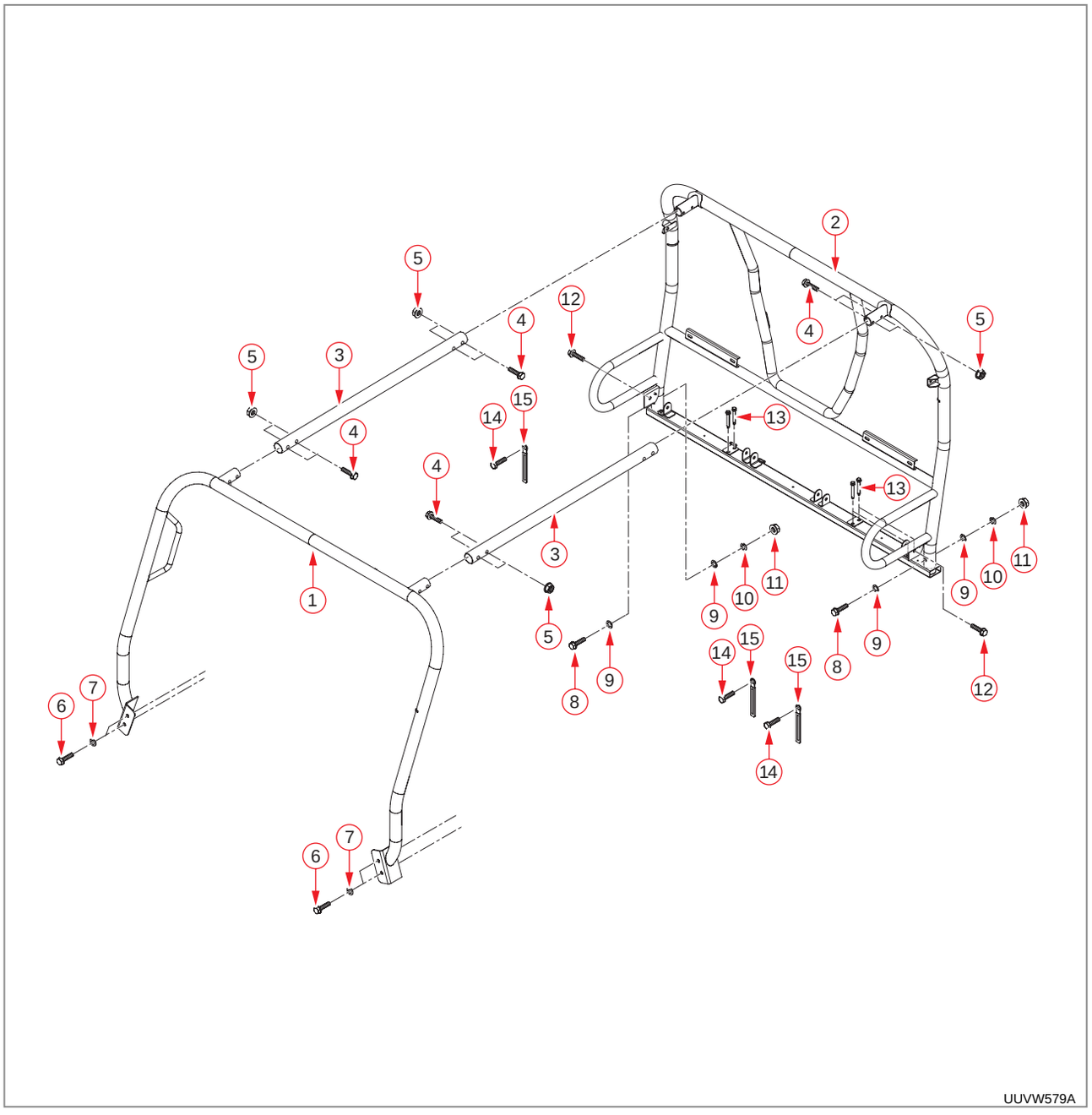
4.8 U1000A GAS CYLINDER



COMPONENTS

(1) BRKT, GAS SPRING
(2) BOLT, FLANGE
(3) NUT
(4) BRACKET, STOPPER
(5) BOLT, FLANGE
(6) COLLAR, GAS SPRING
(7) BOLT
(8) WASHER, PLAIN
(9) NUT, FLANGE
(10) GAS SPRING
(11) JOINT PIN
(12) WASHER, PLAIN
(13) PIN, SNAP

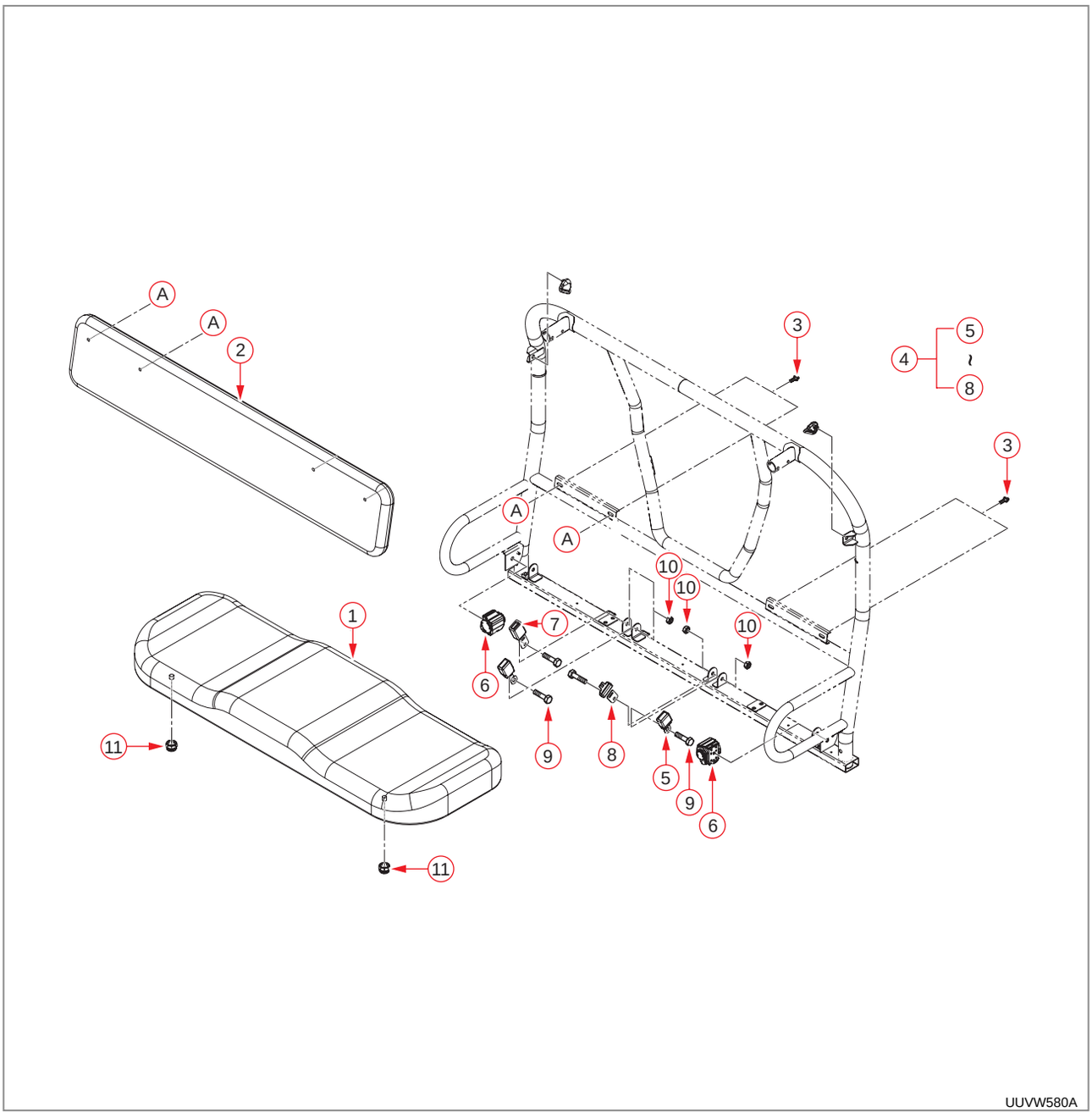
4.9 U0225A ROPS



COMPONENTS

(1) FRAME FRONT ASSY
(2) REAR FRAME ASSY
(3) FRAME MIDDLE
(4) BOLT
(5) FLANGE NUT
(6) BOLT
(7) WASHER
(8) BOLT
(9) WASHER
(10) WASHER,SPRING
(11) NUT
(12) BOLT
(13) BOLT, WASHER
(14) BOLT, FLANGE
(15) CLAM, WIRE

4.10 U0811A SEAT



COMPONENTS

(1) SEAT CUSHION ASSY
(2) SEAT BACK ASSY
(3) FLANGE BOLT
(4) SEAT BELT ASSY(3PT)
(5) BUCKLE
(6) SEAT BELT ASS'Y
(7) BUCKLE
(8) SAFETY BELT(CTR)
(9) BOLT
(10) NUT
(11) SEAT RUBBER MOUNT

REAR AXLE

CHAPTER 7

TABLE OF CONTENTS

1. SPECIFICATIONS

1.1 REAR AXLE CASE OIL

Type	Capacity	Remarks
SAE gear oil #90 or DAEDONG : UTF55 Exxon : Mobil Fluid 423 or 424 BP : Tractran UTH Shell : DONAX-TD	0.8ℓ / 0.2 u.s gal	
Grease: NLGL grade No.2 or equivalent	Sufficient amount	Rear wheel drive universal joint section

1.2 TIGHTENING TORQUE

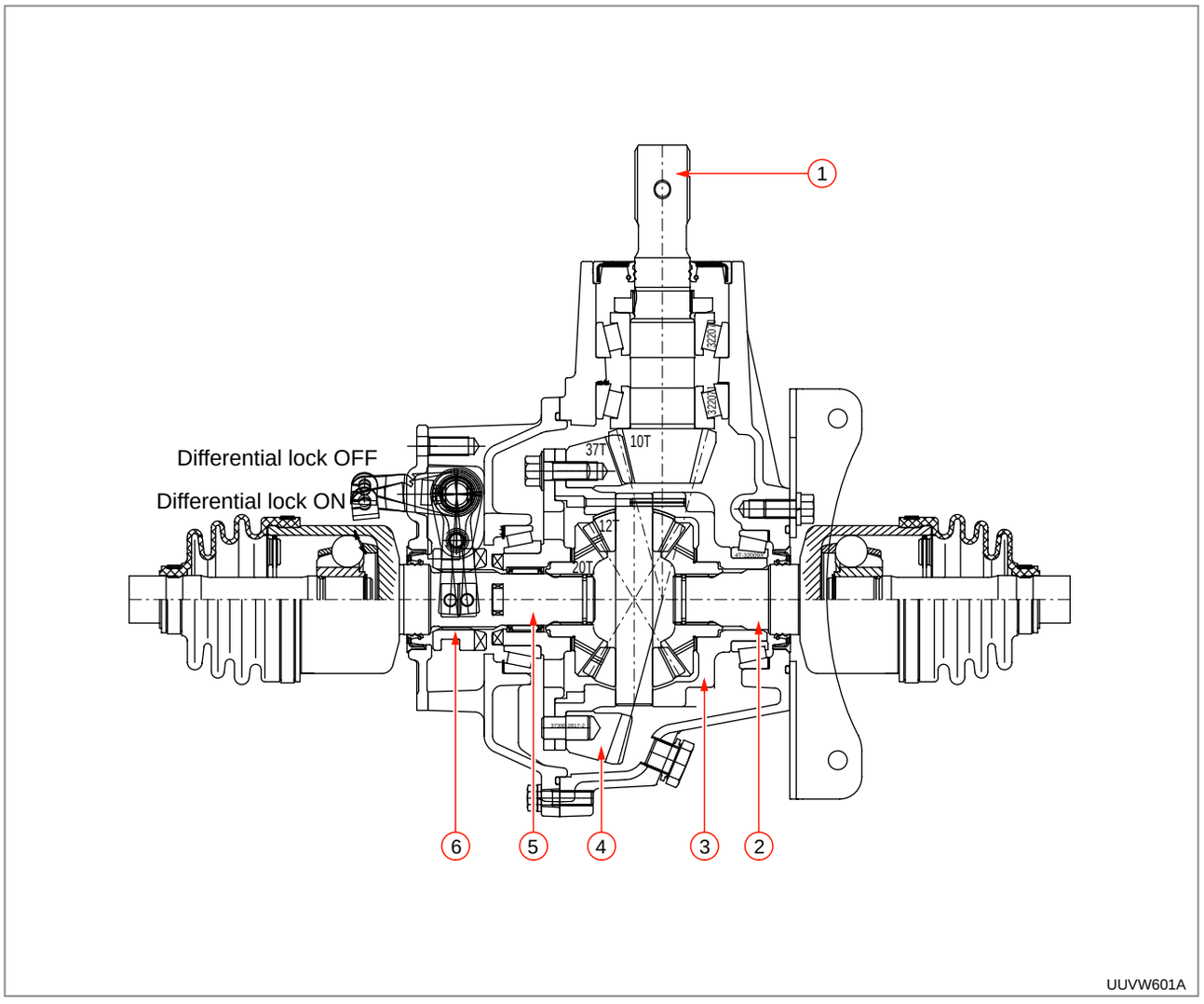
Position	Type	Tightening torque
Rear wheel	Flange nut (M10)	39.2 ~ 45.1 Nm 4.0 ~ 4.6 kgf-m 28.8 ~ 33.1 lb-ft
Rear axle case mounting section	Bolt (M8)	17.6 ~ 20.6 Nm 1.8 ~ 2.1 kgf-m 13.0 ~ 15.1 lb-ft
Rear suspension (upper/lower strut sections)	Reamer bolt (M8)	40.0 Nm 4.1 kgf-m 30.0 lb-ft
Lower arm mounting section	Nut (M10)	40.0 Nm 4.1 kgf-m 30.0 lb-ft
Stabilizer bar clamp	Mounting bolt (M8)	21 ~ 25 Nm 2.1 ~ 2.5 kgf-m 15.1 ~ 18.0 lb-ft
Lower arm mounting carrier section	Bolt (M10)	67.0 Nm 6.8 kgf-m 49.0 lb-ft
Upper arm mounting carrier section	Bolt (M10)	40.0 Nm 4.1 kgf-m 30.0 lb-ft
Differential case mounting section	Bolt (M10)	48.0 ~ 55.9 Nm 4.9 ~ 5.7 kgf-m 35.4 ~ 41.2 lb-ft

1.3 SUSPENSION

Double-A arm coil spring, independent

2. STRUCTURE AND FUNCTION

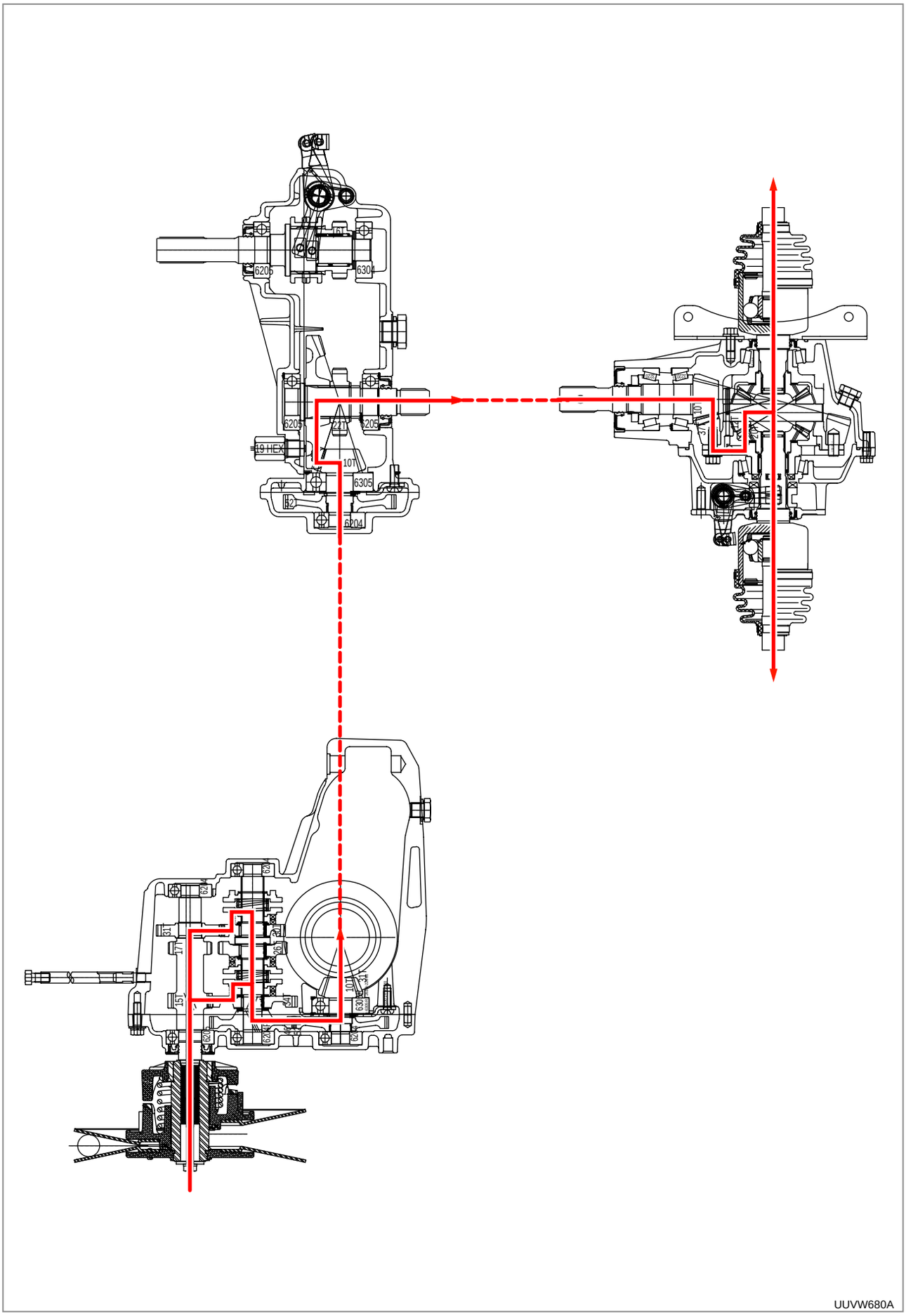
2.1 STRUCTURE OF REAR AXLE SECTION

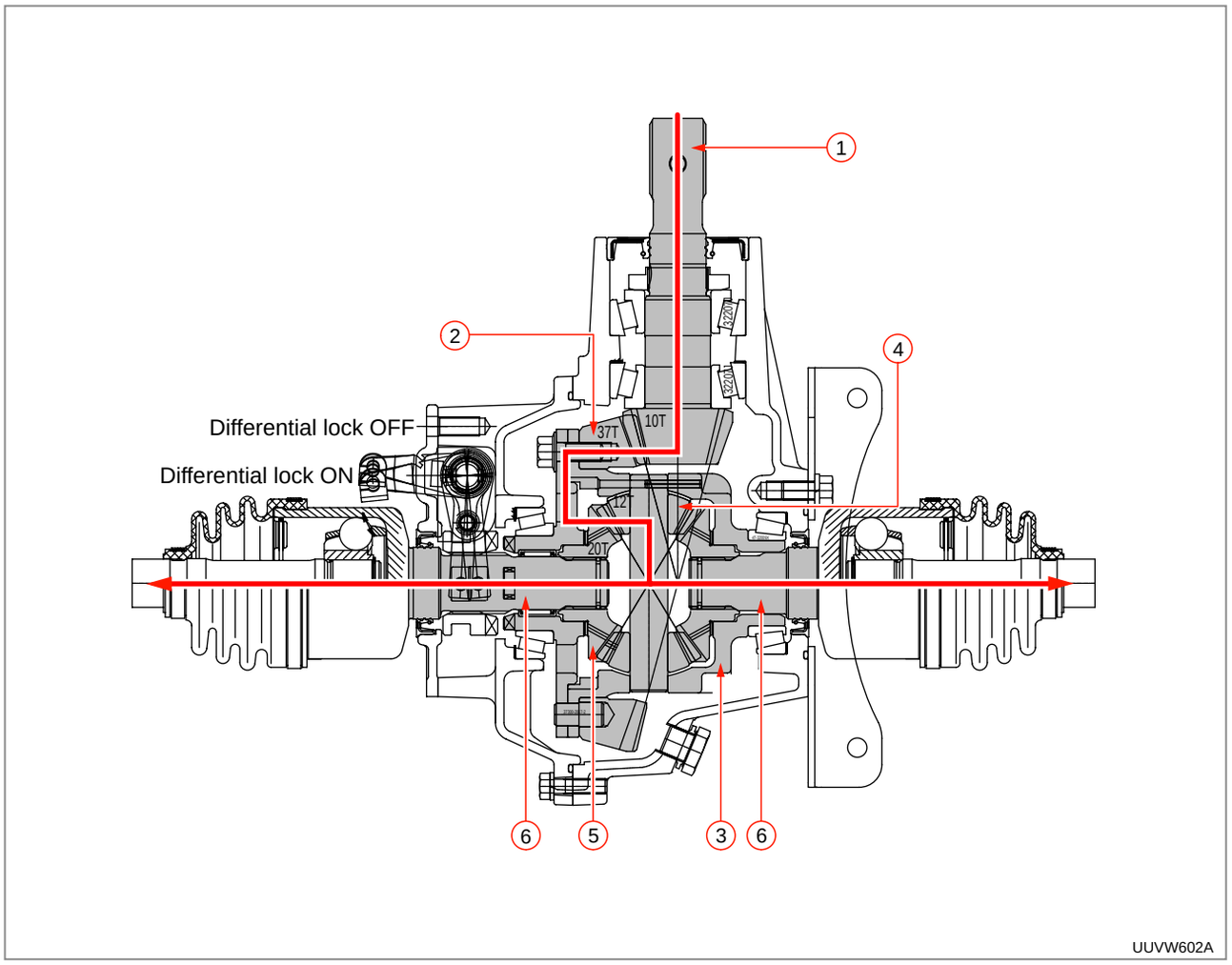


COMPONENTS

(1) 10 spiral bevel pinion
(2) Rear wheel drive shaft assembly (RH)
(3) Rear differential assembly
(4) 37 spiral bevel gear
(5) Rear wheel drive shaft assembly (LH)
(6) Differential shift

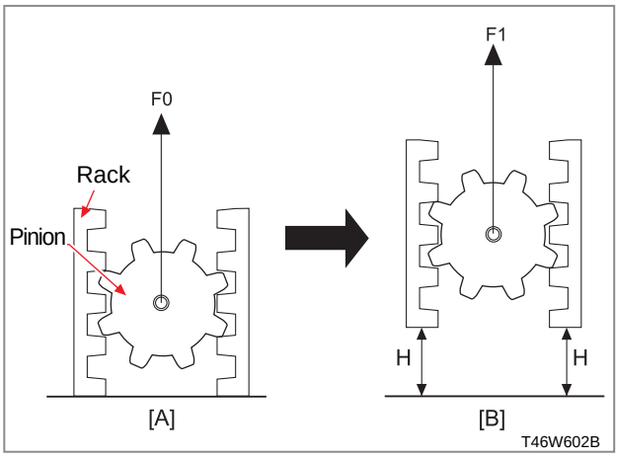
2.2 REAR AXLE POWER TRANSFER DIAGRAM



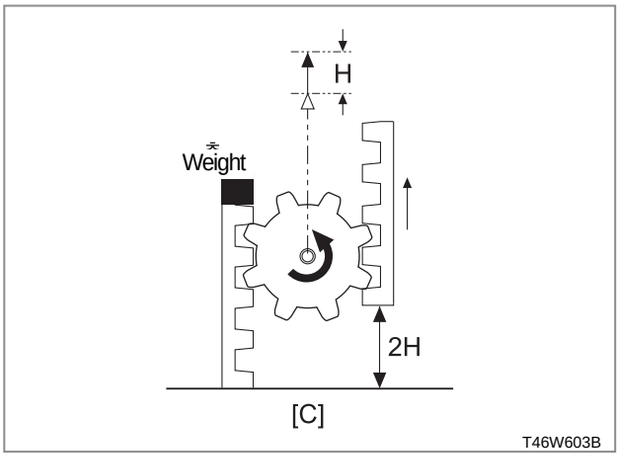


As power is transferred through the rear propeller shaft from the transmission case, this power drives the 37 spiral bevel gear (2) through the 10 spiral bevel pinion (1) resulting in deceleration. Then, this power is transferred to the differential case (3), differential pinion (4), differential side gear (5) and rear wheel drive shaft (6) in order to drive the rear wheels.

2.3 OPERATING PRINCIPLE OF DIFFERENTIAL SYSTEM

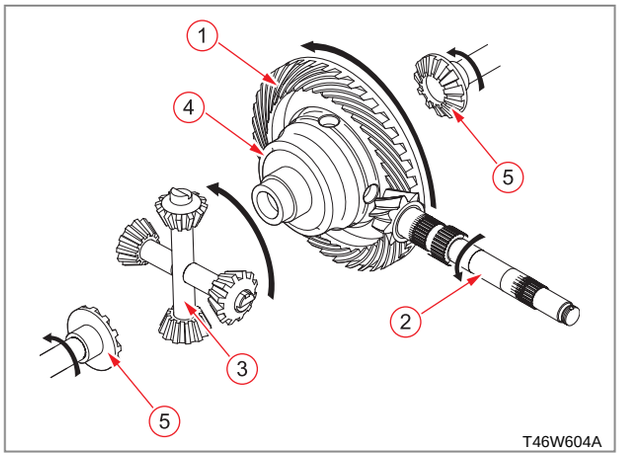


If two racks with same weight are set between the pinion as shown in the figure (A) and the pinion is lifted by pulling up the string attached to it as shown in the figure (B), the pinion does not rotate and the pinion and both racks are lifted in the same height (H).



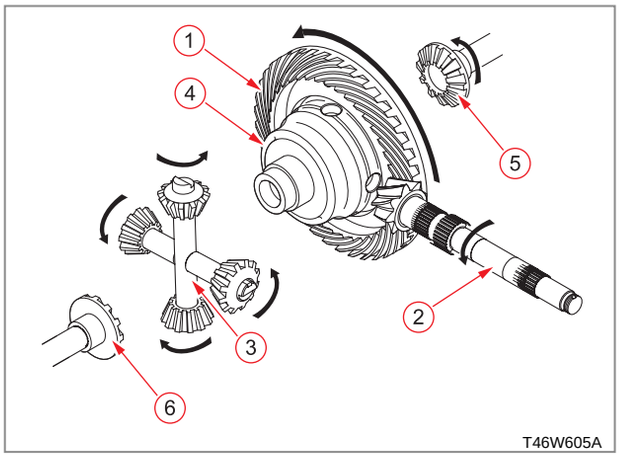
However, if putting a weight only on one rack and lifting the pinion, the pinion rises as it rotates as shown in the figure (C). The rack with a weight keeps its position and the other rack without a weight rises in the amount of the height that the pinion moves and the pinion pushes up the rack. Therefore, this rack rises in double amount of the height that the pinion moves (2H).

In this case, both racks refer to the differential side gears and the pinion refers to the differential pinion. Also, the force that pulls up the pinion is the rotating force of the ring gear.



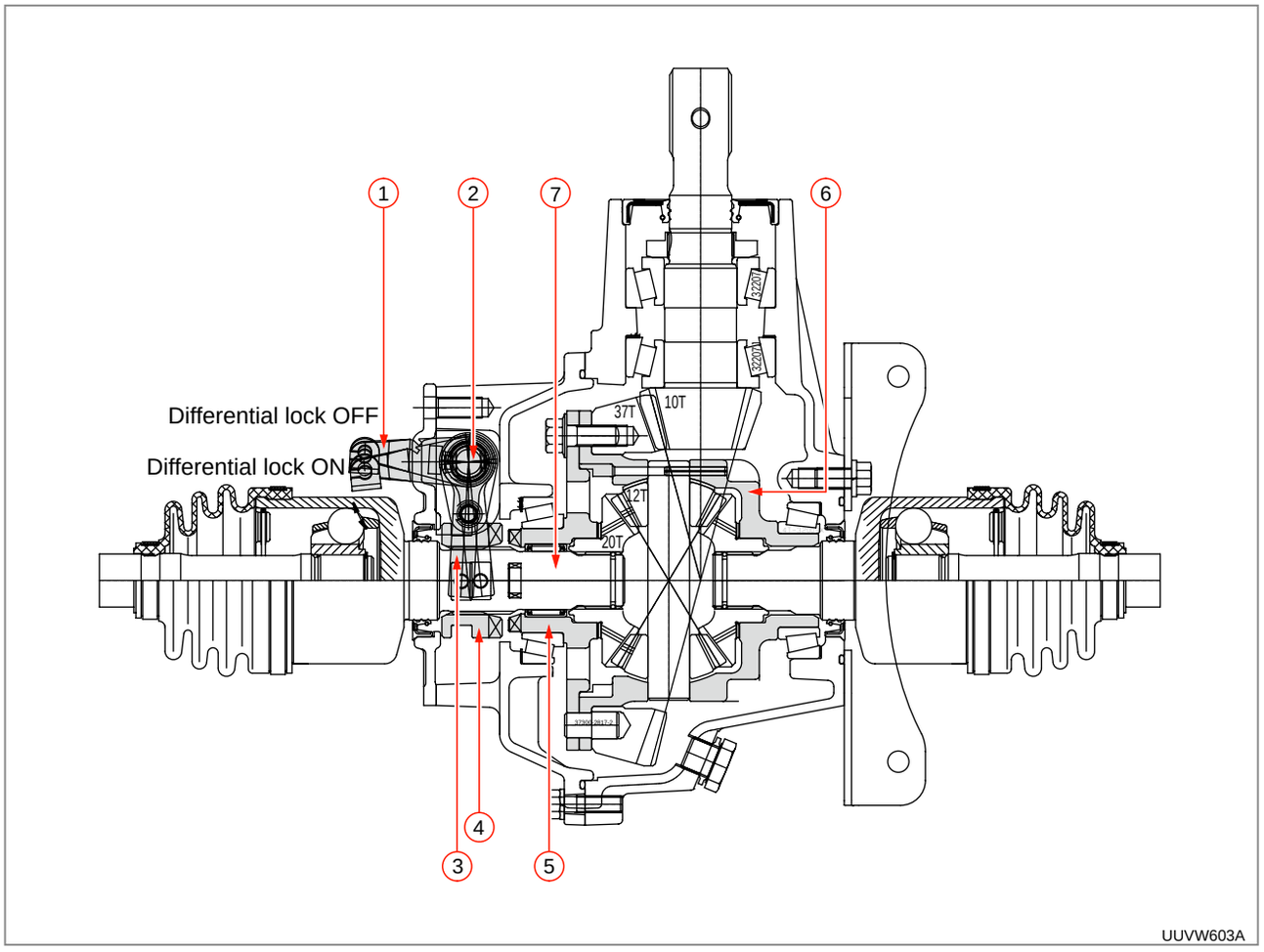
If the vehicle moves forward and the loads on the both wheels are same, the differential pinion (3) idles in the differential case (4) to run the differential side gear (5). In this case, the rotating speed of the ring gear (1), differential case (4) and the both side gears (5) is same.

When cornering, the load applied to the both differential side gears (5) are different since the outer wheels should rotate faster than the inner wheels. Therefore, the differential pinion (3) rotates and idles simultaneously to operate the side gear with low load faster and the side gear with high load slower for comfort cornering.



However, if the wheels on one side are on the slippery road, the load difference between both differential side gears remarkably increases and the self-rotating speed of differential pinion (3) considerably increases too. Therefore, the side gear (5) with very low load rotates with very high speed and the side gear (6) with comparatively high load does not rotate at all.In other words, it is not possible to escape the pit since the wheel on ice with no friction rotates with high speed and the wheel on road with friction does not rotate.

2.4 OPERATING PRINCIPLE OF DIFFERENTIAL LOCK SYSTEM

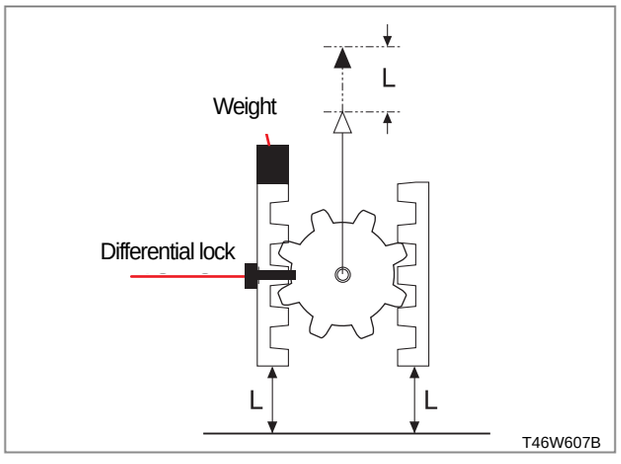


The differential lock system is to solve such problems as described on the previous page.

When the differential lock lever is operated, the differential lever (1) in the figure rotates and the rotating shift arm (2) moves the differential fork (3) which then moves the differential shift (4) to lock the differential system.

The differential shift has the dog clutch and it is connected to the dog clutch on the differential case cover (5) securely.

As the differential case (6) and the drive shaft (7) on one side rotate at the same speed by dog clutch, the drive shaft on the other side rotates at the same speed as well.



The figure left shows the simplified mechanism of differential lock system.

When one rack is fixed to the pinion and the pinion is lifted, the other rack is lifted in the same height (L) as shown in the figure on the left.

If the differential lock system is unnecessarily used on the road with sufficient friction, excessive load is applied to the differential side gears or the differential pinion and the internal gears or the components of the differential lock system can be damaged unless the vehicle is moving forward.

Therefore, the steering wheel should be set to the “straight ahead” position when using the differential lock system.

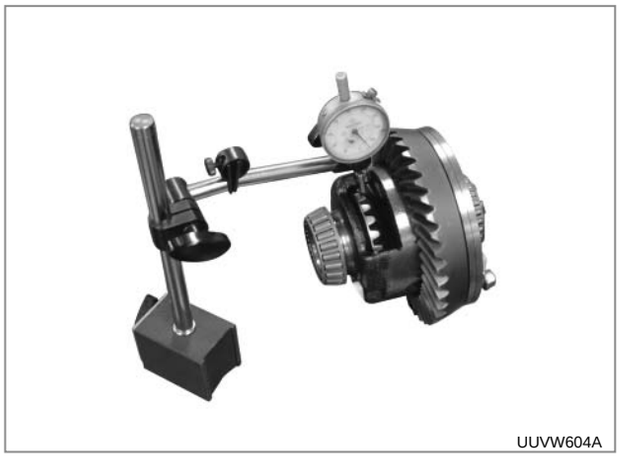
3. TROUBLESHOOTING

Symptom	Cause	Service
Impossible to disengage differential lock system	• Insufficiently lubricated links for differential lock or improperly adjusted cable	• Check the differential lock links, differential lock lever and shift for deformation or breakage and adjust or replace them if necessary.
Creaking noise from tires while driving	• Loose wheel nut	• Check the tightness of the wheel nut and tighten it to the specified torque if necessary.
Rear wheels are driven during differential lock operation, but they are not driven with differential lock disengaged	• Damaged side gear or differential pinion in differential system • Damaged axle or related gear • Damaged CV joints	• Check and replace abnormal parts.

4. INSPECTION AND ADJUSTMENT

4.1 DIFFERENTIAL SYSTEM ASSEMBLY

BACKLASH ADJUSTMENT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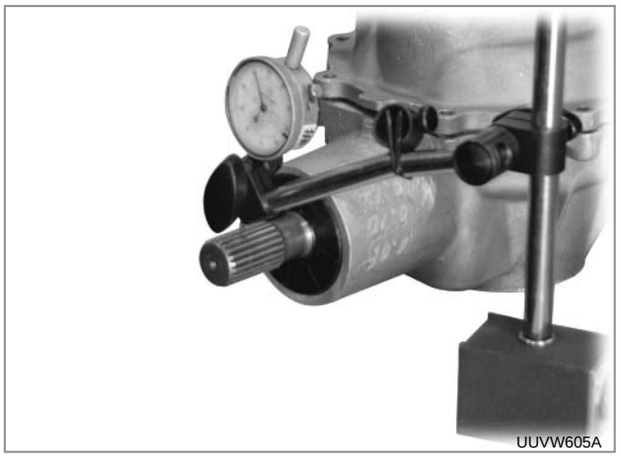
1. Set the lever-type dial gauge as shown in the figure and measure the backlash while turning the differential pinion gently with the contact pin touched with the differential side gear teeth lightly.
2. The backlash for the differential pinion and differential side gear can be adjusted by the differential washer on the differential side gear side.

Standard backlash.....0.15 ~ 0.25 mm
(0.0059 ~ 0.0098 in.)

Differential washer sizes.....1.5 mm (0.059 in.) Standard
1.6 mm (0.063 in.)
1.7 mm (0.067 in.)

IMPORTANT

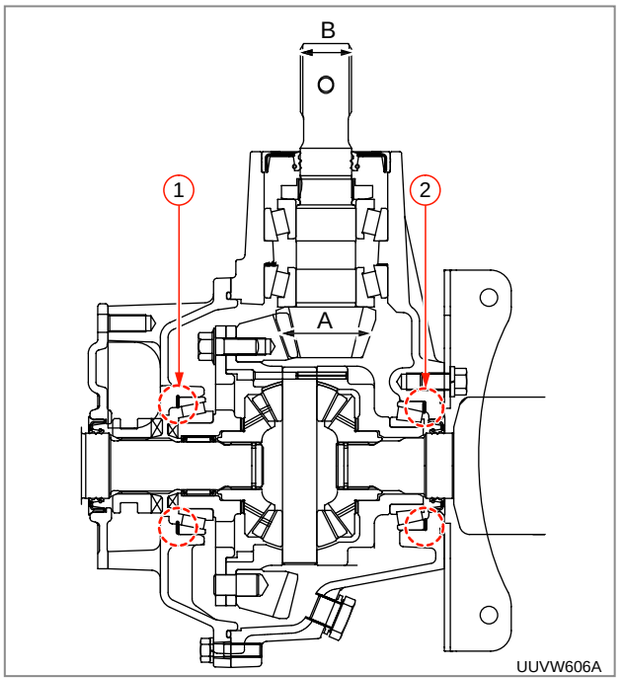
- **Fit the differential washer with different thickness in order to adjust the backlash. However, the thickness of the differential washers should be same on both sides.**


UUVW605A

3. Set the lever-type dial gauge as shown in the figure and set the sensor to contact with the splined section of the 10 spiral bevel pinion lightly.
4. Measure the backlash of the 10 spiral bevel pinion with the 37 spiral bevel gear while turning it gently.

Teeth based Standard backlash
(on the teeth contacted) ...0.2 ~ 0.3 mm
(0.0079 ~ 0.0118 in.)

Spline based
Back lash.....0.12 ~ 0.18 mm
(0.0047 ~ 0.0071 in.)



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5. If the backlash is above the standard, move some of the shims from the section (2) to the section (1). If the backlash is below the standard, move some of the shims from the section (1) to the section (2).

6. The total amount of the shims in the section (1) and (2) should never be changed.

   Shim type: 0.1 mm (0.0039 in.)
   0.2 mm (0.0079 in.)
   0.4 mm (0.0157 in.)
   0.8 mm (0.0315 in.) Standard shim
   1.0 mm (0.0394 in.)
   1.2 mm (0.0472 in.)

REMARK

- **The standard backlash stated in the previous page refers to the distance from the mating surface of the gear teeth. Therefore, the standard backlash value can differ if the backlash is measured at the splined section of the pinion shaft.**
- **As the average effective diameter A of the spiral bevel pinion teeth is different from the effective diameter B of the splined section as shown in the figure on the previous page, the backlash on the spline of shaft can be obtained from the following formula:**

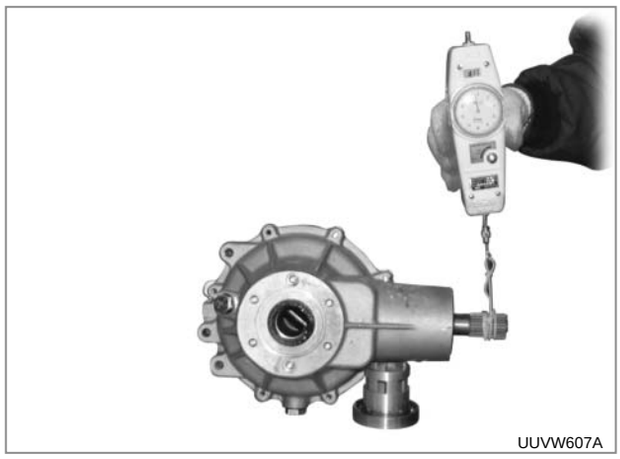
  Backlash measured at splined section

  $$= \text{Teeth based backlash} \times \frac{B}{A}$$

  $$\frac{B}{A} \fallingdotseq 0.6$$

  Therefore the spline based backlash is
  0.2 x 0.6 ~0.3 x 0.6 = 0.12 ~ 0.18 mm
  (0.0047 ~ 0.0071 in.)

TURNING TORQUE ADJUSTMENT


UUVW607A

1. Bind one end of the wiring to the splined section of the bevel pinion and the other end to the push pull gauge.
2. Set the push pull gauge to the "Pull" position and pull the wiring to measure the rotating force.
3. Load of push pull gauge: 6.0 ~ 8.0 kgf
   (13.2 ~ 17.6 lbs)

   Standard turning
   torque .....0.88 ~ 1.18 Nm
   0.09 ~ 0.12 kgf-m
   0.65 ~ 0.86 lb-ft

   Shim type: 0.6 mm (0.0236 in.)
   0.8 mm (0.0315 in.) Standard shim
   1.0 mm (0.0394 in.)
   1.2 mm (0.0472 in.)
   1.4 mm (0.055in.)

REMARK

- **Calculation for load of push pull gauge**

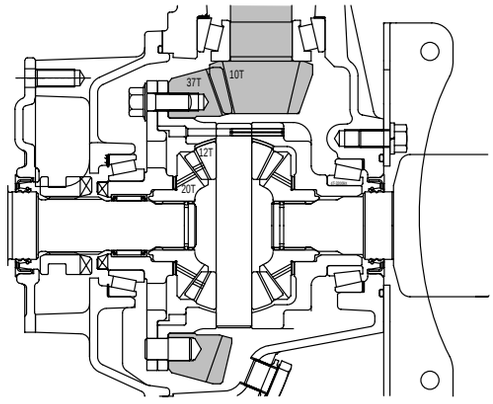
  F = T/R = 0.09 ~ 0.12 kgf-m / 0.015 m
  = 6.0 kgf ~ 8.0 kgf (13.2 lbs ~ 17.6 lbs)
  F: Push pull gauge load
  T: Standard turning torque
  R: Radius or bevel pinion spline

REMARK

- **The pre-load of the taper roller bearing, that supports the spiral bevel pinion shaft, can be adjusted by tightening its mounting nut. (Refer to the diagram in this chapter.) The standard pre-load is defined by the turning torque of the spiral bevel pinion shaft.**
- **The turning torque can be measured using a torque wrench or by tying the shaft with a string and pulling the string down with a pull scale. Make sure to convert the unit correctly.**
- **The turning torque and turning force can differ by the installation condition as shown in the following table:**

Item / Installation condition		(A) Nut tightened with spiral bevel pinion	(B) A + oil seal installed	(C) B + differential gear assembly & ring gear installed
Rear axle pinion shaft	Rotating Torque	0.04 kgf-m 0.39 N-m 0.29 lb-ft	0.07 0.69 0.50	0.12 1.18 0.86
	Turning force	2.6 kgf 5.7 lbs	4.6 10.1	8.0 17.6

TOOTH CONTACT CHECK



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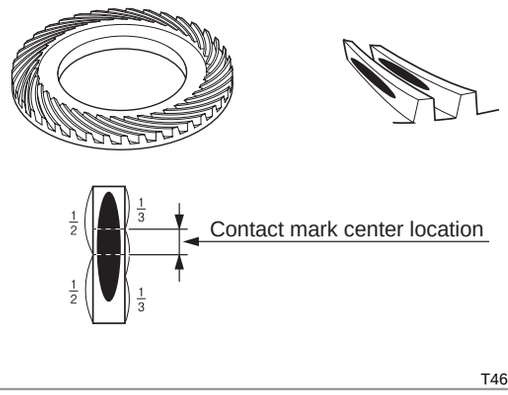
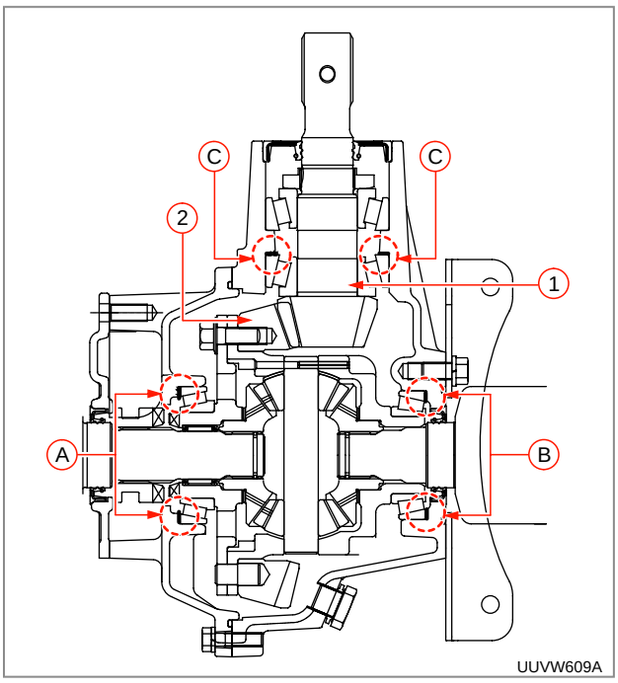
1. Coat all teeth of the spiral bevel pinion with contact grease and install it properly.
2. Turn the bevel pinion for 5 ~ 6 rounds, remove the pinion and check the contact area by a contact mark on the spiral bevel gear teeth.



T46W818B

3. The contact area should be over 35% of the entire teeth area and the center of the contact mark should be close to the center of the pinion in height. Also, the center of the contact mark should be located on the 1/3 spot from the toe of the teeth to the center of the teeth in length.
4. Adjust the shim according to the contact area.

CONTACT CHECK AND SHIM ADJUSTMENT



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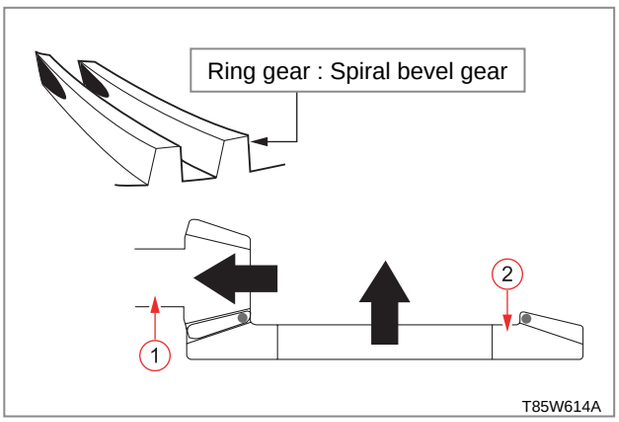
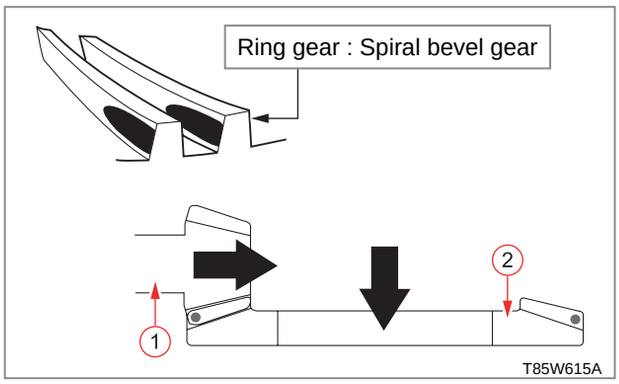
- **TOE CONTACT**



T85W614A

If the center of the contact mark is too close to the toe of the tooth, decrease the amount of shims (C) on the spiral bevel pinion (1) side, increase the amount of shims (A) and decrease the amount of shims (B) on the 37 spiral bevel gear (2) side to push the 37 spiral bevel gear assembly (differential case assembly) into the spiral bevel pinion side so that the backlash is maintained. Then, measure the backlash.

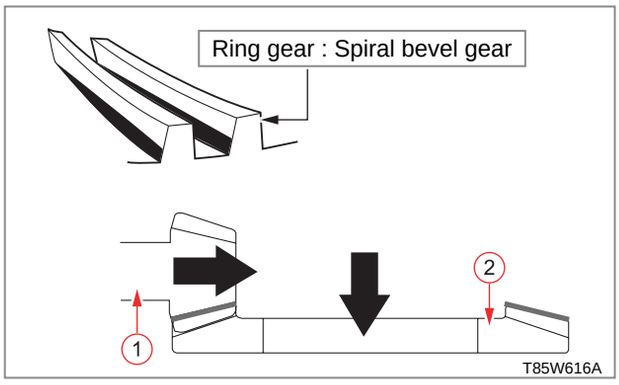
- **HEEL CONTACT**



T85W615A

If the contact mark is close to the heel of the ring gear teeth, decrease the shims (A) on the ring gear side, increase the amount of shims (B) to push the ring gear (2) away from the pinion (1) and increase the amount of shims (C) so that the backlash is maintained. Then, measure the backlash.

- **DEEP CONTACT**



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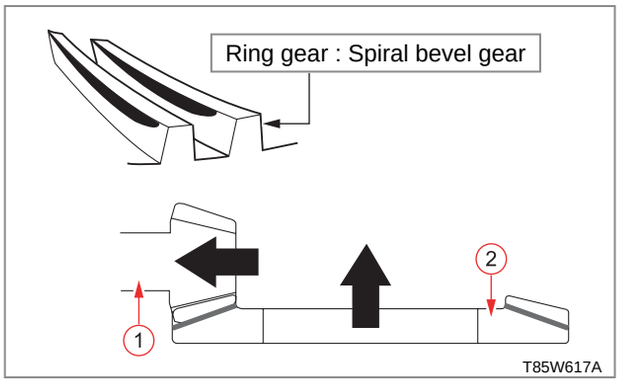
If the contact mark is deep into the ring gear teeth, decrease the amount of shims (C) on the pinion (1), increase the amount of shims (B) on the ring gear (2) and decrease the amount of shims (A) so that the backlash is maintained.

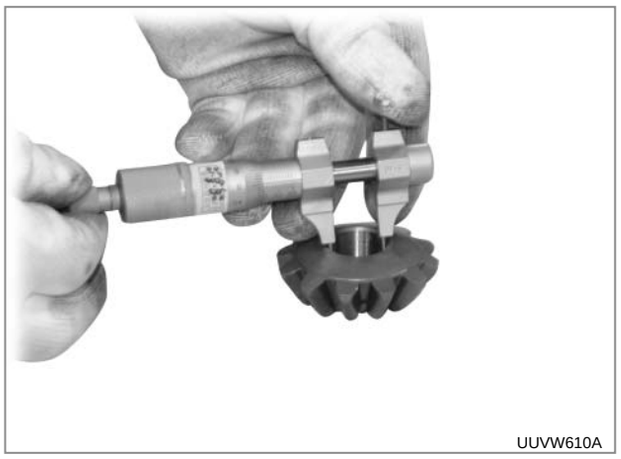
- **TIP CONTACT**



T85W617A

If the contact mark is on the tip of the ring gear teeth, increase the amount of shims (C) on the pinion (1) side, decrease the shims (B) on the ring gear (2) side and increase the shims (A) so that the backlash is within the specified range.

CLEARANCE CHECK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UUVW611A

1. Differential pinion and differential pinion shaft
   a. Measure the I.D. of the differential pinion and O.D. of the differential pinion shaft.
   b. Check the clearance by comparing the measurement. If the clearance is outside the allowable limit, replace the components with new ones.

Differential pinion I.D.	20.040 ~ 20.061 mm (0.76898 ~ 078980 in.)
Differential pinion shaft O.D.	19.959 ~ 19.980 mm (0.78579 ~ 0.78661 in.)
Standard clearance	0.06 ~ 0.102 mm (0.00236 ~ 0.00402 in.)
Allowable clearance	0.25 mm (0.00984 in.)

2. Differential case, cover and differential side gear


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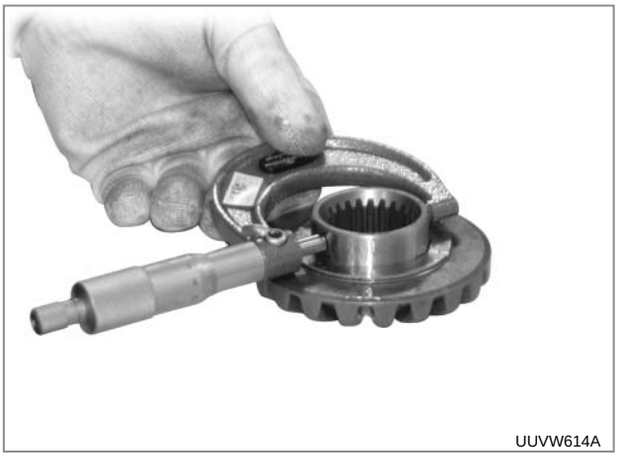
UUVW613A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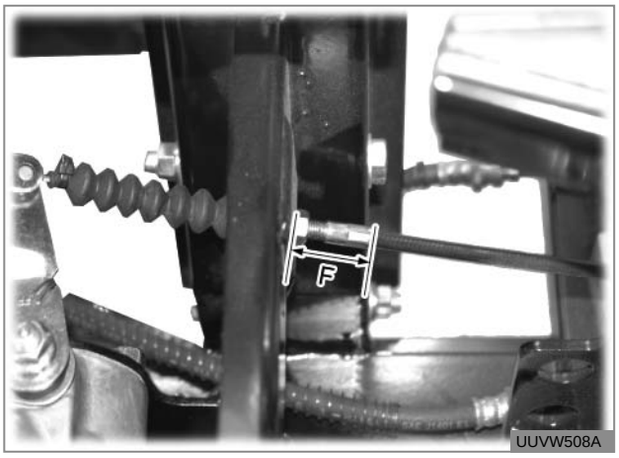
   a. Measure the inner diameter of the differential case cover and the outer diameter of the differential side gear.
   b. Check the clearance by comparing the measurement. If the clearance is outside the allowable limit, replace the components with new ones.

Differential case cover I.D.	40.500 ~ 40. 562 mm (1.5945 ~ 1.5969 in.)
Differential side gear O.D.	40.411 ~ 40.450 mm (1.5910 ~ 1.5925 in.)
Standard clearance	0.050 ~ 0.151 mm (0.00197 ~ 0.00594 in.)
Allowable clearance	0.35 mm (0.01375 in.)

4.2 DIFFERENTIAL LOCK CABLE LENGTH



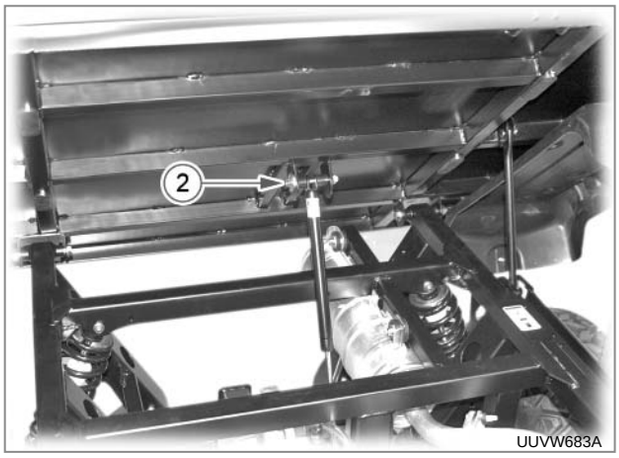
1. Set the differential lock lever to the "UNLOCK" position. Then, adjust the differential lock cable length to the bracket with the nut on the adjusting screw from its mounting sections on both sides.
   Set length for section E: 40 mm (1.575 in.)
2. To adjust the set length for the section F, set the differential lever in the "UNLOCK" position on the rear axle case side, pull the cable gently to fit it into the mounting bracket, and then adjust the cable length so that the lever can be moved to the "LOCK" position freely. Then, tighten the mounting nut.

5. DISASSEMBLY, SERVICE AND ASSEMBLY

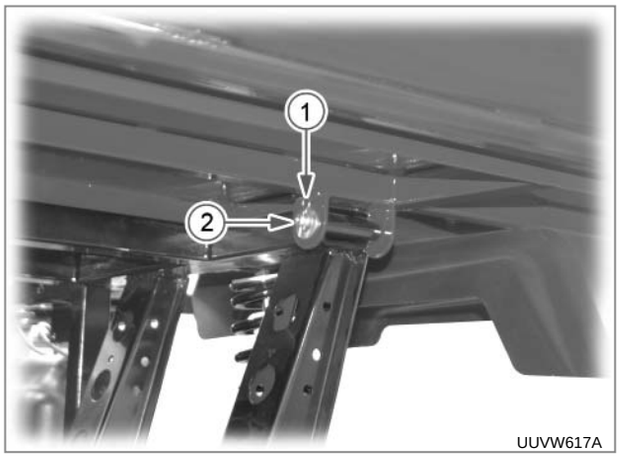
5.1 REAR AXLE CASE REMOVAL (REAR AXLE DISASSEMBLY)

1. Park the vehicle on firm and level ground, stop the engine and apply the parking brake.

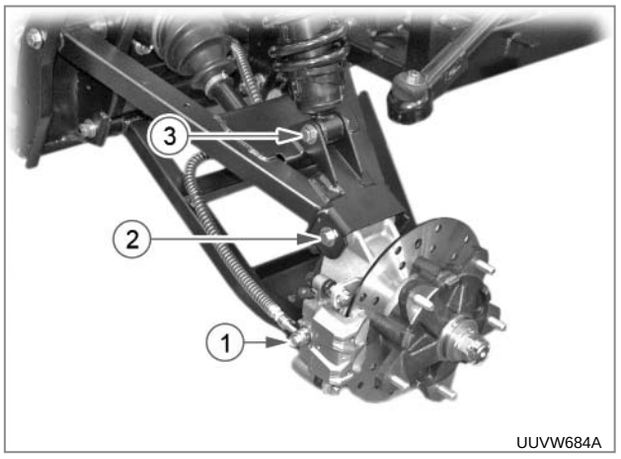
2. Place a oil drain container under the rear axle case and unscrew the filler plug (1) and drain plug (2) to drain the oil. Then, install the plugs to their original positions.
3. Remove the cargo bed.



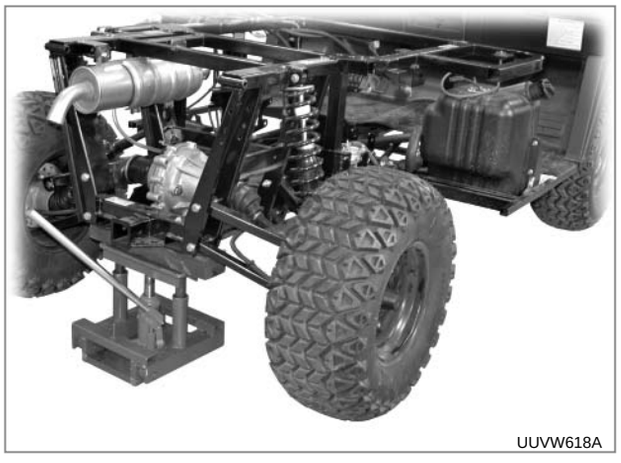
- Lift the cargo bed, pull out the cargo bed support pole snap pin (1) and the gas cylinder fixing bolt(2). Then, put the pole onto the guide and lower the cargo bed gently.



- Pull out the rear cargo bed frame mounting snap pin (1) and remove the pins (2) on both sides.

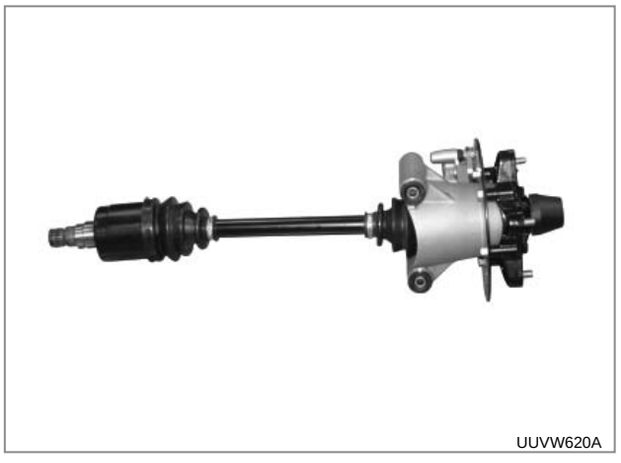


5. Disconnect the brake fluid hose (1) and remove the upper/lower rear arm mounting bolts (2) (M10, 2 EA) and strut assembly mounting bolt (3) (M8, 1 EA) using the 14 mm and 12 mm spanners.



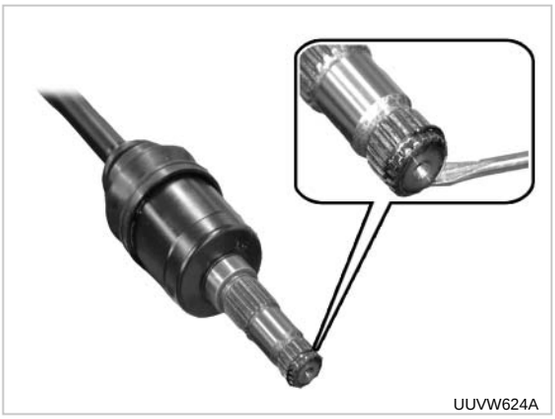
4. Unscrew the rear wheel mounting nuts (M10, 10 EA) using the 14 mm socket wrench and place a hydraulic stand under the frame for support. Then, lift the frame off the ground slightly and remove the rear wheels.

Front/rear wheel nut (M10)
tightening torque .....39.2 ~ 45.1 Nm
4.0 ~ 4.6 kgf-m
28.8 ~ 33.1 lb-ft

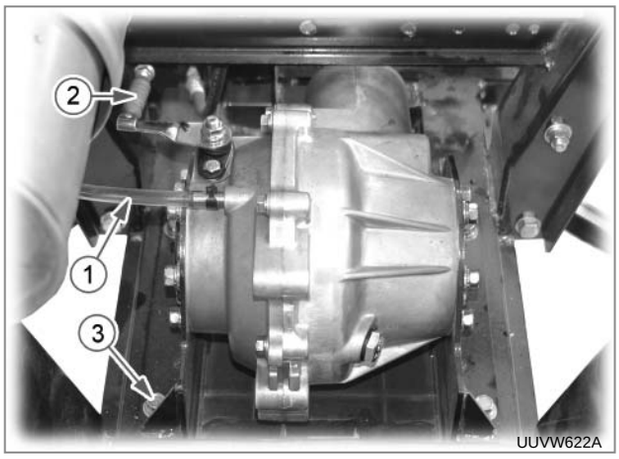


6. Pull out the rear axle drive shaft (CV joint) assembly (same for the left and right sides).

IMPORTANT

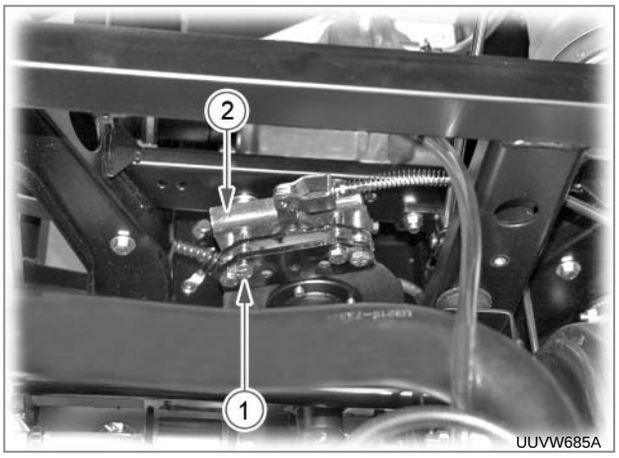

UUVW624A

- **The splined end of the CV joint is equipped with the inner-extensible snap ring. When removing the CV joint, apply impact to the CV joint gently with a lever to remove it. When installing it, tap it in gently with a rubber hammer.**
- **When installing the rear axle drive shaft to the rear axle case, be careful not to miss the O-ring and make sure to apply grease on it.**



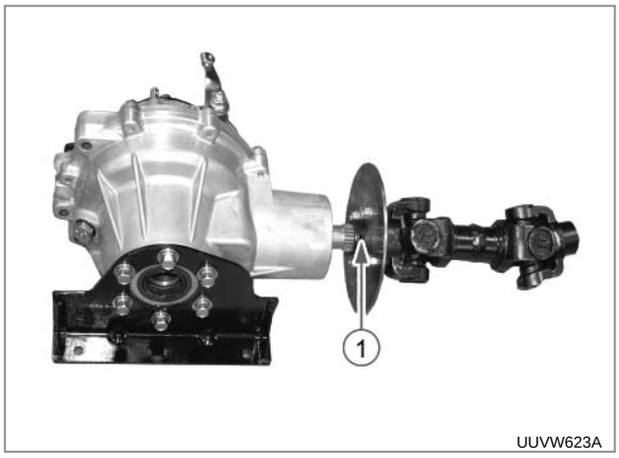
UUVW622A

8. Disconnect the bleeder hose (1) and differential lock cable (2) and unscrew the mounting bolts (3) (M10, 4 EA) with the 14 mm socket wrench to remove the rear axle case assembly with the rear universal joint.



UUVW685A

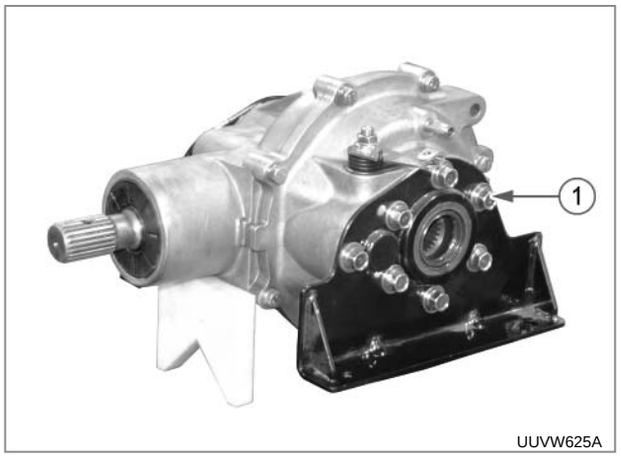
7. Unscrew the parking brake caliper mounting bolts (1) to remove the parking brake caliper assembly (2). (Refer to chapter "Brake" for details.)



UUVW623A

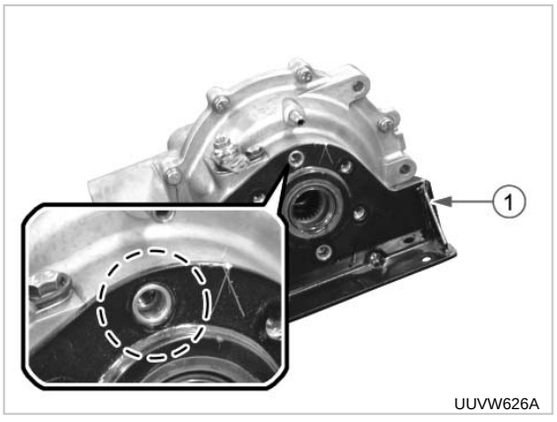
9. Pull out the spring pin (1) that connects the rear axle case assembly and rear universal joint to separate the rear axle case assembly.

5.2 REAR AXLE CASE DISASSEMBLY AND ASSEMBLY

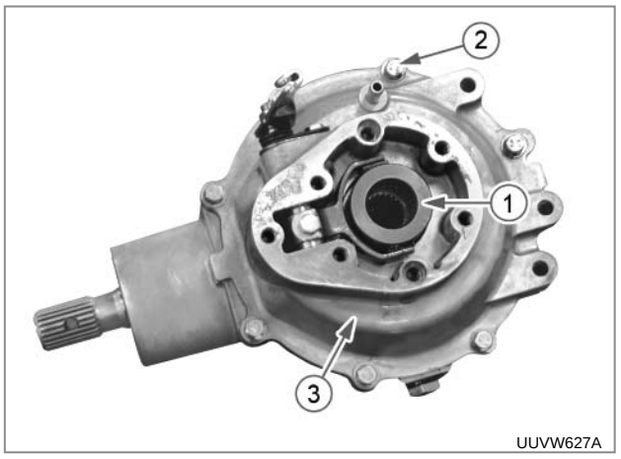


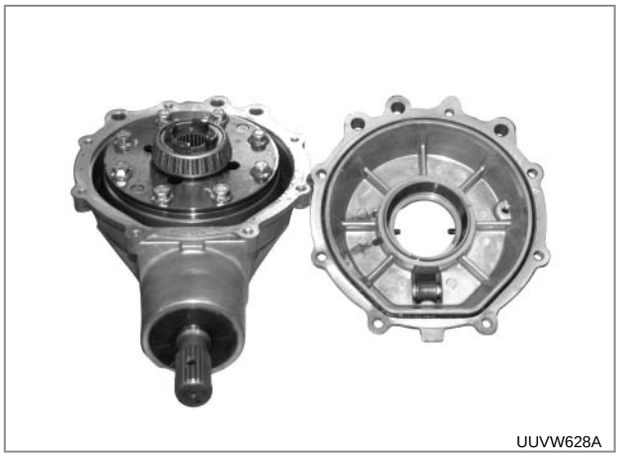
1. Unscrew the rear axle case mounting bracket bolts (1) (M10, 13 EA) using the 14 mm socket wrench to remove the brackets (LH/RH).

IMPORTANT



- **Apply LOCTITE #242 or equivalent to the bolt threads before installing the bolt. Be careful no to miss the bushings that are inserted in the two upper and two lower bracket mounting holes.**
- **When installing the bracket (LH) (1) to the rear axle case, clean its mating surface and apply Three Bond 1206D or equivalent on it.**





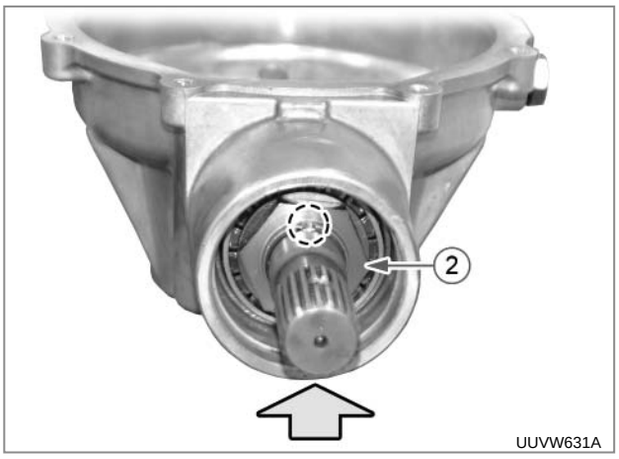
2. Pull out the differential lock shifter (1) and unscrew the rear axle case mounting bolts (2) (M8, 7 EA) using the 12 mm spanner to remove the rear axle case cover (3).

Bolt (M8)

tightening torque ..... 17.6 ~ 20.6 Nm
1.8 ~ 2.1 kgf-m
13.0 ~ 15.1 lb-ft

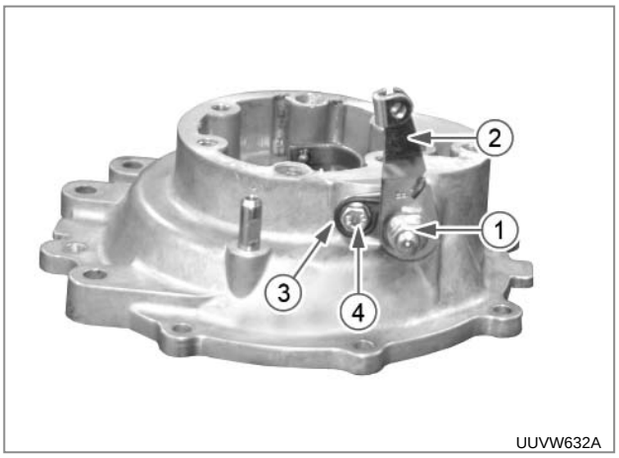
3. Separate the differential system assembly from the rear axle case.

UUVW630A



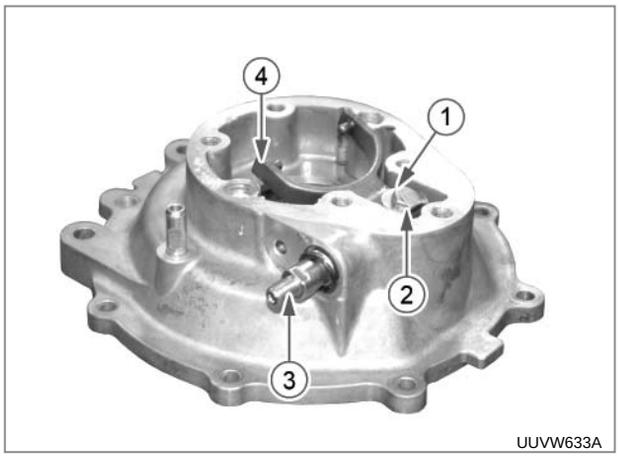
UUVW631A

4. Pull out the oil seal (1), unfold the caulking part of the caulking nut and unscrew the caulking nut (2). Then, tap the spiral bevel pinion shaft from outside the case inward to remove the bevel pinion shaft. If necessary, remove the taper roller bearing. When reassembling them, replace the oil seal with a new one and apply a sufficient amount of grease to its mating surface.



UUVW632A

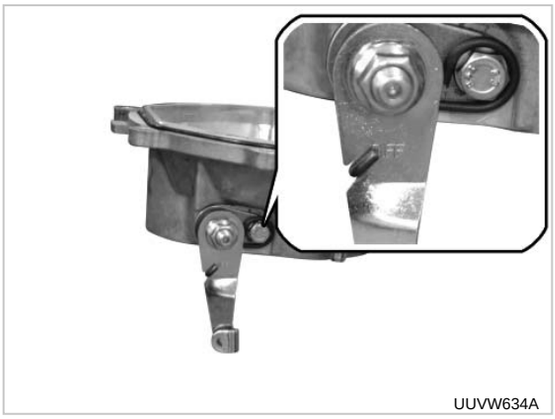
5. If necessary, unscrew the differential lock shift arm mounting nut (1) (M10, 1 EA), pull out the shift arm (2) and spring and unscrew the fixing plate mounting bolt (4) to remove the fixing plate.



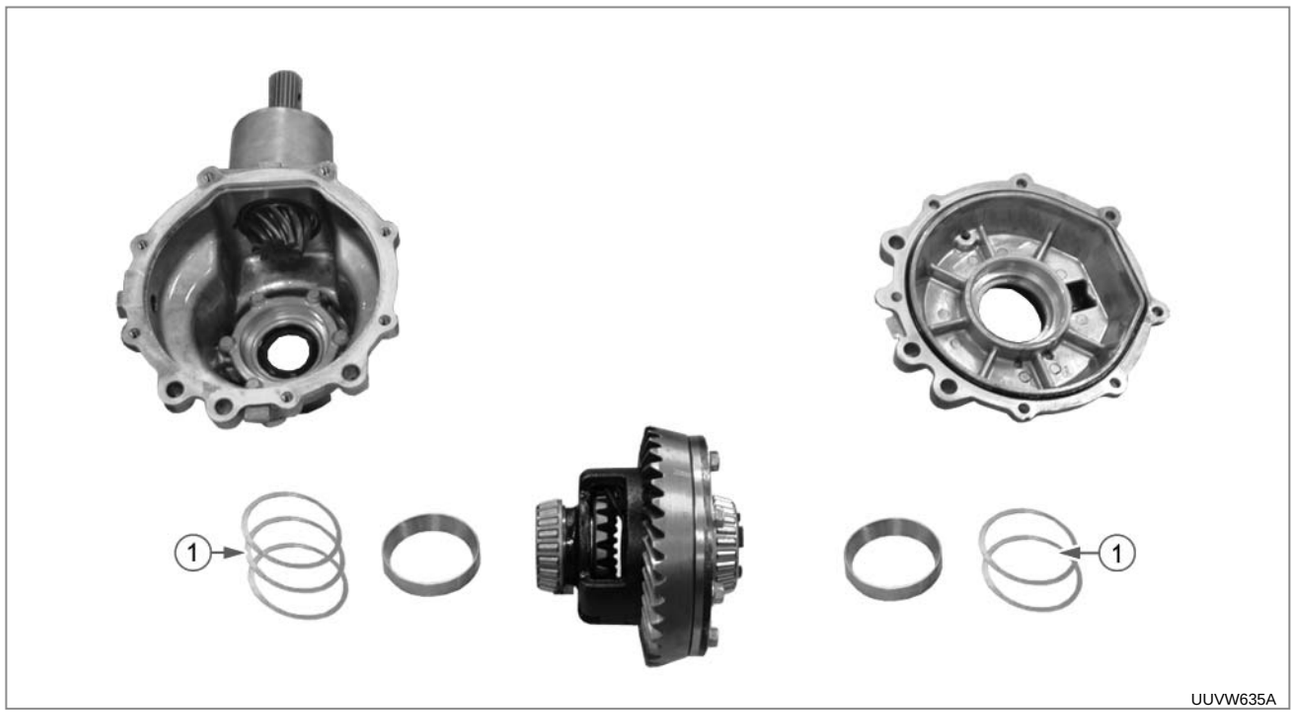
UUVW633A

6. Unfold the tab part of the shift arm shaft tongue washer (1) and remove the shift arm shaft (3) and shift hook (4) by pulling the shift arm shaft.
   Be careful not to miss the O-ring and check its condition. If it is damaged, replace it with a new one. Before fitting the new O-ring, apply a small amount of grease or oil on it.

REMARK


UUVW634A

- **When installing the shift arm and spring, make sure that the mark "DIFF" is visible and the spring hook groove faces upward.**



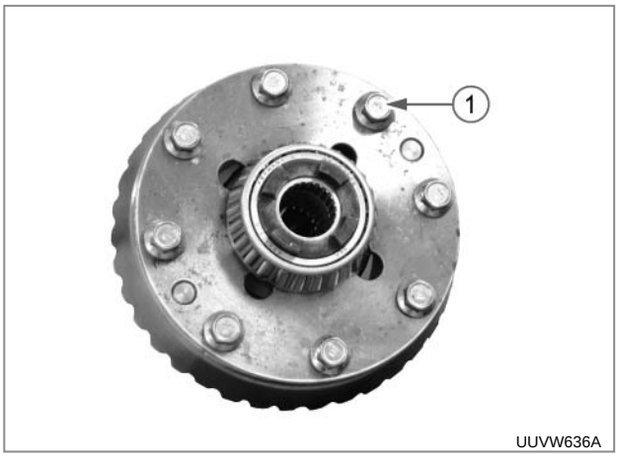
7. When removing the outer wheels of the taper roller bearings from the rear axle case and rear axle case cover, keep the adjusting shims (1) in a safe place so that they can be fitted back in their original condition.

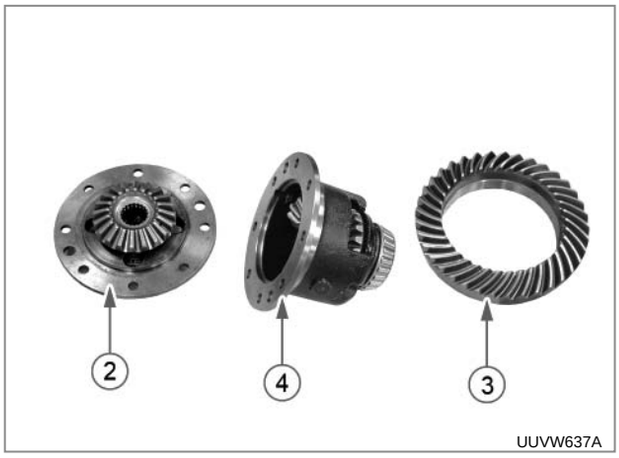
8. Assemble in the reverse order of disassembly.

IMPORTANT

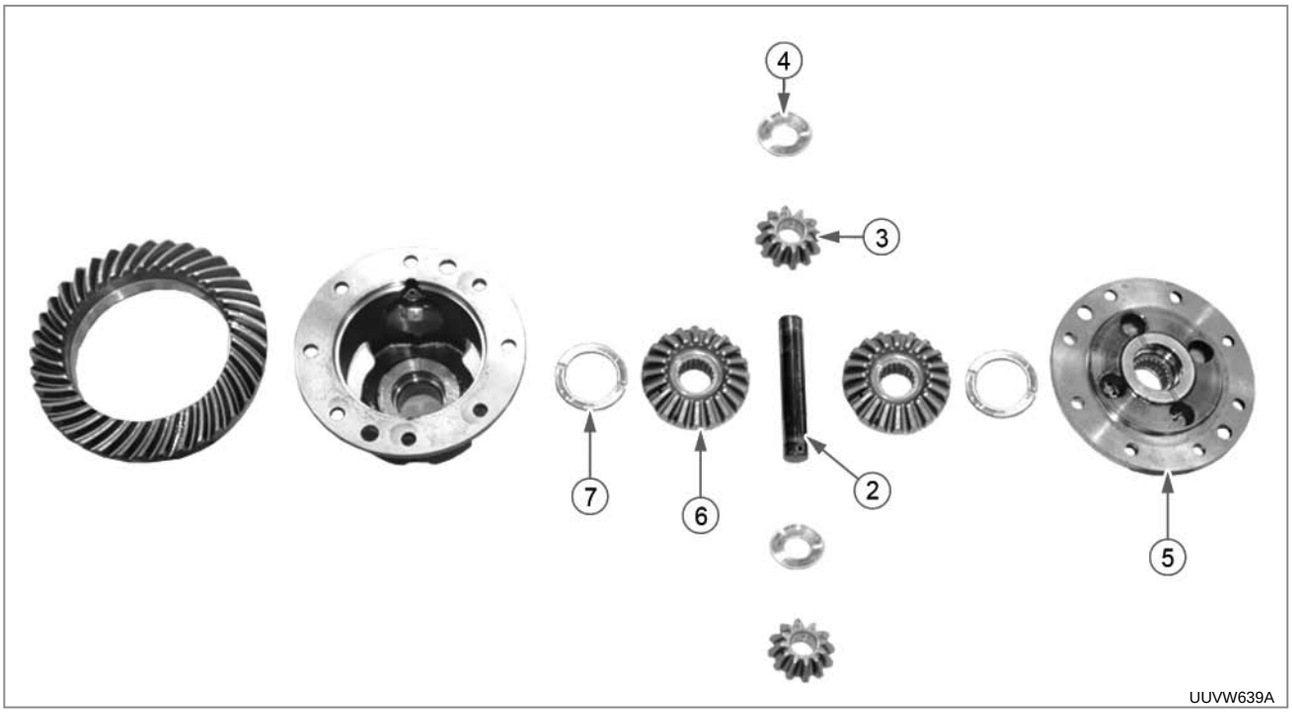
- **Apply a small amount of oil or grease to the surface of the O-ring of the cover before installing the rear axle case and cover. If the O-ring is damaged, replace it with a new one.**

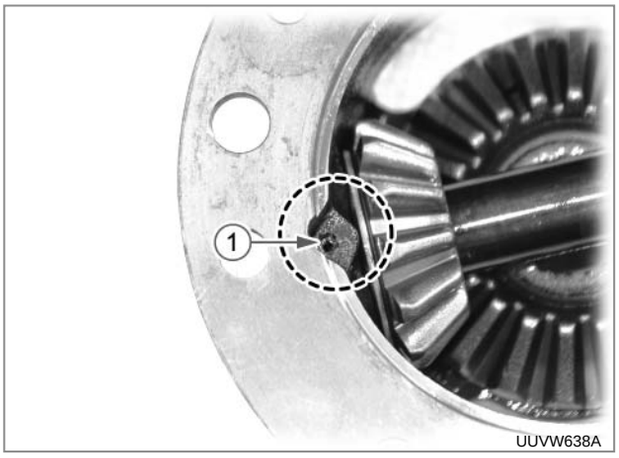
5.3 REAR DIFFERENTIAL SYSTEM DISASSEMBLY AND ASSEMBLY





1. Unscrew the differential case mounting bolts (1) (M10, 8 EA) to remove the side gear cover (2), spiral bevel gear (3) and differential case (4) in order. (If necessary, remove the taper roller bearings (LH/RH).)



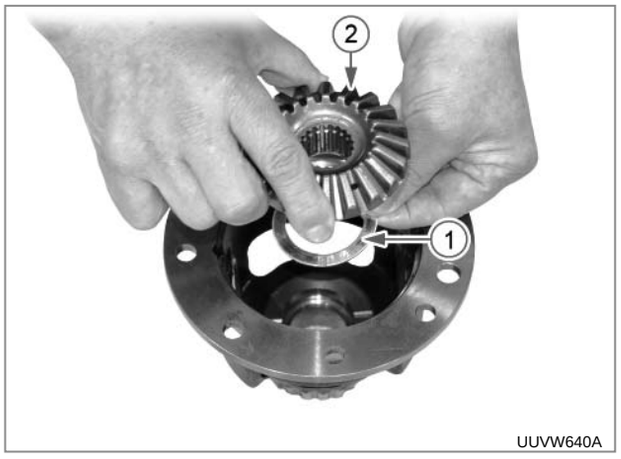


2. Pull out the spring pins (1) from the differential case and tap the differential pinion shaft (2) to remove the differential pinions (3), differential pinion washers (4) and differential pinion shaft. Then, remove the side gears (6) and differential washers (7) from the side gear cover (5) and differential case.

REMARK

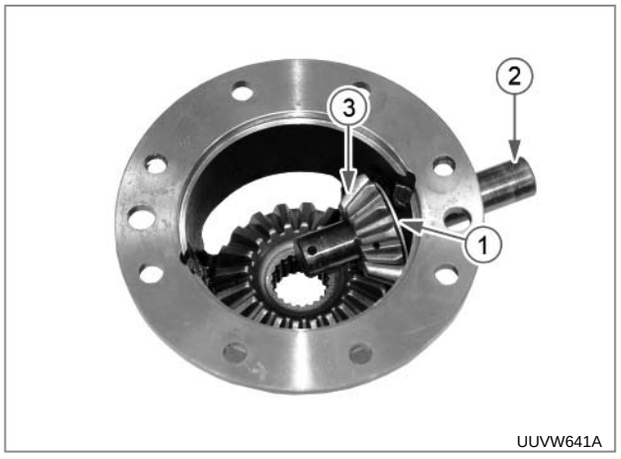
- **The needle bearing in the side gear cover cannot be removed as it is pressed in the cover.**

▶ ASSEMBLY



UUVW640A

1. Put the differential washer (1) into the differential case. Then, install the differential side gear (2).



UUVW641A

2. Fit the differential pinion washer (1) to the groove from the differentia case side without a spring pin hole. Then, pass the differential pinion shaft (2) through and install the differential pinion (3), differential pinion for the other side and differential pinion washer in order.

IMPORTANT

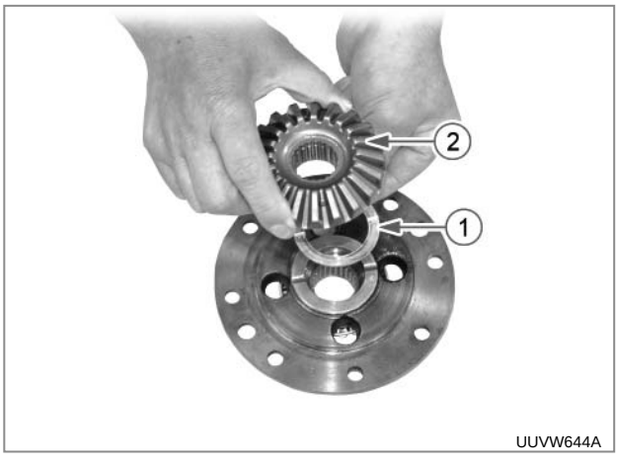

UUVW642A


S76W668A

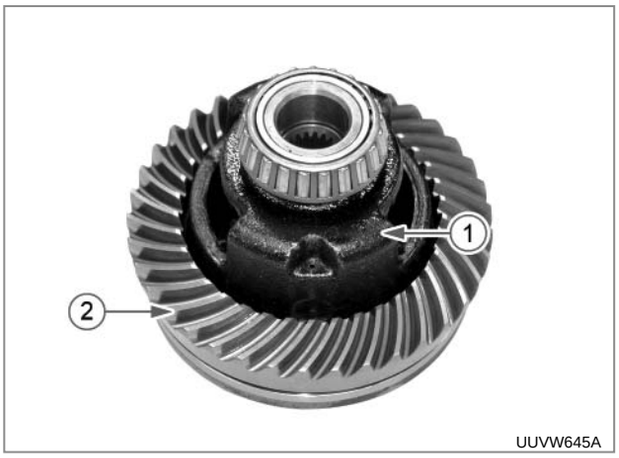
- **Make sure that the washer protrusion of the differential pinion is seated to the groove of the differential case.**

UUVW643A

3. Align the spring pin hole of the differential pinion shaft with the hole of the differential case, turn the case upside down and tap the spring pins (1) into the case.



4. Insert the differential washer (1) into the side gear cover and install the side gear (2). Then, fit this assembly with the differential case.

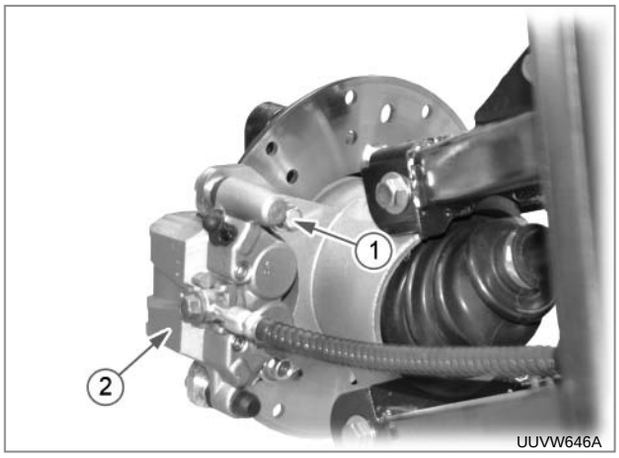


5. Install the spiral bevel gear (2) to the differential case and secure it with the bolts. Make sure to apply adhesive (Three Bond 1372 or equivalent) to the bolt threads and tighten them diagonally in several steps to the specified torque.

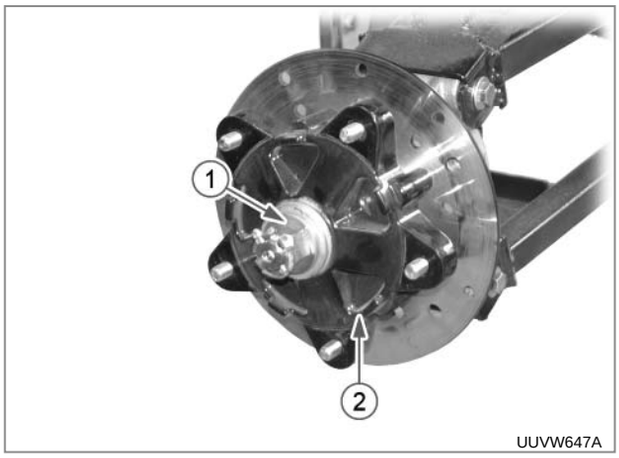
Mounting bolt (M10)
tightening torque ..... 48 ~ 55.9 Nm
4.9 ~ 5.7 kgf-m
35.4 ~ 41.2 lb-ft

6. If necessary, tap the taper roller bearings into the both sides.

5.4 REAR AXLE REPLACEMENT

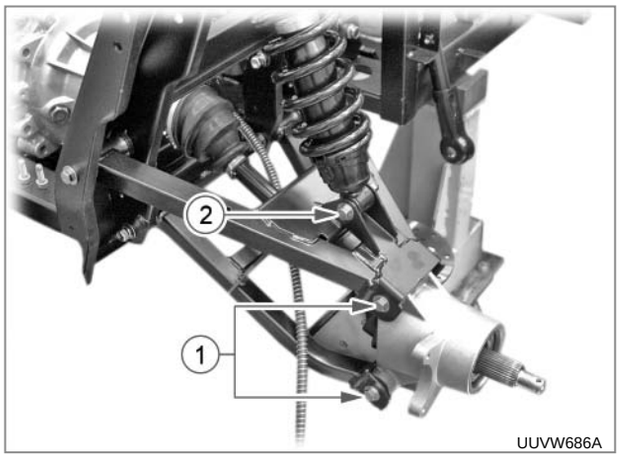


1. Unscrew the brake caliper mounting bolts (1) (M8, 2 EA) to remove the brake caliper (2).

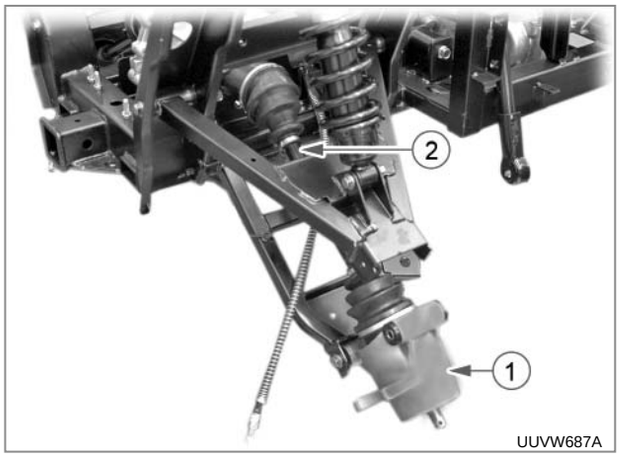


2. Remove the cap, pull out the slotted split pin and then remove the slotted nut (1) using the 27 mm spanner. Then, remove the brake disc assembly (2).

Slotted nut
tightening torque ..... 95 Nm
9.7 kgf-m
70 lb-ft

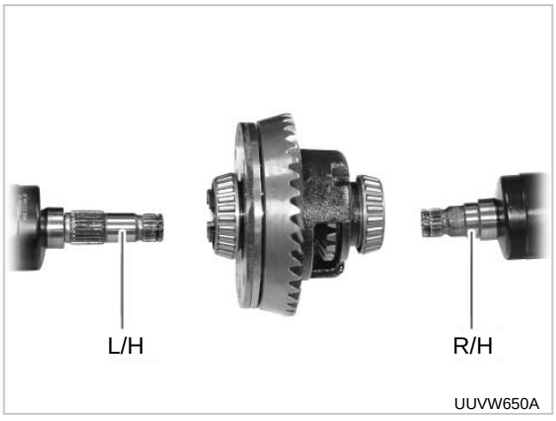


3. Unscrew the rear arm upper/lower mounting bolts (1) (M10, 2 EA) and strut assembly mounting bolt (2) (M8, 1 EA) using the 14 mm and 12 mm spanners to remove them.



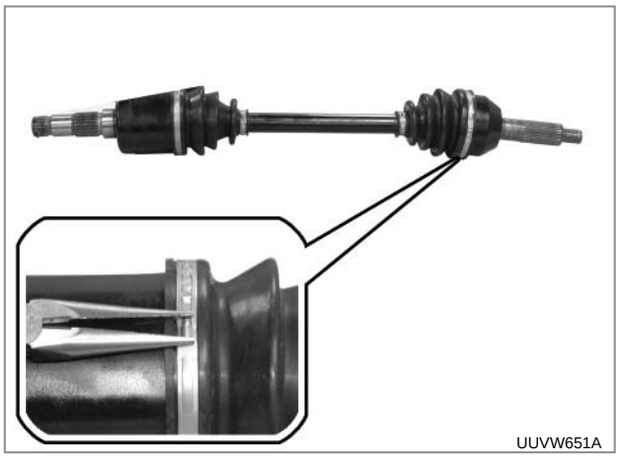
4. Pull out the carrier (1) and axle assembly (2).

⚠ CAUTION

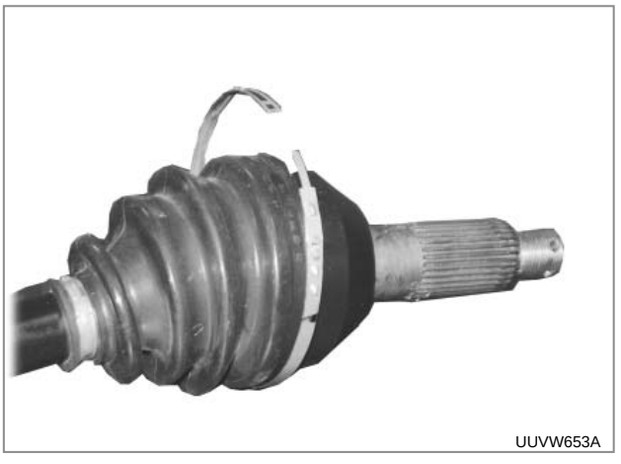


- **When installing the rear axle drive shafts to the rear axle case, be careful not to switch their original installation positions.**

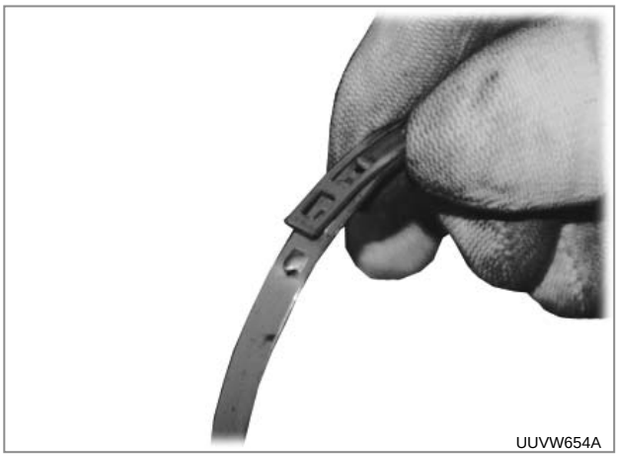
5.5 CV JOINT BOOT REPLACEMENT



1. Remove the rubber bellows band from the rear axle assembly. Then, remove the rubber bellows.



2. The outer band can be disconnected by nipping the protrusion with pliers as shown in the figure.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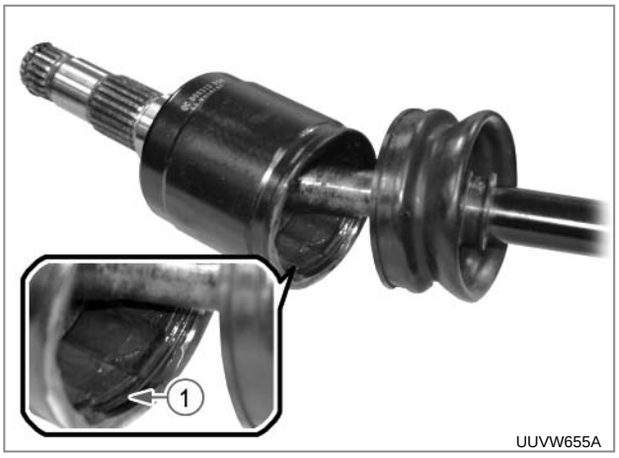
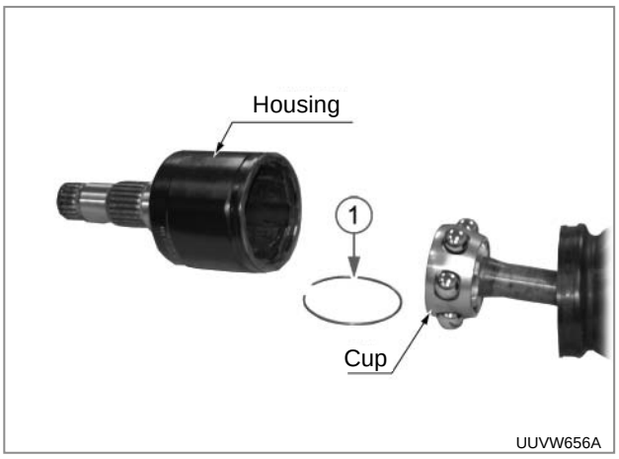
3. When installing the band, align the band with the boot mounting groove, nip the protrusion, pull the outer band and hook the band to the hook.

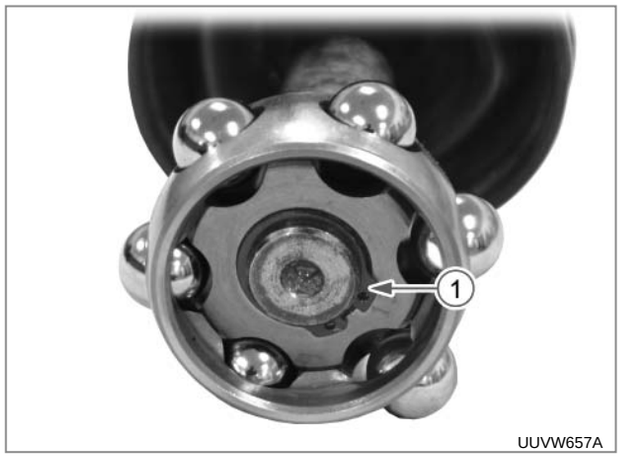


UUVW655A



UUVW656A

4. Remove the housing stop ring (1) from the CV joint. Then, separate the joint as a unit.



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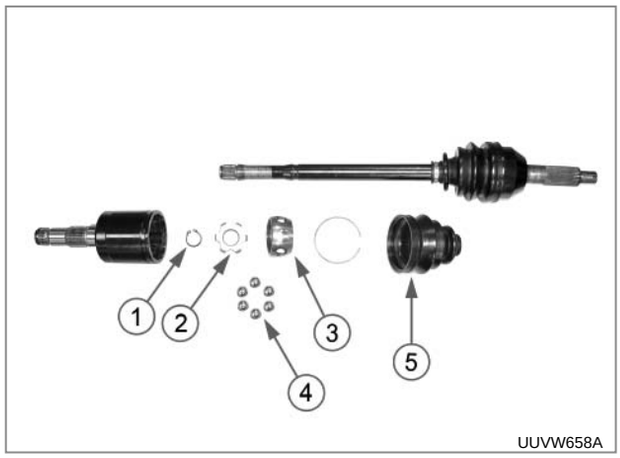


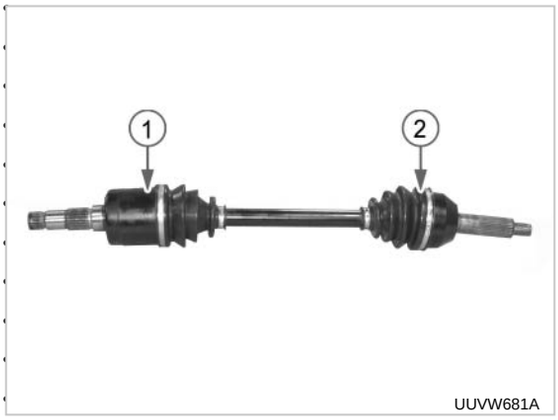
UUVW658A

5. Pull out the snap ring (1). Then, remove the ball joint guide (2), case (3), ball (4) and rubber bellows (5) in order.
6. For reassembly, fit the rubber bellows to the shaft, insert the ball joint case, fit the ball joint guide and fit the snap ring. Then, fit the ball into the hole, push it in along the housing groove and fit the stop ring.

IMPORTANT

- **During assembly, fill the rear axle drive shaft housing with a sufficient amount of grease. Make sure to apply grease to the ball and case assembly.**

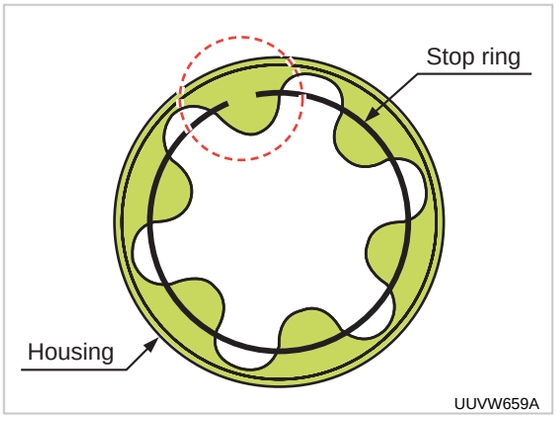
REMARK



- **Only the CV joint (1) on the differential case side can be removed.**
- **The CV joint (2) on the wheel side is pressed in and cannot be removed.**
- **Remove the CV joint on the differential case side, and then remove the two boots.**
- **When installing the CV joint, the larger opening of the bearing cup should be inserted into the housing first.**

IMPORTANT

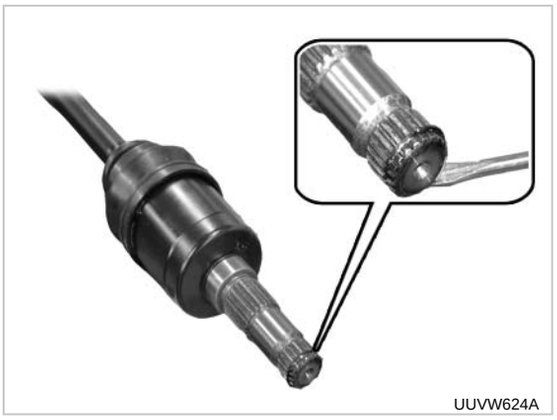
- **Drive shaft housing stop ring mounting location**



- **Make sure that the opening of the stop ring seats on the protrusion of the drive shaft housing.**

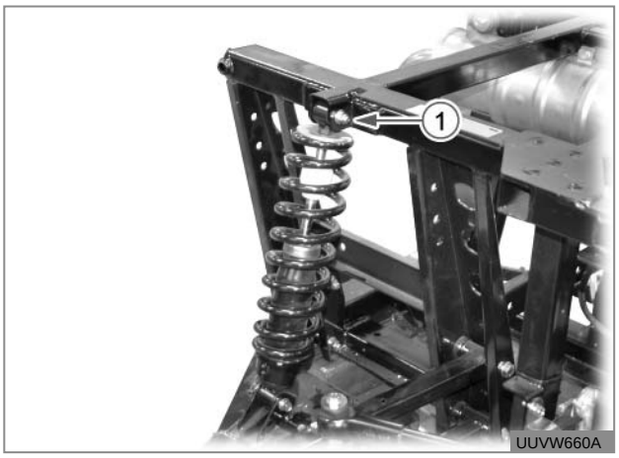
7. Fit the rubber bellows to the housing and secure it with the band.

IMPORTANT

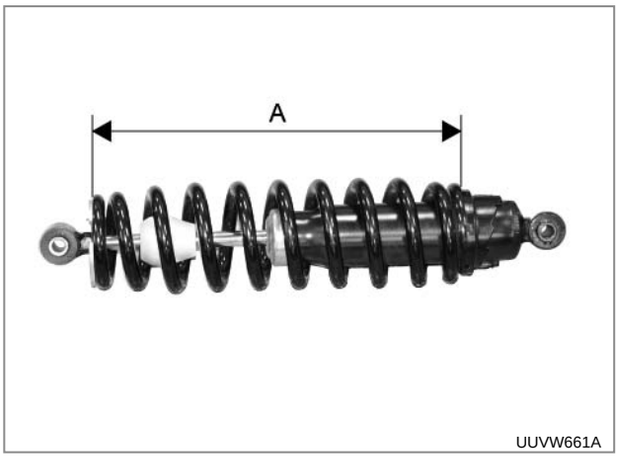


- **When installing the rear axle drive shaft to the rear axle case, be careful not to miss the O-ring and make sure to apply grease on it.**

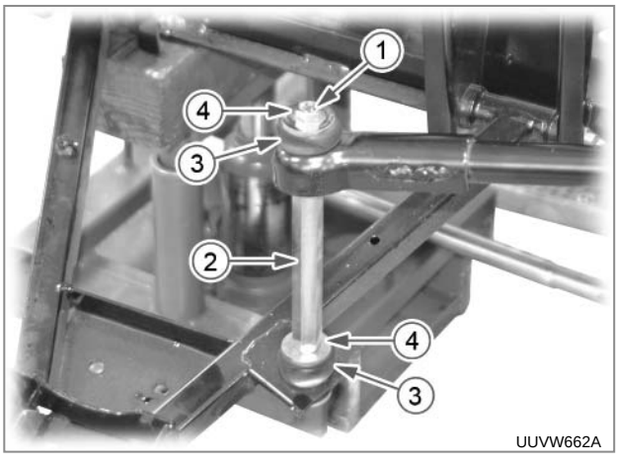
5.6 SUSPENSION ASSEMBLY REMOVAL



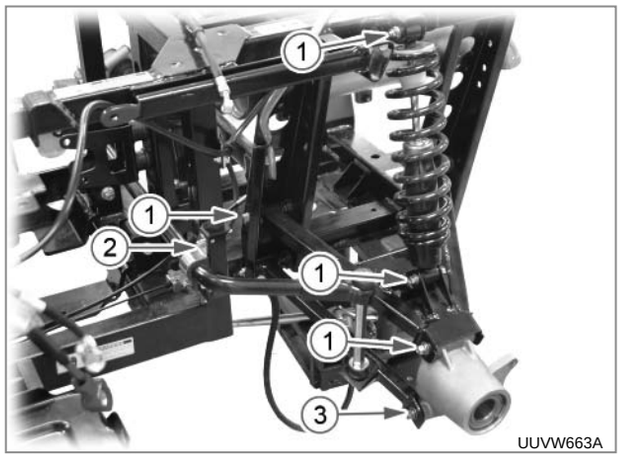
1. Unscrew the strut mounting bolts (1) (M8, 2 EA) with the 14 mm and 12 mm spanners and remove the strut assembly.



2. Set the rear suspension spring length A to be 290 ± 3 mm (11.42 ± 0.12 in.) during assembly.



3. Unscrew the upper and lower mounting bolts (1) (M10, 2 EA) for the stabilizer bar to remove the step bar (2), mounting cushion (3) and plain washer (4).

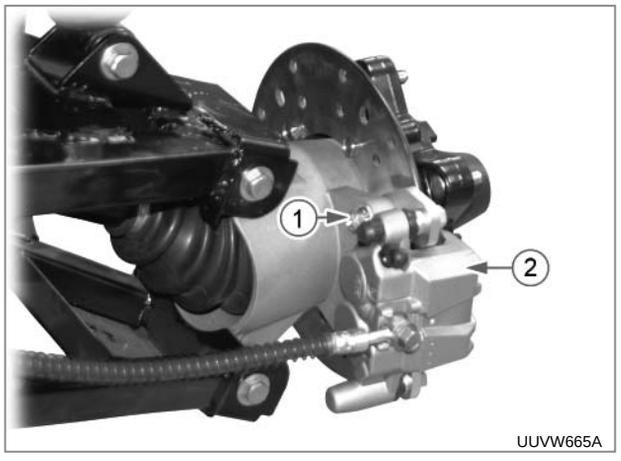


4. When assembling the rear suspension, tighten each tightening section to the specified torque.
   ①. 41 Nm, 4.1 kgf-m, 29.5 lb-ft
   ②. 21 ~ 25 Nm, 2.1 ~ 2.5 kgf-m, 15.1 ~ 18.0 lb-ft
   ③. 68 Nm, 6.8 kgf-m, 49.0 lb-ft

5.7 REAR CARRIER REPLACEMENT

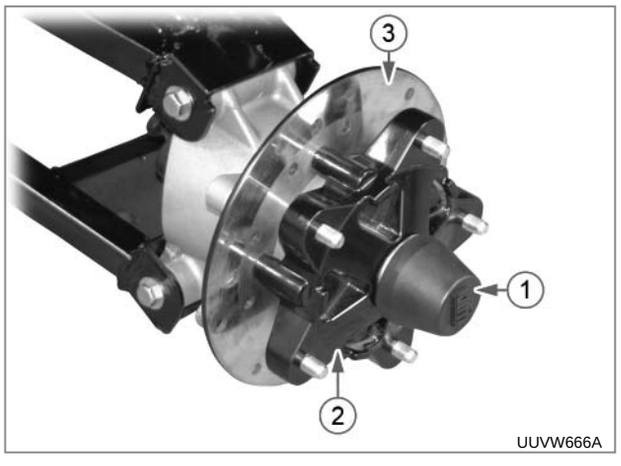

UUVW664A

1. Set a hydraulic jack under the rear frame as a support and remove the rear wheels.



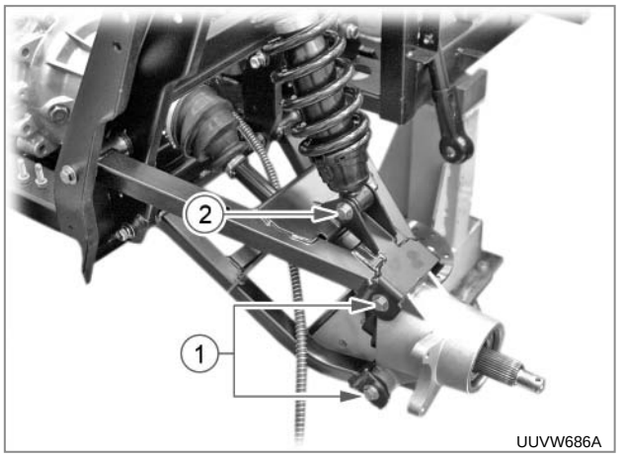
UUVW665A

2. Unscrew the brake caliper mounting bolts (1) to remove the brake caliper (2).



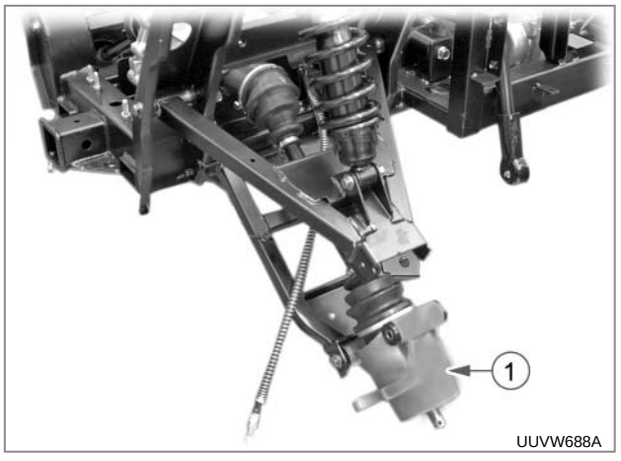
UUVW666A

3. Pull out the rear axle cover (1) and remove the split pin and slotted nut to remove the hub (2) and brake disc (3) assembly.



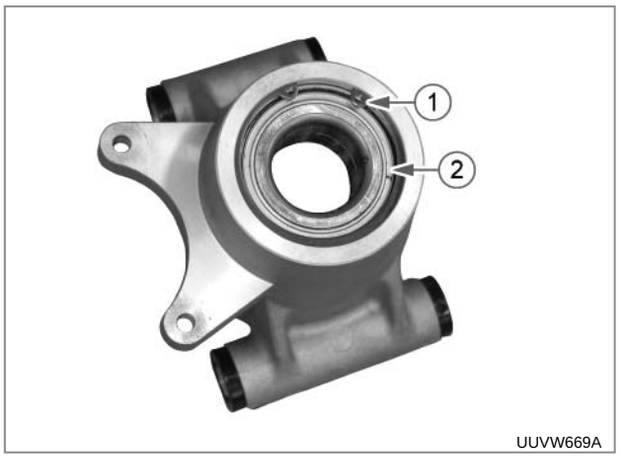
UUVW686A

4. Remove the upper/lower rear arm mounting bolts (1) and carrier assembly mounting bolt (2).



UUVW688A

5. Pull out the carrier assembly (1).



UUVW669A

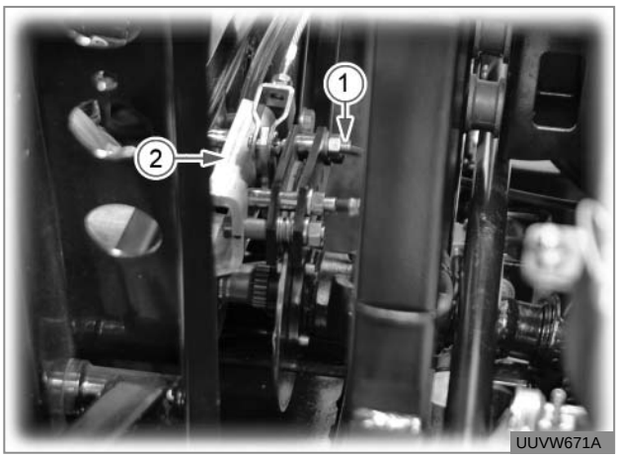
6. Pull out the snap ring (1) and tap the bearing (2) to remove it.
7. Assemble the carrier in the reverse order of disassembly.

5.8 REAR PROPELLER SHAFT REPLACEMENT

1. Park the vehicle on level ground, apply the parking brake and stop the engine.

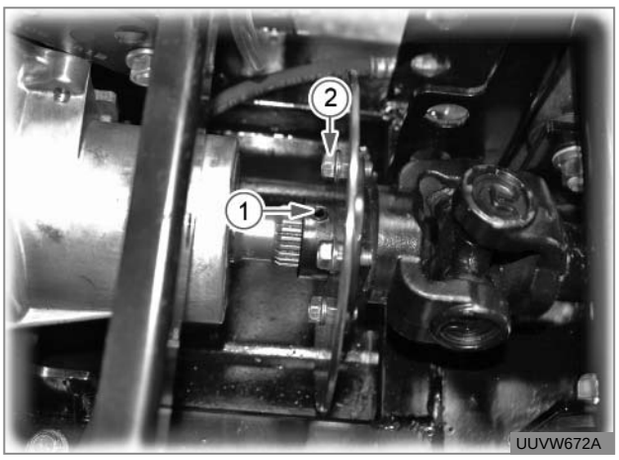

UUVW689A

2. Raise and support the cargo bed.



UUVW671A

3. Unscrew the parking brake caliper mounting bolts (1) to remove the caliper assembly (2).



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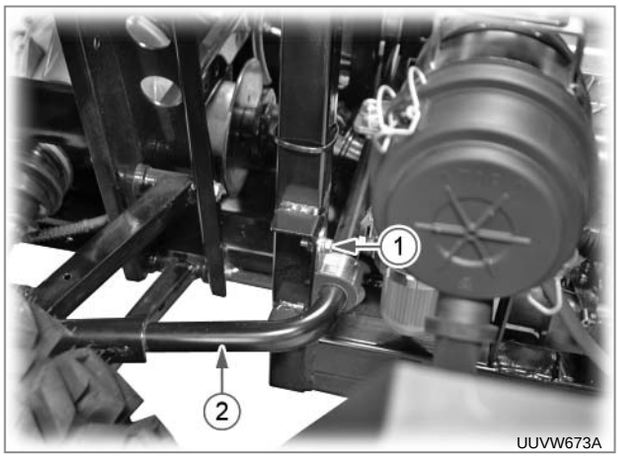
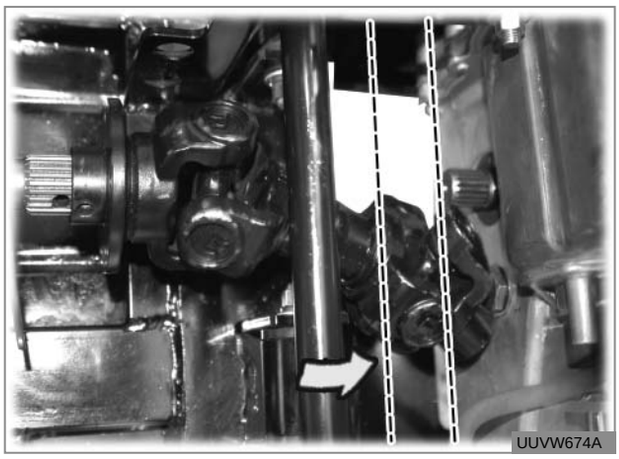
4. Tap the propeller shaft mounting spring pin (1) on the rear axle case side and unscrew the brake disc mounting bolts (2) to remove the brake disc.



UUVW673A

5. Loosen the left and right mounting bolts (1) (M8, 4 EA) for the stabilizer.


UUVW674A

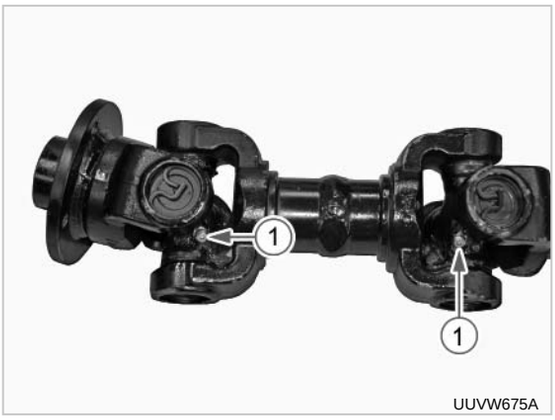
6. Pull the propeller shaft toward the rear axle case with the stabilizer lifted up to separate it from the transmission case. Then, pull it toward the transmission case to remove it.

REMARK

- **If the propeller shaft to be removed is interfered with the transmission due to its torque angle, rotate the rear wheels to find the right angle so that it can be removed without any interference.**

7. Assemble in the reverse order of disassembly.
8. When assembling the components, tighten the brake disc mounting bolts first to install the disc. Then, fit the spring pin to secure the propeller shaft.

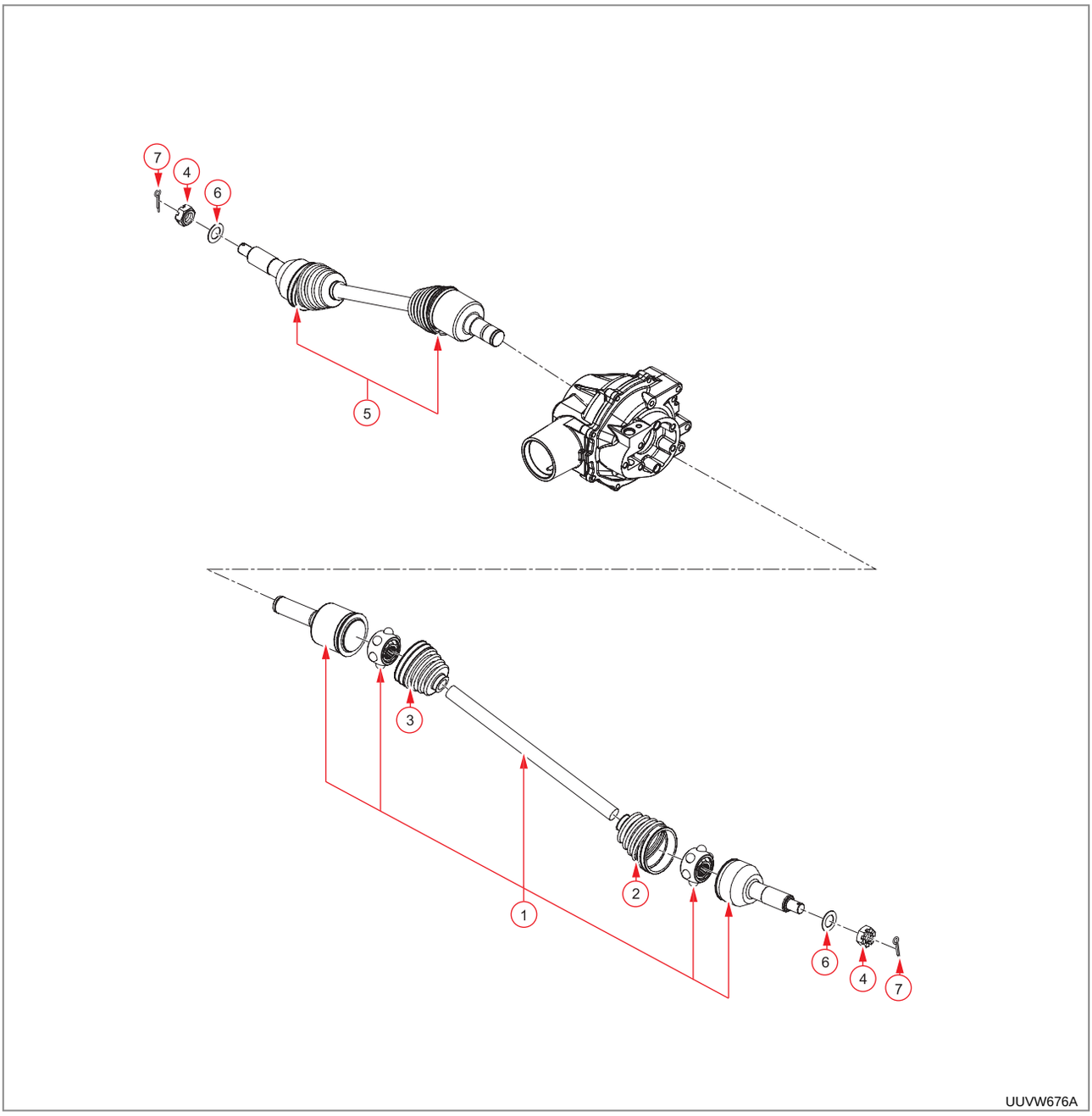
REMARK



- **When installing a new propeller shaft, apply grease to the grease nipple (1) on the cross-bearing side sufficiently.**
  (Grease: NLGL grade No. 2 or equivalent)

6. COMPONENTS

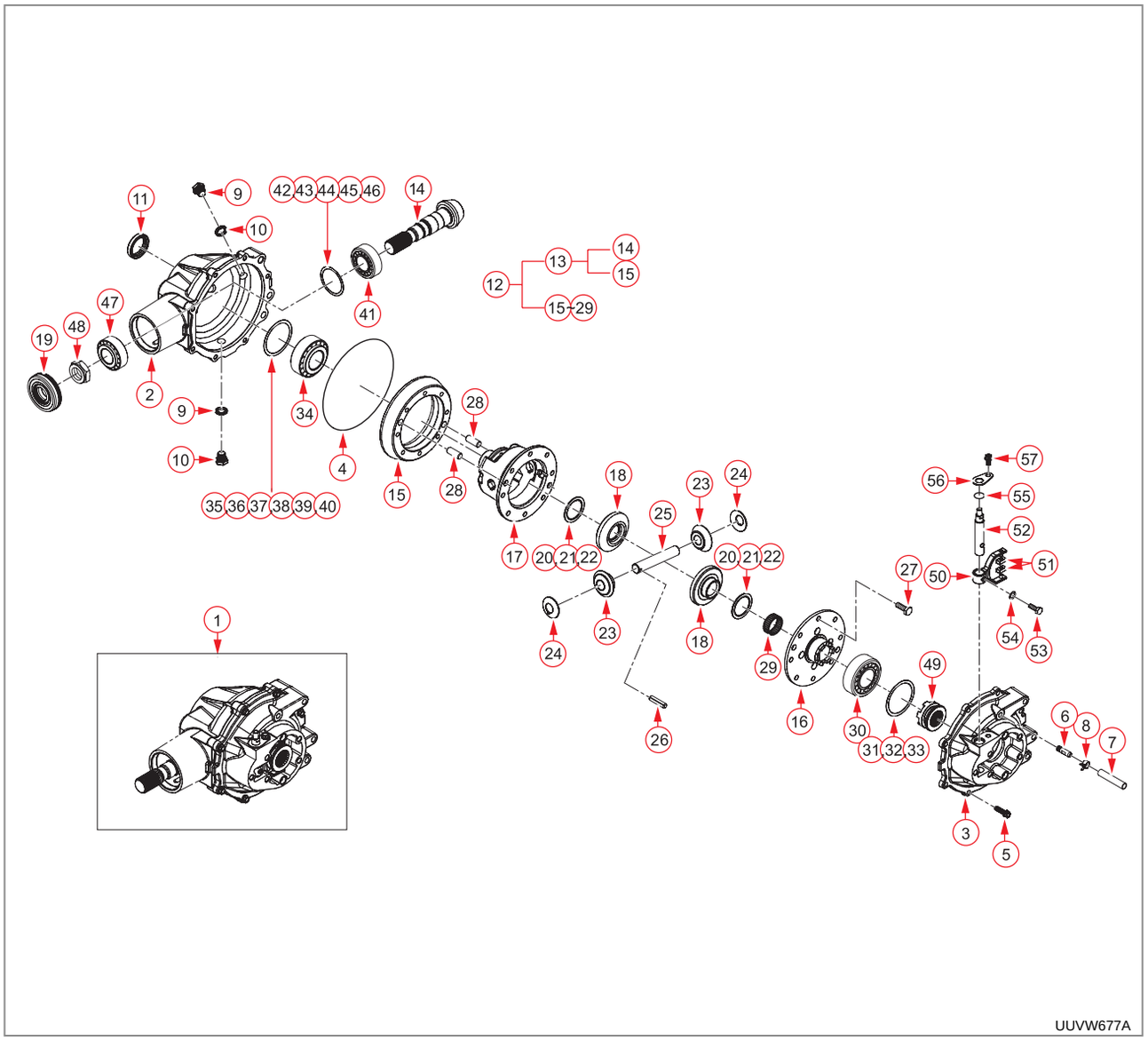
6.1 U200A REAR AXLE DRIVE SHAFT



COMPONENTS

(1) DRIVE SHAFT ASSY, RR-LH
(2) BOOT REPAIR KIT FRT O/B (W/ GREASE)
(3) BOOT REPAIR KIT FRT I/B (W/ GREASE)
(4) NUT
(5) DRIVE SHAFT ASSY, RR-RH
(6) WASHER, PLAIN
(7) PIN, SPLIT

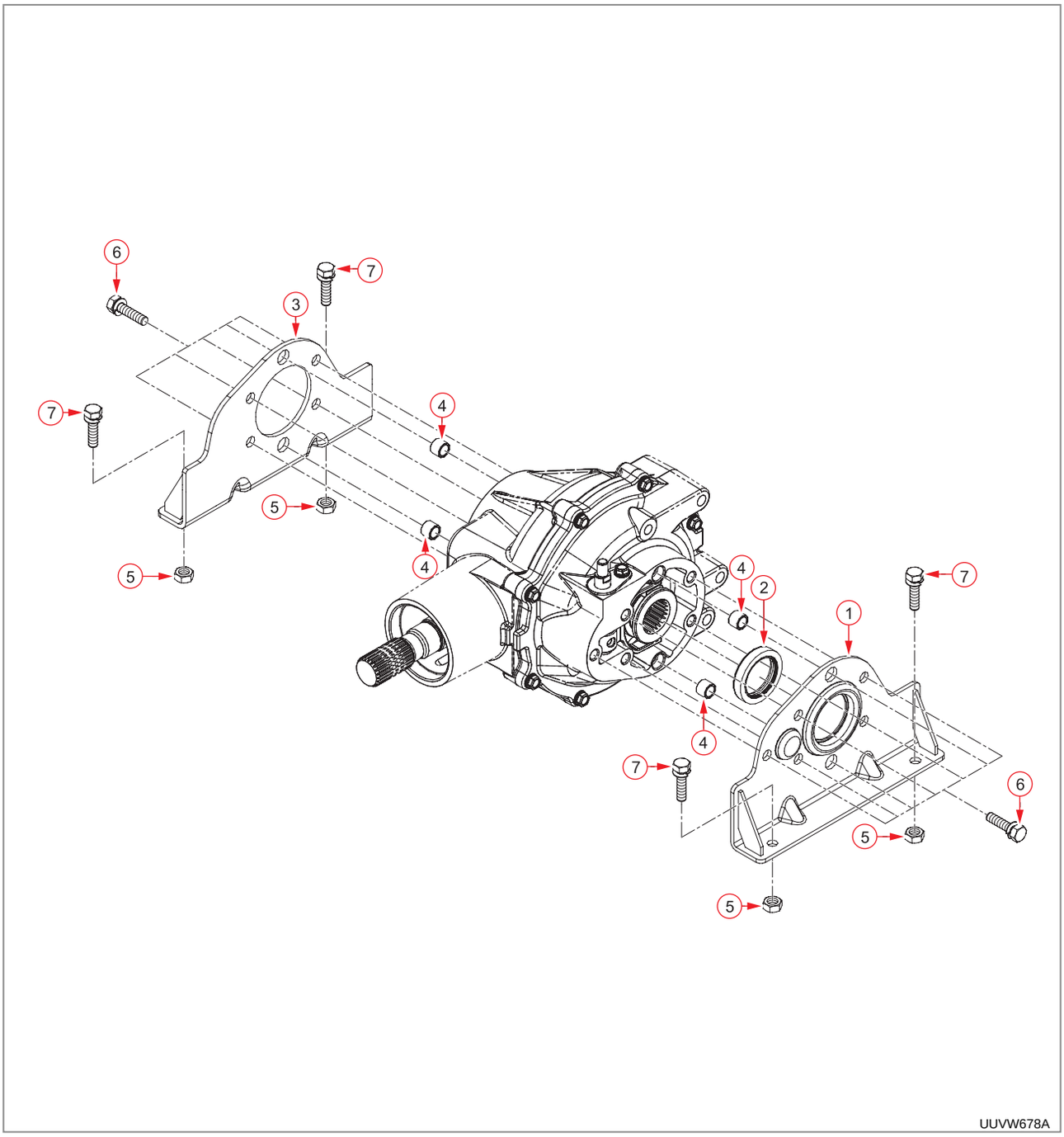
6.2 U210A REAR DIFFERENTIAL SYSTEM



COMPONENTS

(1) REAR AXLE CASE ASSY
(2) CASE, REAR AXLE
(3) COVER, REAR AXLE CASE
(4) O RING
(5) BOLT
(6) CONNECTOR, AIR BREATHER
(7) HOSE, OVER FLOW
(8) CLIP, PIPE
(9) WASHER, SEAL
(10) PLUG
(11) OIL SEAL(38*54*9.5)
(12) ASSY DIFFERENTIAL
(13) SPIRAL BEVEL GEAR ASSEMBLY
(14) PINION, SPIRAL BEVEL
(15) GEAR 37, BEVEL
(16) COVER, DIFFERENTIAL CASE
(17) CASE, DIFFERENTIAL
(18) GEAR, DIFF. SIDE
(19) OIL SEAL(30*75*12)
(20) WASHER, DIFF.3
(21) WASHER, DIFF.
(22) WASHER, DIFF.
(23) PINION
(24) WASHER
(25) SHAFT, PINION
(26) PIN SPRING
(27) BOLT
(28) PIN, STRAIGHT
(29) BEARING, NIDDLE
(30) BEARING, TAPER ROLLER
(31) SHIM 0.1
(32) SHIM 0.2
(33) SHIM 0.4
(34) BEARING, TAPE ROLLER
(35) SHIM(0.1)
(36) SHIM 0.2
(37) SHIM(0.4)
(38) SHIM
(39) SHIM
(40) SHIM(1.2)
(41) BEARING, TAPER ROLLER
(42) SHIM 0.6
(43) SHIM 0.8
(44) SHIM1.0
(45) SHIM 1.2
(46) SHIM 1.4
(47) BEARING, TAPER ROLLER
(48) NUT32
(49) SHIFT, DIFF.
(50) FORK, SHAFT
(51) GUIDE, SHIFT
(52) ARM, SHIFT(DIFF.)
(53) BOLT, REAMER
(54) WASHER
(55) O RING
(56) PLATE, LOCK
(57) BOLT

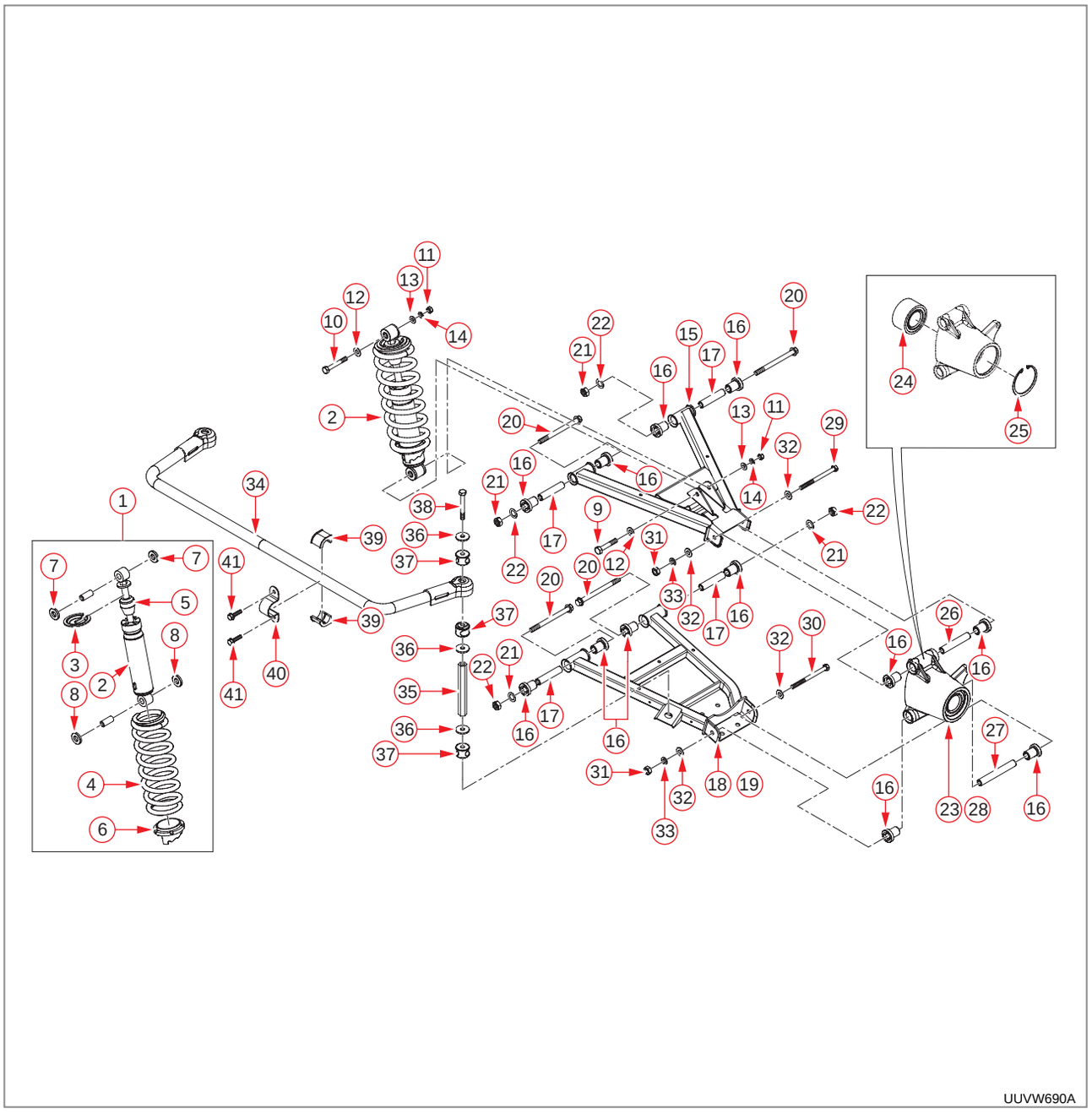
6.3 U680A REAR DIFFERENTIAL



COMPONENTS

(1) REAR DIFF BRACKET ASSY, RH
(2) OIL SEAL(38*54*9.5)
(3) REAR DIFF BRACKET ASSY, RH
(4) BUSHING, CENTERING
(5) NUT
(6) BOLT
(7) BOLT

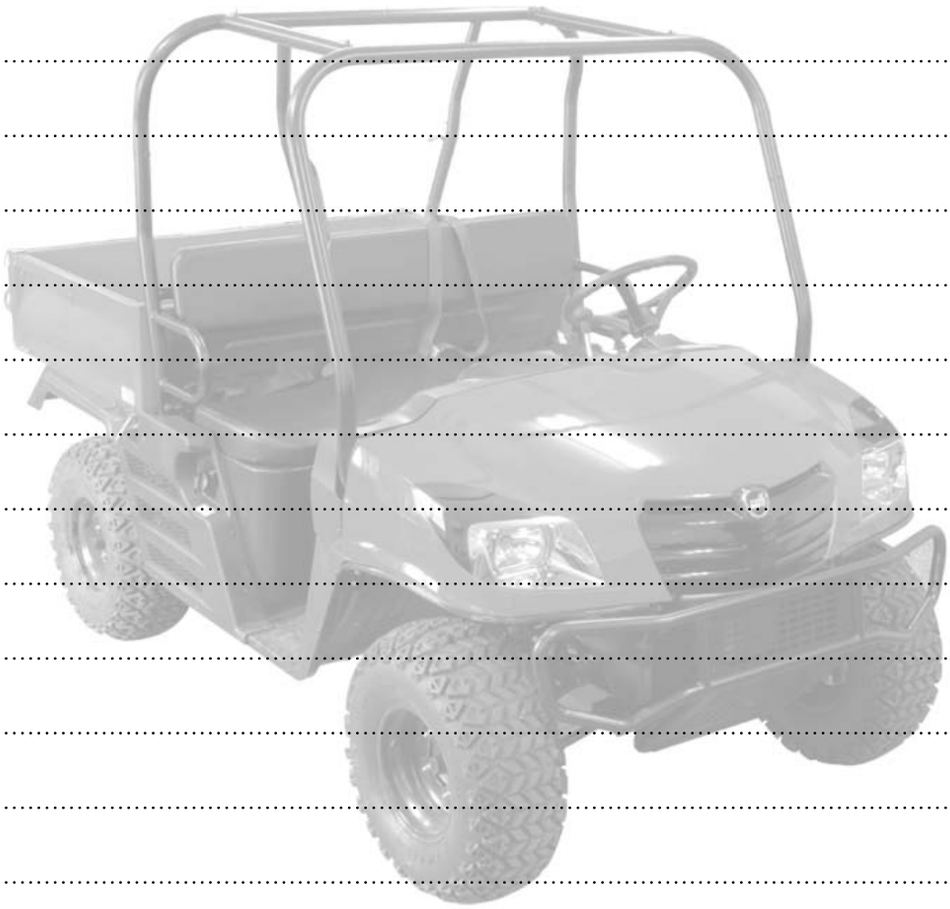
6.4 U0510A REAR SUSPENSION



COMPONENTS

(1) STRUT ASSY, RR
(2) STRUT ASSY, RR
(3) SPRG SEAT, UPR RR
(4) FRICTION SPRING
(5) BUMP, STOPPER
(6) SPRG SEAT, LWR FR
(7) BUSHING, RR SHK ABS
(8) BUSHING, LWR_RR SHK/ABS
(9) REAMER BOLT, SUS LWR, REAR (M8)
(10) REAMER BOLT, SUS UPR, REAR (M8)
(11) NUT
(12) WASHER, PLAIN
(13) WASHER, PLAIN
(14) WASHER, SPRING
(15) ARM ASSY-UPR-RR
(16) BUSHING, ARM
(17) BUSH
(18) ARM ASSY-LWR-RR-LH
(19) ARM ASSY-LWR-RR-RH
(20) BOLT
(21) WASHER, SPRING
(22) NUT
(23) CARRIER ASSY-RR-LH
(24) HUB BEARING, RR
(25) SNAP RING
(26) TUBE, CARRIER UPR
(27) TUBE, CARRIER LOW
(28) CARRIER ASSY-RR-RH
(29) BOLT, UPR ARM MTG TO CARRIER (M10X110)
(30) BOLT, LWR ARM MTG TO CARRIER (M10X135)
(31) NUT
(32) WASHER, PLAIN
(33) WASHER, SPRING
(34) BAR, STABILIZER
(35) STAB BAR LINK
(36) WASHER, STAB BAR
(37) BUSH, STAB BAR
(38) BOLT
(39) BUSHING, STAB BAR MTG.
(40) CLAMP, STAB BAR MTG.
(41) BOLT, WASHER

MEMO



BRAKE

CHAPTER 8

TABLE OF CONTENTS

1. SPECIFICATIONS

1.1 GENERAL SPECIFICATIONS

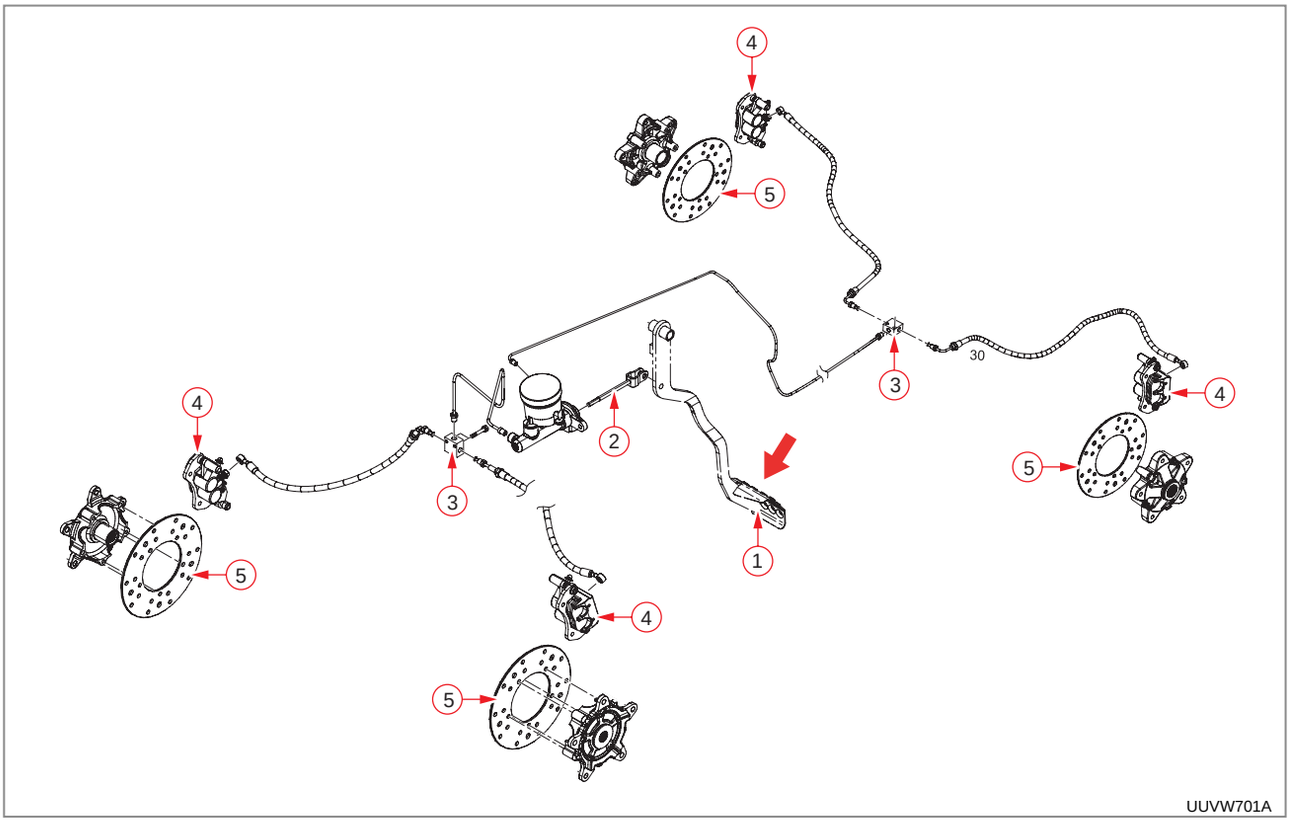
Item	Specification	Remarks
Brake type	Hydraulically operated pedal type caliper disc	
Brake pedal free play	15 ~ 20 mm (0.59 ~ 0.79 in.)	
Allowable min. brake disc thickness	3.5 mm (0.318 in.)	Specification for new component: 4.0 mm (0.157 in.)
Allowable min. brake pad thickness	2.0 mm (0.083 in.)	Specification for new component: 5.0 mm (0.197 in.)
Brake (stop) switch installation clearance(from contact plate to switch tip)	0 ~ 1 mm (0 ~ 0.039 in.)	
Clearance for parking brake caliper pad	4.8 mm (0.189 in.) or more	
Clearance for front/rear wheel brake caliper pad	4.6 mm (0.181 in.) or more	
Brake fluid	DOT3 or equivalent	Add fluid to the reservoir up to the MAX line after bleeding.

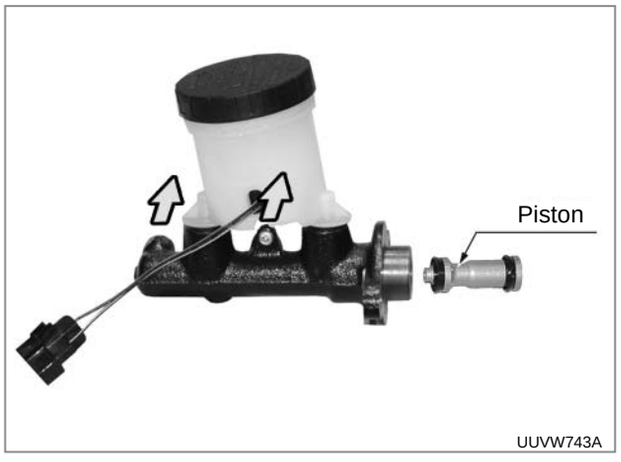
1.2 TIGHTENING TORQUE

Position	Specification	Tightening torque
Front/rear wheel & parking brake disc mounting bolt	M8	24.5 Nm 2.5 kgf-m 18.0 lb-ft
Front/rear wheel & parking brake caliper mounting bolt	M8	24.5 Nm 2.5 kgf-m 18.0 lb-ft
Brake pipe mounting nut		18.6 Nm 1.9 kgf-m 13.7 lb-ft

2. STRUCTURE AND FUNCTION

2.1 FRONT AND REAR WHEEL BRAKES



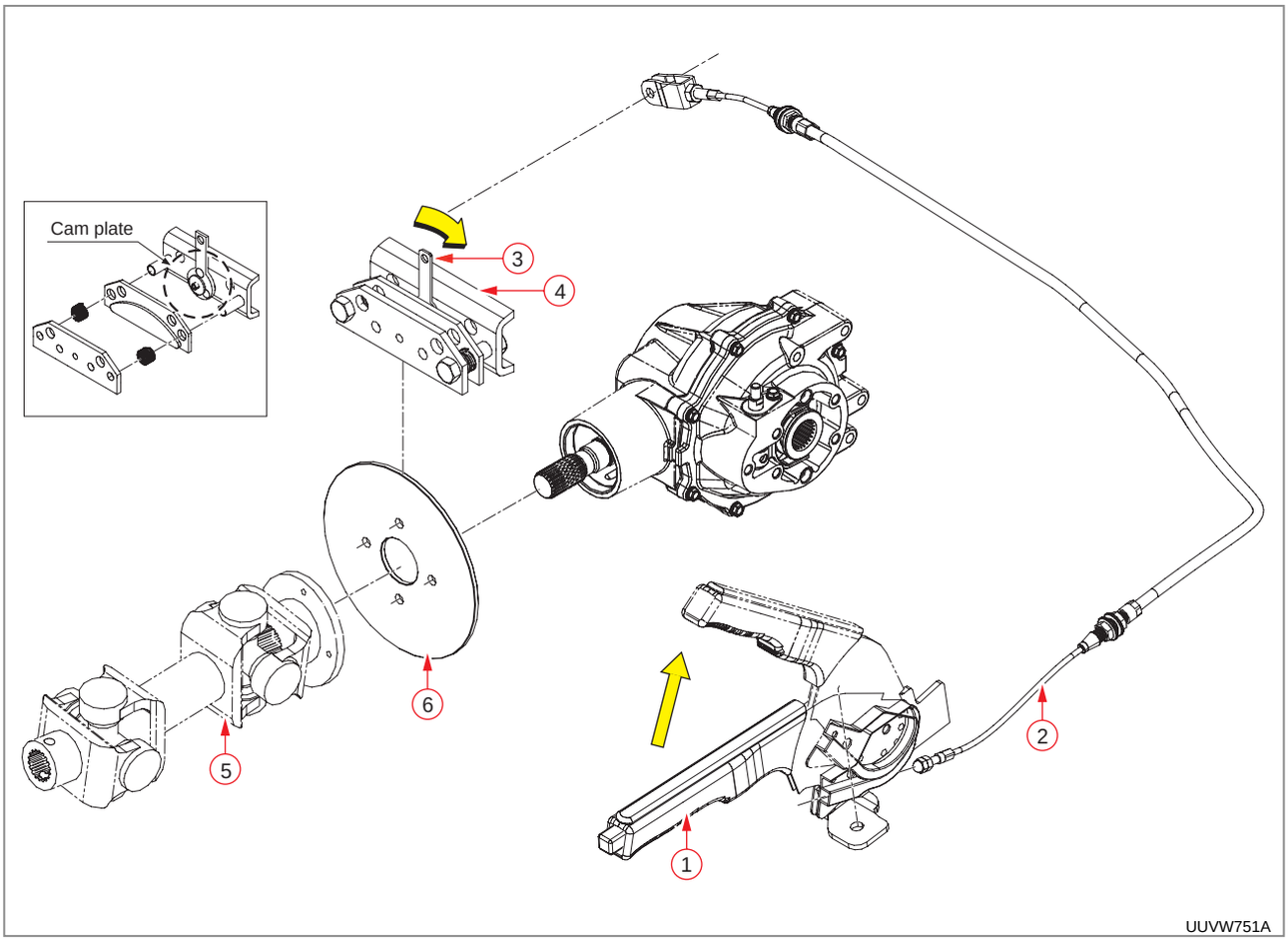


When the brake pedal (1) is depressed, the master cylinder rod (2) pushes the master cylinder piston to deliver the brake fluid in the slave cylinder to each wheels.

This brake fluid flows to the fitting tee (3) through the brake tubes for the front/rear wheels and then is lead to the pistons of the left and right brake calipers (4) for the front and rear wheels.

As the piston is extended, the brake pad is compressed against the disc and the axle integrated with this disc stops.

2.2 PARKING BRAKE



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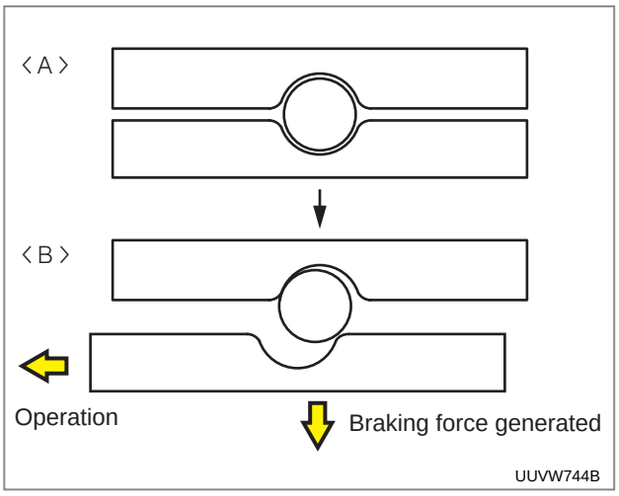
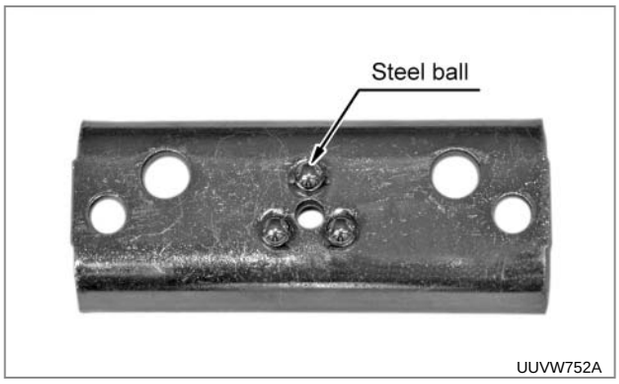


UUVW744B



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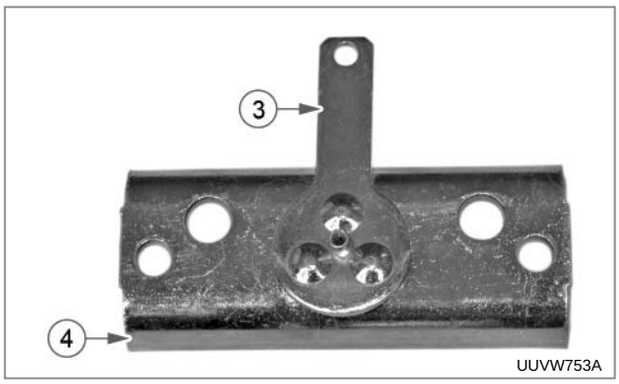

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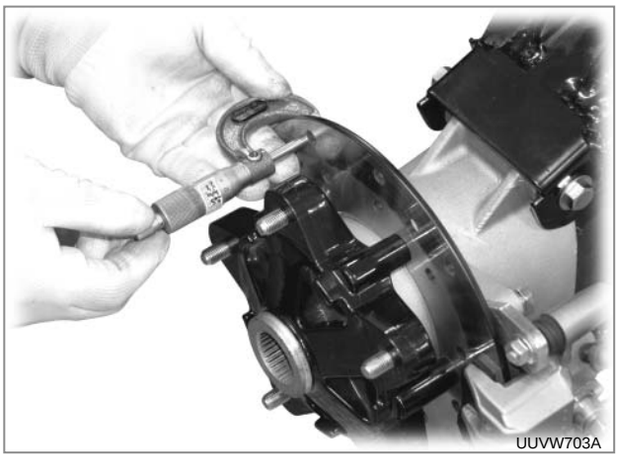
When the parking brake lever is pulled up, the cam lever (3) is rotated by the cable. The cam lever and bracket (4) are equipped with the steel ball pockets and the steel ball is seated in center in a normal state as shown in the figure A. When the parking brake lever is pulled up and the cam lever is rotated, the steel ball is pushed to the edge of the pockets of the cam lever and bracket and the force in the driving direction is applied to the cam lever and bracket. This force compresses the brake pad of the back of the cam lever against the disc, resulting in a braking force generated.

3. TROUBLESHOOTING

Symptom	Cause	Solution
Vehicle pulls to one side when depressing the brake pedal	• Excessively worn brake disc or pad • Damaged brake link • Damaged brake fluid tube	• Replace the part. • Replace the part. • Check and replace the tube line.
Insufficient braking force	• Improperly adjusted brake free play • Excessively worn brake disc or plate • Damaged brake fluid tube	• Adjust the free play. • Replace the part. • Check the brake fluid circulating system.
Braking noise	• Worn or hardened brake disc lining	• Replace the part.
Braking delay	• Insufficient brake fluid, air in fluid • Loose brake pedal return spring	• Add the fluid and bleed the system. • Replace the return spring.

4. INSPECTION AND ADJUSTMENT

4.1 BRAKE DISC THICKNESS



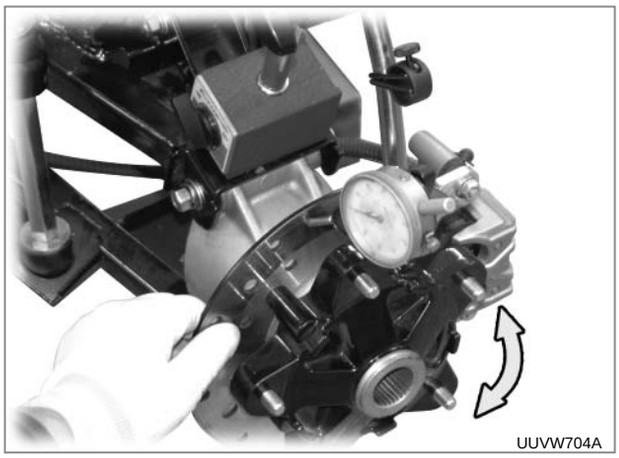
1. Measure the thickness of the front/rear brake discs with a micrometer.
   Standard disc thickness: 4.0 mm (0.157 in.)
   Allowable limit: 3.5 mm (0.138 in.)

IMPORTANT

- **Check if the surface of the disc is worn unevenly, scratched or split. If an abnormal condition is found, replace it with a new one.**

2. Measure the thickness of the parking brake disc with the same procedure.
   Standard disc thickness: 4.0 mm (0.157 in.)
   Allowable limit: 3.5 mm (0.138 in.)

4.2 BRAKE DISC RUNOUT



1. Set a dial gauge on top of the lower arm of the rear axle. Measure the runout while turning the hub left and right with the sensor in contact with the side of the brake disc lightly.
   Standard runout: 0.254 mm (0.01 in.) or lower
2. Measure the runout of the parking brake disc with the same procedure.
   Standard runout: 0.35 mm (0.0138 in.) or lower

4.3 CALIPER PAD CLEARANCE AND THICKNESS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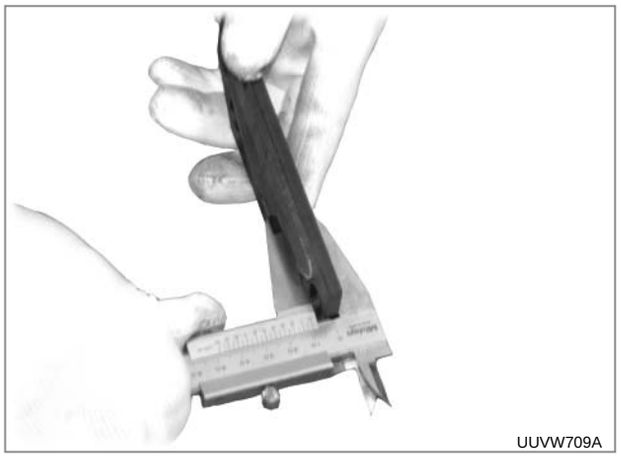
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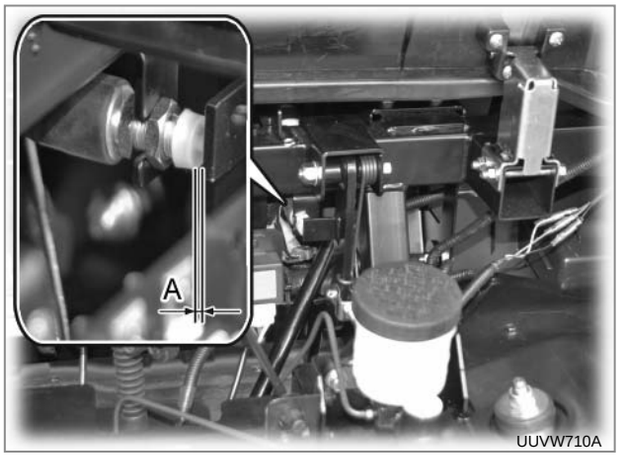
1. Measure the clearance of the parking brake caliper with vernier calipers.
   Standard clearance: 4.8 mm (0.189 in.) or higher
   Standard brake pad thickness (new) : 5.0 mm (0.1969 in.)
   Allowable brake pad thickness: 2.0 mm (0.0787 in.) or higher
2. Measure the thickness and clearance of the caliper pads for the front and rear brakes with the same procedure.
   Clearance for front/rear wheel brake caliper pad : 4.6 mm (0.181 in.) or higher
   Standard brake pad thickness (new) : 5.0 mm (0.197 in.)
   Allowable brake pad thickness : 2.0 mm (0.083 in.)

4.4 BRAKE LAMP SWITCH INSTALLATION CLEARANCE (OPTIONAL)

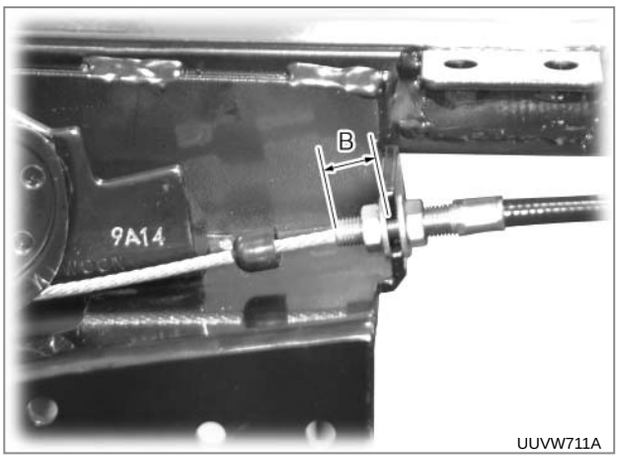


UUVW710A

1. When installing the brake lamp switch, release the brake pedal and set the distance from the brake lamp switch contact to the pressing plate with the plate fully pressed to be within 1 mm.

Item	Standard
Brake lamp switch clearance (A)	0 ~ 1 mm (0 ~ 0.039 in.)

4.5 PARKING BRAKE WIRE INSTALLATION (LENGTH ADJUSTMENT)

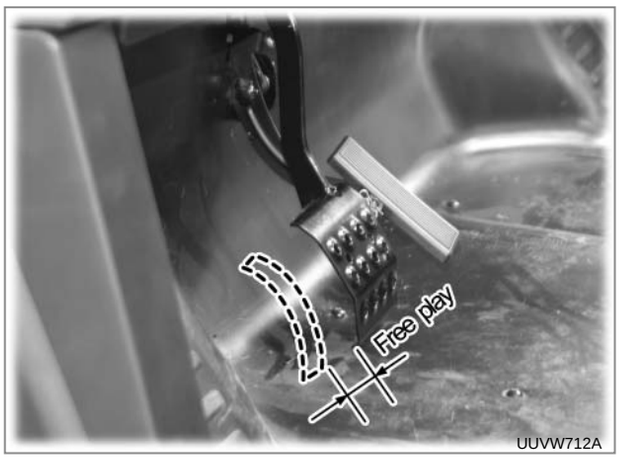


1. Connect the parking brake cable to the caliper.
2. Pull the parking brake lever fully until a clicking sound is heard for 7 to 8 times and secure the adjustment part B to the bracket on the parking brake lever side with the nut.
3. Tighten the adjusting nut and cover it with the cap.

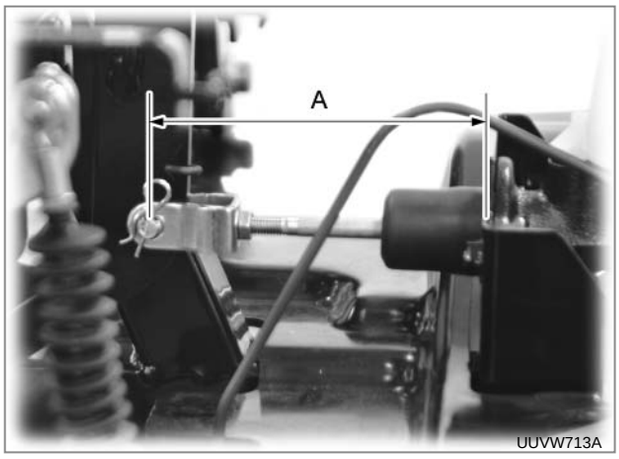
REMARK

- **Operating force for parking brake: 15 ~ 20 kgf (33 ~ 44 lbs)**

4.6 BRAKE PEDAL FREE PLAY



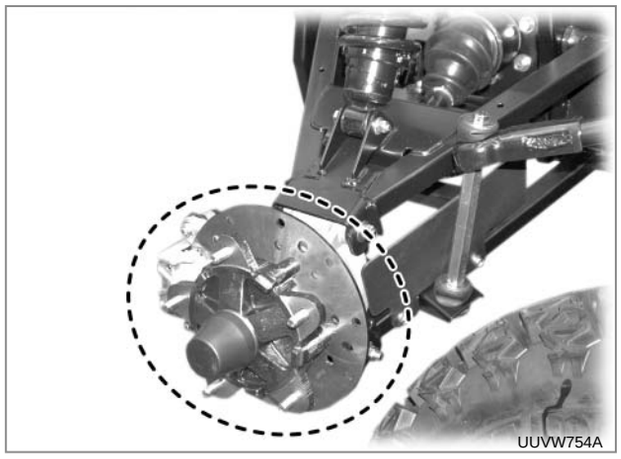
1. Adjust the free play while pressing the brake pedal with a hand gently.
   Proper free play: 15 ~ 20 mm (0.59 ~ 0.79 in.)



2. The free play of the brake pedal can be adjusted by adjusting the installation length of the brake master cylinder rod.
   Initial rod installation length (A): 128 mm (5.04 in.)

5. DISASSEMBLY, SERVICE AND ASSEMBLY

5.1 REAR WHEEL BRAKE REMOVAL (BRAKE PAD AND DISC REPLACEMENT)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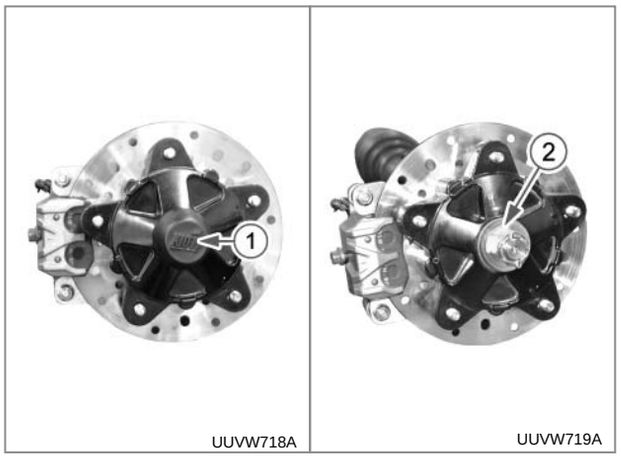

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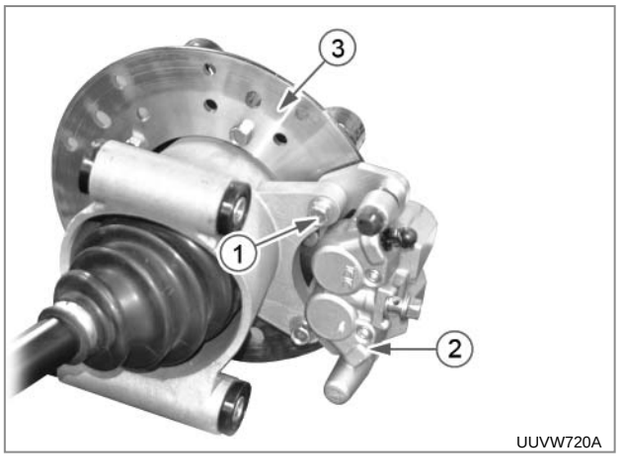
1. Remove the axle cap (1). Then, remove the ball joint bolt mounting split pin and slotted nut (2).

REMARK

- **Do not disconnect the brake hose while replacing the brake pad.**
- **If the hose is disconnected, bleed the hose.**



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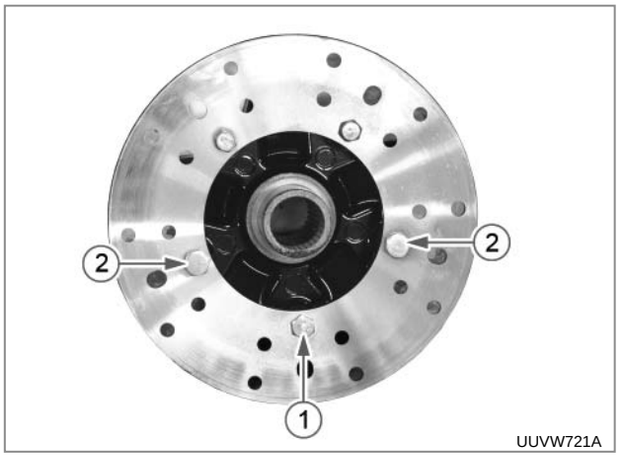
2. Unscrew the brake caliper mounting bolts (1) (M8, 2 EA) to remove the brake caliper (2) from the brake disc assembly (3).
   When installing the brake caliper, apply LOCTITE #242 or equivalent to the threads of its mounting bolts (1) and tighten its bolts to the specified torque.

   Mounting bolt (M8)
   tightening torque .....24.0 Nm
   2.5 kgf-m
   18.0 lb-ft



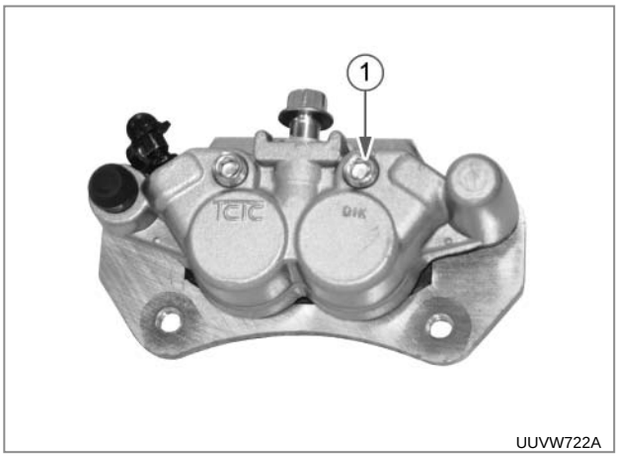
UUVW721A

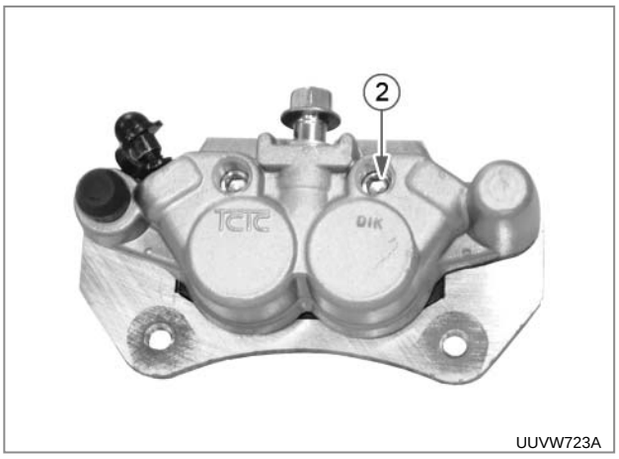
3. Unscrew the brake disc mounting bolts (1) to remove the disc. When tightening the bolts, apply LOCTITE #242 or equivalent to their threads and tighten them to the specified torque.

   Mounting bolt (M8)
   tightening torque .....24.0 Nm
   2.5 kgf-m
   18.0 lb-ft

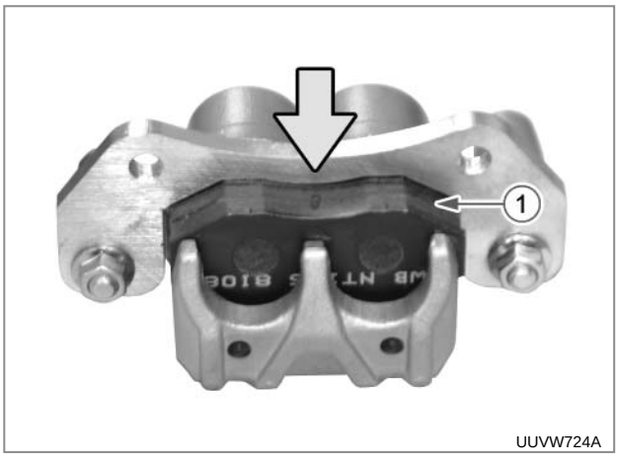
IMPORTANT

- **Use the reamer bolts (2) for two holes among the five bolt mounting holes. The reamer bolt mounting holes are machined larger than the normal bolt mounting holes.**
- **Make sure to check the bolt hole size during installation.**

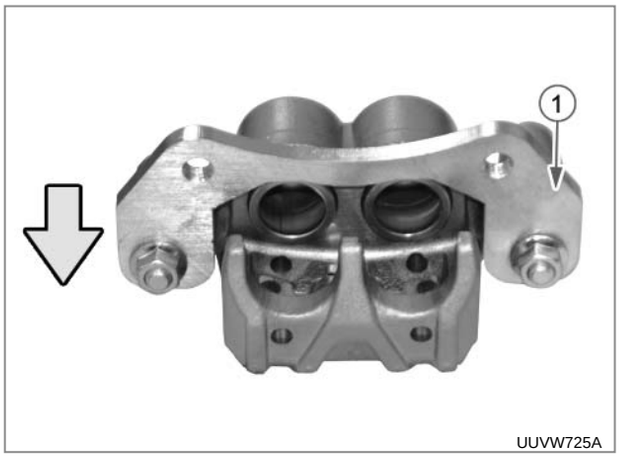




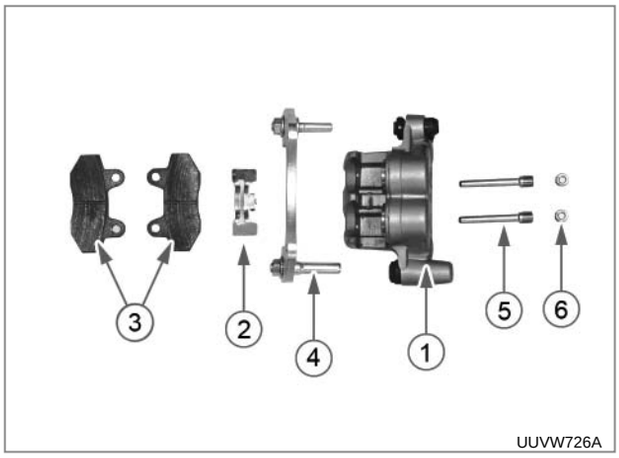
4. Unscrew the hexagon screws (1) from the brake caliper and remove the mounting screws (2) using the 6 mm hex. wrench.



5. Remove the brake pad (1) by pressing it down.

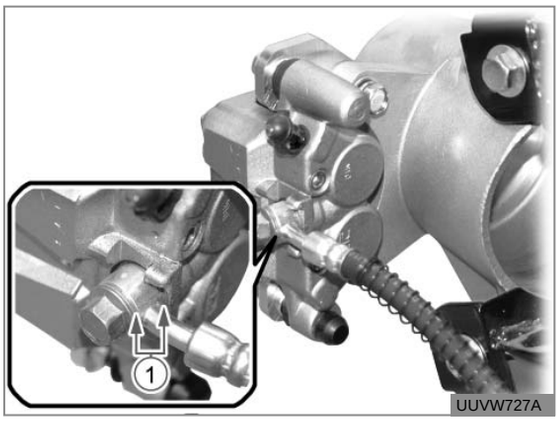


6. If necessary, pull out the guide forward and remove the spring.



7. For assembly, insert the spring (2) into the caliper body (1), fit the pads (3) to both sides and insert the guide (4). Then, tighten the mounting screws (5) and then tighten the hexagon screws (6).

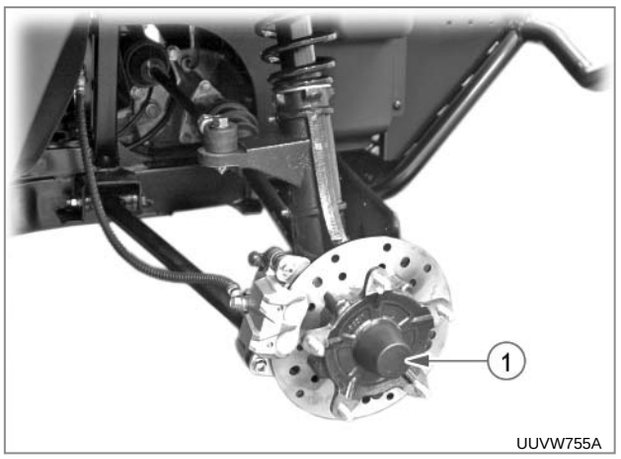
IMPORTANT

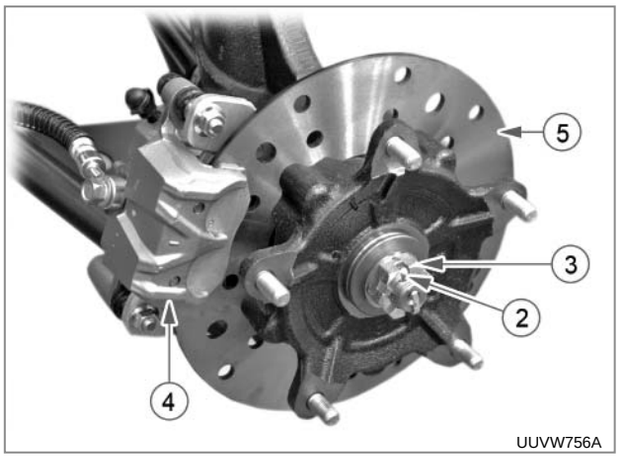


- **When connecting the brake hose to the caliper, insert the copper washers (1) to the both ends and tighten it to the specified torque. The copper washers should be replaced with new ones during sassembly.**

Specified torque .....16.0 ~ 21.0 Nm
1.6 ~ 2.1 kgf-m
11.8 ~ 15.4 lb-ft

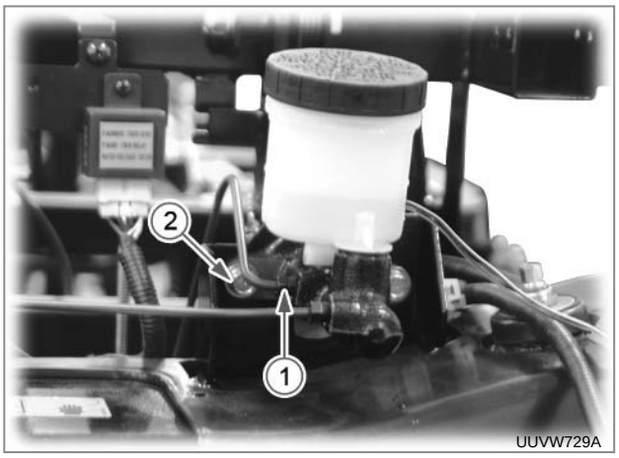
5.2 FRONT WHEEL BRAKE REMOVAL (BRAKE PAD AND DISC REPLACEMENT)





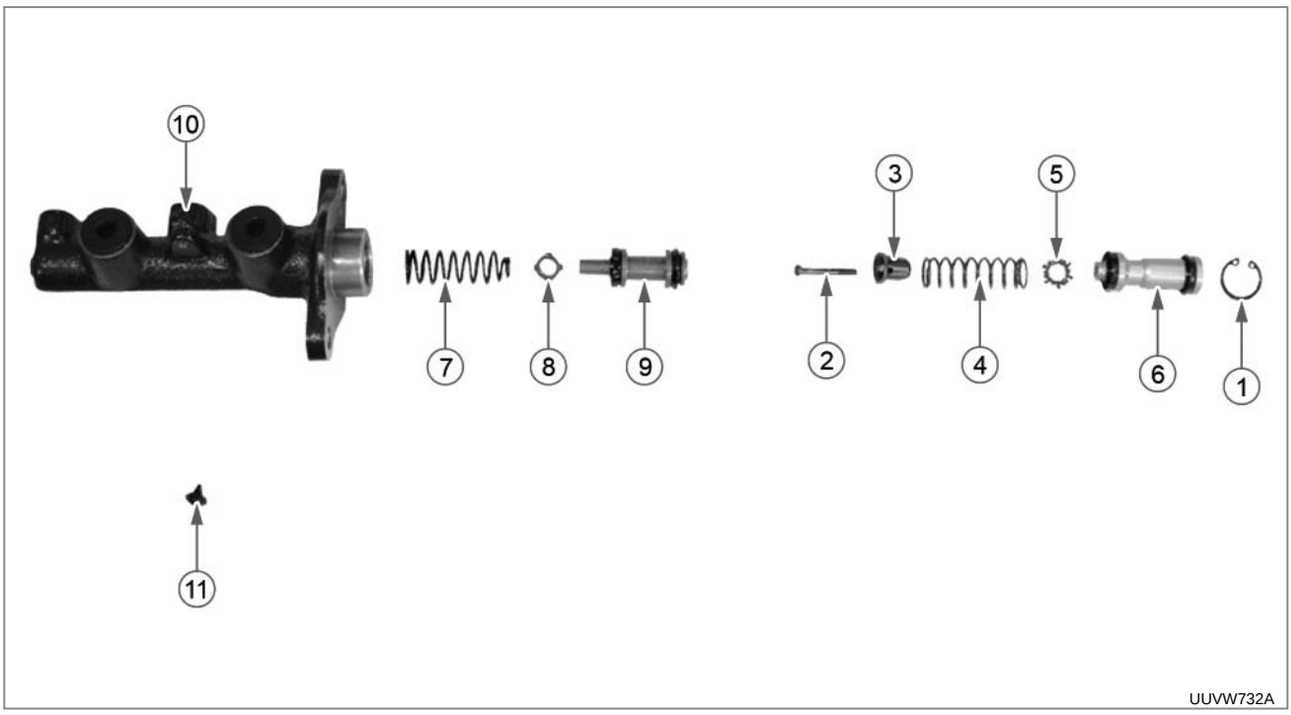
1. Remove the axle cap (1). Then, remove the ball joint bolt mounting split pin (2) and slotted nut (3).
2. Unscrew the brake caliper (4) mounting bolts to remove the brake caliper and brake disc (5).
3. Refer to the description in the section "Rear wheel brake removal" in this chapter for disassembly procedures related to the brake pad and disc replacement work.

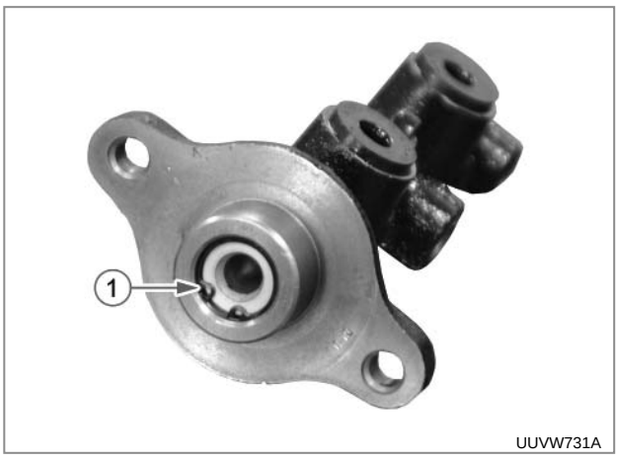
5.3 BRAKE MASTER CYLINDER DISASSEMBLY



1. Unscrew the front/rear brake fluid pipe connector nuts (1). Then, unscrew the mounting bolts (2) (M8, 2 EA) to remove the brake fluid cylinder assembly.

2. Unscrew the screw (1) and tap the brake fluid reservoir upward to remove it.





3. Pull out the brake fluid cylinder snap ring (1), remove the piston 1 and 2 and unscrew the screw (2) for the piston 1 to remove the tappet (3), spring (4), piston fixing plate (5) and piston (6). Then, remove the spring (7), piston fixing plate (8) and piston (9) from the piston 2.
   If necessary, remove the retainer (10), and set bolt (11).
4. Assemble in the reverse order of disassembly.

Set bolt (11)

tightening torque .....1.96 ~ 2.45 Nm
0.2 ~ 0.25 kgf-m
1.44 ~ 1.8 lb-ft

IMPORTANT

- **When connecting the brake pipe, place its connector section to the mounting surface, tighten its nut to the specified torque with an open end wrench.**

Specified

torque for nut.....16.0 ~ 21.0 Nm
1.6 ~ 2.1 kgf-m
11.8 ~ 15.4 lb-ft

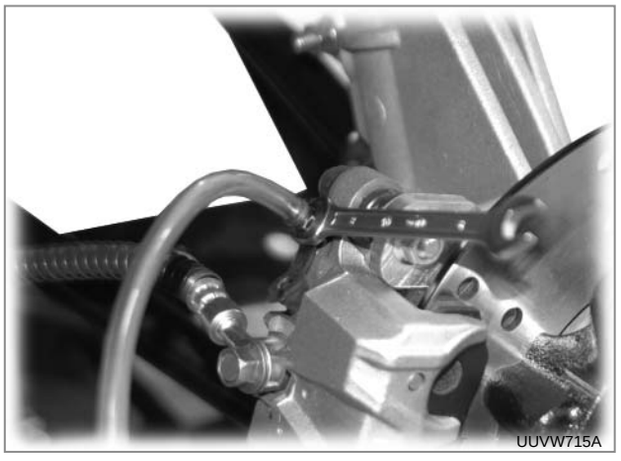
REMARK

- **Piston stroke: 30 ± 1 mm (1.18 ± 0.039 in.)**

5.4 BLEEDING BRAKE LINE


UUVW714A

1. Replenish the brake fluid reservoir with fluid up to the MAX level.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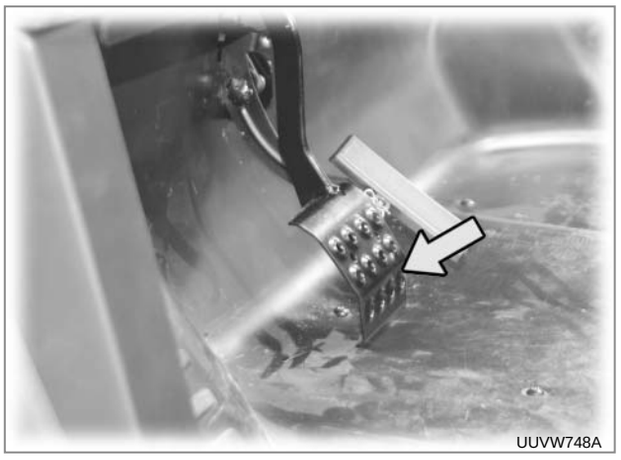
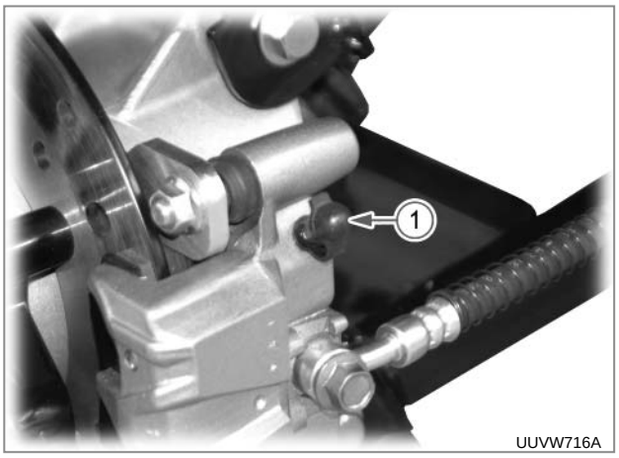
2. Remove the front wheels, open the bleeding cap from the brake caliper. Connect one end of the hose to an empty container for the drained brake fluid and the other end to the bleeding pipe.


UUVW748A

3. Loosen the bleeding pipe and depress the brake pedal several times continuously.



4. When the brake fluid is drained through the bleeding pipe, there are air bubbles in the fluid. Drain the brake fluid until there is no bubbles. Then, tighten the bleeding pipe and close the cap (1).
5. Bleed the front and rear brakes with the same procedures.

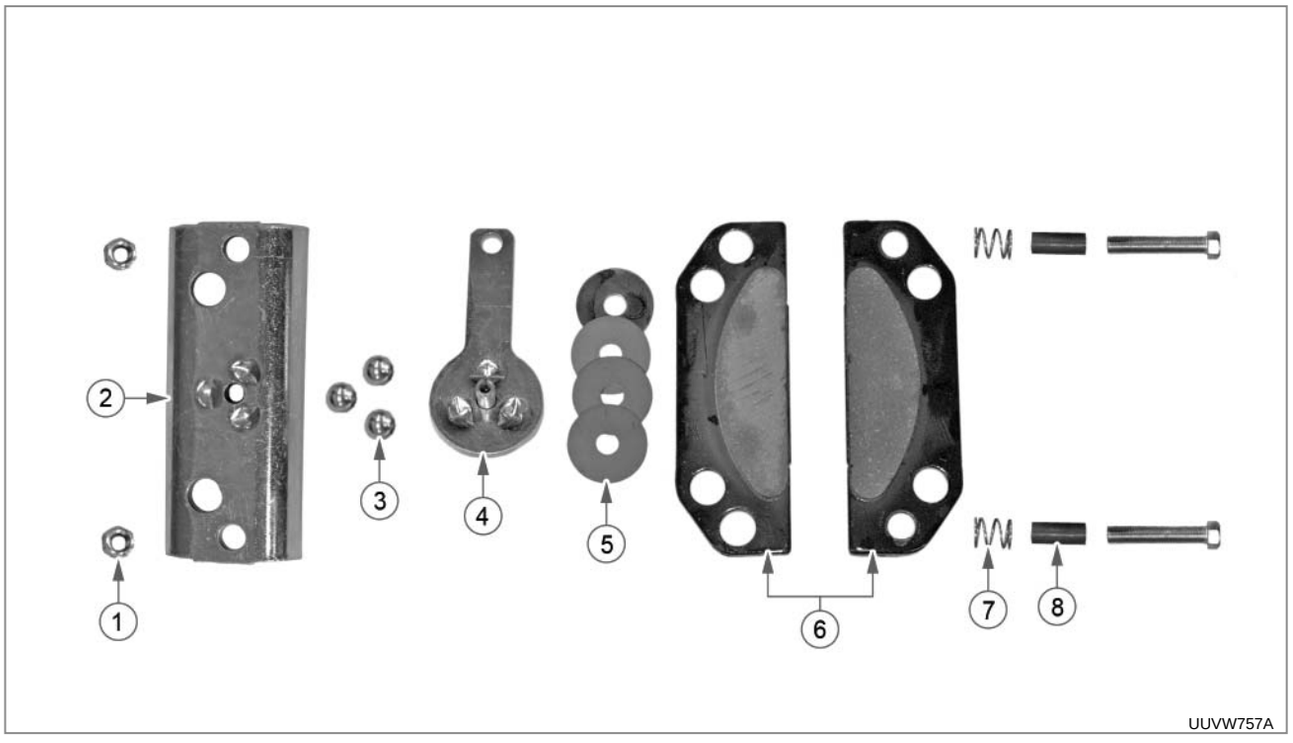
REMARK

- **The brake line bleeding work should be performed by more than one person.**
- **Bleed the line from the caliper farthest from the driver's seat.**

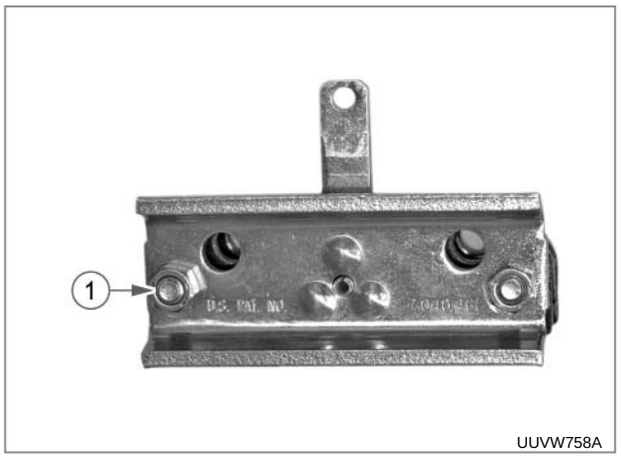
IMPORTANT

- **Make sure that the brake fluid level in the brake fluid reservoir does not fall below the MIN line during bleeding the brake line.**
- **Make sure to fill the brake fluid reservoir up with the brake fluid to the MAX line after bleeding the brake line.**

5.5 PARKING BRAKE DISASSEMBLY AND ASSEMBLY (PARKING BRAKE PAD REPLACEMENT)



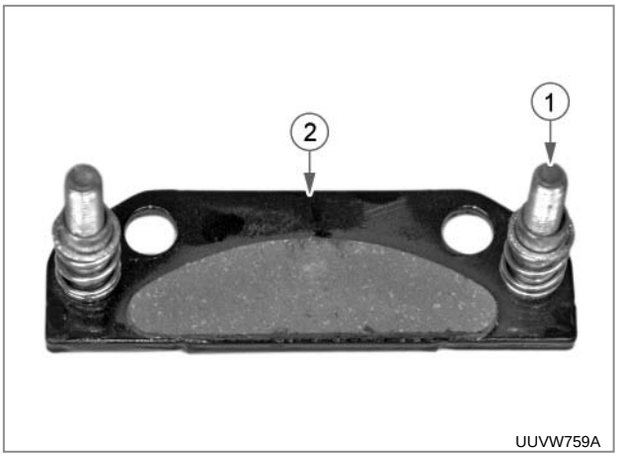
UUVW757A



UUVW758A

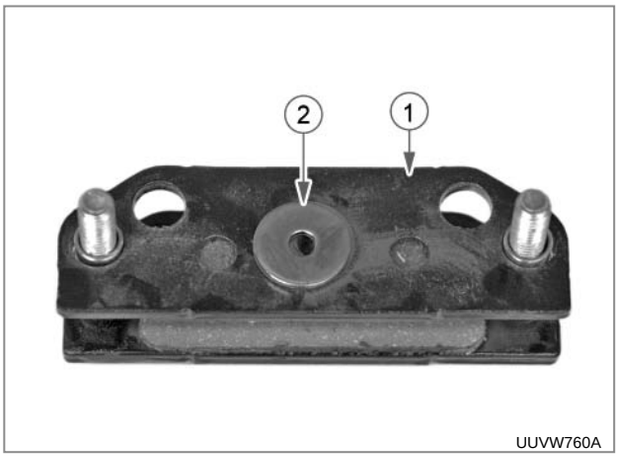
1. Unscrew the parking brake caliper mounting nuts (1) (M10, 2 EA) to remove the bracket (2), ball (3), cam lever (4), support plates (5), pad (6), spring (7) and spacer (8) in order.

2. Assemble in the reverse order of disassembly.



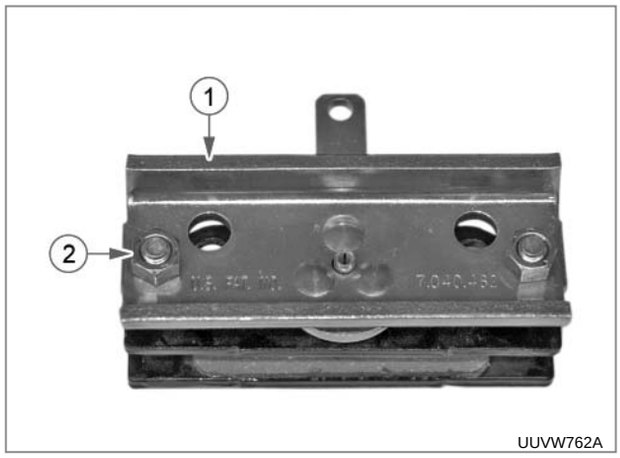
UUVW759A

- Fit the bolts (1) to the pad (2) and insert the spacers and springs.



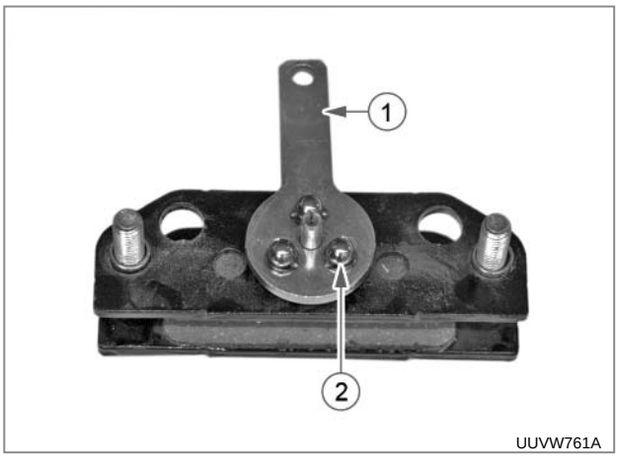
UUVW760A

- Fit the other pad (1) to the bolts and place the support plates (2) as a figure.



UUVW762A

- Fit the bracket (1) to the bolts and tighten the nuts (2).



UUVW761A

- Place the cam lever (1) and balls (2) onto the support plates.

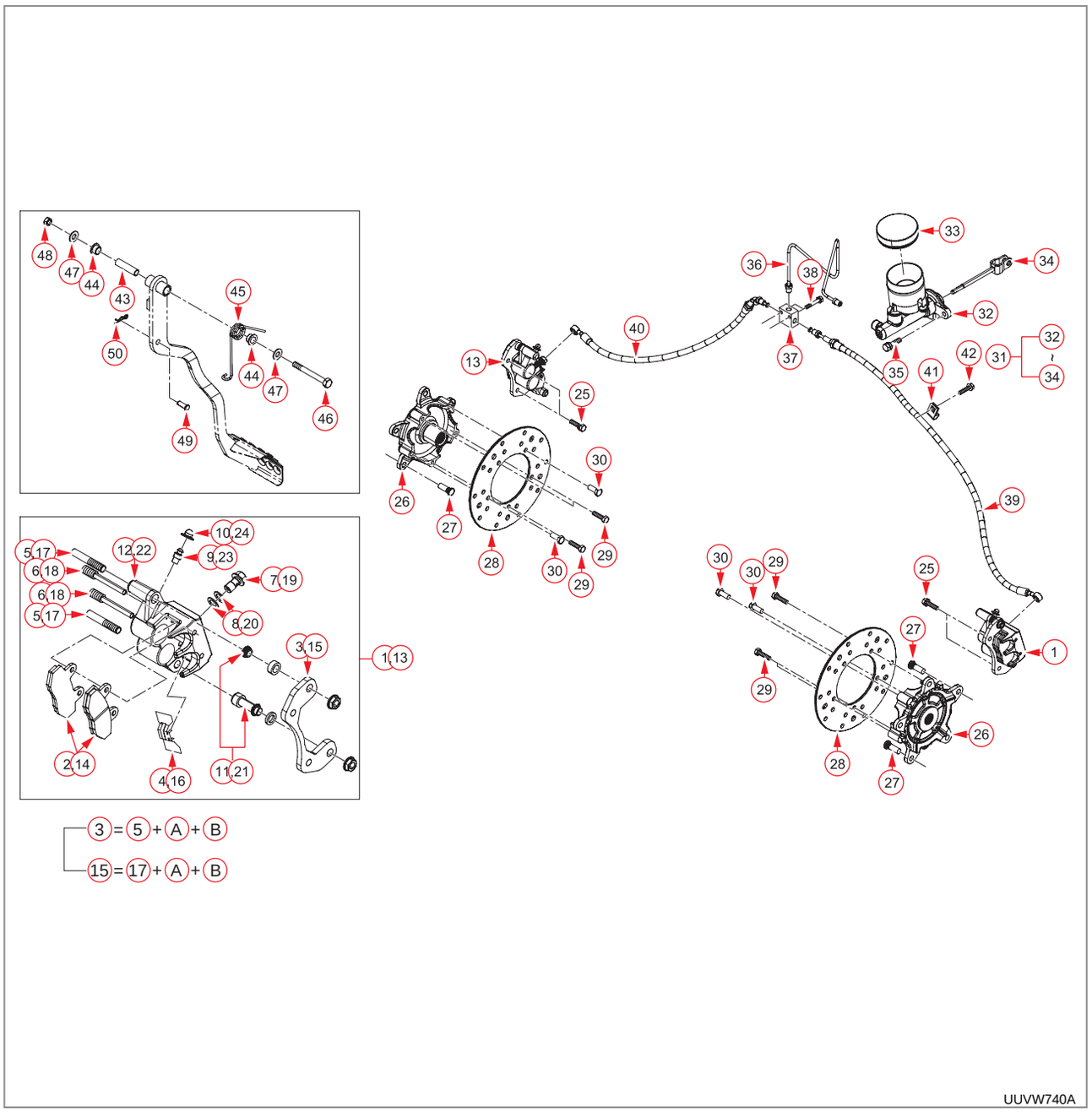
IMPORTANT


UUVW705A

- The clearance of the brake pad should be over 4.8 mm (0.189 in.).

6. COMPONENTS

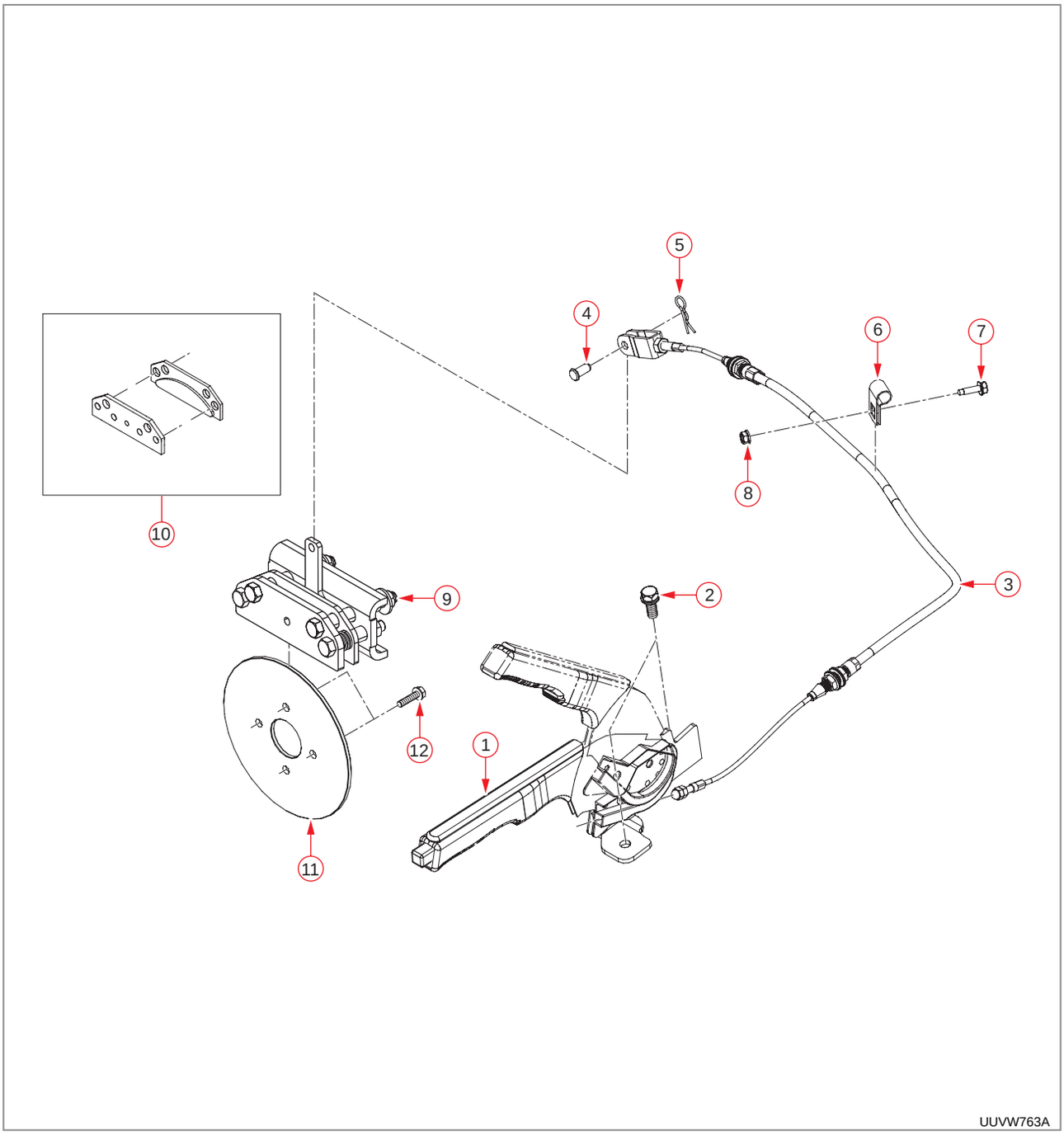
6.1 U300A FRONT BRAKE



COMPONENTS

(1) CALIPER ASSY, LH
(2) PAD, COMP
(3) CARRIER ASSY DIFF
(4) SPRING PAD
(5) BOLT
(6) NUT
(7) BOLT, UNION
(8) WASHER
(9) BREATHER
(10) CAP, BREATHER
(11) BOOT KIT
(12) CARRIER ASSY DIFF
(13) CALIPER ASSY, RH
(14) PAD, COMP
(15) CARRIER ASSY DIFF
(16) SPRING PAD
(17) BOLT
(18) NUT
(19) BOLT,UNION
(20) WASHER
(21) BOOT KIT
(22) CARRIER ASSY DIFF
(23) BREATHER
(24) CAP, BREATHER
(25) WASHER BOLT
(26) HUB ASSY, FR
(27) BOLT(M10x1.25), HUB
(28) DISC, BRAKE FRT
(29) BOLT
(30) REAMER BOLT, HUB
(31) MASTER CYLINDER ASSY
(32) TANK BODY ASSY
(33) CAP ASSY
(34) ROD ASSY
(35) WASHER BOLT
(36) TUBE, FRT BRAKE ASSY
(37) FITTING TEE
(38) BOLT
(39) TUBE, FRT BRAKE LH
(40) TUBE, FRT BRAKE RH
(41) CLAMP
(42) BOLT, FLANGE
(43) TUBE, BRAKE PEDAL BUSH
(44) BUSH, BRAKE PEDAL PIVOT
(45) SPRING, BRAKE PEDAL
(46) BOLT
(47) WASHER, PLAIN
(48) NUT
(49) PIN
(50) CIR CLIP

6.2 U0431A PARKING BRAKE



COMPONENTS

(1) PARKING BRAKE ASSY
(2) BOLT, WASHER
(3) CABLE ASSY-PARKING
(4) JOINT PIN
(5) PIN, SNAP
(6) CLAMP
(7) BOLT, FLANGE
(8) NUT, FLANGE
(9) CALIPER ASSY, PARK BRAKE
(10) PAD, PARKING BRAKE
(11) DISK, PACKING BRAKE
(12) BOLT, FLANGE

FRONT AXLE

CHAPTER 9

TABLE OF CONTENTS

1. SPECIFICATIONS

1.1 GENERAL SPECIFICATIONS

Item	Specifications	Remarks
Oil	SAE gear oil #90 or DAEDONG UTF55 Exxon Mobil fluid 423/424 BP Tractran UTH Shell DONAX-TD	
Grease	NLGL grade No.2 or equivalent	Lower section of hub strut
Front axle case oil capacity	0.5 ℓ (0.13 u.s.gal)	
Turning radius	3.9 m (13 ft)	
Front tire	Size 25 x 10 - 12 6PR Inflation pressure: 0.84 kgf/cm² (82.7 kPa, 12 psi)	
Front wheel	Tread: 1,262 mm (49.7 in.)	
Suspension	Independent MacPherson strut suspension	

1.2 TIGHTENING TORQUE

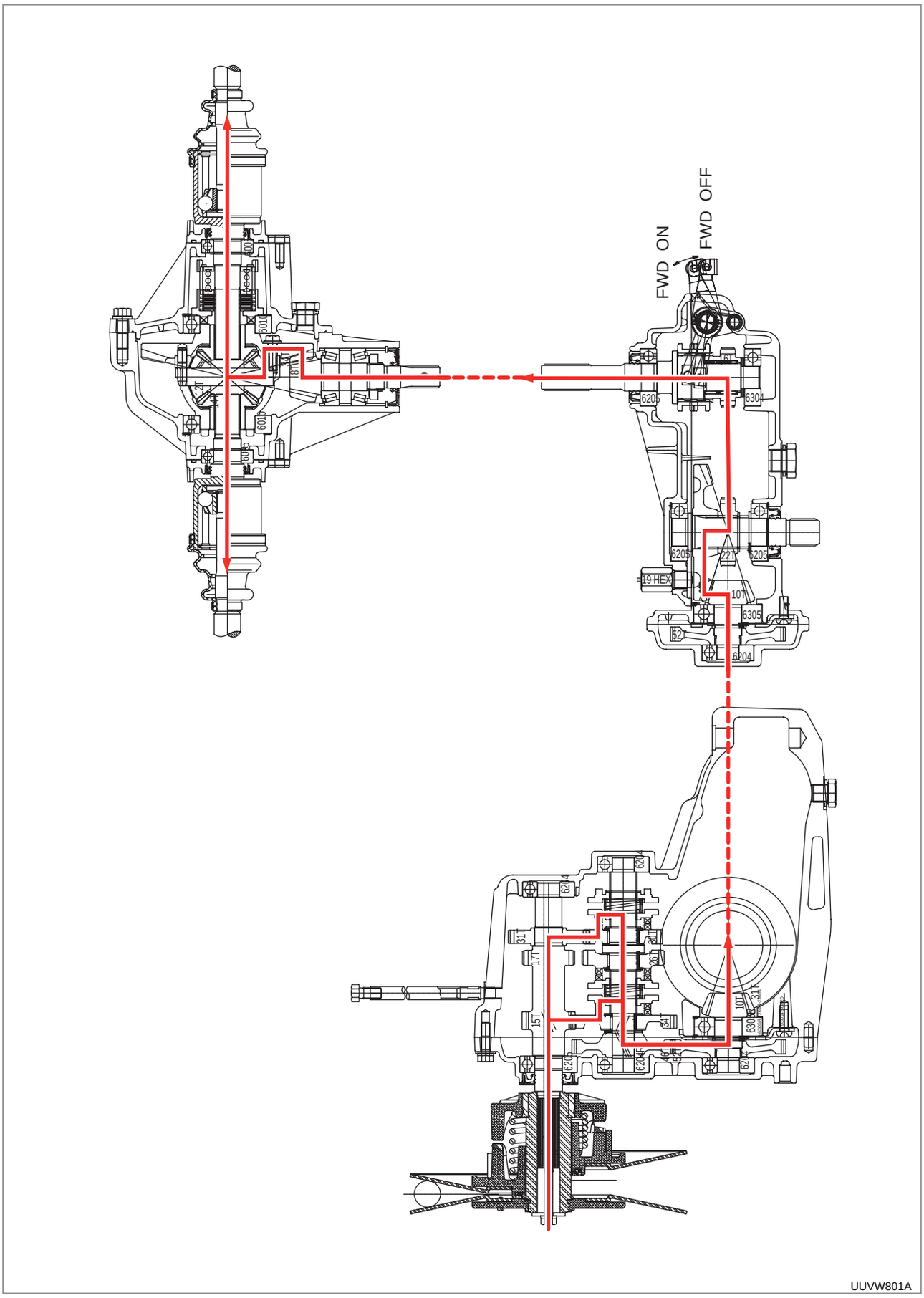
Position	Size	Tightening torque
Front wheel mounting nut	M10	39.2 ~ 45.1 Nm 4.0 ~ 4.6 kgf-m 28.8 ~ 33.1 lb-ft
Slotted tie rod end nut	M10	54.0 ~ 61.0 Nm 5.4 ~ 6.1 kgf-m 38.9 ~ 43.9 lb-ft
Upper strut mounting nut	M12	21.0 Nm 2.1 kgf-m 15.1 lb-ft
Knuckle mounting bolt	M8	25.0 Nm 2.5 kgf-m 18.0 lb-ft
Lower arm mounting nut	M10	41.0 Nm 4.1 kgf-m 29.5 lb-ft
Lower knuckle ball joint mounting nut (slotted)	M10	35.0 Nm 3.5 kgf-m 25.2 lb-ft
Differential case & spiral bevel gear mounting bolt	M8	29.4 ~ 34.3 Nm 3.0 ~ 3.5 kgf-m 21.6 ~ 25.2 lb-ft
Front axle case mounting bolt	M10	39.2 ~ 44.1 Nm 4.0 ~ 4.5 kgf-m 28.8 ~ 32.4 lb-ft

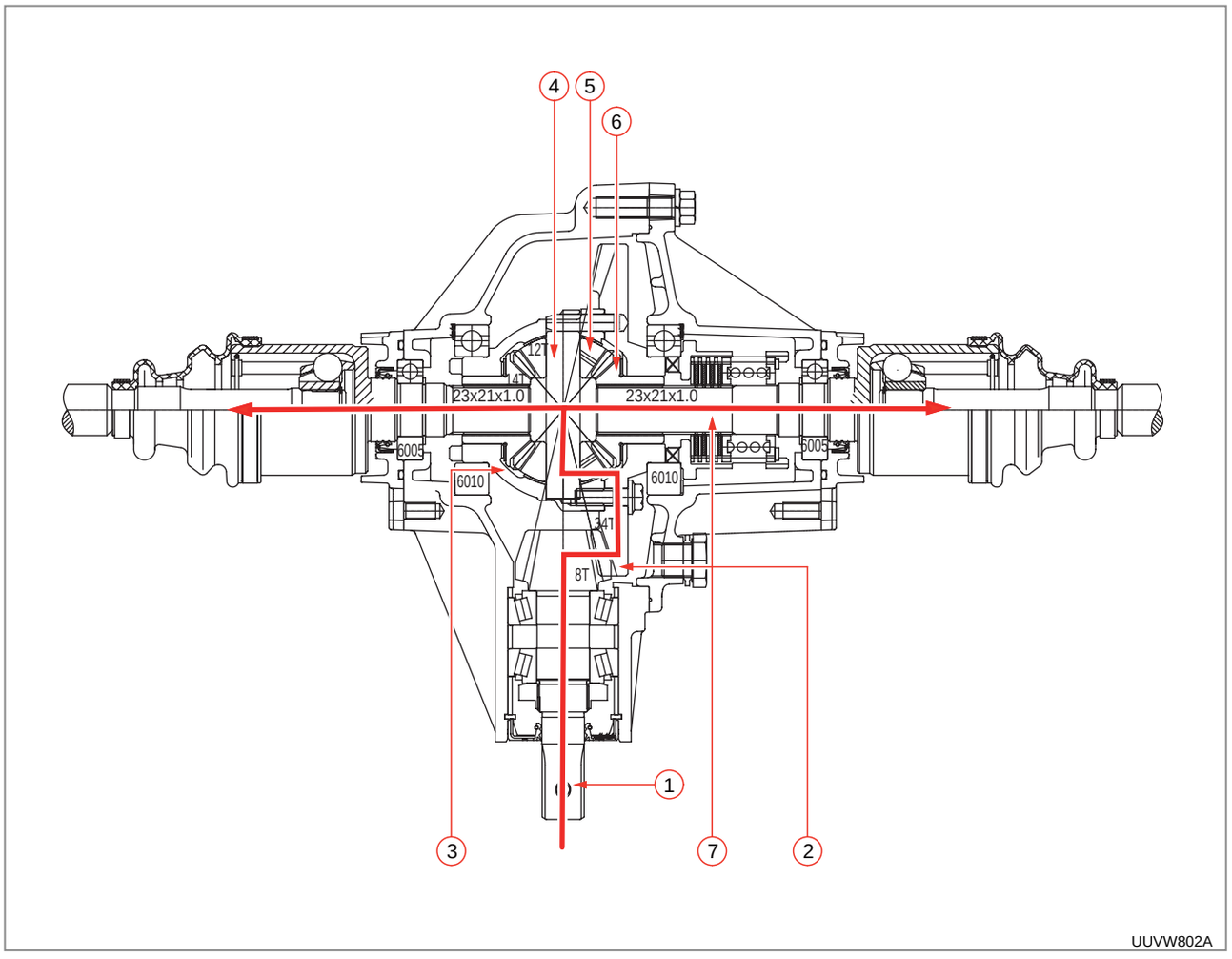
1.3 SEALANT AND ADHESIVE

Spiral bevel gear mounting bolt	Three Bond 1372 or equivalent
Mating surface of front axle case and cover	Three Bond 1206D or equivalent

2. STRUCTURE AND FUNCTION

2.1 FRONT AXLE POWER TRANSFER DIAGRAM

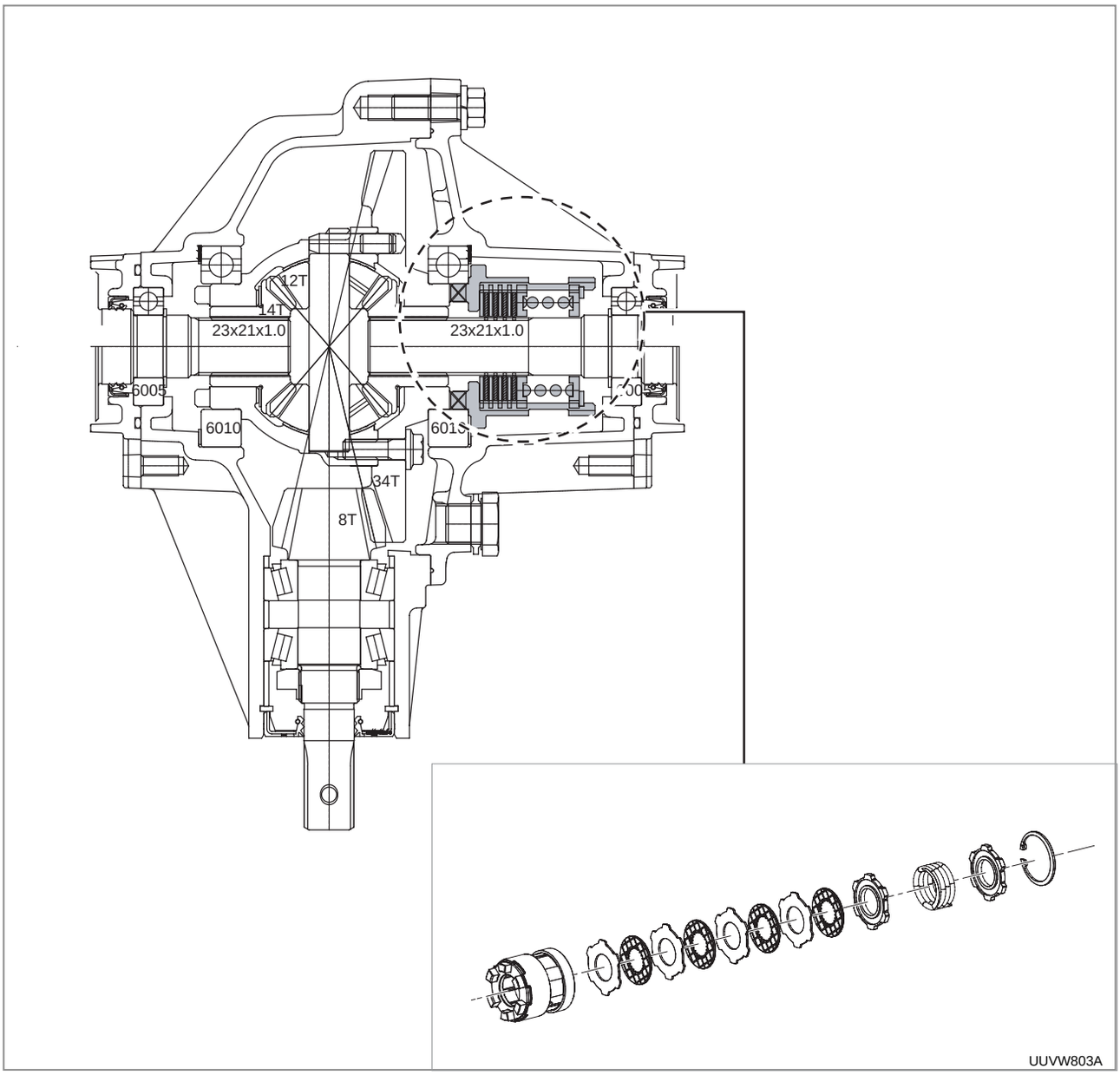




- As the power is transferred from the transmission through the front propeller shaft, it is passed to the differential case through the 8 bevel pinion shaft and 34 bevel gear. Then, the internal bevel gear is rotated by the rotating differential case and the power is transferred to the front wheel drive shaft, which is connected to the differential side gear, in order to drive the front wheels.
- Power transfer

  1) 8 bevel pinion shaft → 2) 34 spiral bevel gear → 3) Front differential case → 4) Differential pinion shaft → 5) Differential pinion → 6) Differential side gear → 7) CV joint

2.2 LSD (LIMITED SLIP DEVICE)



The rear axle is equipped with the manual differential lock as a dog clutch while the front axle is equipped with the automatic LSD (Limited Slip Differential).

The LSD consists of four friction discs, four plates and one pressure spring. Some differential lock effect can be achieved only by fixing the spiral bevel gear (ring gear) and one axle to each other. When the vehicle is driven or cornering on a normal paved road, the turning speed difference between the ring gear and axle is not immense and the friction between the friction disc and plate can be tolerant. However, when excessive turning speed difference between the left and right of the axle is occurred by imbalanced friction applied to the right and left wheels on a slippery road, the turning speed difference between the friction disc and plate becomes excessive, resulting in immense friction. As a result, this friction reduces some level of a speed difference by the differential to help the vehicle escape from a slippery area easily.

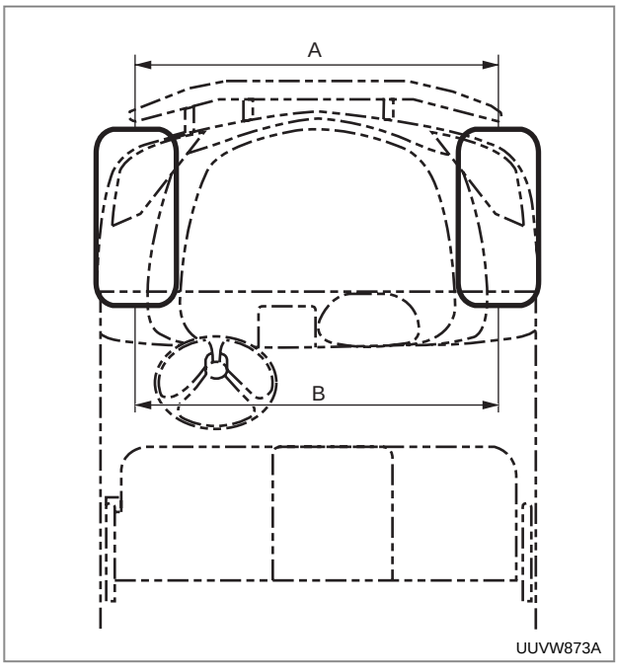
The half of this friction clutch pack is always soaked in lubricant to achieve durability of the friction disc.

3. TROUBLESHOOTING

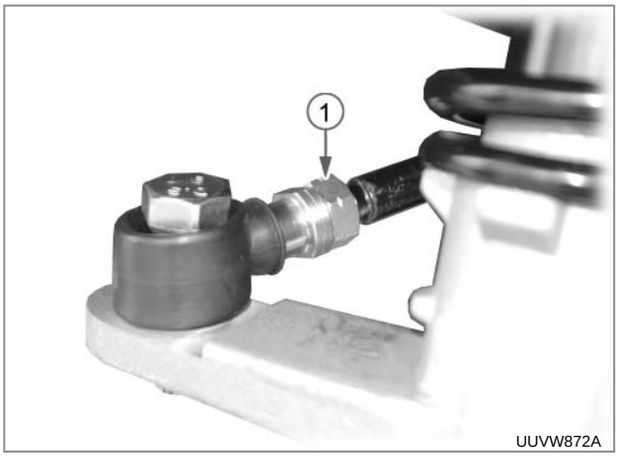
Symptom	Cause	Solution
Front wheels wander to right or left	• Uneven tire pressure	• Adjust
	• Improperly adjusted toe-in (improper wheel alignment)	• Adjust
	• Loose tie rod end	• Tighten
Front wheel cannot be driven	• Broken drive shaft	• Replace
	• Broken front wheel drive gear in transmission	• Replace
	• Broken front differential gear	• Replace
	• Loose front wheel drive cable	• Adjust or replace
Abnormal noise from front axle	• Insufficient oil	• Change and replenish oil
	• Damaged gears	• Replace the damaged part
	• Damaged bearings	• Replace the damaged part
	• Abnormal backlash	• Adjust the backlash
	• Improperly adjusted pre-load on taper roller bearing of spiral pinion shaft	• Adjust the pre-load
	• Bad CV joint	• Replace CV joint
Oil leaked from front differential case	• Excessive oil	• Add proper amount of oil
	• Damaged O-rings	• Replace the O-ring
	• Clogged overflow pipe	• Clean. Replace if necessary
	• Damaged seal of spiral pinion shaft	• Replace
	• Damaged taper roller bearing of spiral bevel pinion shaft	• Replace, adjust the pre-load
Broken front axle drive shaft	• Improper front tire installed	• Check the specified tire speed (refer to "GENERAL")
	• Deformed front/rear tires	• Check the specified tire speed (refer to "GENERAL")
	• Abnormal front/rear wheel drive ratio	• Use the specified tire only.
	• Improper tire inflation pressure	• Keep the specified tire inflation pressure
Improper steering	• Abnormal toe-in (vehicle cannot move straight forward)	• Adjust
	• Damaged tie rod	• Replace
	• Different inflation pressure between left and right tires	• Replace the tires

4. INSPECTION AND ADJUSTMENT

4.1 TOE-IN ADJUSTMENT

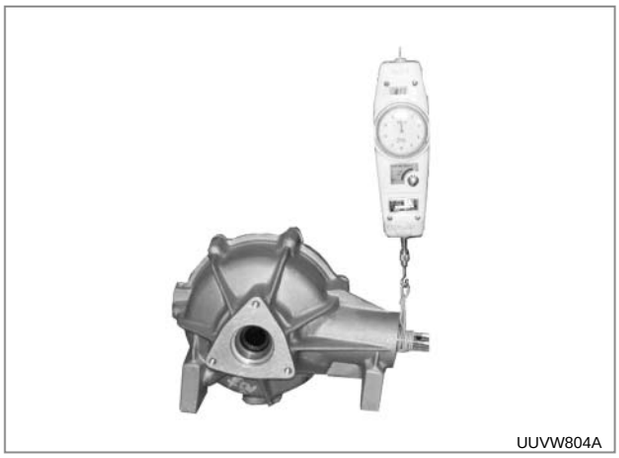


1. Park the vehicle on level ground, stop the engine and apply the parking brake.
2. Lift the front axle slightly with a hydraulic jack and set the front wheels in a straight ahead position.
3. Measure the distance between the front and rear part of the front wheels (on hub level).
4. Adjust the toe-in so that the rear distance (B) is 2 to 8 mm longer than the front distance (A).
   [B - A = 2 ~ 8 mm (0.0787 ~ 0.3149 in.)]



5. To adjust the toe-in, unscrew the mounting nuts (1) at the ends of the tie rod, turn the tie rod end to set the toe-in to the specification and tighten the mounting nuts again.

4.2 TURNING TORQUE OF 8 BEVEL PINION SHAFT



1. After tying the pinion shaft with a string, measure the load by pulling the string down with a pull scale.

Load of pull scale.... 9.2 ~ 12.2 kgf
20.3 ~ 26.9 lbs

When measuring the load by engaging a torque wrench to the spline of the spiral bevel pinion shaft:

Torque value ..... 0.88 ~ 1.176 Nm
0.09 ~ 0.12 kgf-m
0.65 ~ 0.87 lbf-ft

When measuring the load by a pull scale as shown in the figure:

$$\text{Load of pull scale (F) (kgf)} = \frac{\text{Torque value (T) (kgf-m)}}{\text{Radius of spline shaft (R)}}$$

$$F = \frac{0.09 \sim 0.12 \text{ kgf-m}}{R\ (0.0098 \text{ m})}$$

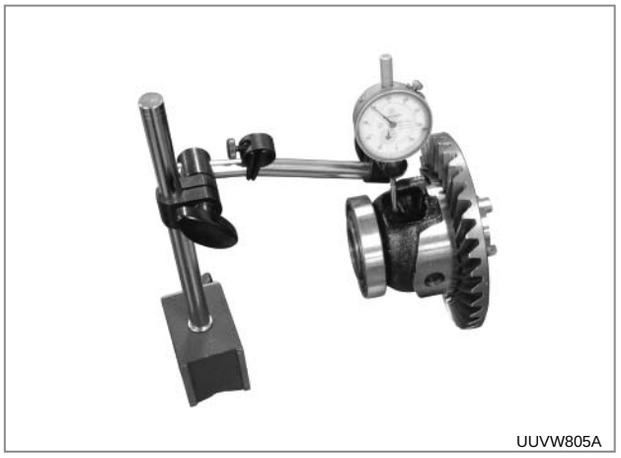
$$F = 9.2 \sim 12.2 \text{ kgf } (20.3 \sim 26.9 \text{ lbs})$$

REMARK

- **The pre-load of the taper roller bearing, that supports the spiral bevel pinion shaft, can be adjusted by tightening its mounting nut. (Refer to the diagram in this chapter.) The standard pre-load is defined by the turning torque of the spiral bevel pinion shaft.**
- **The turning torque can be measured using a torque wrench or by tying the shaft with a string and pulling the string down with a pull scale. Make sure to convert the unit correctly.**
- **The turning torque and turning force can differ by the installation condition as shown in the following table:**

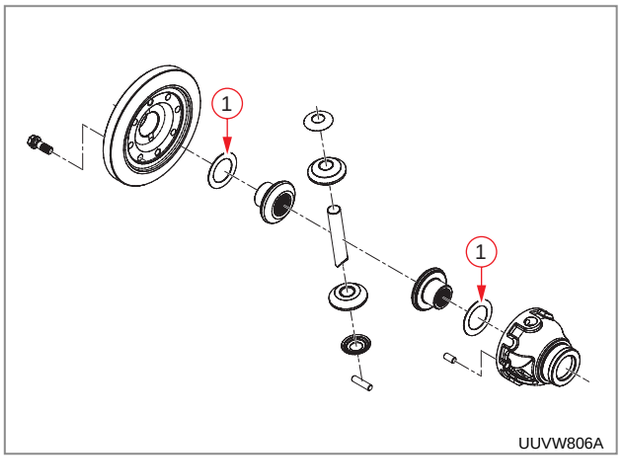
		Ⓐ	Ⓑ	Ⓒ
Item \ Installation condition		Nut tightened with spiral bevel pinion	A+ oil seal installed	B+ differential gear assembly & ring gear installed
Front axle	Torque	0.04 kgf-m	0.06	0.12
	Turning force	4.0 kgf	6.0	12.0

4.3 BACKLASH OF DIFFERENTIAL PINION AND DIFFERENTIAL SIDE GEAR


UUVW805A

1. Install the dial indicator (lever type) so that its pointer contacts with the surface of the differential side gear through the hole of the differential case as shown in the figure.
2. Measure the backlash of the differential side gear while moving the differential pinion gently.

   Standard backlash: 0.15 ~ 0.25 mm (0.0059 ~ 0.0098 in.)

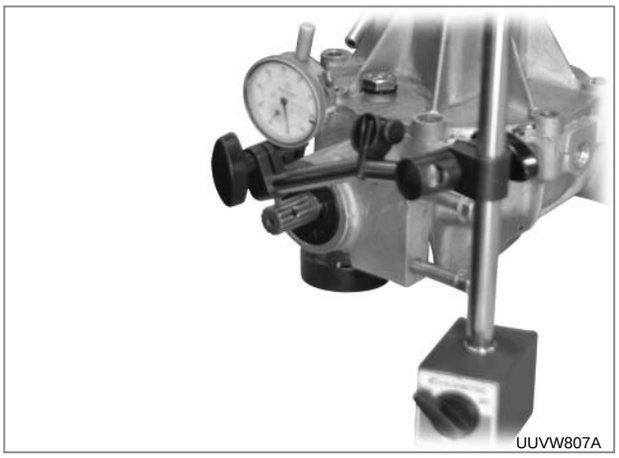


UUVW806A

3. If necessary, replace the shim (1) installed on the back of the differential side gear to adjust the backlash. However, the shims with the same thickness should be installed in both side gears.

   Size of adjusting shim: 0.8 mm (0.031 in.)
   1.0 mm (0.039 in.) Standard shim
   1.2 mm (0.047 in.)

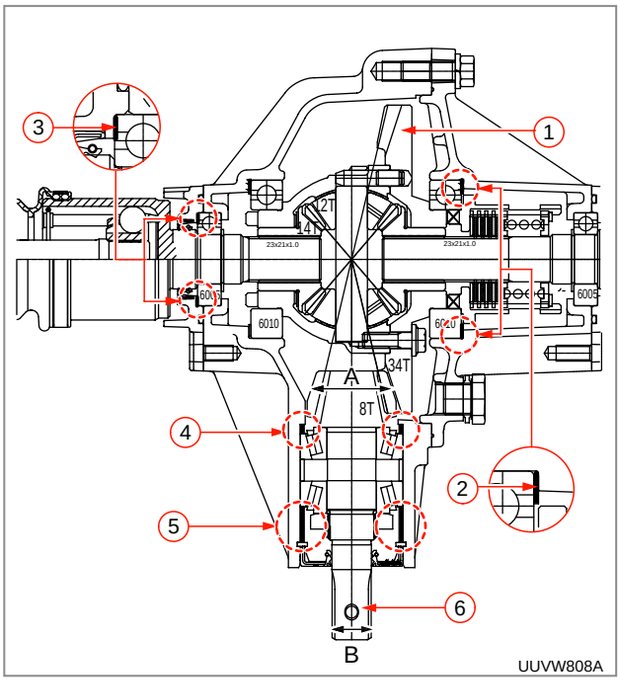
4.4 BACKLASH OF 8 BEVEL PINION SHAFT AND 34 BEVEL GEAR


UUVW807A

1. Set the lever type dial indicator so that it contacts with the spline of the 8 spiral bevel pinion shaft as shown in the figure.
2. Measure the backlash by moving the 8 bevel pinion shaft by hand lightly.

Teeth based Backlash : 0.2 ~ 0.3 mm
(0.008 ~ 0.012 in.)

Spline based Backlash : 0.08 ~ 0.12 mm
(0.0031 ~ 0.0047 in.)



UUVW808A

3. Adjust the shims (2) and (3) if the 34 spiral bevel gear (1) should be moved to adjust the backlash.

Size of shim : 0.1 mm (0.0039 in.)
0.2 mm (0.0079 in.)
0.4 mm (0.0157 in.)
0.8 mm (0.0315 in.)
1.0 mm (0.0394 in.)
1.2 mm (0.0472 in.)

4. Replace the collars (4) and (5) installed to the front and rear sides of the shaft if the 8 spiral bevel pinion shaft (6) should be moved. However, the total thickness of the front and rear collars should be 22.75 mm (0.8957 in.).

Size of adjusting collar : 4.55 mm (0.1791 in.)
4.65 mm (0.1831 in)
4.75 mm (0.1870 in.)
4.85 mm (0.1909 in.)
4.95 mm (0.1949 in.)
17.8 mm (0.7008 in.)
17.9 mm (0.7047 in.)
18.0 mm (0.7087 in.)
18.1 mm (0.7126 in.)
18.2 mm (0.7165 in.)

5. Measure the contact area if the shim or collar has been adjusted.

This procedure can be skipped if it is not necessary to adjust the shim.

REMARK

- **The standard backlash stated in the previous page refers to the distance from the mating surface of the gear teeth. Therefore, the standard backlash value can differ if the backlash is measured at the splined section of the pinion shaft.**
- **As the average effective diameter A of the spiral bevel pinion teeth is different from the effective diameter B of the splined section as shown in the figure on the previous page, the backlash on the spline can be obtained from the following formula:**

Backlash measured at splined section

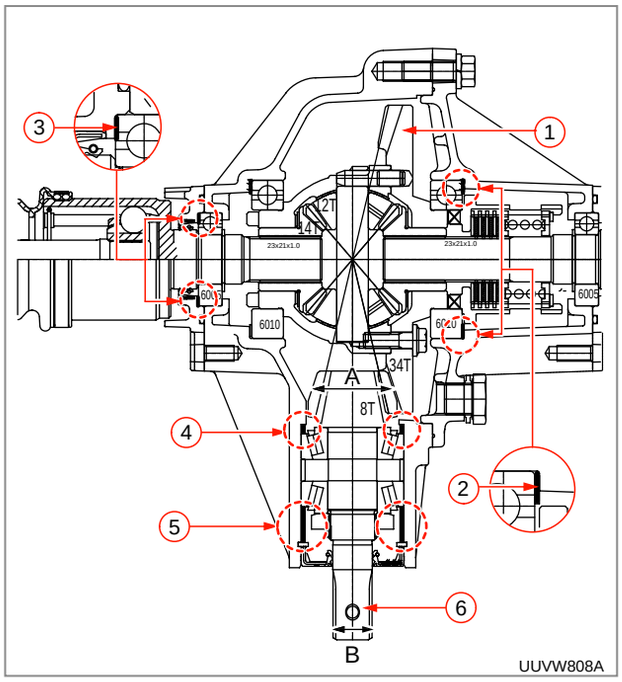
$$= \text{Teeth based backlash} \times \frac{B}{A}$$

$$\frac{B}{A} \fallingdotseq 0.4$$

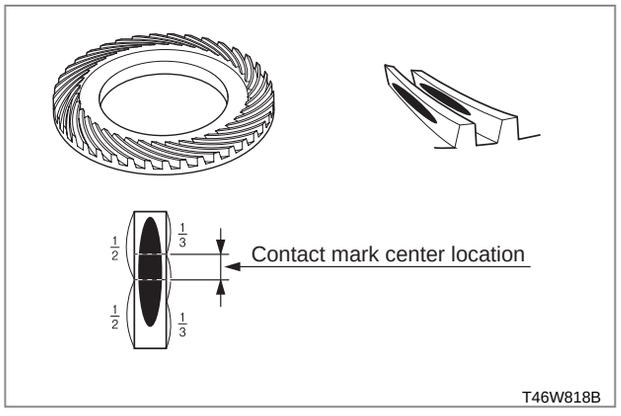
Therefore the spline based backlash is
0.2 x 0.4 ~0.3 x 0.4 = 0.08 ~ 0.12 mm
(0.0031 ~ 0.0047 in.)

4.5 TOOTH CONTACT OF SPIRAL BEVEL GEAR

INSPECTION



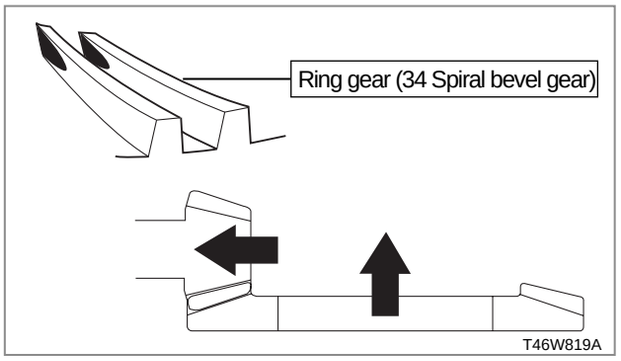
1. Remove the 8 bevel pinion shaft (6) and 34 spiral bevel gear (1) and clean the teeth thoroughly.
2. Coat all the teeth of the pinion shaft (3) with contact grease and reassemble it.
3. Turn the pinion shaft for approx. 10 rounds and check the contact area by a contact mark on the teeth of the 34 spiral bevel gear (1).
4. Adjust the teeth contact with the shim (2), (3), (4) and (5).



The contact area should be over 35 % of the entire teeth area and the center of the contact mark should be close to the center of the pinion in height. Also, the center of the contact mark should be located on the 1/3 spot from the toe of the teeth to the center of the teeth in length.

ADJUSTMENT

A. TOE CONTACT

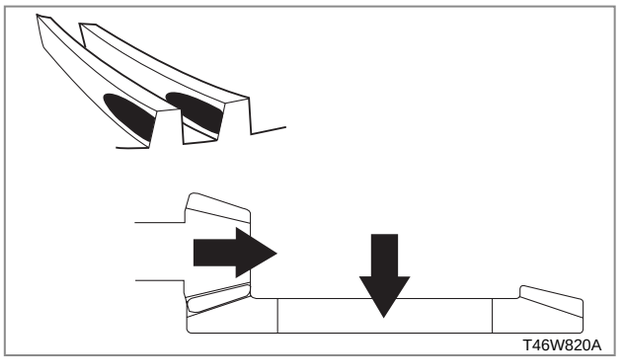


If the center of the contact mark is too close to the toe of the tooth, push back the pinion shaft and push in the ring gear to the pinion direction so that the back lash is maintained. Then, measure the backlash.

Increase in front shim (4) of pinion shaft (gear side)

- Decrease in rear shim (5)
- Increase in ring gear shim (2)
- Decrease in ring gear shim (3)

B. HEEL CONTACT

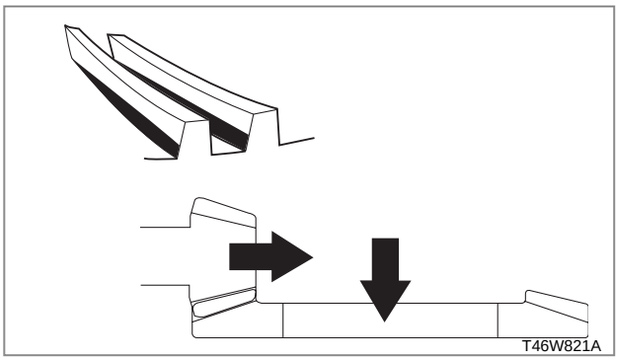


If the contact mark is close to the heel of the ring gear teeth, push the pinion shaft toward the ring gear and push the ring gear away from the pinion so that the backlash is maintained. Then, measure the backlash.

Decrease in front shim (4) of pinion shaft (gear side)

- Increase in rear shim (5)
- Decrease in ring gear shim (2)
- Increase in ring gear shim (3)

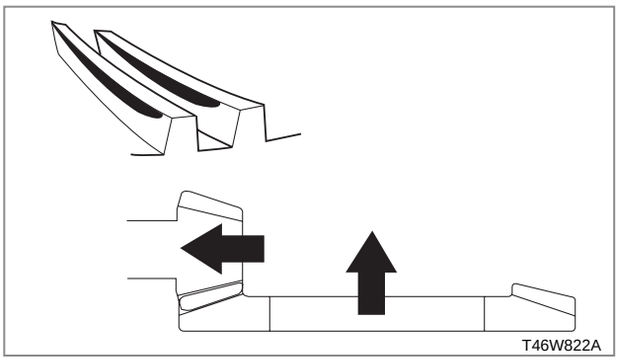
C. DEEP CONTACT



If the contact mark is deep into the ring gear teeth, push the ring gear away from the pinion. If necessary, push the pinion toward the ring gear to maintain the backlash. Then, measure the backlash for the final time.

- Decrease in ring gear shim (2)
- Increase in ring gear shim (3)
- Decrease in front shim (4) of pinion shaft (gear side)
- Increase in rear shim (5)

D. TIP CONTACT



If the contact mark is on the tip of the ring gear teeth, pull the ring gear toward the pinion. If necessary, pull the pinion shaft backward to maintain the backlash. Then, measure the backlash for the final time.

- Increase in ring gear shim (2)
- Decrease in ring gear shim (3)
- Increase in front shim (4) of pinion shaft (gear side)
- Decrease in rear shim (5)

4.6 DIFFERENTIAL SYSTEM CLEARANCE CHECK

4.6.1 DIFFERENTIAL PINION AND DIFFERENTIAL PINION SHAFT

- Measure the outer diameter of the differential pinion shaft and the inner diameter of the differential pinion.
- Check the clearance by comparing the measurement. If the clearance is outside the allowable limit, replace the components with new ones.

Differential pinion shaft O.D.	15.966 ~ 15.984 mm 0.6286 ~ 0.6293 in.
Differential pinion I.D.	16,000 ~ 16.018 mm 0.6299 ~ 0.6306 in.
Standard clearance	0.016 ~ 0.052 mm 0.00063 ~ 0.00204 in.
Allowable clearance	0.25 mm (0.00984 in.)

4.6.2 DIFFERENTIAL CASE, SPIRAL BEVEL GEAR AND DIFFERENTIAL SIDE GEAR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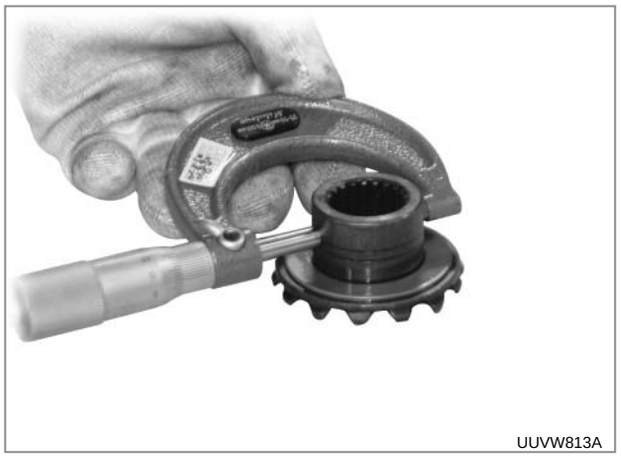
UUVW812A

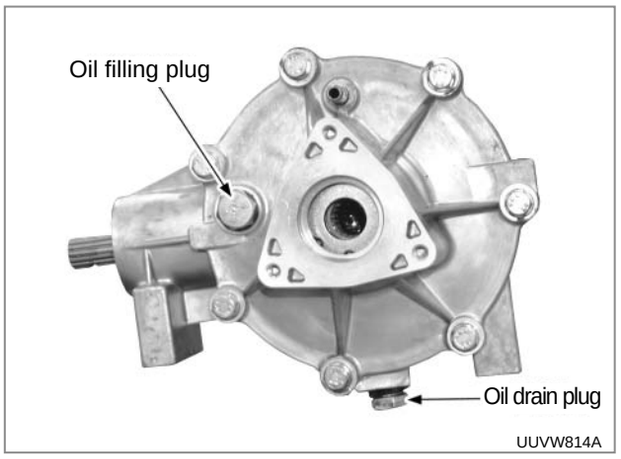

UUVW813A

- Measure the inner diameter of the differential case and spiral bevel gear as well as the outer diameter of the differential side gear. Then, compare these measurements.
- Check the clearance. If it is out of the specified limit, replace the components with new ones.

Differential case I.D.	Ø32.025 ~ Ø32.050 mm Ø1.2608 ~ Ø1.2618 (in.)
Differential side gear O.D.	Ø31.959 ~ Ø31.975 mm Ø1.2582 ~ Ø1.2589 (in.)
Standard clearance	0.05 ~ 0.091 mm 0.00197 ~ 0.00358 in.
Allowable clearance	0.25 mm (0.00984 in.)

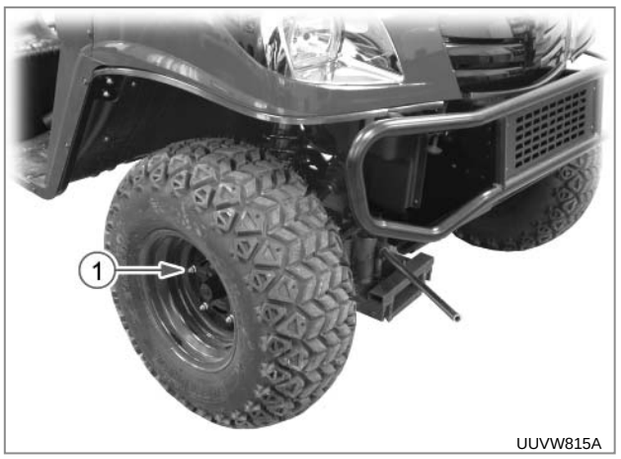
5. DISASSEMBLY, SERVICE AND ASSEMBLY

5.1 CV JOINT REMOVAL



UUVW814A

1. Park the vehicle on firm and level ground, stop the engine and apply the parking brake. Then, drain the front axle case oil.



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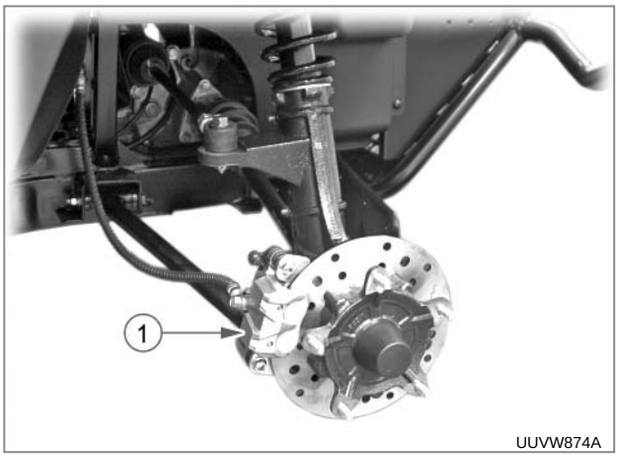
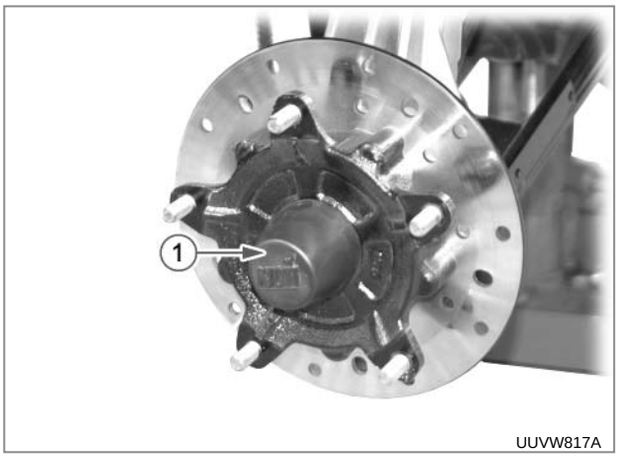
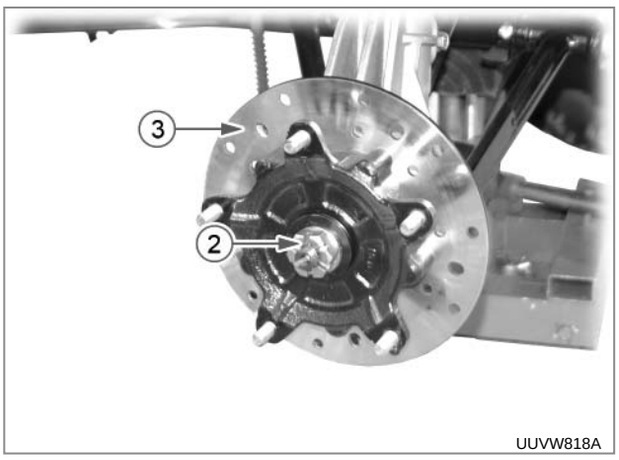
2. Place a hydraulic jack under the front frame and unscrew the front wheel mounting nuts (1) (M10, 5 EA) with the 14 mm socket wrench to remove the front wheels.

Front wheel (M10 nut) tightening torque ..... 39.2 ~ 45.1 Nm
4.0 ~ 4.6 kgf-m
28.8 ~ 33.1 lb-ft



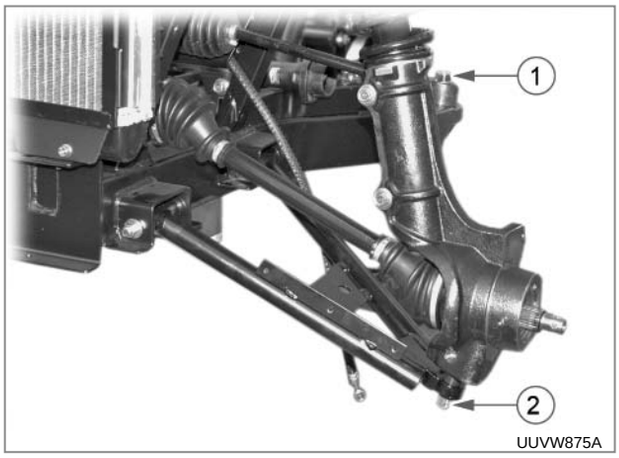
3. Unscrew the brake caliper (1) mounting bolts (M8, 2 EA) to remove the brake caliper.





4. Pull out the axle cap (1) and remove the slotted nut (2). Then, tap the brake disc assembly (3) forward gently to remove it as one unit.

Slotted nut
tightening torque ..... 95 Nm
9.7 kgf-m
70 lb-ft

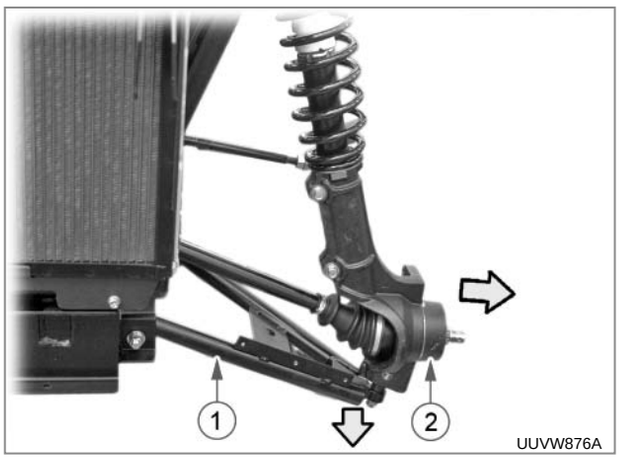


5. Remove the slotted nut (1) and split pin under the tie rod end mounting bolt as well as the slotted nut (2) and split pin under the front knuckle mounting bolt to separate the tie rod end and lower arm.

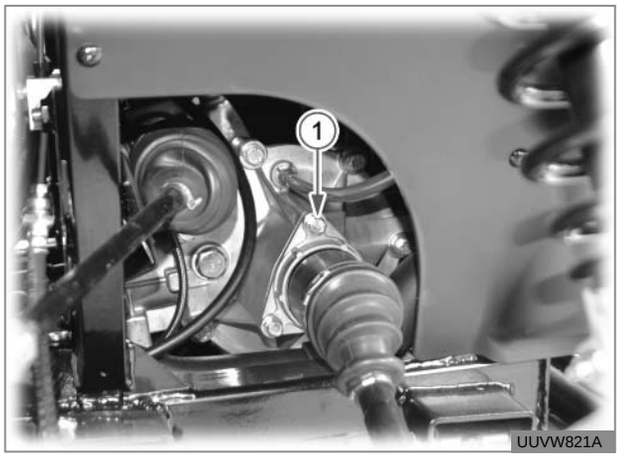
IMPORTANT

- **When installing the tie rod end mounting bolt, tighten the slotted nut to the specified torque and then tighten it further until the split pin hole is aligned with the nut groove.**

Slotted nut
tightening torque ..... 54 ~ 61 Nm
5.4 ~ 6.1 kgf-m
38.9 ~ 43.9 lb-ft

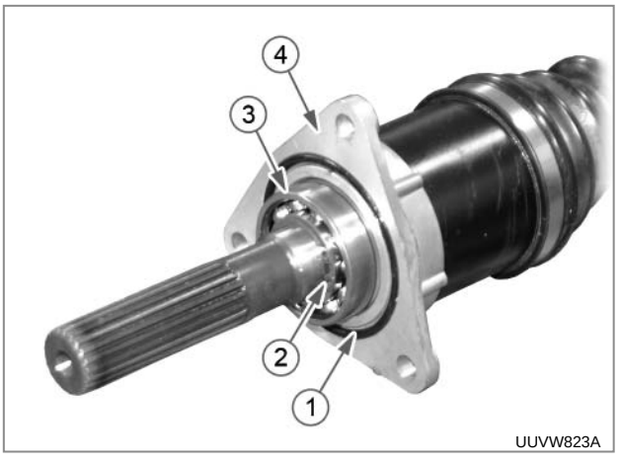


6. Tap the lower arm (1) downward to remove it. Then, pull the knuckle (2) down to separate it from the front axle drive shaft.

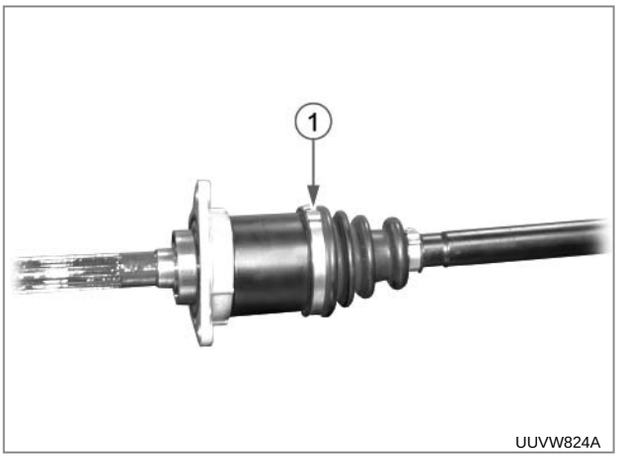


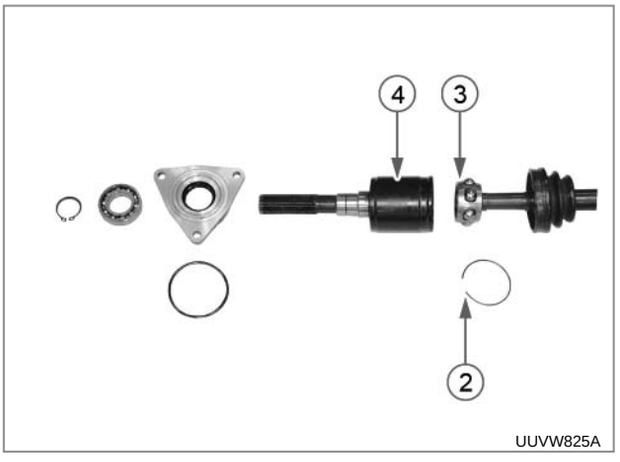
7. Unscrew the front axle drive shaft bearing holder mounting bolts (1) (M8, 3 EA) using the 12 mm socket wrench and pull the front axle drive shaft to remove it as an assembly.

5.2 CV JOINT BOOT REPLACEMENT



1. Remove the O-ring (1) and snap ring (2) from the front axle drive shaft assembly. Then, tap the bearing holder to remove the ball bearing (3) and bearing holder (4).





2. Undo the rubber bellows mounting band (1) and remove the rubber bellow. Then, remove the stop ring (2) from the opening of the drive shaft housing to remove the ball joint (3) as one unit.

IMPORTANT

- **During installation, make sure that the larger opening of the CV joint (3) cup is inserted into the housing (4) first. Otherwise, the bending angle of the joint is insufficient, leading to breakage.**

REMARK

- **Drive shaft boot band removal**


UUVW826A


UUVW827A

1. **The band can be disconnected by unfolding its bending section, unfolding its outer part and pushing it in the opposite direction of winding.**


UUVW828A

2. **The band can be installed by aligning it with the boot groove, pulling and tightening its outer part, folding and inserting it to the bending section and folding the bending section to secure this outer part.**

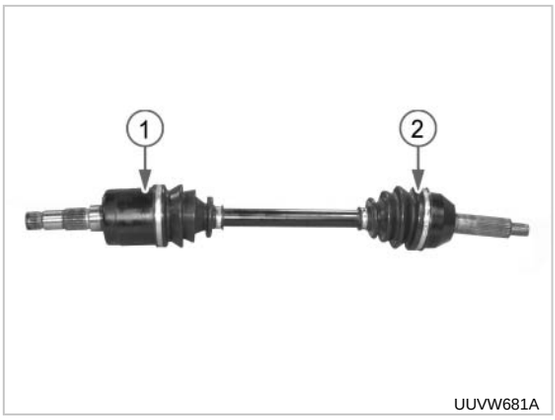
3. If necessary, pull out the snap ring and remove the ball joint guide, case, ball and rubber bellows in order. (Refer to "Rear axle drive shaft disassembly" in this chapter.)
4. For reassembly, fit the rubber boot to the shaft, insert the CV joint cup, fit the guide and fit the snap ring. Then, fit the ball into the hole, push it in along the housing groove and fit the stop ring.

IMPORTANT

- **During assembly, fill the drive shaft housing with a sufficient amount of grease. Make sure to apply grease to the ball not to miss it when installing it to the case.**
- **When installing the bearing holder, be careful not to damage the oil seal. If a new bearing holder is used, apply grease to its mating surface for the O-ring and oil seal.**

5. Fit the rubber bellows to the housing and secure it with the band.

REMARK



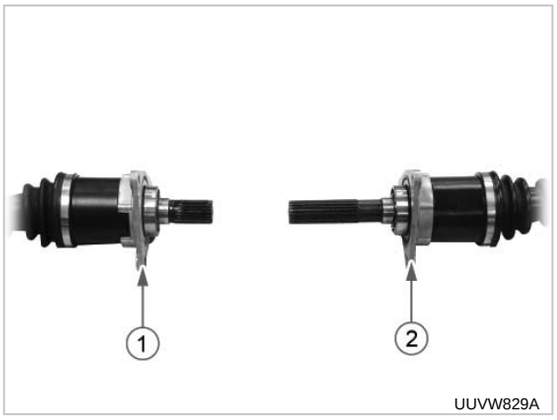
UUVW681A

- **Components of CV joint boot kit: boot, band and grease**
- **Each EV joint has two boot kits.**
- **The CV joint on the wheel side (1) is pressed in and cannot be removed.**
- **To replace the boot, remove the joint on the axle case side (2) and remove the two boots.**

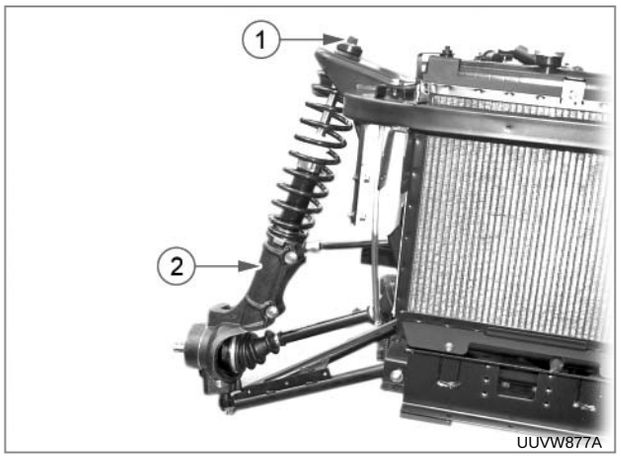
5.3 FRONT DIFFERENTIAL CASE REMOVAL

1. Remove the front wheels. Then, remove the front axle drive shaft assemblies (LH/RH). (For the removal procedures, refer to "5.1 Front axle disassembly.")

IMPORTANT

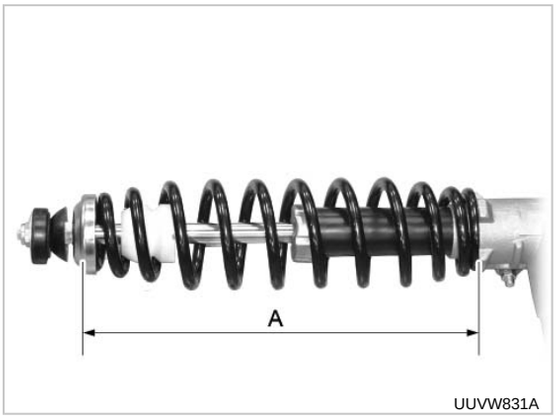


- **As the front axle drive shafts for the left (1) and right (2) are different, be careful not to mix them.**

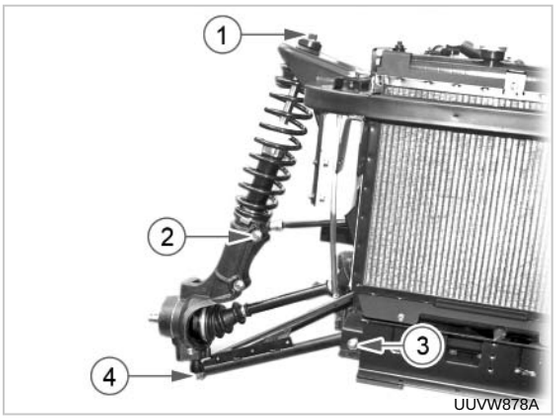


2. Unscrew the front strut assembly mounting nuts (1) with the 19 mm spanner to remove the strut assembly (2).

IMPORTANT



- **During assembly, set the spring length "A" of the front strut assembly to be 328 ± 3 mm (12.9 ± 0.12 in.).**



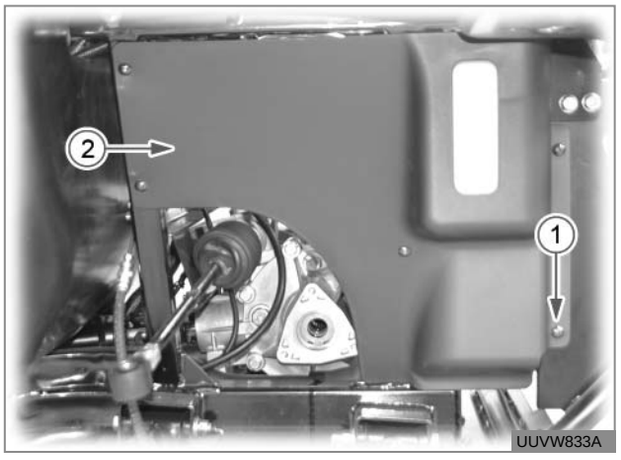
Tighten each tightening section to the specified torque when assembling the front suspension section.

(1) 21 Nm, 2.1 kgf-m, 15.1 lb-ft

(2) 25 Nm, 2.5 kgf-m, 18.0 lb-ft

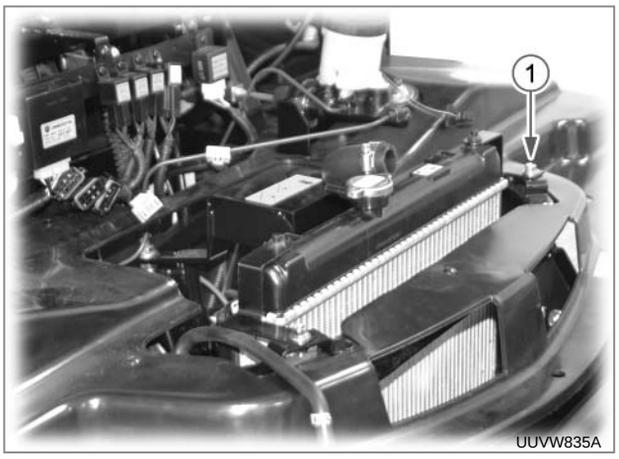
(3) 41 Nm, 4.1 kgf-m, 29.5 lb-ft

(4) 35 Nm, 3.5 kgf-m, 25.2 lb-ft

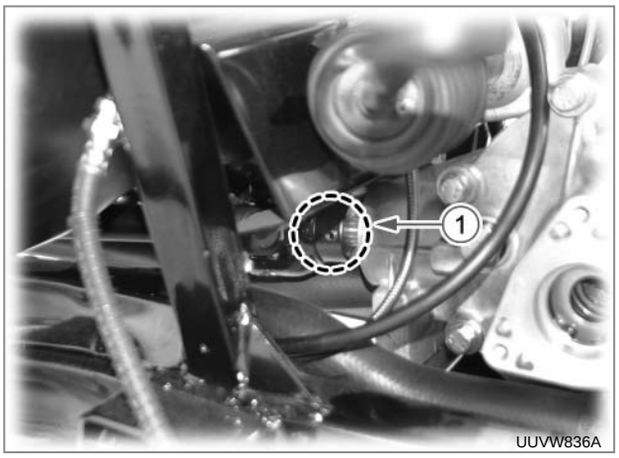


3. Unscrew the mudguard cover mounting screws (1) (RH) and remove the mudguard cover (2).

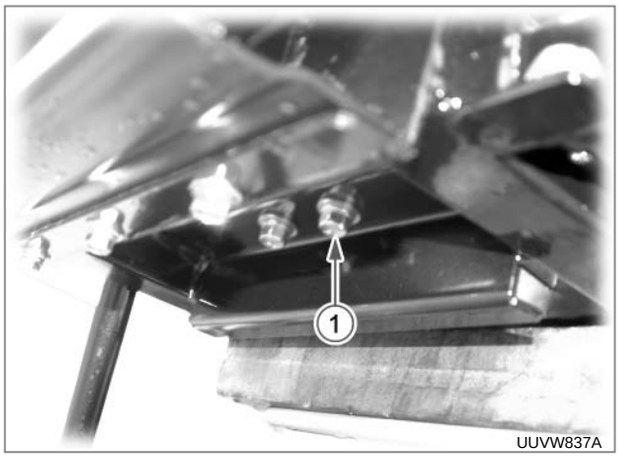
4. Unscrew the radiator drain cock to drain the coolant (referring to "Engine removal" in chapter 2). Then, undo the coolant hose connecting clamp to disconnect the coolant hose, and disconnect the cooling fan motor connector (1).

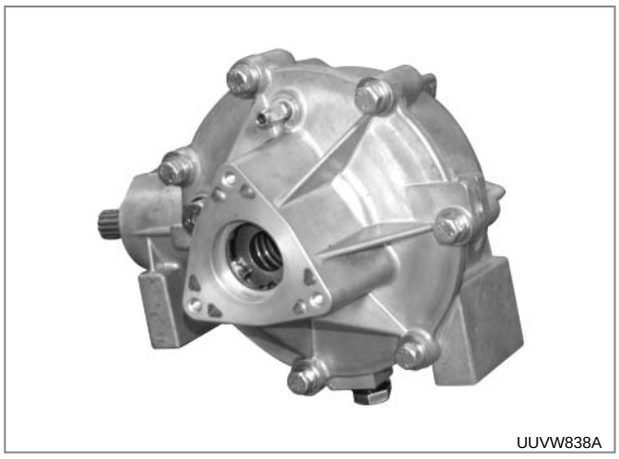


5. Unscrew the radiator mounting bolts (1) (M8, 2 EA) with the 12 mm spanner to remove the radiator.



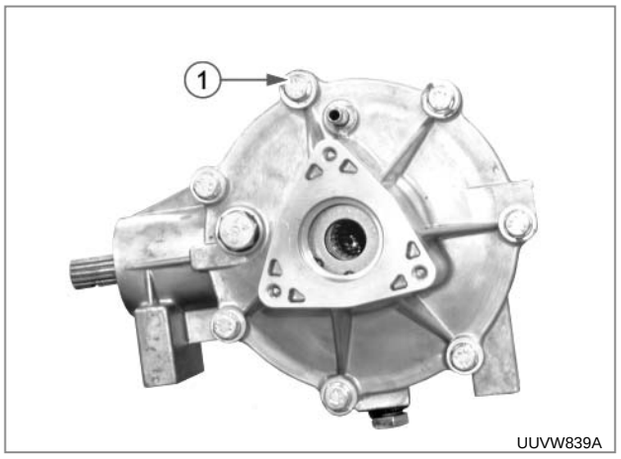
6. Pull out the propeller shaft joint connecting spring pin (1) and disconnect the propeller shaft.





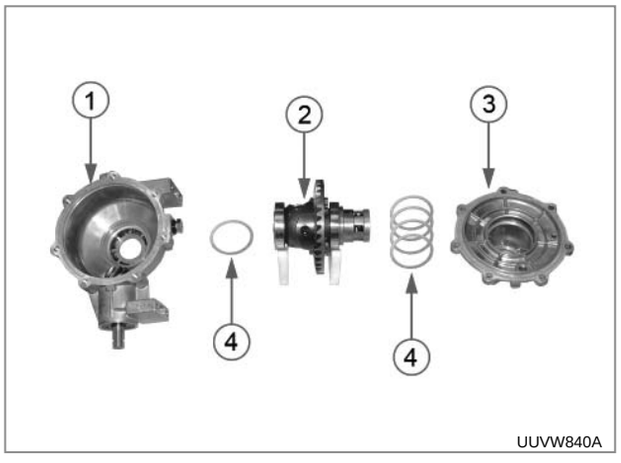
7. Unscrew the front axle case mounting bolts (1) (M10, 4 EA) and disconnect the bleeding hose. Then, remove the front differential case assembly by lifting it up.

5.4 FRONT DIFFERENTIAL CASE DISASSEMBLY AND ASSEMBLY

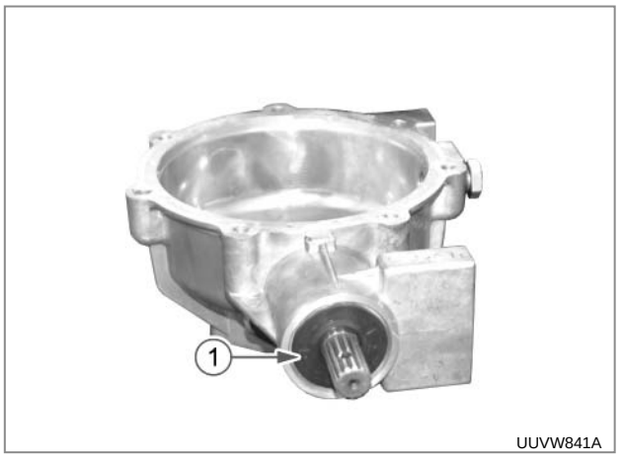


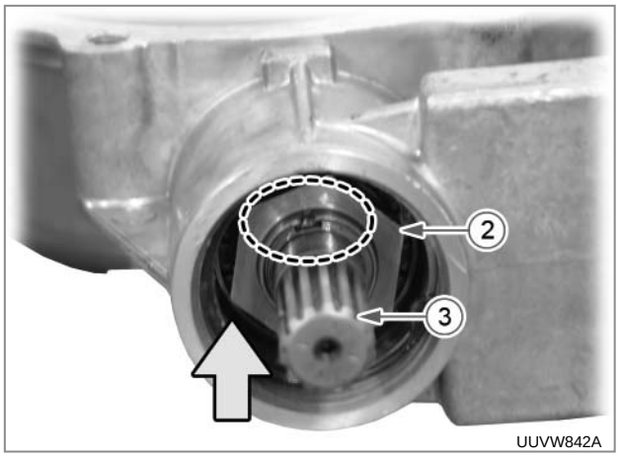
1. Unscrew the front differential case mounting bolts (1) (M10, 7 EA) with the 14 mm socket wrench.

   Bolt specified torque..... 39.2 ~ 44.1 Nm
   4.0 ~ 4.5 kgf-m
   28.8 ~ 32.4 lb-ft



2. Remove the front differential case (1), differential assembly (2) and front differential case cover (3). Keep the adjusting shims (4) in a safe place to install them back to their original state during assembly.



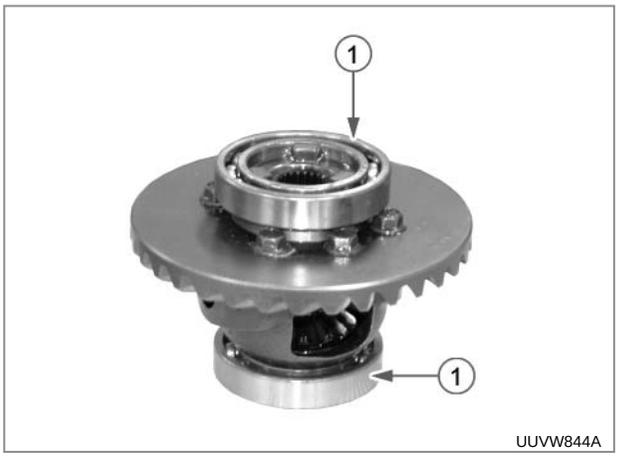


3. Pull out the oil seal (1) and unfold the staking part of the staking nut and unscrew the caulking nut (2). Then, tap the spiral bevel pinion shaft from outside inward to remove the bevel pinion shaft (3).
   If necessary, remove the taper roller bearing.
   When reassembling them, replace the oil seal with a new one and apply grease to its mating surface.
4. Assemble in the reverse order of disassembly.

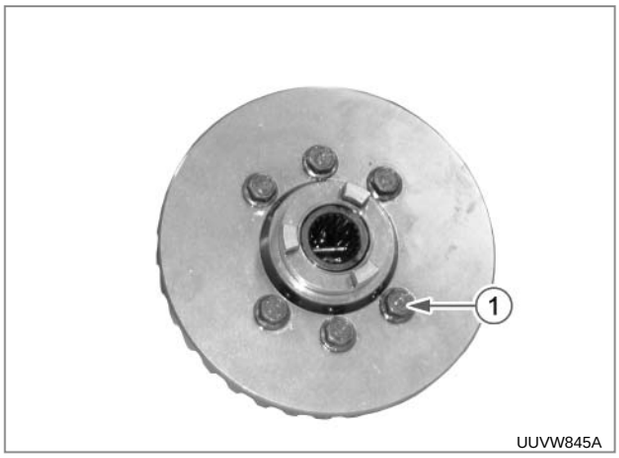
5.5 DIFFERENTIAL SYSTEM DISASSEMBLY AND ASSEMBLY

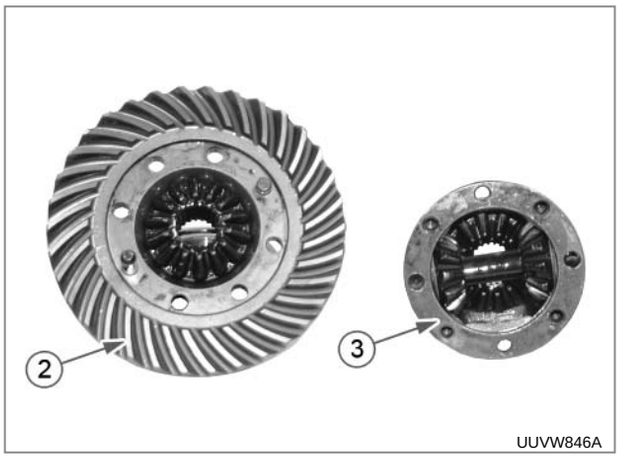
5.5.1 DIFFERENTIAL SYSTEM DISASSEMBLY

1. Remove the clutch assembly (1) from the front differential assembly.

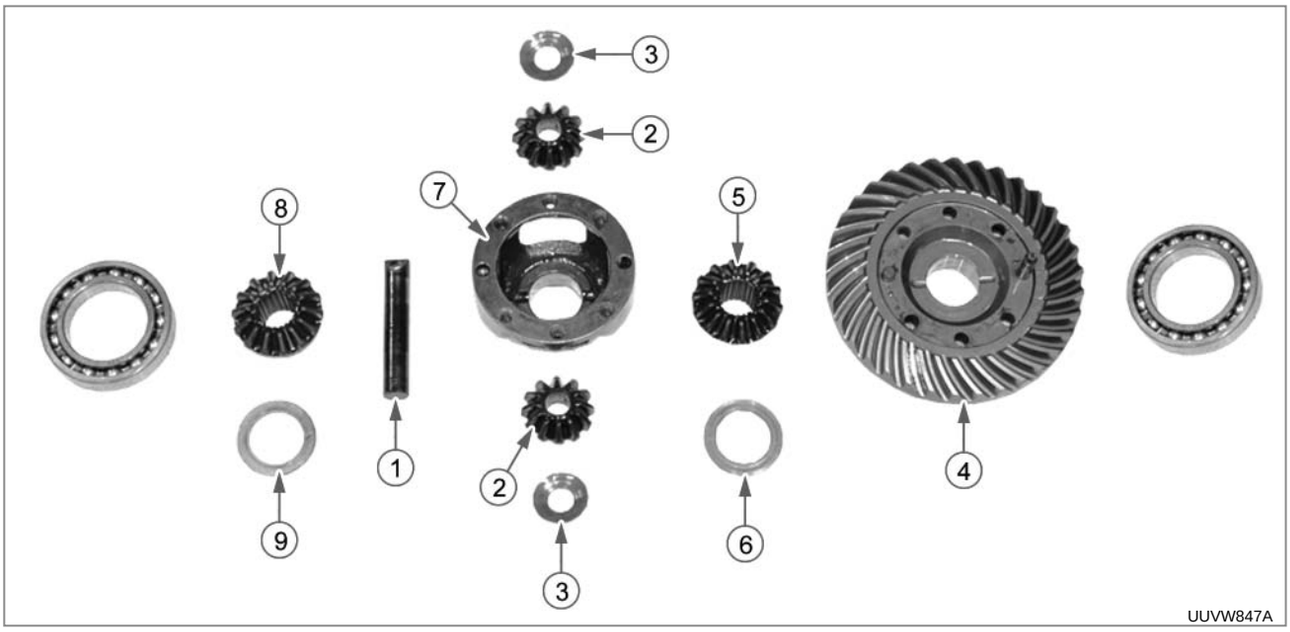


2. Remove the ball bearing (1) from the front differential assembly.





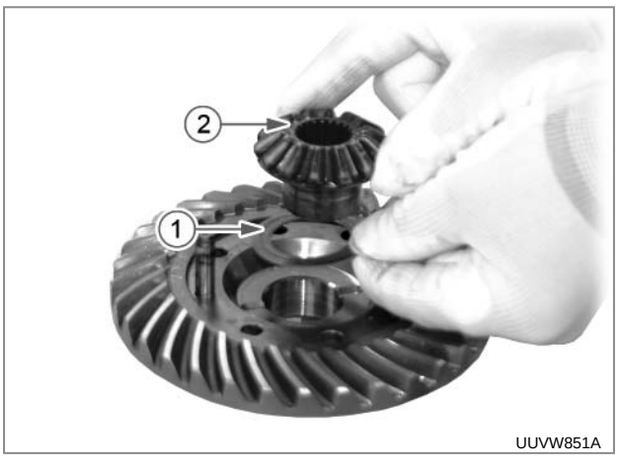
3. Unscrew the spiral bevel gear mounting bolts (1) (M8, 6 EA) with the 12 mm socket wrench and remove the spiral bevel gear (2) and differential case (3) by tapping them with a rubber hammer.



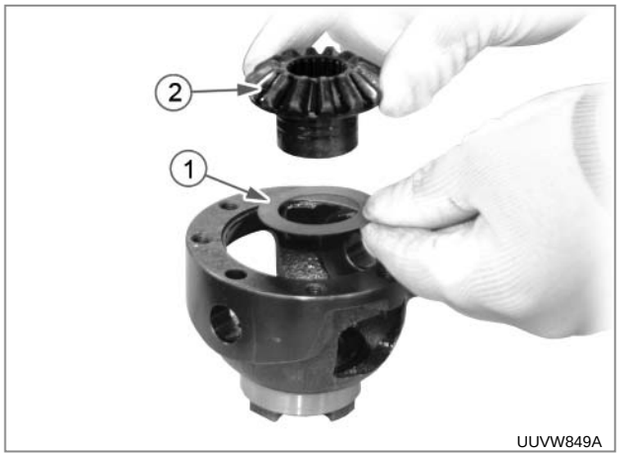
4. Pull out the differential pinion shaft (1) and remove the differential pinions (2) and differential pinion washers (3). Then, remove the side gear (5) and differential washer (6) from the spiral bevel gear (4) and the side gear (8) and differential washer (9) from the differential case (7).

5.5.2 DIFFERENTIAL SYSTEM ASSEMBLY

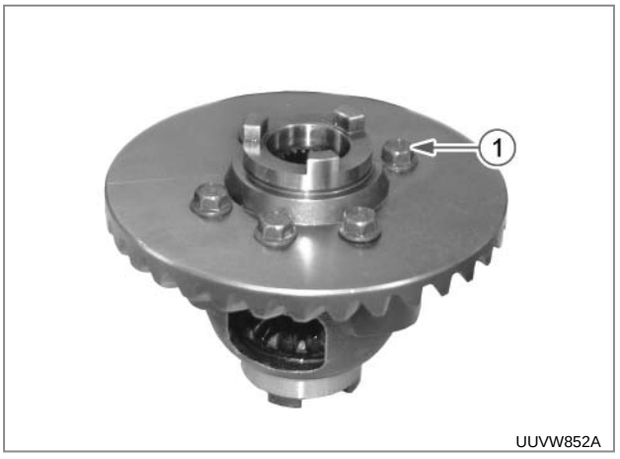
1. Fit the straight pin (1) and knock pin (2) into the spiral bevel gear.



4. Insert the differential washer (1) and side gear (2) into the spiral bevel gear.

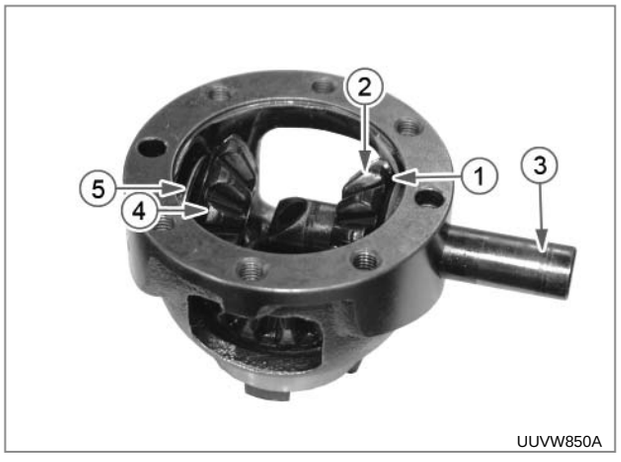


2. Insert the differential washer (1) and side gear (2) into the differential case.

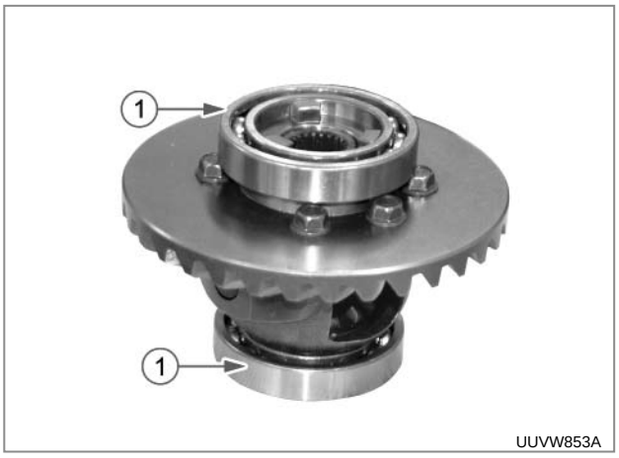


5. Install the spiral bevel gear to the differential case and tighten the mounting bolts (1) diagonally to the specified torque in several steps. Make sure to apply adhesive (Three Bond 1372 or equivalent) to their threads.

Bolt (M8) specified torque ..... 29.4 ~ 34.3 Nm
3.0 ~ 3.5 kgf-m
21.6 ~ 25.2 lb-ft



3. After inserting the differential pinion washer (1) and differential pinion (2) to the differential case, fit the differential pinion shaft (3) with its hole facing up. Then, insert the differential pinion (4) and differential pinion washer (5).



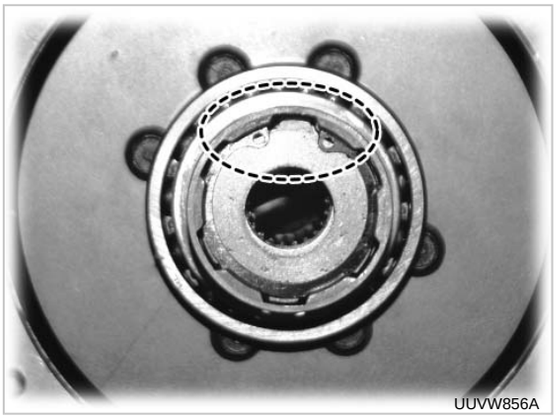
6. Tap the ball bearings (1) onto the front and back.

7. Tap the clutch assembly into the case with a rubber hammer.

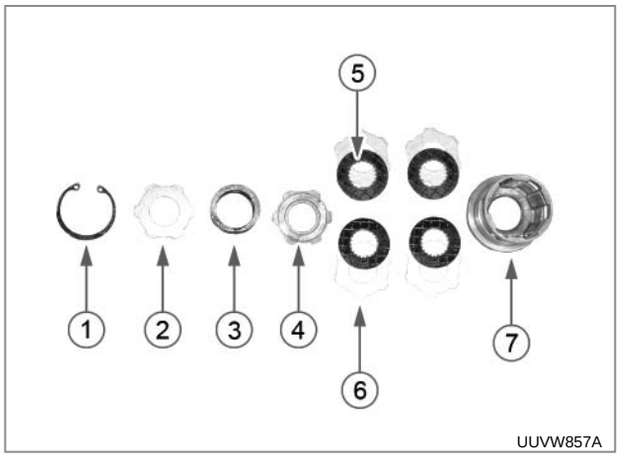
5.6 LSD DISASSEMBLY AND ASSEMBLY

1. Take out the snap ring (1).

IMPORTANT



- **When installing the snap ring to the clutch assembly, its opening should be between the protrusions of the case.**



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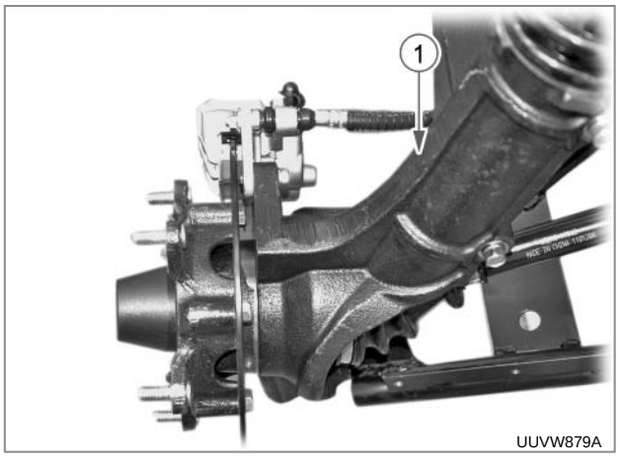
2. Remove the spring seating plate (2), spring (3), spring seating plate (4), clutch discs (5), clutch plates (6) and case (7) in order.
3. Assemble in the reverse order of disassembly.
4. When installing the clutch plates, align their spline grooves.

REMARK

- **When disassembling the clutch assembly, proper tools, such as a spring compressor, should be used to remove the snap ring due to high spring tension.**

5.7 FRONT AXLE KNUCKLE ASSEMBLY DISASSEMBLY AND ASSEMBLY (FRONT KNUCKLE REPLACEMENT)



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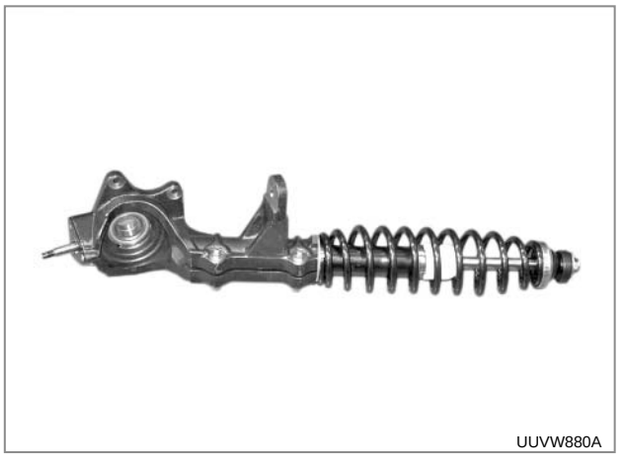
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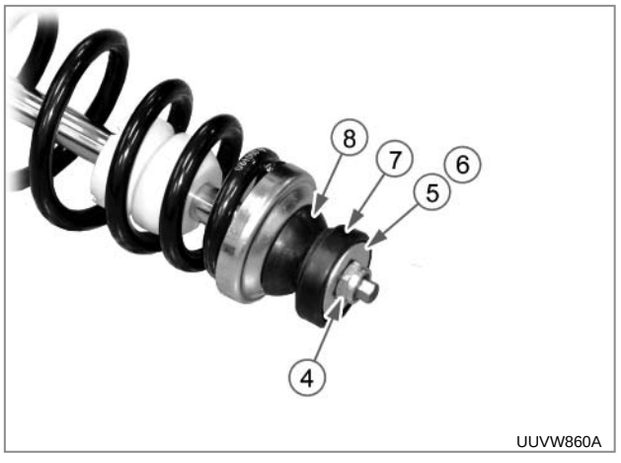
1. Remove the knuckle assembly (1). (Refer to "Front axle disassembly.")



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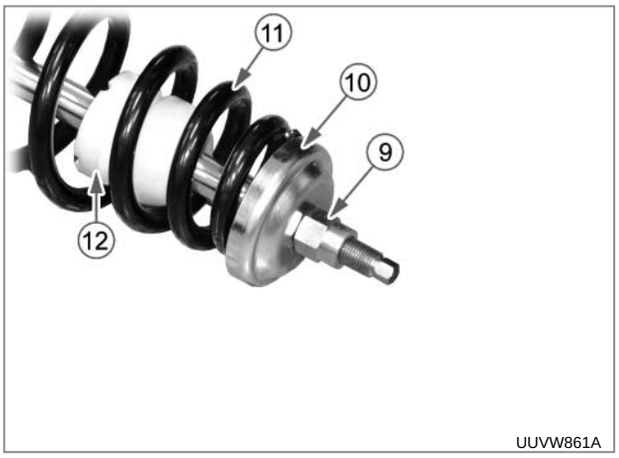
2. Unscrew the mounting nut (4) with the 19 mm spanner and remove the washer (5), rubber spacer (6), upper mounting ball (7) and lower mounting ball (8) in order.



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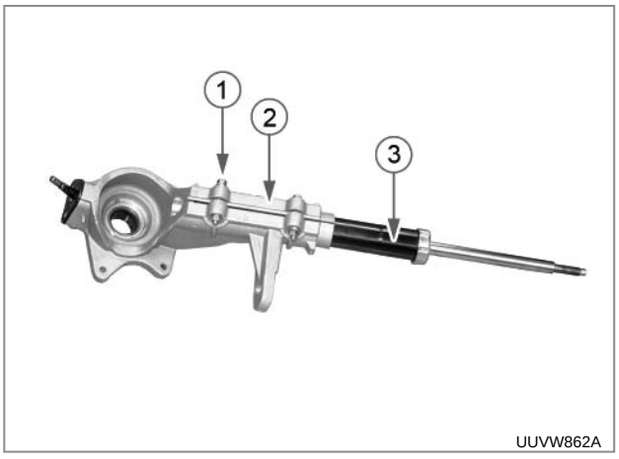
3. Unscrew the mounting nut (9) with the 19 mm spanner and remove the spring seat (10), spring (11) and bumper stopper (12).



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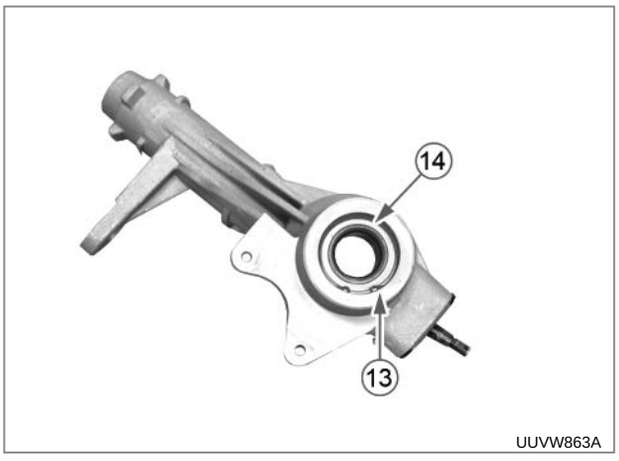
4. Unscrew the knuckle mounting bolts (1) (M8, 2 EA) with the 12 mm spanner and separate the knuckle (2) and shock absorber assembly (3).



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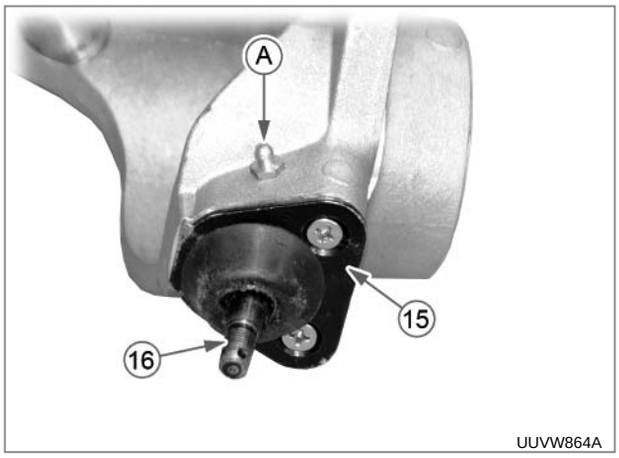
5. Pull out the knuckle snap ring (13) and remove the bearing (14).



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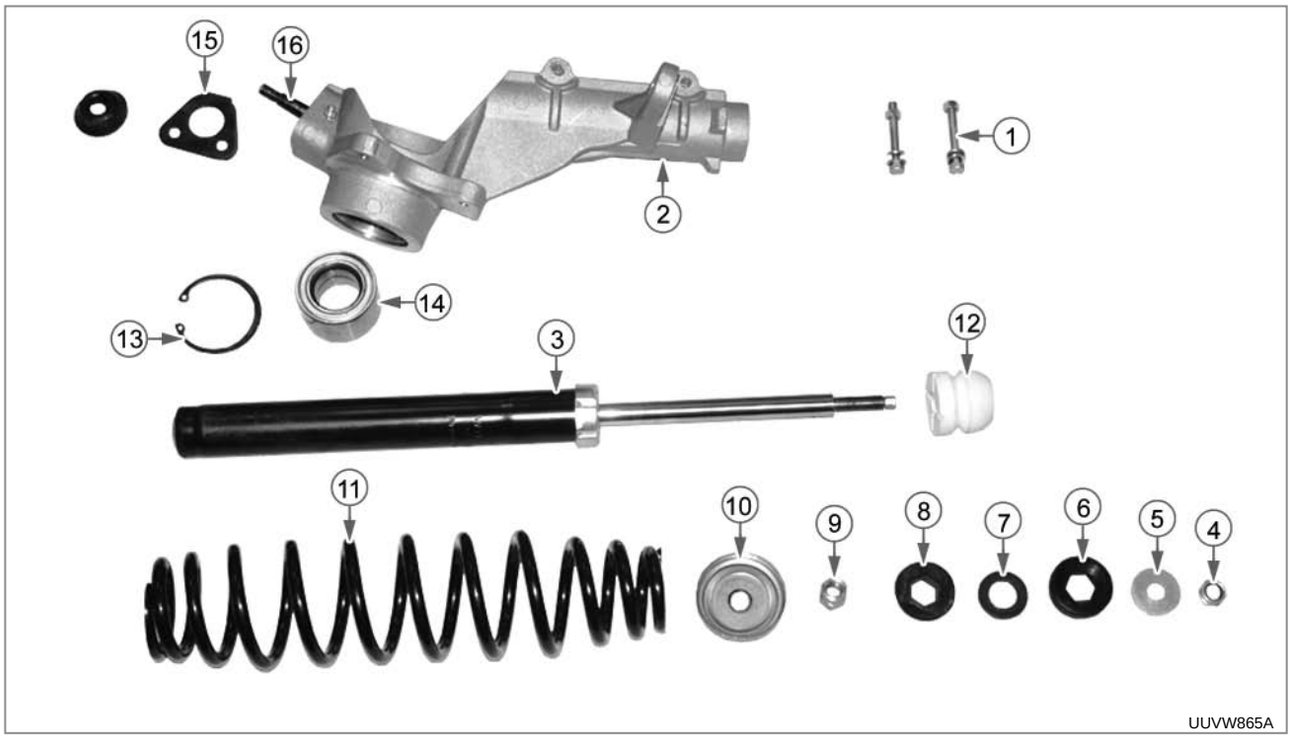
6. Unscrew the ball joint bracket mounting screws and separate the bracket (15) and ball joint (16).

REMARK

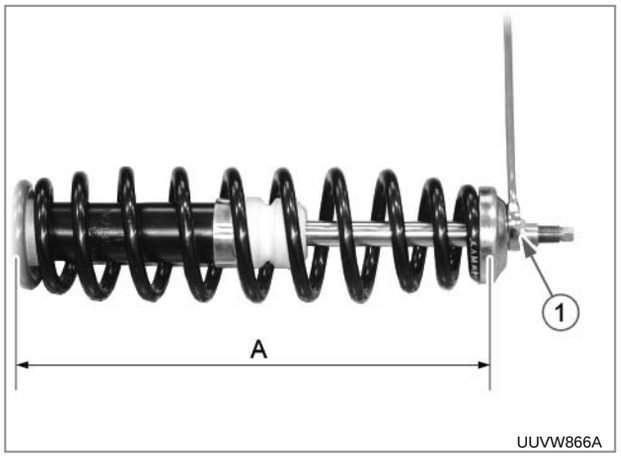
- **When replacing the knuckle, replace the ball joint as well since it is pressed in and cannot be removed.**

IMPORTANT

- **Apply approx. 10 g of grease to the knuckle ball joint, installed to the front knuckle, through the grease nipple (A). Then, turn the ball joint for lubrication and add more grease until grease comes out through the ball joint gap.**

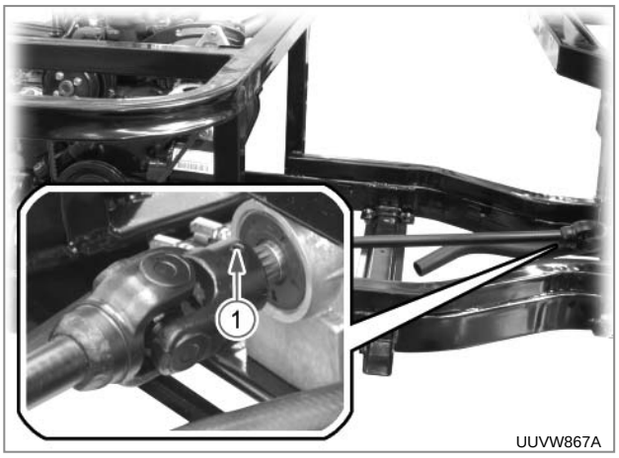


7. Assemble in the reverse order of disassembly.

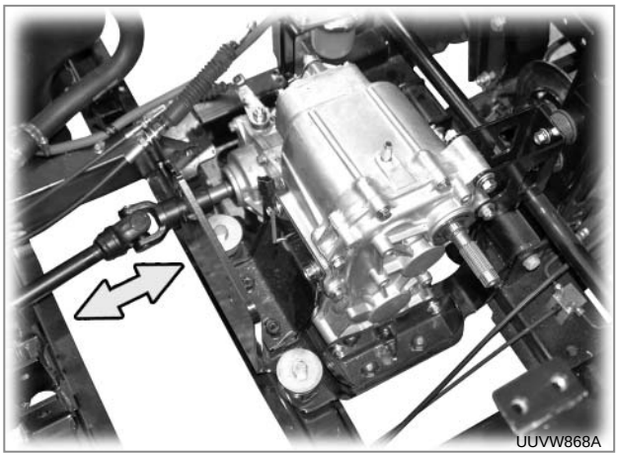


8. Place and install the front wheel shock absorber onto the knuckle. Then, tighten the mounting nut (1) to set the spring length "A" to be 328 ± 3 mm.

5.8 PROPELLER SHAFT(FRONT UNIVERSAL JOINT) REPLACEMENT



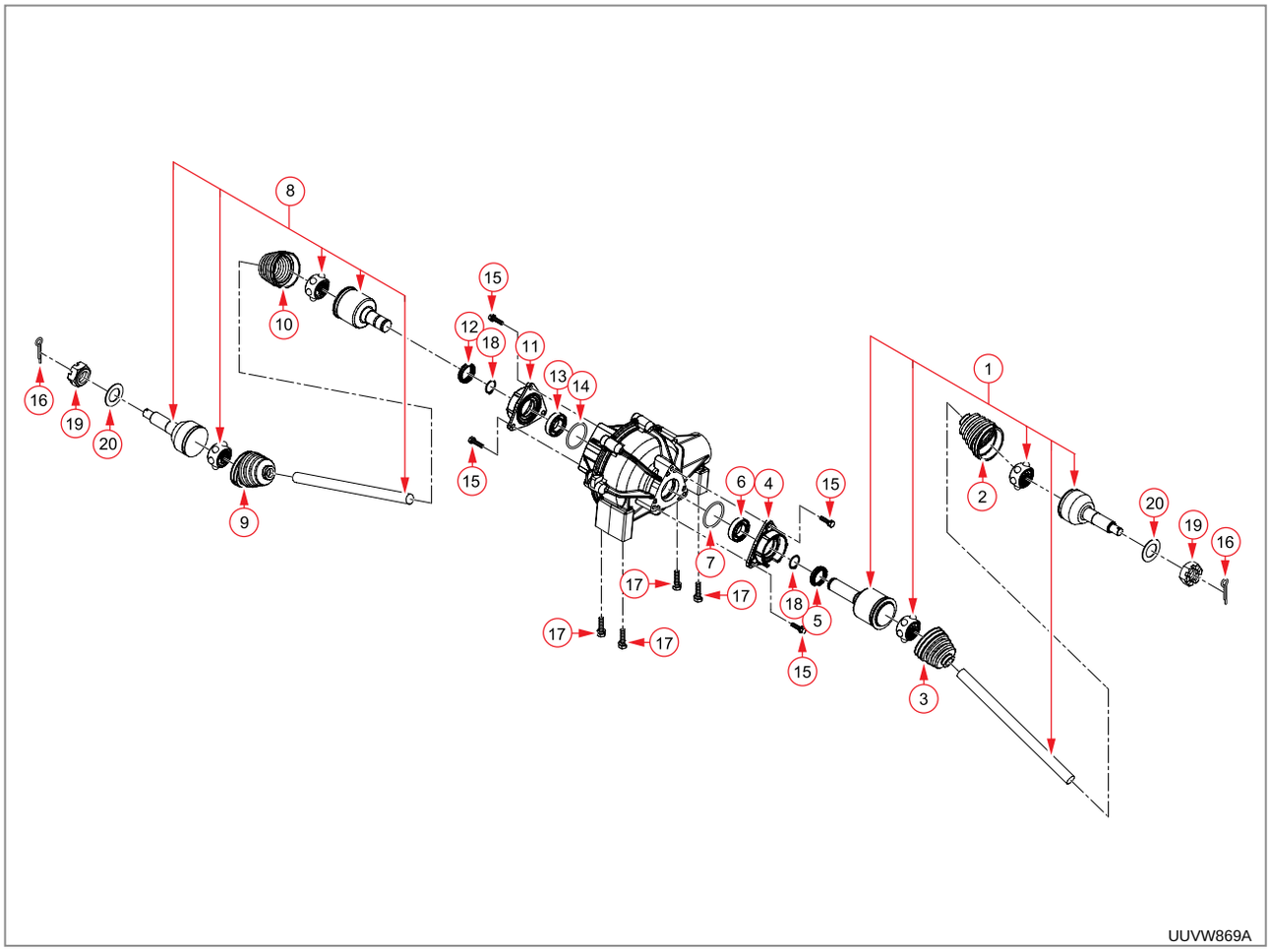
1. Remove the propeller shaft mounting spring pin (1) on the front axle case side by tapping it.



2. Pull the propeller shaft toward the transmission to separate it from the front axle case. Then, remove it by pulling it toward the front axle case.

6. COMPONENTS

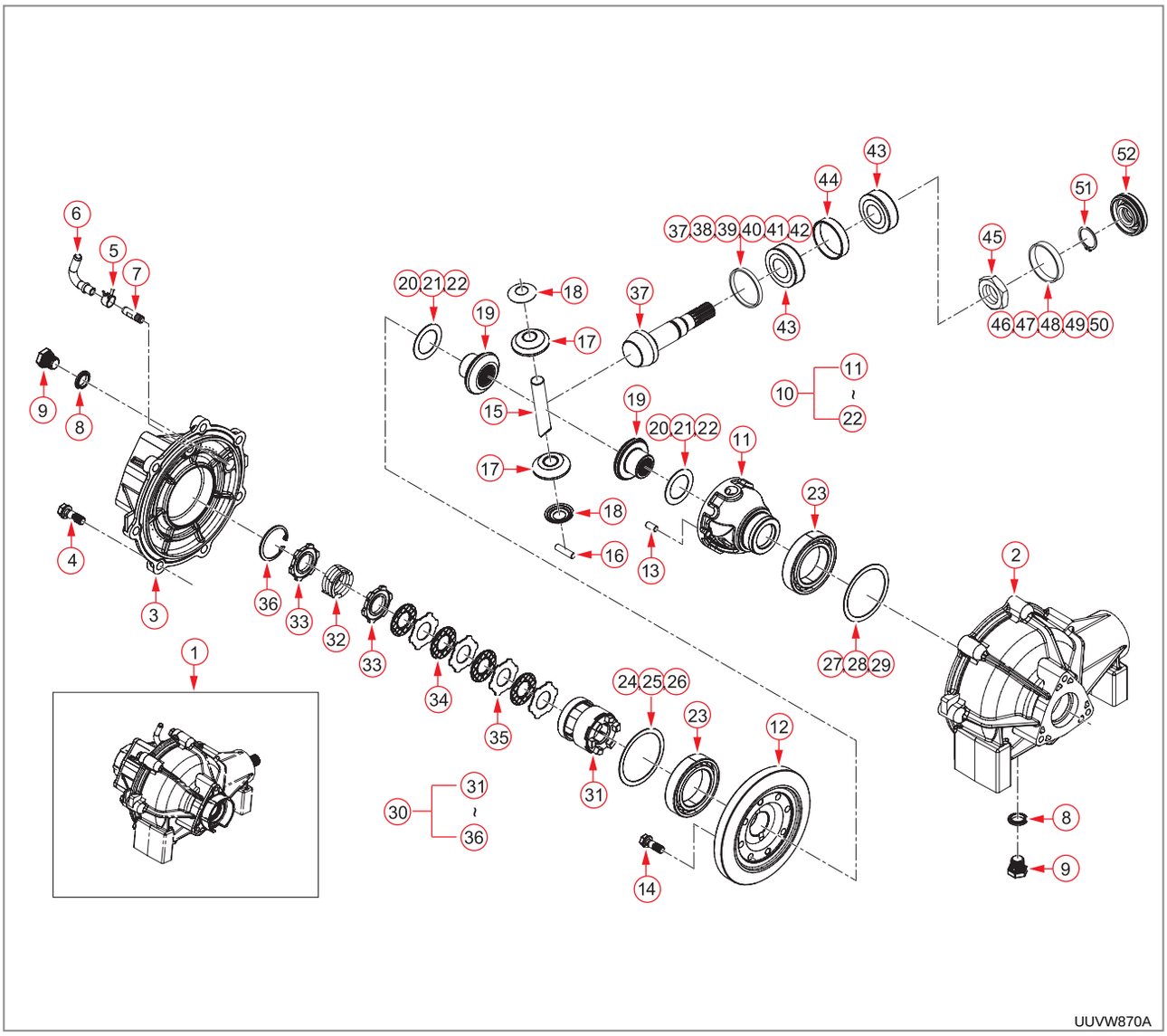
6.1 U100A FRONT AXLE DRIVE



COMPONENTS

(1) FRONT DRIVE SHAFT, LH
(2) BOOT REPAIR KIT FRT O/B (W/ GREASE)
(3) BOOT REPAIR KIT FRT I/B (W/ GREASE)
(4) WINNOW BEARING HOLDER
(5) OIL SEAL(30*40*8)
(6) BEARING, BALL
(7) O RING
(8) FRONT DRIVE SHAFT, RH
(9) BOOT REPAIR KIT FRT O/B (W/ GREASE)
(10) BOOT REPAIR KIT FRT I/B (W/ GREASE)
(11) WINNOW BEARING HOLDER
(12) OIL SEAL(30*40*8)
(13) BEARING,BALL
(14) O RING
(15) WASHER BOLT
(16) PIN, SPLIT
(17) BOLT
(18) CIR CLIP, EXTERNAL
(19) NUT
(20) WASHER, PLAIN

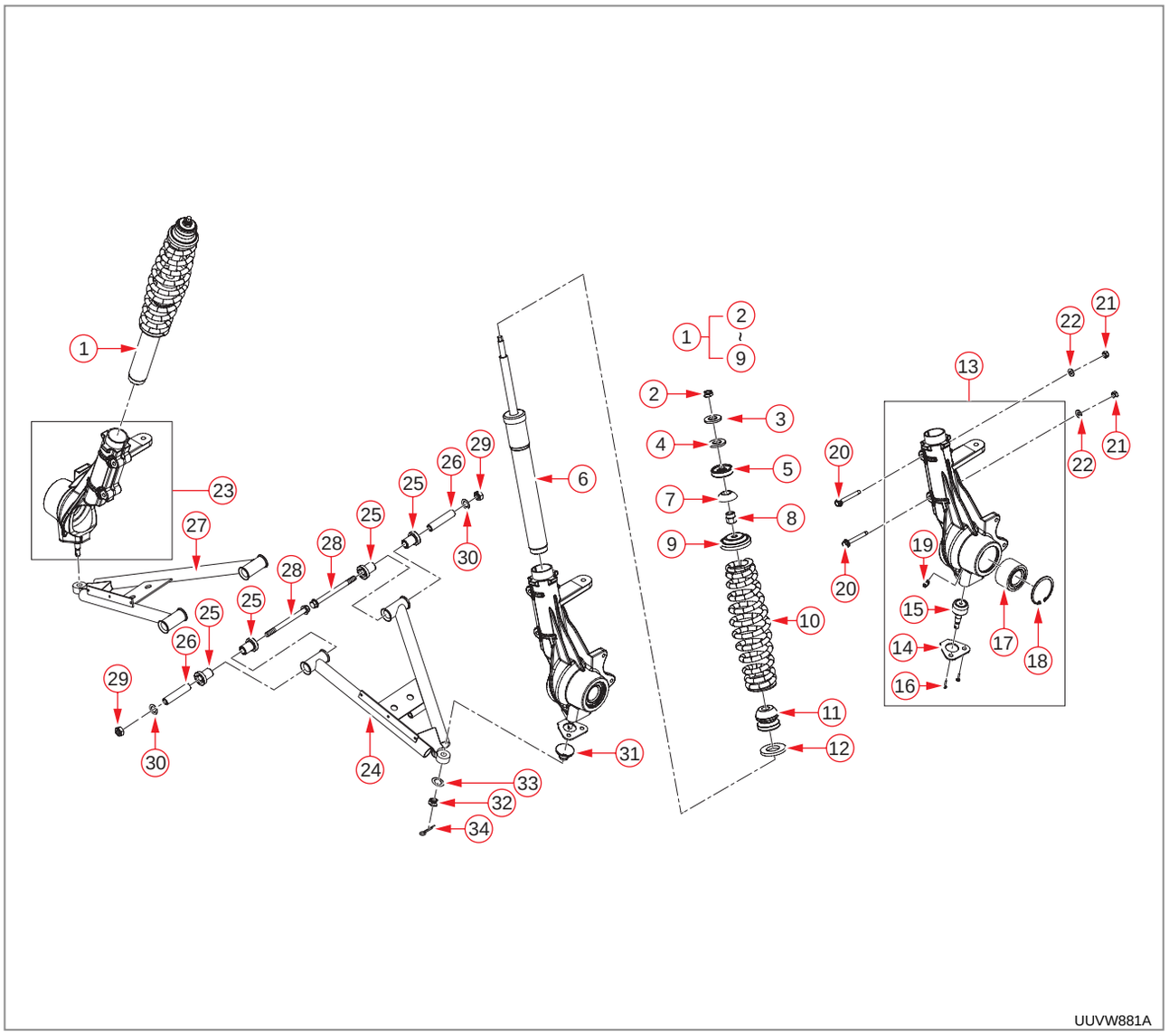
6.2 U110A FRONT DIFF. CASE



COMPONENTS

(1) FRONT AXLE CASE ASSY
(2) CASE, FRONT AXLE
(3) COVER, FRONT CASE
(4) BOLT
(5) CONNECTOR, AIR BREATHER
(6) HOSE, OVER FLOW
(7) CLIP, PIPE
(8) WASHER, SEAL
(9) PLUG
(10) FRONT DIFF.GEAR CASE ASSY
(11) CASE, FRONT DIFF
(12) GEAR, 34BEVEL
(13) PIN, STRAIGHT
(14) BOLT, UBS
(15) SHAFT, DIFFERENTIAL PINION
(16) PIN, STRAIGHT
(17) PINION, DIFFERENTIAL
(18) WASHER, DIFFERENTIAL SIDE
(19) GEAR, DIFF. SIDE
(20) SHIM 0.8
(21) SHIM 1.0
(22) SHIM 1.2
(23) BALL BEARING, 6010SH
(24) SHIM 0.1
(25) SHIM 0.2
(26) SHIM 0.4
(27) SHIM 0.8
(28) SHIM 1.0
(29) SHIM 1.2
(30) CLUTCH, LSD ASSY
(31) BODY, CLUTCH
(32) SPRING CLUTCH
(33) SHEET, SPRING(T3.5)
(34) DISK, CLUTCH
(35) PLATE, CLUTCH(T1.5)
(36) RING, SNAP
(37) BEVEL PINION SHAFT 8
(38) COLLAR
(39) COLLAR
(40) COLLAR
(41) COLLAR
(42) COLLAR
(43) BEARING,TAPER ROLLER
(44) SPACER
(45) NUT 24
(46) COLLER 2
(47) COLLER 2
(48) COLLER 2
(49) COLLER 2
(50) COLLER 2
(51) RING, SNAP
(52) SEAL, OIL

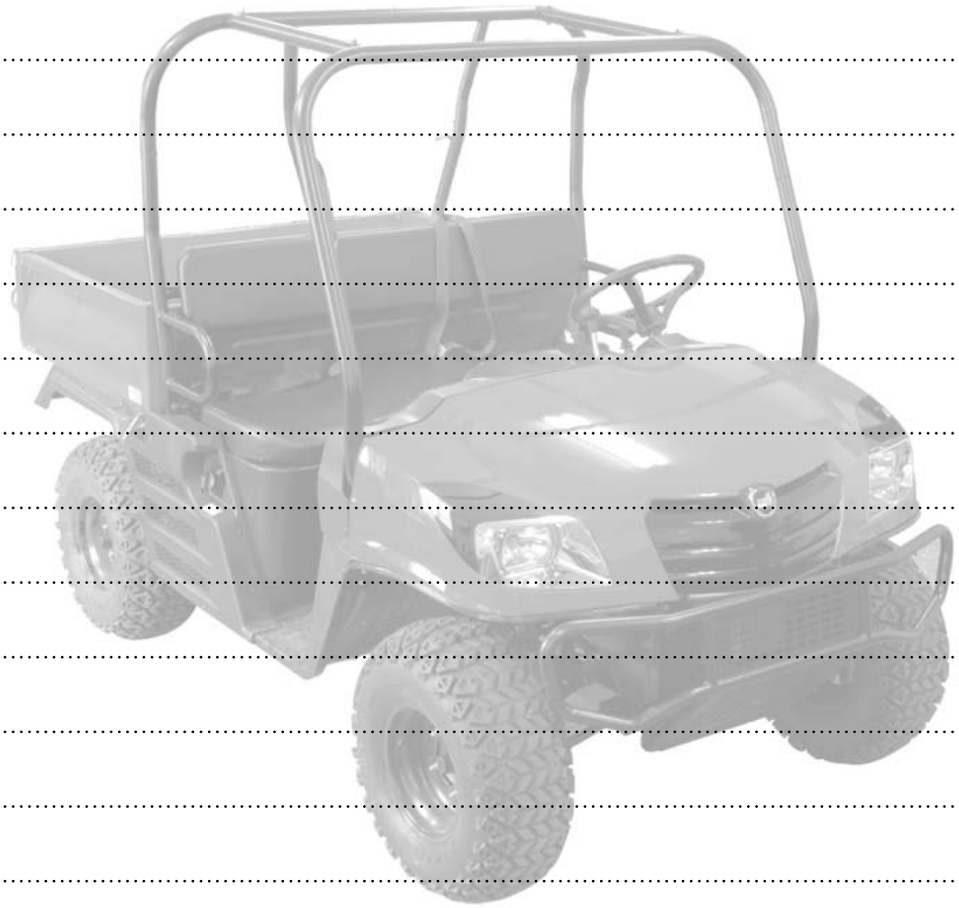
6.3 U0500A FRONT SUSPENSION



COMPONENTS

(1) STRUT ASSY, FRT
(2) NUT, STRUT TOP MTG
(3) WASHER
(4) SPACER, RUBBER
(5) BALL, UPR STRUT UPR MTG
(6) SHK/ABS ASSY, FR
(7) BALL, LWR STRUT UPR MTG
(8) COLLAR
(9) SPRG SEAT, UPR FR
(10) FRICTION SPRING
(11) BUMP, STOPPER
(12) SPRG SEAT, LWR FR
(13) KUNCKLE ASSY-FR-LH
(14) BRACKET, B/JOINT
(15) BOLL JOINT ASSY, FR LWR
(16) BOLT
(17) HUB BEARING, FR
(18) SNAP RING
(19) NIPPLE, GREASE
(20) BOLT, WASHER
(21) NUT
(22) WASHER, PLAIN
(23) KUNCKLE ASSY-FR-RH
(24) ARM-LWR-FR-LH
(25) BUSHING, ARM
(26) BUSH
(27) ARM-LWR-FR-RH
(28) BOLT
(29) NUT
(30) WASHER, PLAIN
(31) BOOT, BALL JOINT
(32) NUT, CASTLE
(33) WASHER, PLAIN
(34) PIN, SPLIT

MEMO



STEERING SYSTEM CHAPTER 10

TABLE OF CONTENTS

1. SPECIFICATIONS

1.1 STEERING GEARBOX

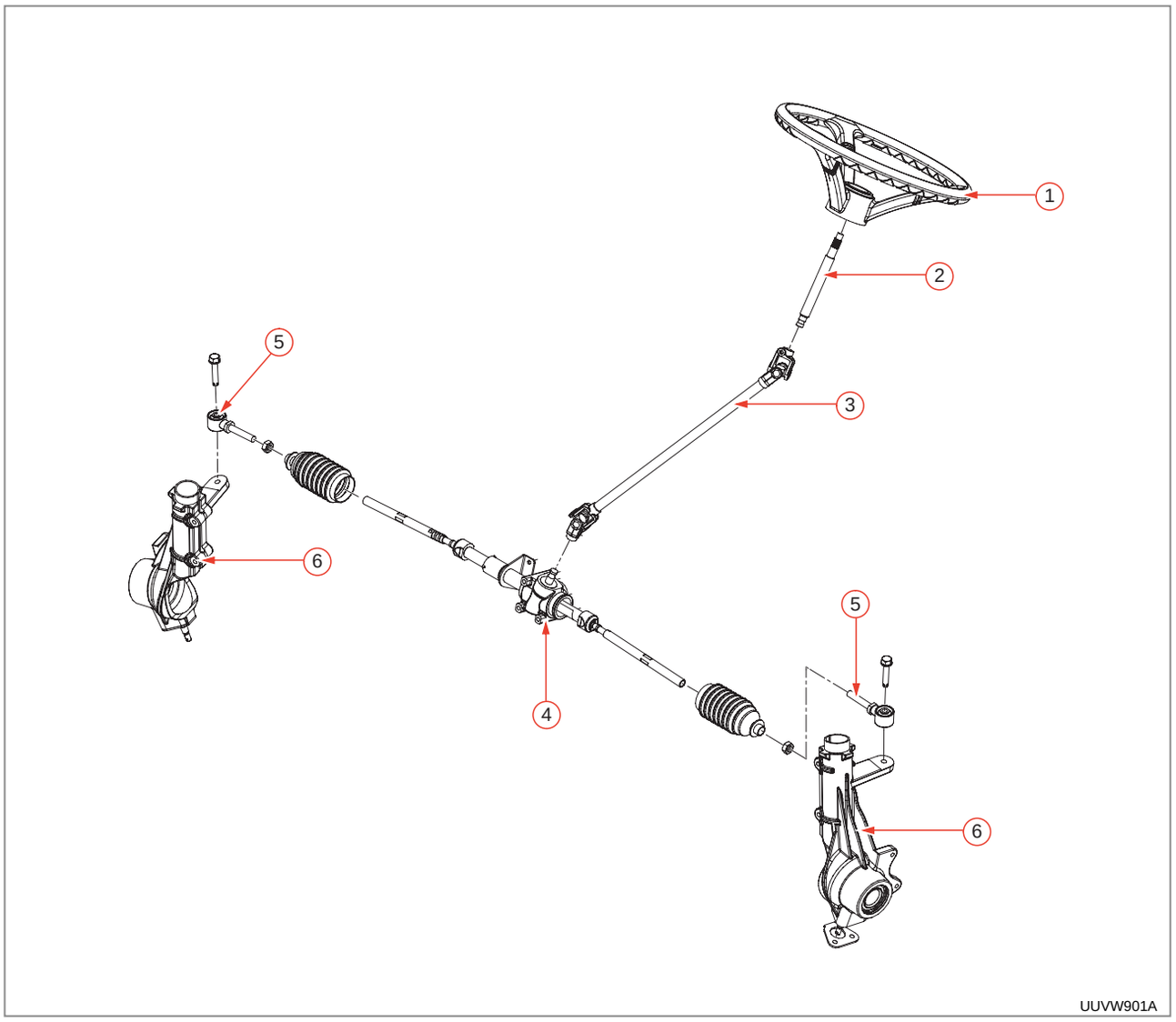
Item	Specifications	Remarks
Type	Manual (rack & pinion)	
Distance from tie rod end to end (from center of ball)	934.8± 1.5 mm (36.803 ± 0.059 in.)	
Average turning torque	1 ~ 1.5 Nm (0.102 ~ 0.153 kgf-m, 0.735 ~ 1.102 lb-ft)	
Rotating ratio (rack moving distance / pinion shaft rotation)	32.52 mm/rev (1.28 in./rev)	
Steering wheel revolution (factory spec.)	3.69 turns	

1.2 TIGHTENING TORQUE

Position	Size	Tightening torque
Steering wheel mounting nut	M12	48.0 ~ 55.9 Nm 4.9 ~ 5.7 kgf-m 35.3 ~ 41.0 lb·ft
Slotted tie rod end mounting nut	-	53 ~ 60 Nm 5.4 ~ 6.1 kgf-m 39 ~ 44 lb·ft
Steering gearbox mounting bolt	M8	40 Nm 4.1 kgf-m 30 lb·ft

2. STRUCTURE AND FUNCTION

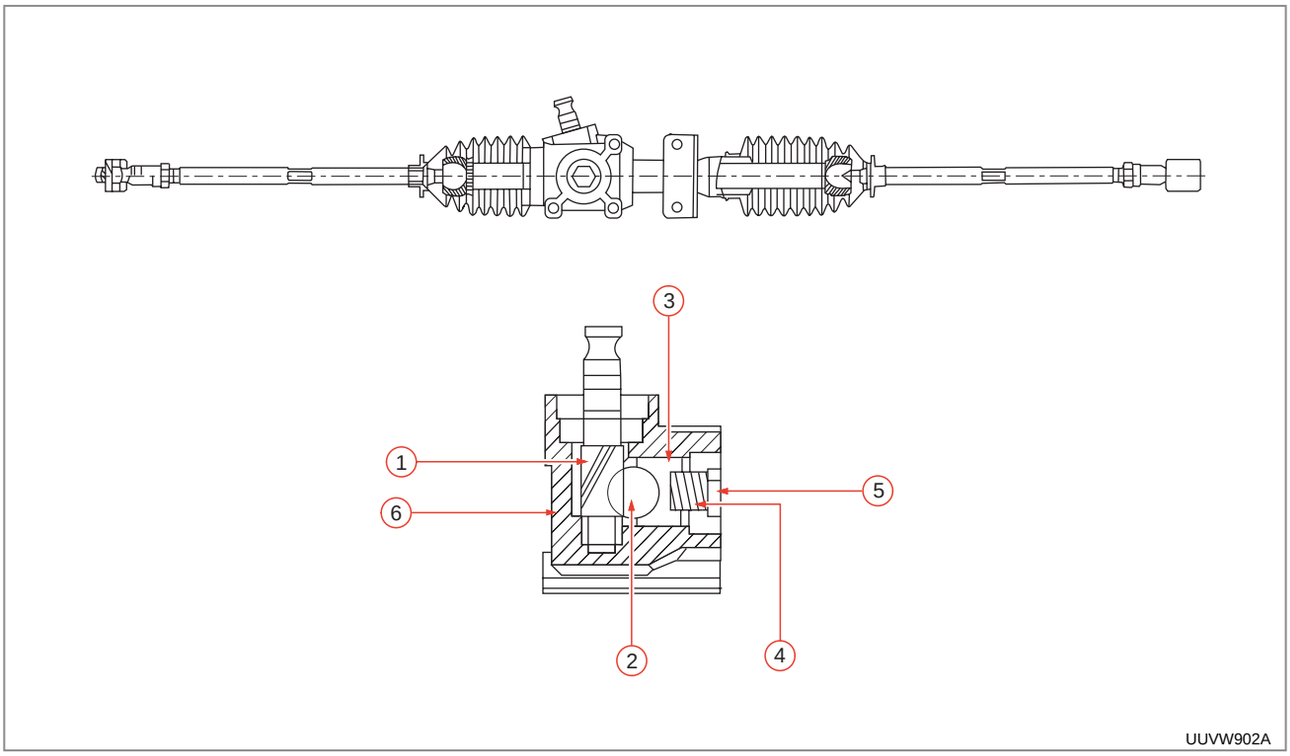
2.1 OPERATING SYSTEM DIAGRAM



- When the steering wheel (1) is turned, the steering wheel shaft (2), that its splined part is engaged with the steering wheel, rotates and this movement is transferred to the steering gear box (4) through the universal joint (3).
  Then, this rotational motion of the steering wheel shaft is converted to the straight-line motion to the left or right by the rack and pinion in the gearbox

Finally, the steering gearbox moves the tie rods (5) and knuckles (6) to steer the wheels to the left or right.

2.2 STRUCTURE IN STEERING GEARBOX

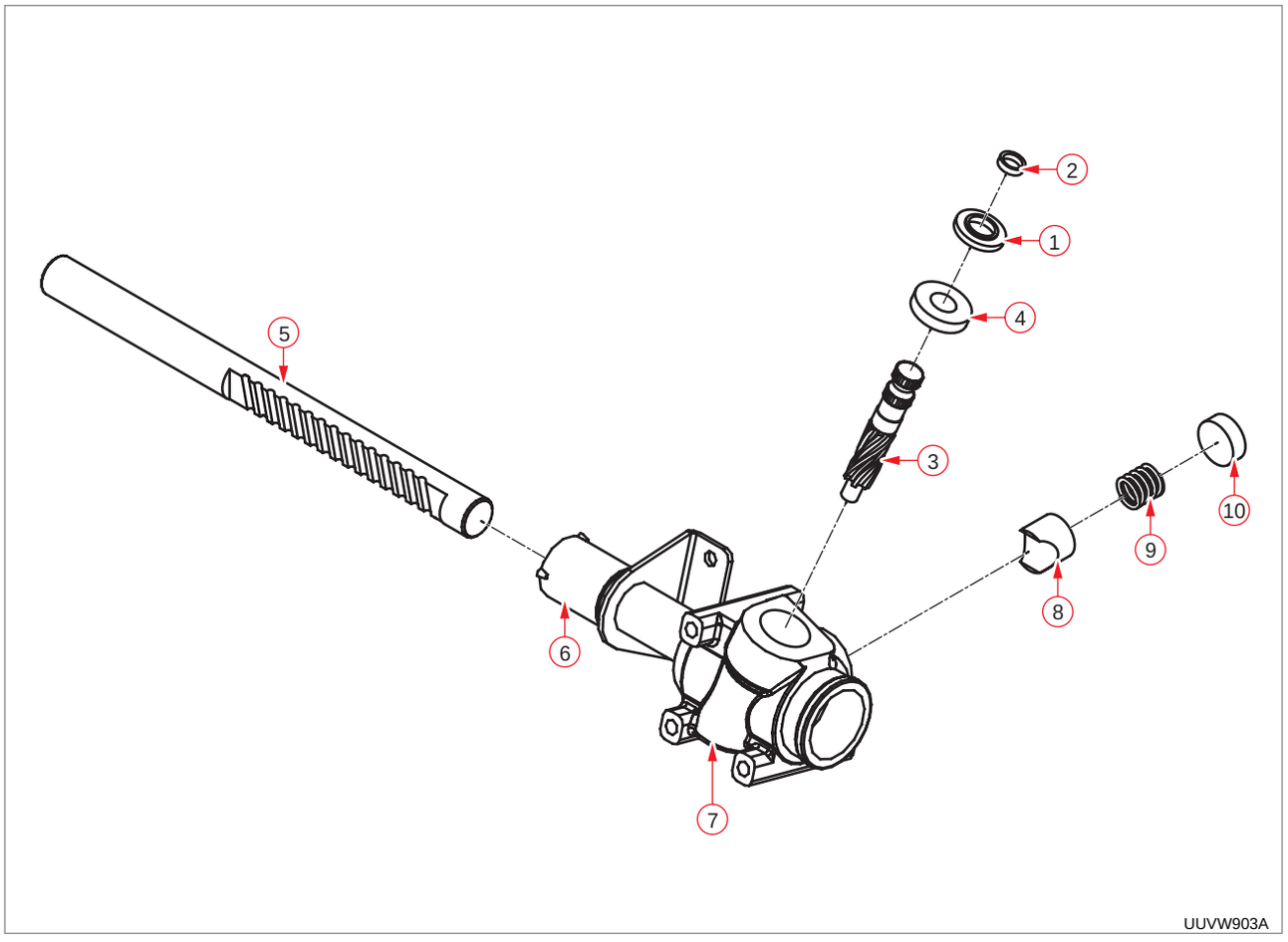


COMPONENTS

(1) PINION SHAFT
(2) RACK
(3) RACK SUPPORT
(4) SPRING
(5) PLUG
(6) GEARBOX BODY

In the steering gearbox, the pinion is engaged with the rack. When the pinion rotates, the rack moves to the side in a linear motion.

2.3 STEERING GEARBOX COMPONENTS



COMPONENTS

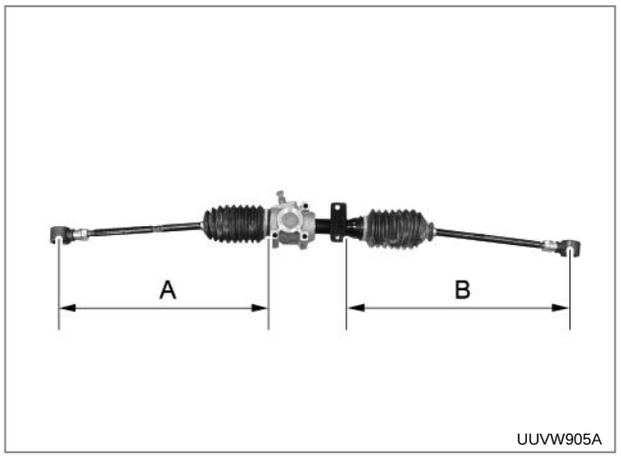
(1) PLUG
(2) OIL SEAL
(3) PINION SHAFT
(4) BALL BEARING
(5) RACK
(6) RACK GUIDE
(7) STEERING GEARBOX
(8) RACK SUPPORT
(9) SPRING
(10) PLUG

3. TROUBLESHOOTING

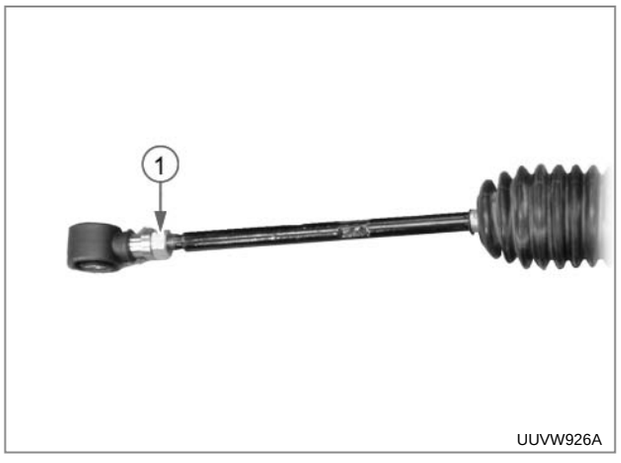
Symptom	Cause	Solution
Vehicle pulls to right or left	• Improper front tire size, inflation pressure or shape • Worn or damaged tie rod end • Improper toe-in	• Adjust the inflation pressure or replace the tires • Replace • Adjust
Excessive steering wheel reaction	• Worn or damaged tie rod end • Improper toe-in • Damaged front axle	• Replace • Adjust • Replace
Steering wheel vibrates	• Abnormally worn tire, abnormal size or low inflation pressure • Damaged gearbox bearing or gear	• Repair and replace • Replace
Abnormal noise	• Worn steering gearbox gear	• Replace

4. INSPECTION AND ADJUSTMENT

4.1 TIE-ROD LENGTH ADJUSTMENT



1. When installing the steering gearbox assembly to the vehicle, the tie-rod length A and B should be set correctly in advance.
   A : 381.8 mm (15.03 in.)
   B : 420.1 mm (16.54 in.)



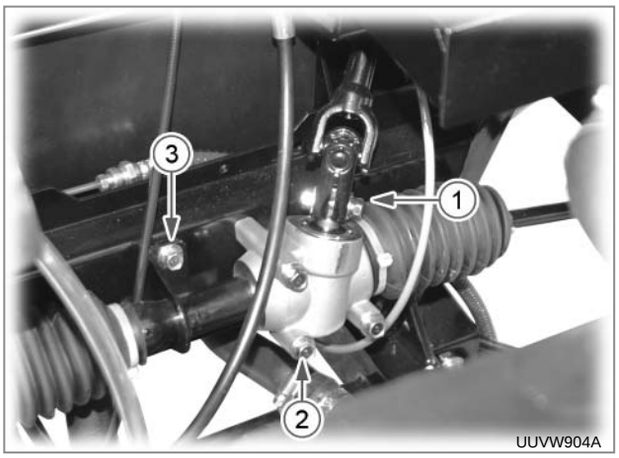
2. Unscrew the tie-rod end mounting nut (1), turn the tie-rod end to set its length correctly, and tighten the mounting nut firmly.

4.2 TOE-IN ADJUSTMENT

1. Adjust the toe-in so that the distance between the front of the front wheels is 2 ~ 8 mm (0.079 ~ 0.315 in.) shorter than the distance between the rear of the front wheels.
2. To adjust the distance, unscrew the tie-rod end mounting nut and turn the tie-rod end.
3. For detailed instructions, refer to "Toe-in adjustment" in chapter 9 "Front Axle."

5. DISASSEMBLY, SERVICE AND ASSEMBLY

5.1 STEERING GEARBOX REMOVAL



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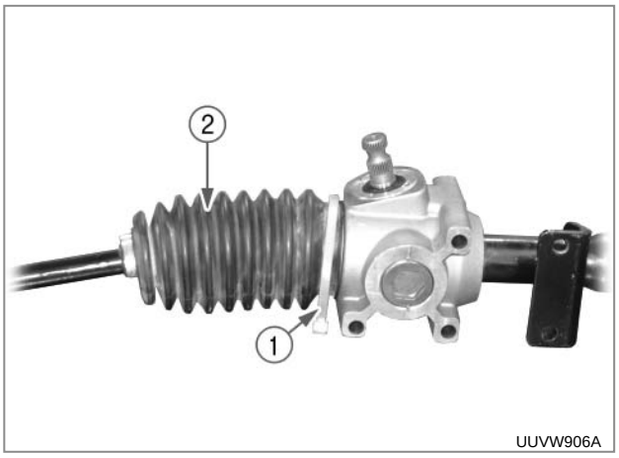
1. Unscrew the steering column mounting bolt (1) (M8, 1 EA). Then, unscrew the gearbox mounting bolts (2) (M8, 3 EA) and bracket mounting bolts (3) (M8, 2 EA) to remove the steering gearbox assembly. Make sure to maintain the tie-rod length to the specification during reassembly. (4. Refer to "Tie-rod length adjustment" in section "Inspection and adjustment.")

IMPORTANT

- **When installing the steering gearbox mounting bolt and bracket mounting bolt, apply LOCTITE #242 or equivalent to their threads and tighten them to the specified torque.**

M8 bolt
tightening torque..... 41.0 Nm
4.2 kgf-m
30.1 lb-ft



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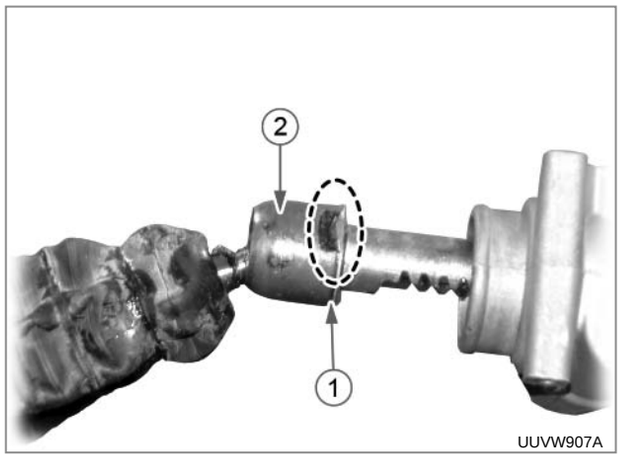
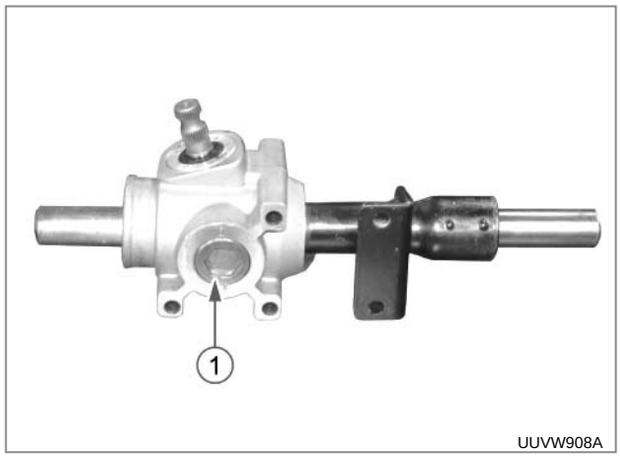
2. Undo the band (1) and remove the rubber boot bellows (2).



UUVW907A

3. Unfold the caulked part of the holder (1) and rotate the ball joint (2) to separate the left and right ball joint assemblies from the steering gearbox.



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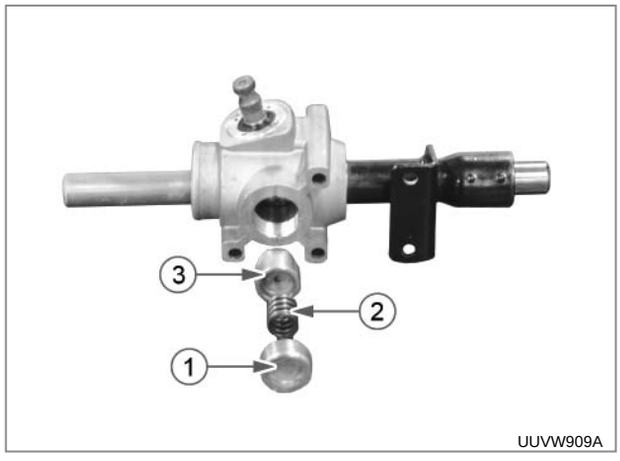
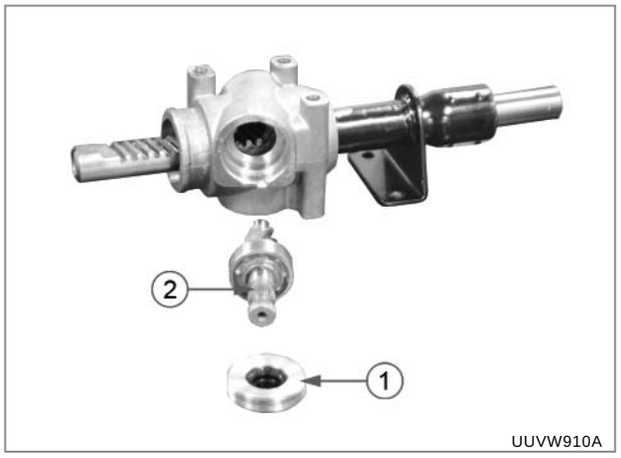
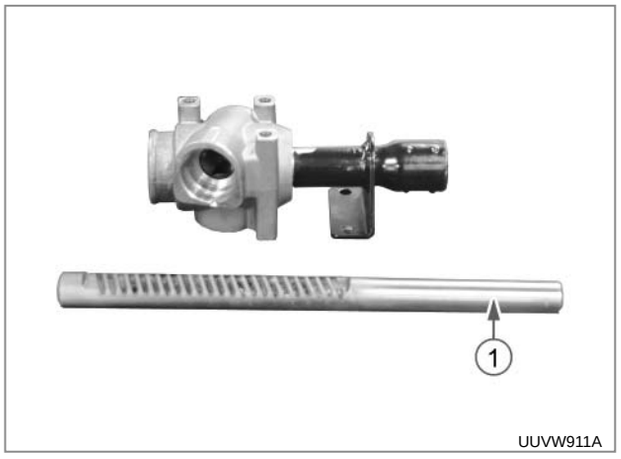


UUVW909A

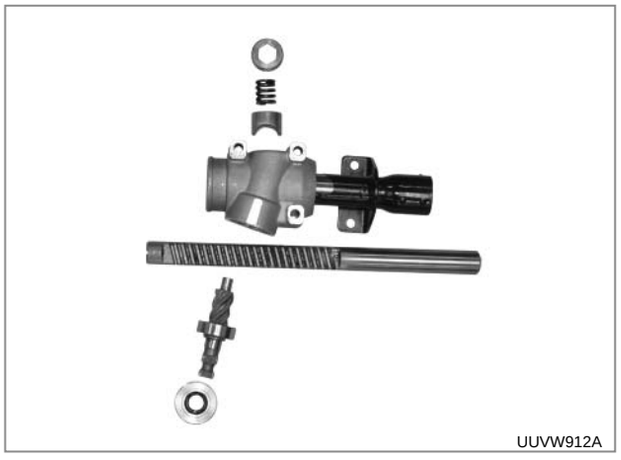
4. Unscrew the hexagon bolt (1) on the bottom using the 17 mm hex. wrench and remove the spring (2) and shaft guide (3).



5. Remove the cap (1) and pull out the pinion shaft (2).



6. Remove the rack (1) by pulling it to the side.

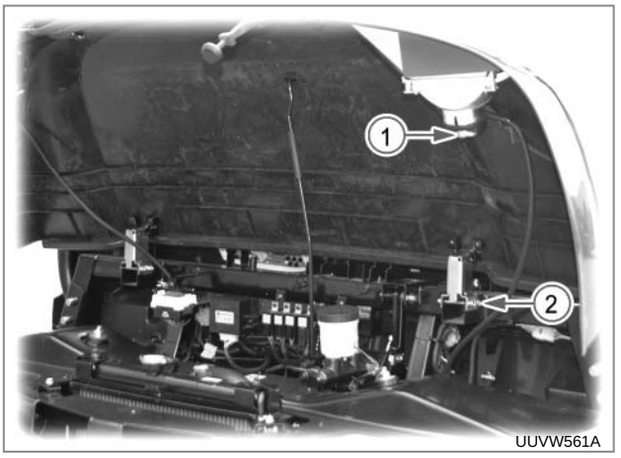


7. Assemble in the reverse order of disassembly.

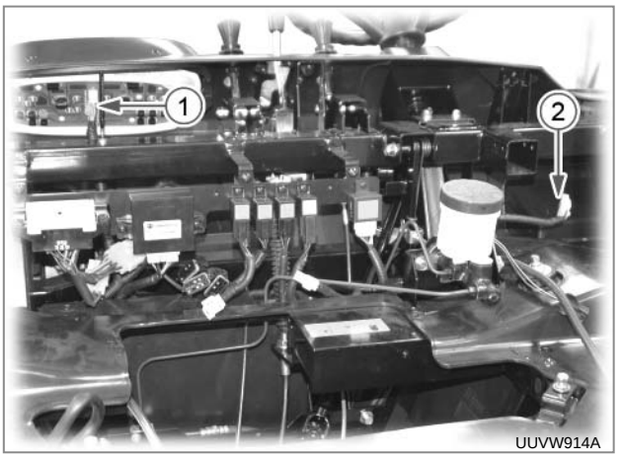
REMARK

- **When removing the cap, be careful not to damage the oil seal. If a new oil seal is to be fitted, apply grease to its mating surface.**
- **During assembly, apply grease to the engaging sections of the gears and in the case sufficiently.**

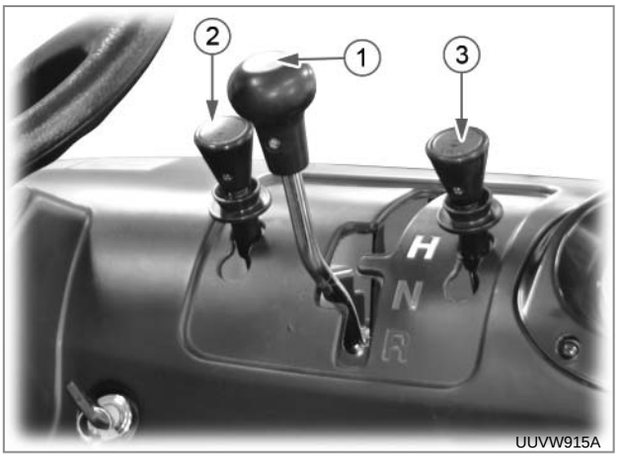
5.2 STEERING COLUMN REMOVAL AND INSTALLATION



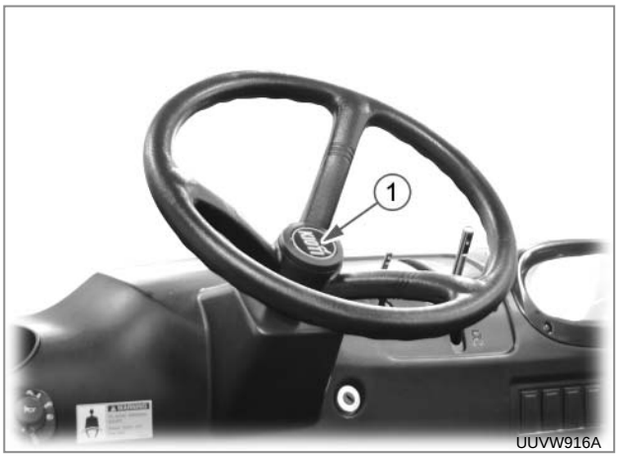
1. Open and support the hood, disconnect the headlamp connector (1) and unscrew the ratchet mounting bolts (2) (M8, 4 EA) to remove the hood.



2. Disconnect the connectors for the instrument cluster (1), power supply, ignition switch and combination switch (2).



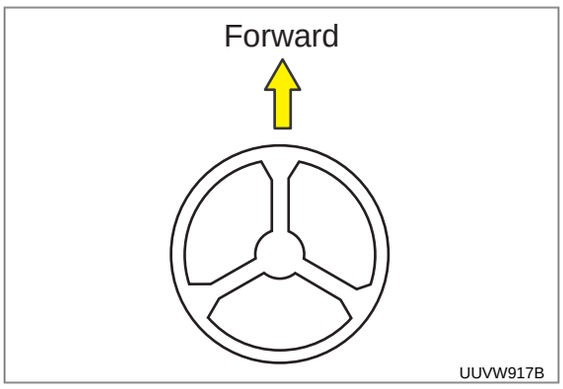
3. Unscrew the screws for the selective shift lever (1), differential lock lever (2) and front wheel drive lever (3) and remove their grips.



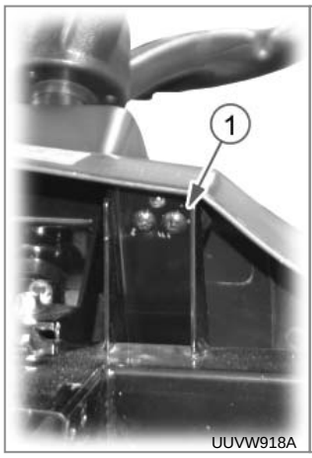
4. Remove the steering wheel cap (1) and unscrew the wheel mounting nut (M12, 1 EA) using the 17 mm socket wrench to remove the steering wheel.

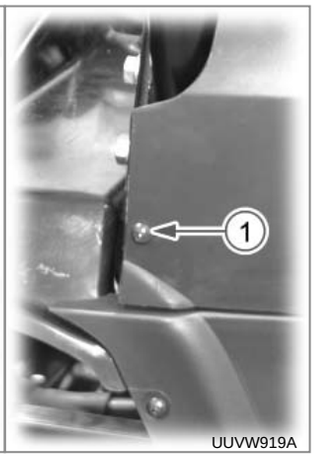
Mounting nut
tightening torque ..... 48.0 ~ 55.9 Nm
4.9 ~5.7 kgf-m
35.3 ~ 41.2 lb·ft

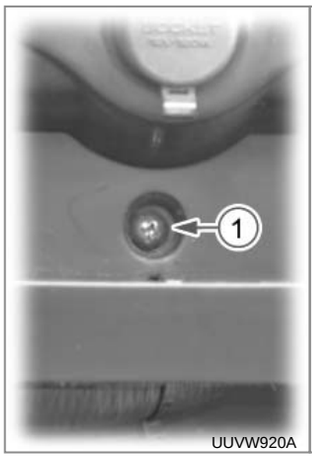
REMARK



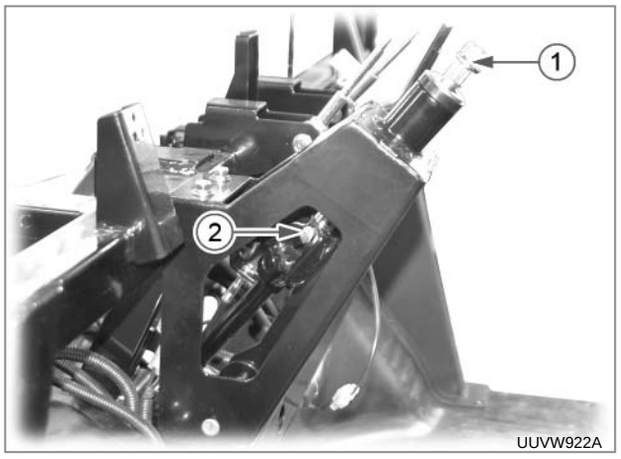
- **When installing the steering wheel, set the front wheel in the straight forward direction and fit the steering wheel in the straight ahead direction as shown in the figure.**

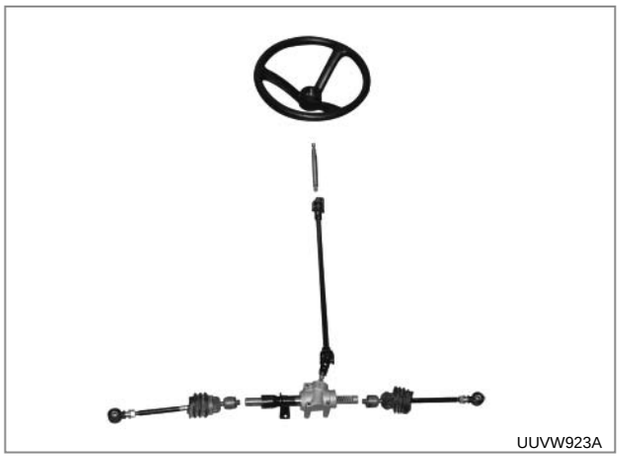




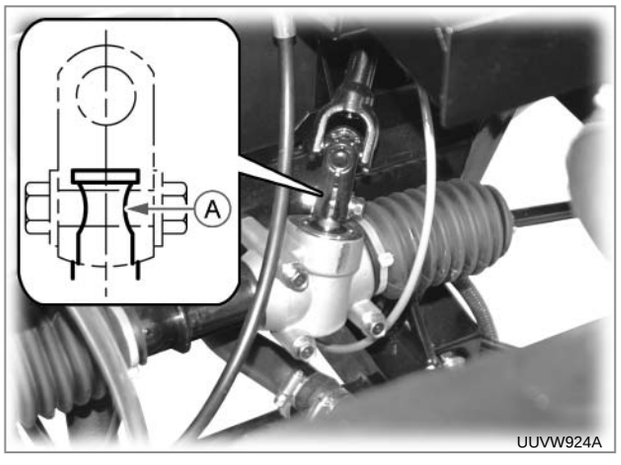


5. Unscrew the panel mounting screws (1) (M8, 8 EA) to remove the panel. (Screws - under hood: 2 EA (LH)/ 2 EA (RH), side of body: 1 EA (LH)/1 EA (RH), center of panel: 1 EA, in console box: 1 EA)





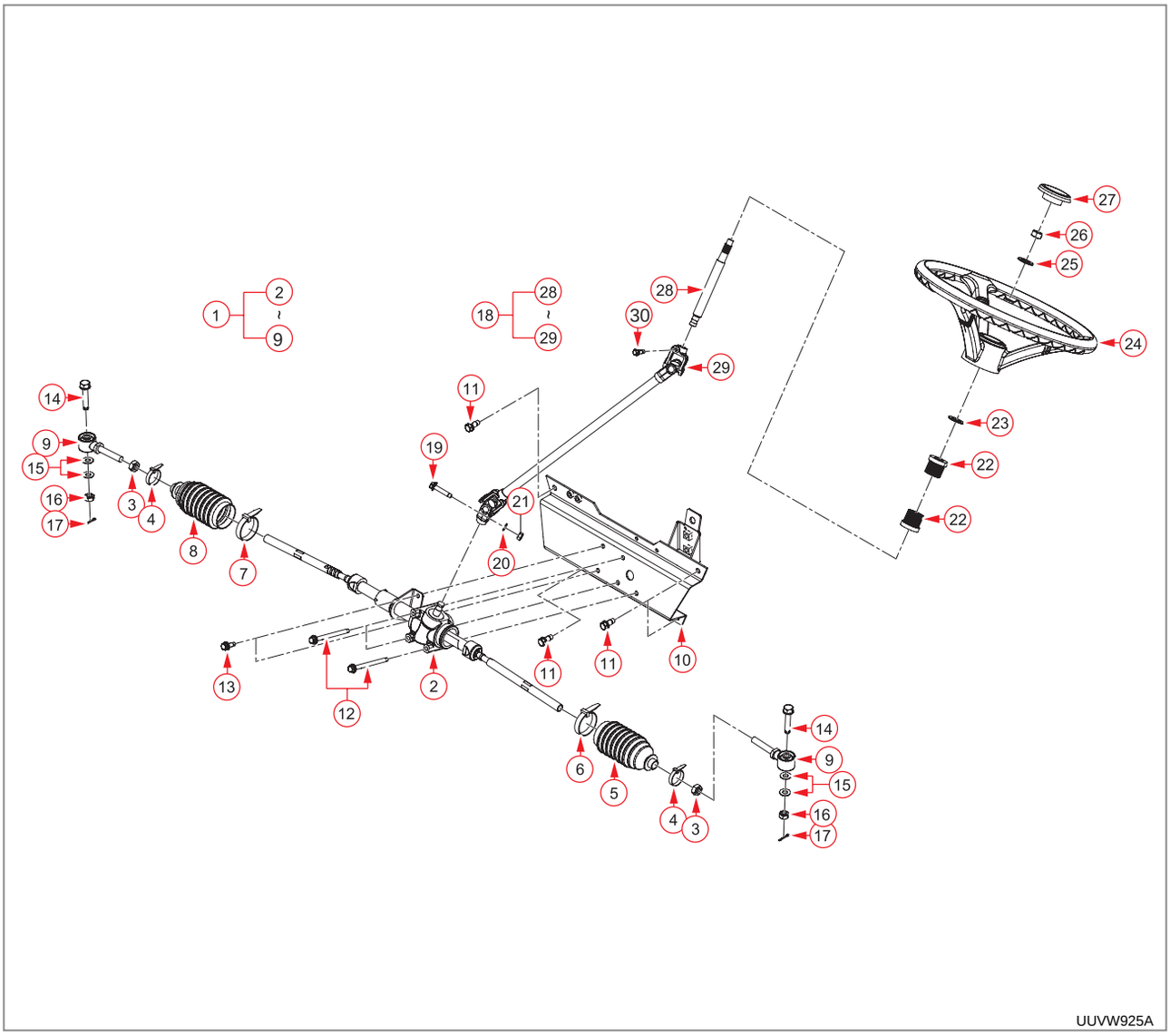
6. Remove the steering column assembly by tapping the steering shaft (1) downward. Then, unscrew the steering column mounting bolt (2) (M8, 1 EA) with the 13 mm spanner to remove the steering column.
7. Install in the reverse order of removal.



8. When installing the steering column, the bolt should be on the groove (A) of the steering gear.

6. COMPONENTS

6.1 U250A STEERING



COMPONENTS

(1) STEERING GEAR BOX ASSY
(2) GEAR BOX, STEERING
(3) NUT
(4) CLIP, A
(5) BOOT LH
(6) CLIP, B
(7) CLIP, C
(8) BOOT RH
(9) TIE ROD ASSY
(10) BRKT, STEERING UNIT
(11) BOLT
(12) BOLT
(13) WASHER BOLT
(14) BOLT
(15) WASHER, PLAIN
(16) NUT, CASTLE
(17) PIN, SPLIT
(18) COLUMN SHAFT ASSY
(19) BOLT
(20) WASHER, PLAIN
(21) NUT
(22) RUBBER, CUSHION
(23) WASHER
(24) HANDLE
(25) WASHER, SPRING
(26) NUT
(27) CAP, HANDLE
(28) SHAFT, HANDLE
(29) SHAFT, STEERING GEAR BOX
(30) BOLT

HYDRAULIC SYSTEM CHAPTER 11

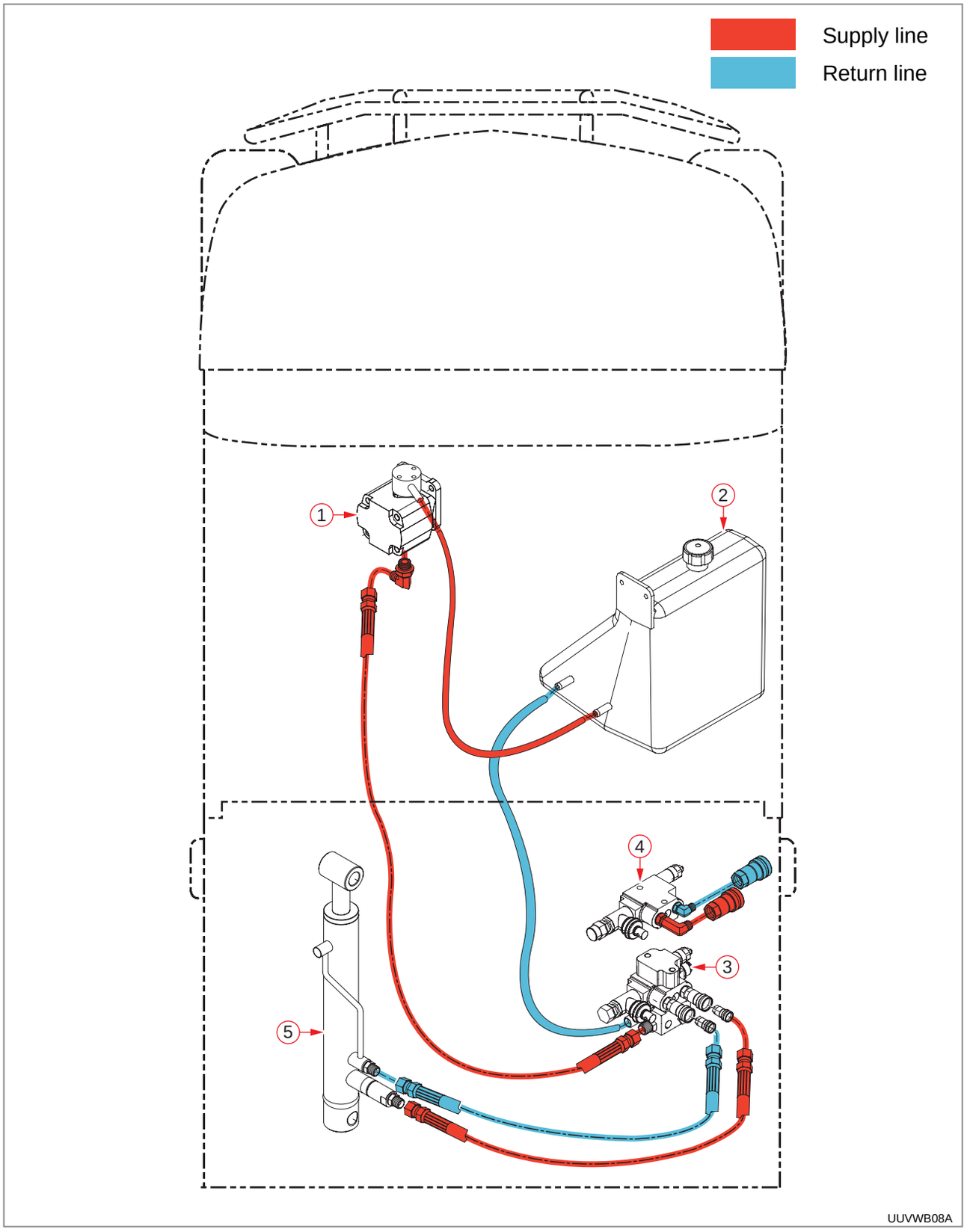
TABLE OF CONTENTS

1. SPECIFICATIONS

Item	Specifications	Remarks
Operating oil	Daedong UTF55 Exxon Mobilfluid 423 or 424 BP Tractran UTH Shell DONAX-TD	
Oil tank capacity	15.0 ℓ (3.96 u.s.gal.)	
Gear pump capacity Gear pump discharge flow Maximum pressure Rotating direction	22.5 ℓ/min (5.94 u.s.gal./min) 10 cc/rev 210 kgf/cm^2 (20.58 MPa, 2,986 psi) Counterclockwise	
Dumping cylinder	Single rod, double acting type Cylinder outside diameter Φ 50mm (1.968 in.) Cylinder inside diameter Φ 40mm (1.575 in.) Rod outside diameter Φ 25mm (0.984 in.) Stroke 195mm (7.677 in.) Front block port PF3/8 Nipple PF1/4	
Relief valve pressure	155 ~ 160 kgf/cm^2 15.19 ~ 15.68 MPa 2,204 ~ 2,275 psi	
External hydraulic port specification	1 valve (2 ports: flat face, self- sealing, 1-1/4)	
Dumping valve Valve mounting bolt tightening torque	Port PF3/8 24.5 ~ 27.4 Nm 2.5 ~ 2.8 kgf-m 18.0 ~ 20.2 lb-ft	

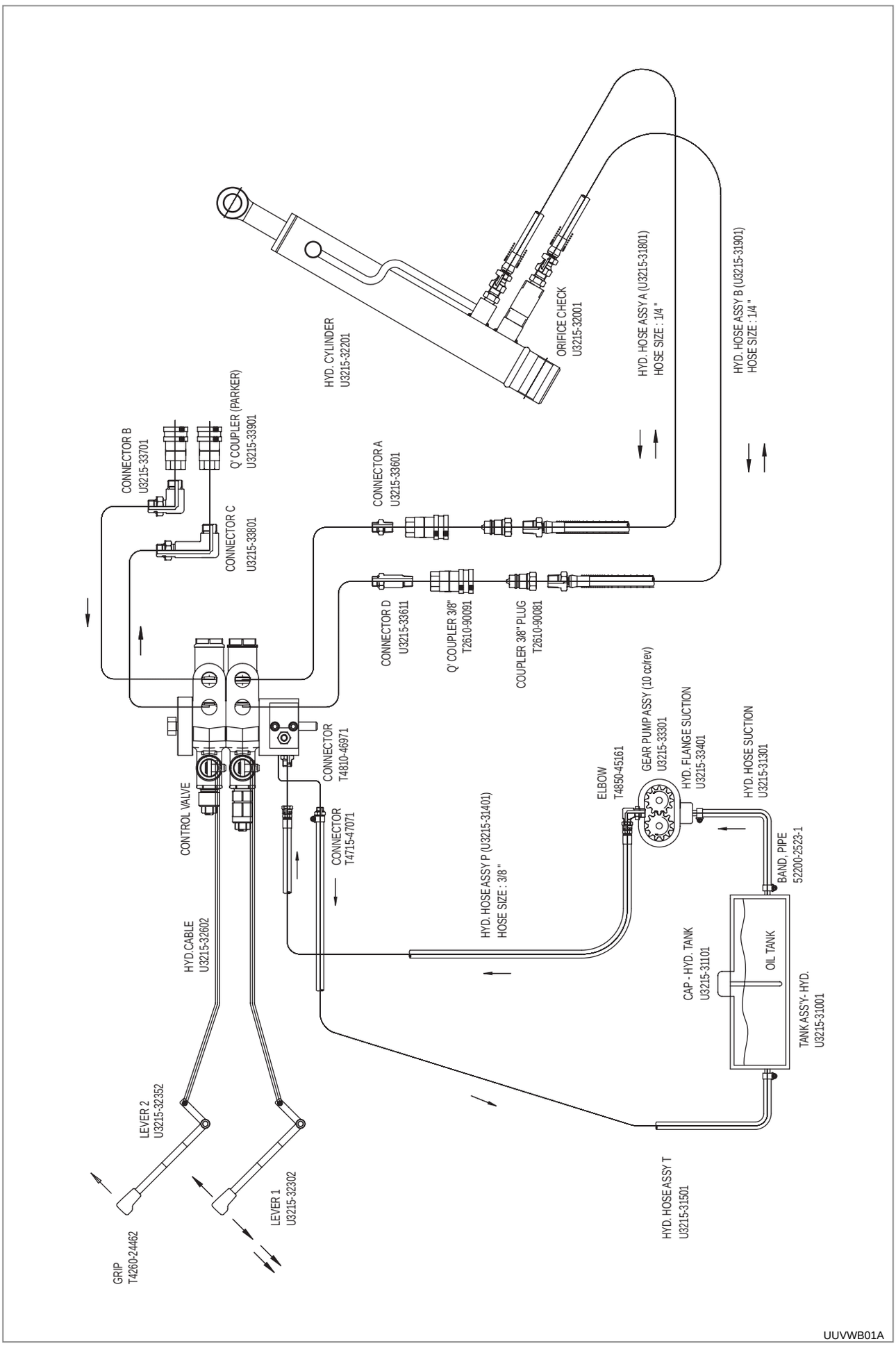
2. OPERATING PRINCIPLE

2.1 HYDRAULIC COMPONENT LAYOUT

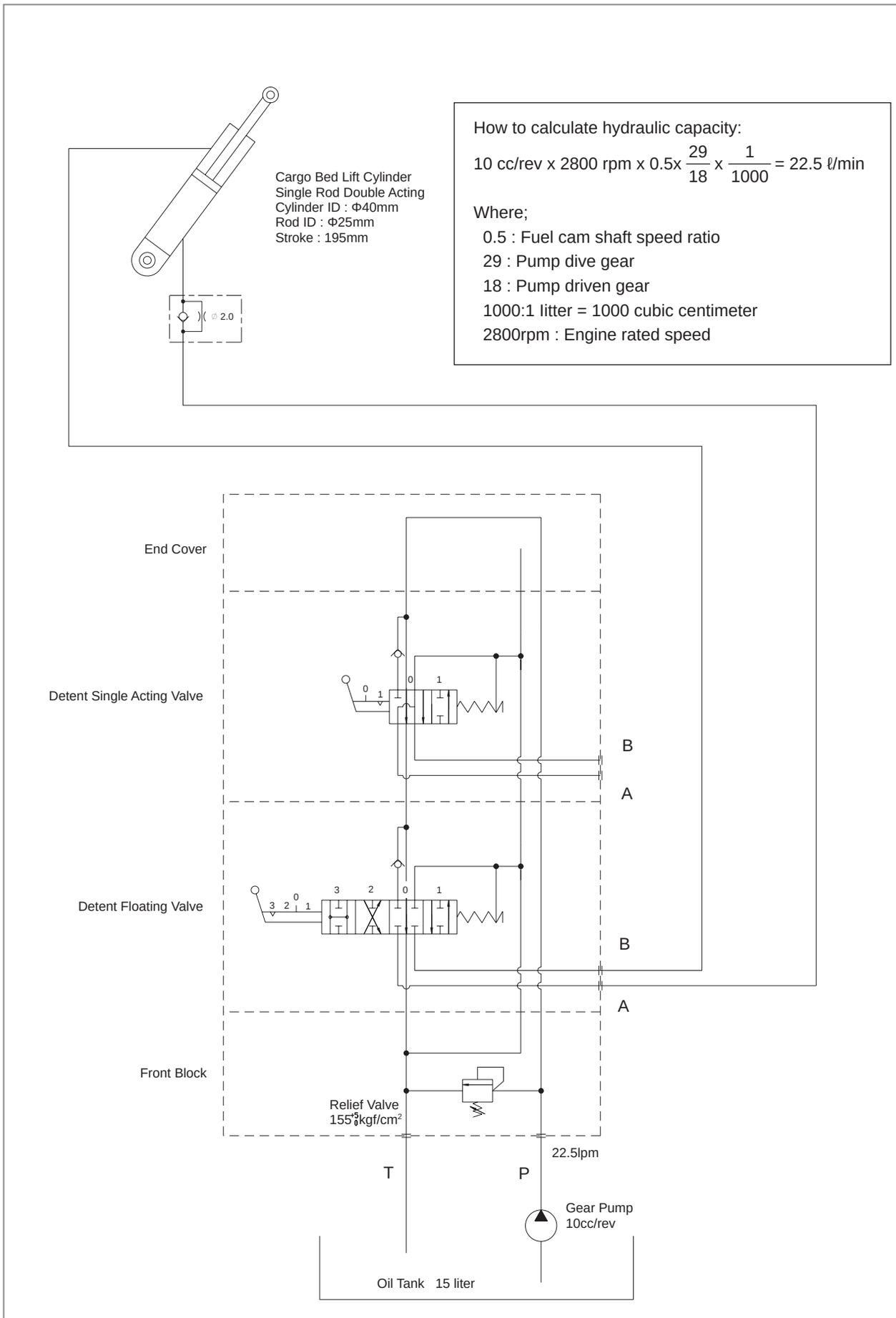


COMPONENTS

(1) GEAR PUMP
(2) OIL TANK
(3) DUMPING VALVE
(4) AUXILIARY HYDRAULIC VALVE
(5) DUMPING CYLINDER


HYD. CYLINDER
U3215-32201
ORIFICE CHECK
U3215-32001
HYD. HOSE ASSY A (U3215-31801)
HOSE SIZE : 1/4 "
HYD. HOSE ASSY B (U3215-31901)
HOSE SIZE : 1/4 "
CONNECTOR B
U3215-33701
Q' COUPLER (PARKER)
U3215-33901
CONNECTOR C
U3215-33801
CONNECTOR A
U3215-33601
CONNECTOR D
U3215-33611
Q' COUPLER 3/8"
T2610-90091
COUPLER 3/8" PLUG
T2610-90081
CONTROL VALVE
CONNECTOR
T4810-46971
CONNECTOR
T4715-47071
ELBOW
T4850-45161
GEAR PUMP ASSY (10 cc/rev)
U3215-33301
HYD. FLANGE SUCTION
U3215-33401
HYD. HOSE SUCTION
U3215-31301
HYD. HOSE ASSY P (U3215-31401)
HOSE SIZE : 3/8 "
BAND, PIPE
52200-2523-1
HYD.CABLE
U3215-32602
CAP - HYD. TANK
U3215-31101
OIL TANK
TANK ASS'Y- HYD.
U3215-31001
LEVER 2
U3215-32352
LEVER 1
U3215-32302
GRIP
T4260-24462
HYD. HOSE ASSY T
U3215-31501
UUVWB01A

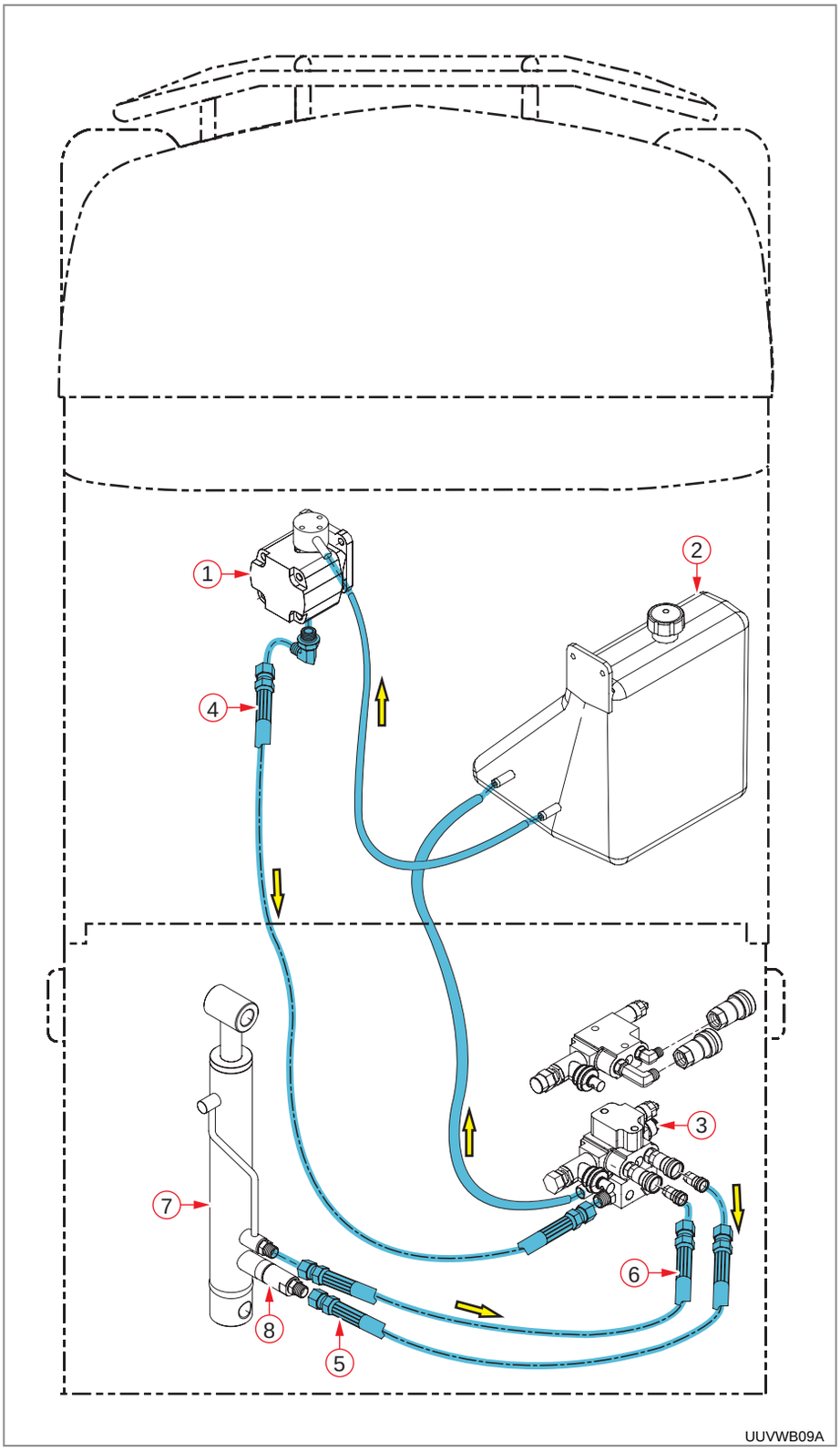
2.2 HYDRAULIC CIRCUIT



2.3 HYDRAULIC LINE

2.3.1 DUMPING OPERATION

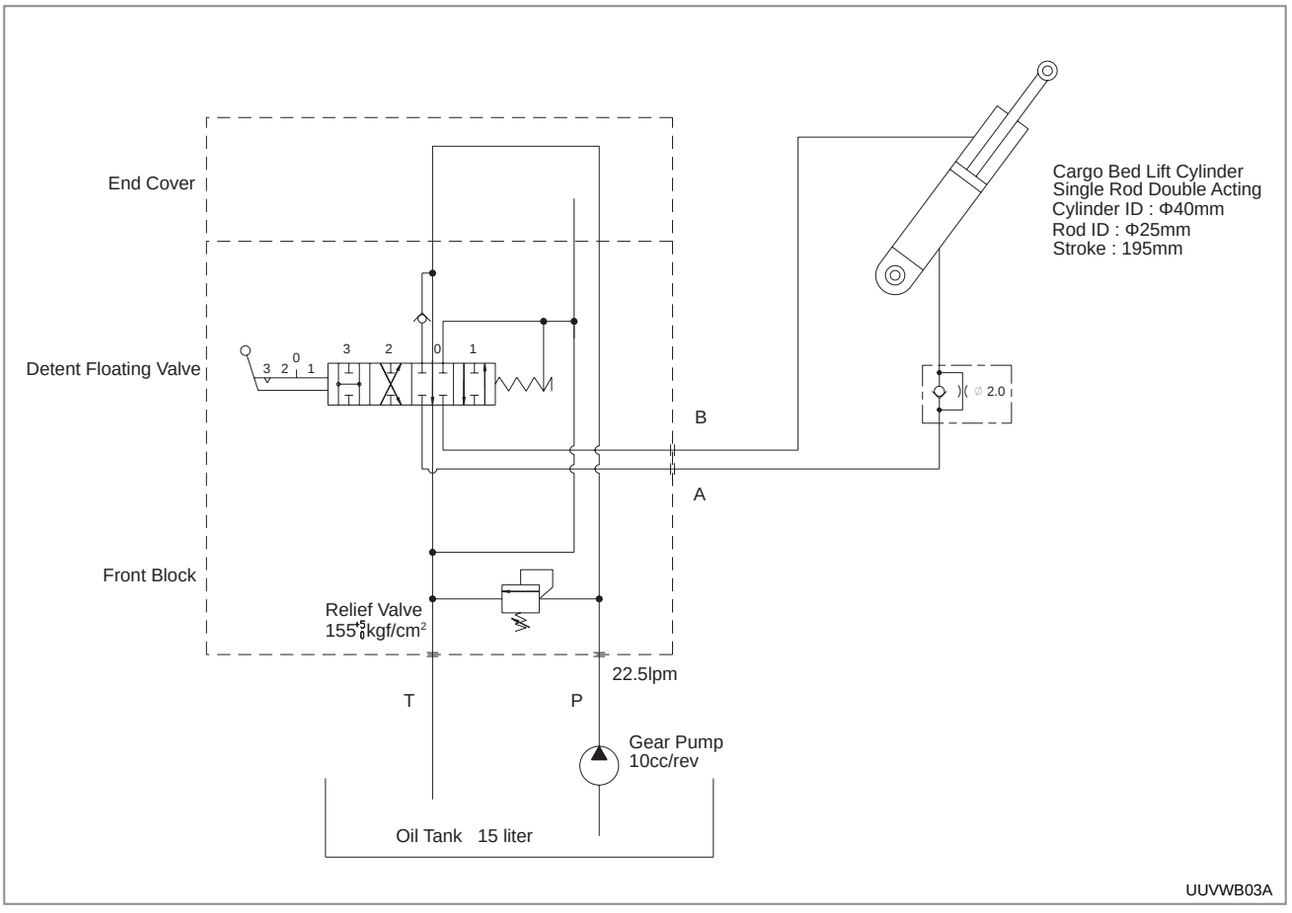
HYDRAULIC OIL FLOW DIAGRAM



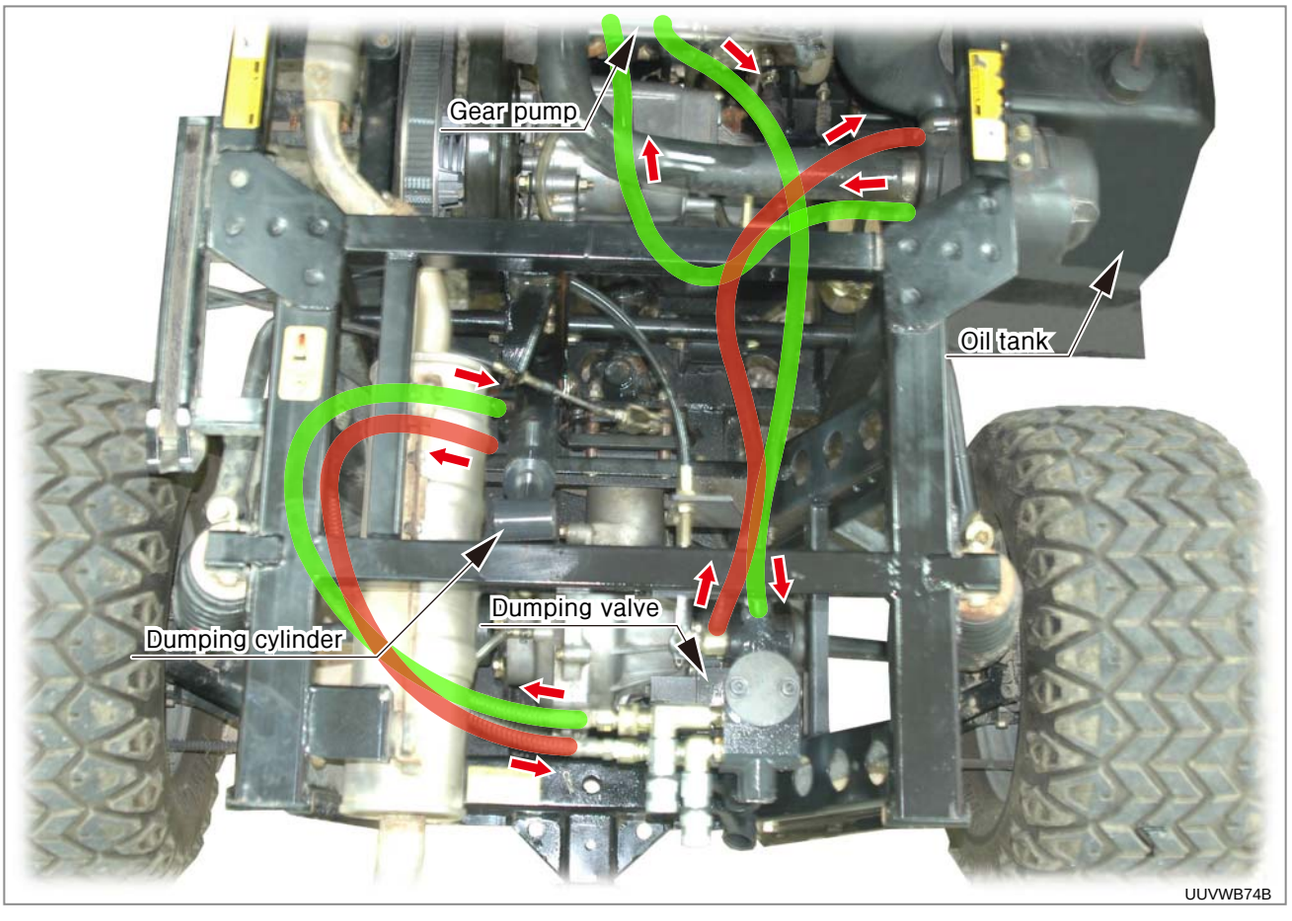
(1) GEAR PUMP
(2) OIL TANK
(3) DUMPING VALVE (TO DUMP)
(4) HYDRAULIC HOSE P
(5) HYDRAULIC HOSE B (WHITE TAG)
(6) HYDRAULIC HOSE A (YELLOW TAG)
(7) DUMPING CYLINDER
(8) ORIFICE & CHECK VALVE

- As the gear pump (1) pushes out the hydraulic oil, the hydraulic oil flows to the front block under the dumping valve (3). Then, it passes through the dumping valve and auxiliary hydraulic valve (if equipped) and then flows to the end cover on the upper section. If the spool of the dumping valve or auxiliary hydraulic valve is in the neutral state, the oil, flowed into the valve from the end cover, returns to the oil tank passing through the carry-over line of the valve and the front block. The front block is equipped with the relief valve which opens when the oil pressure rises over 155 kgf/cm² due to its overload in order to protect the system.

CIRCUIT



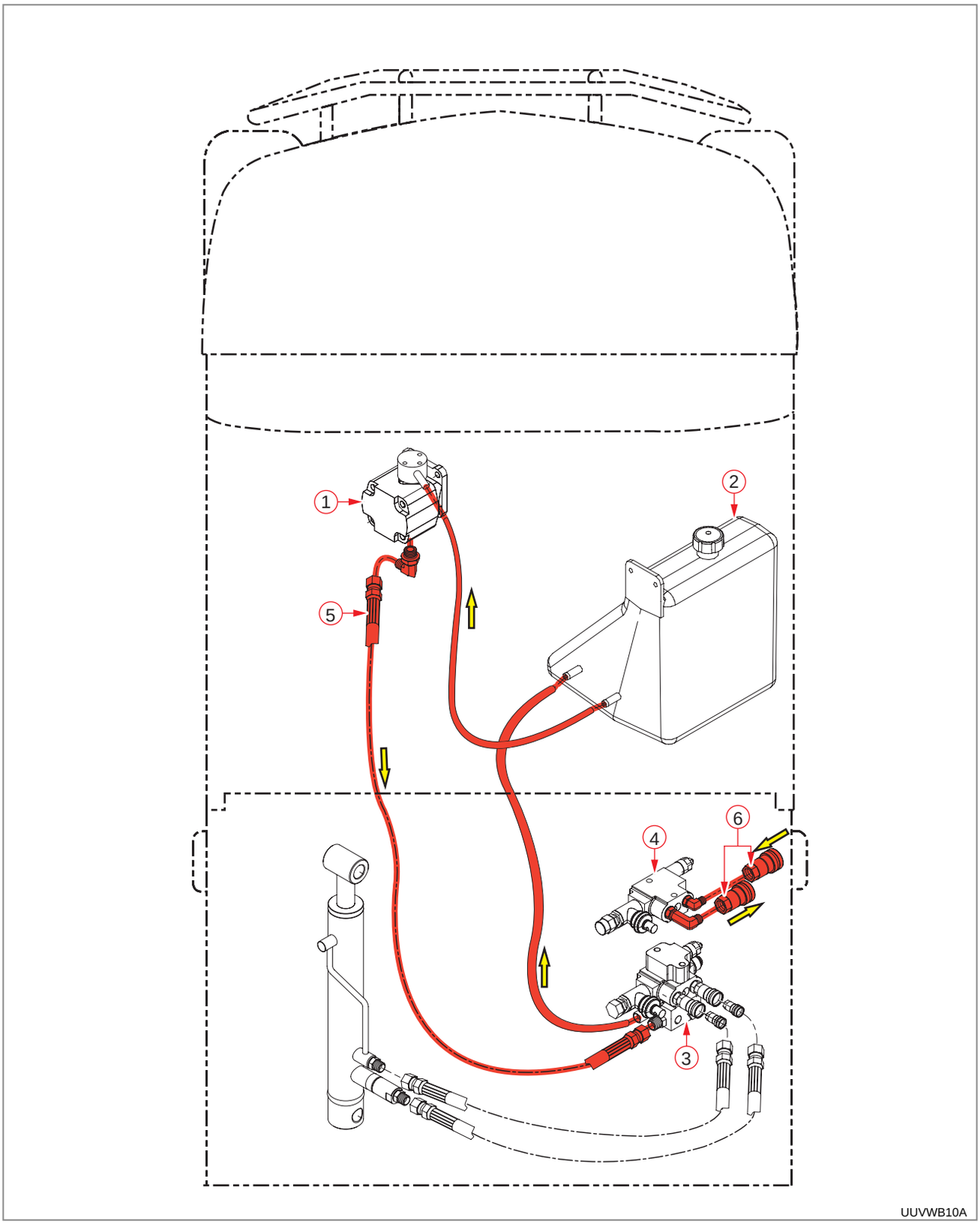
UUVWB03A



UUVWB74B

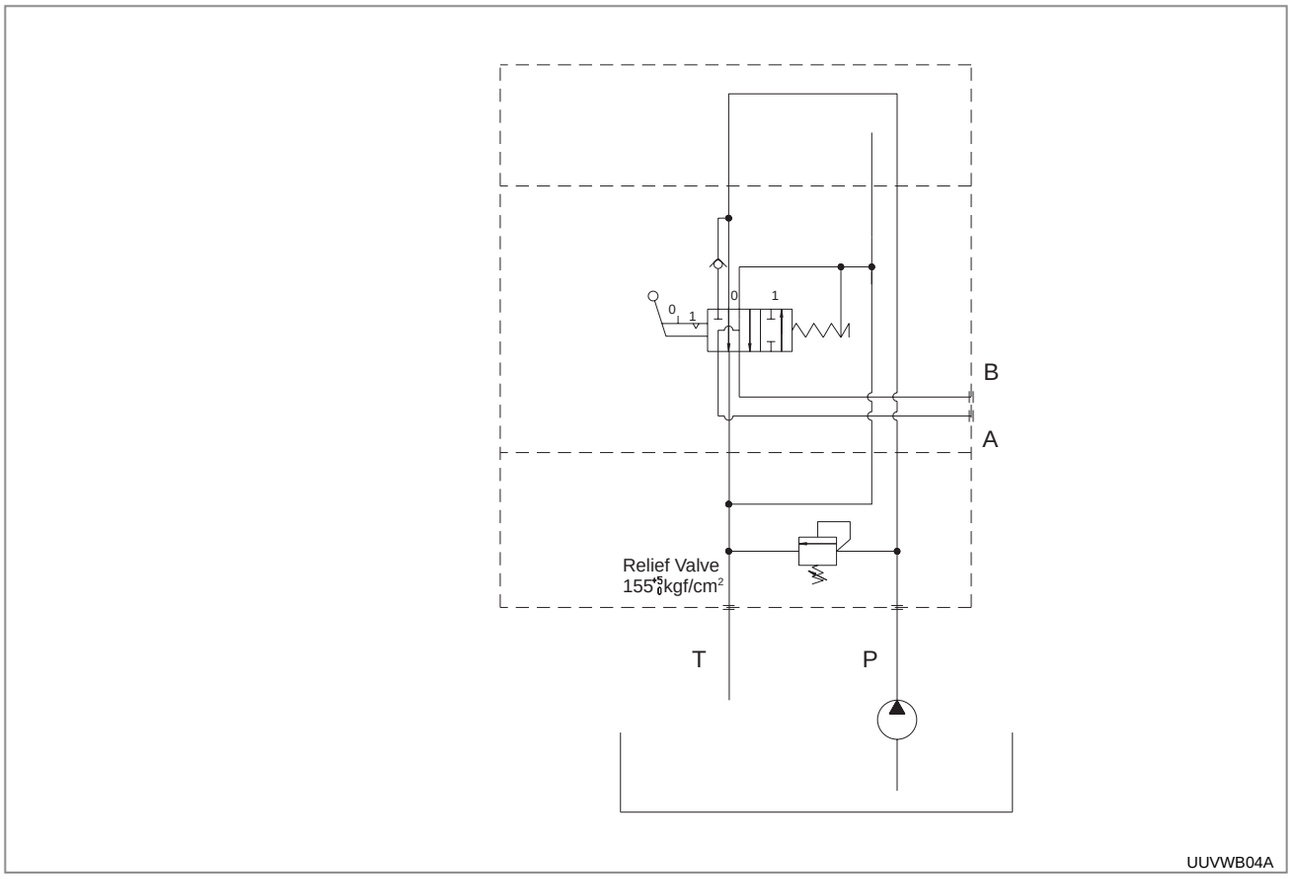
2.3.2 EXTERNAL HYDRAULIC OIL OPERATION

HYDRAULIC OIL FLOW DIAGRAM



(1) GEAR PUMP
(2) OIL TANK
(3) FRONT BLOCK ASSEMBLY
(4) AUXILIARY HYDRAULIC VALVE
(5) HYDRAULIC HOSE P
(6) QUICK COUPLER (PARKER)

CIRCUIT



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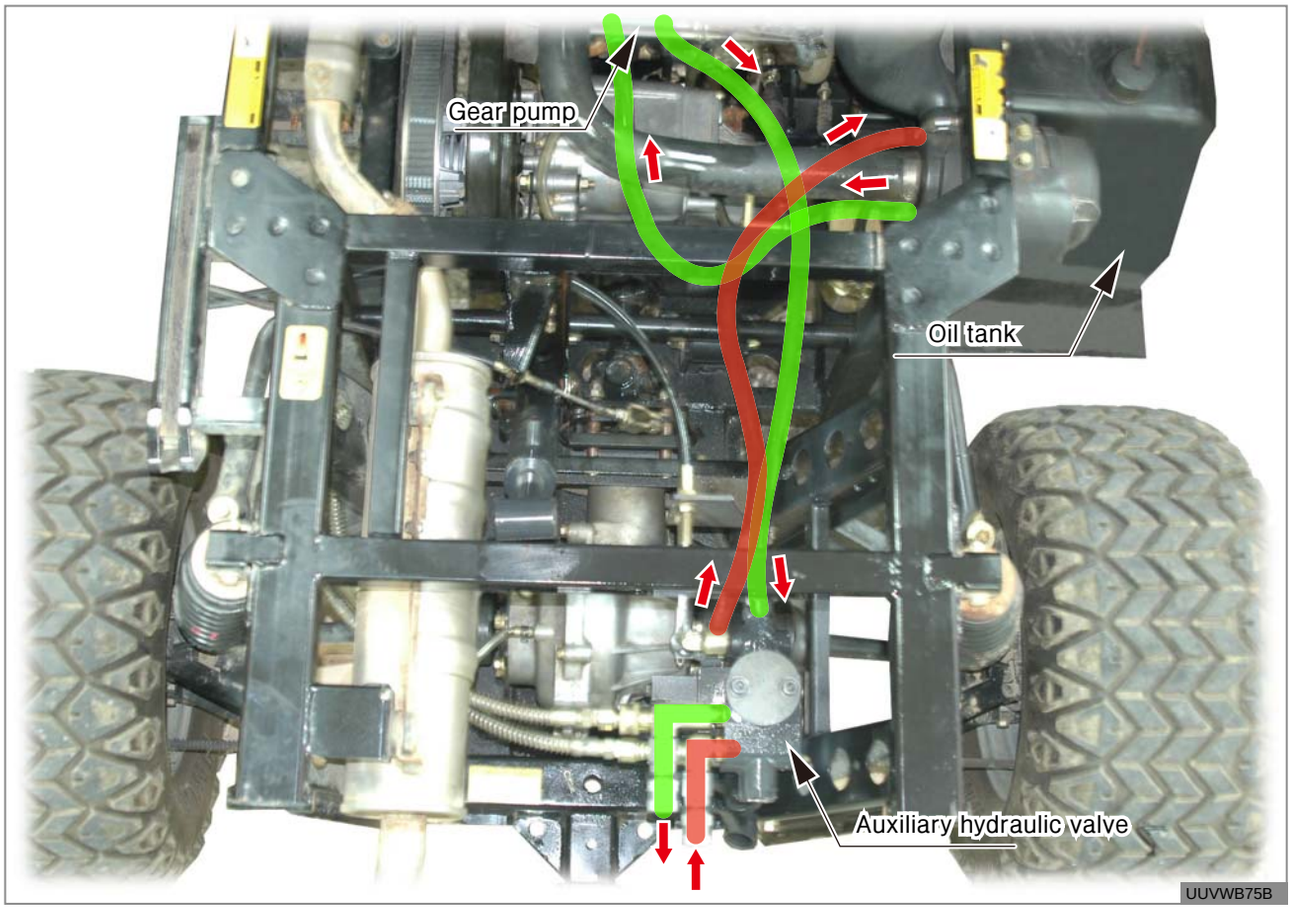
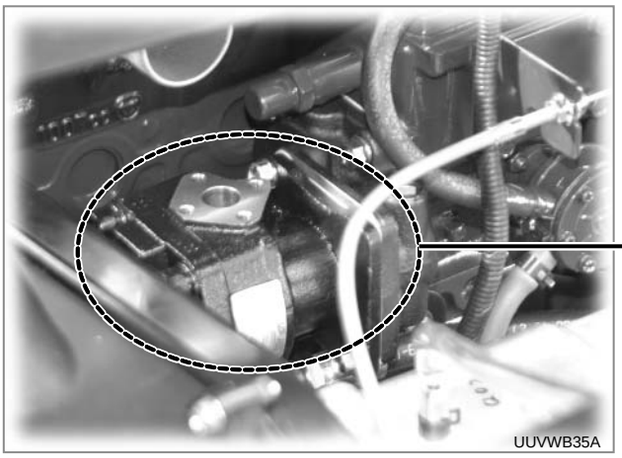


UUVWB75B

2.4 GEAR PUMP

MOUNTING LOCATION AND STRUCTURE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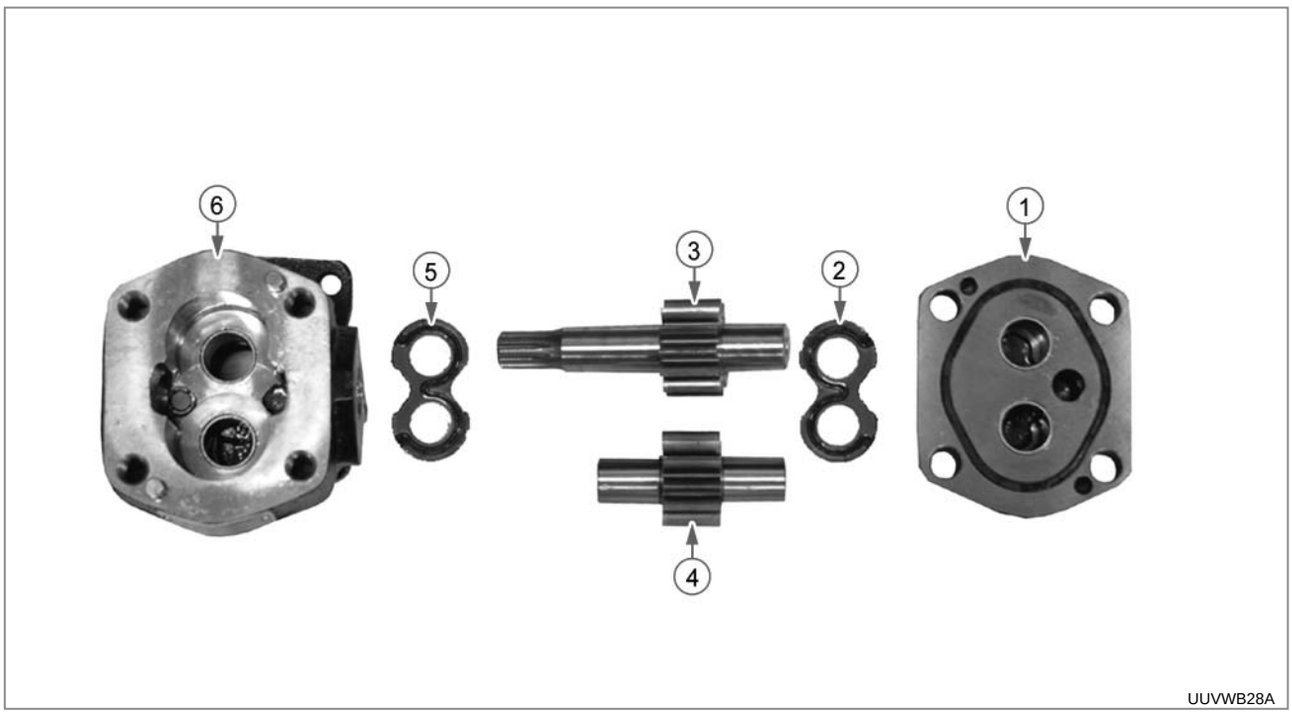
UUVWB36A



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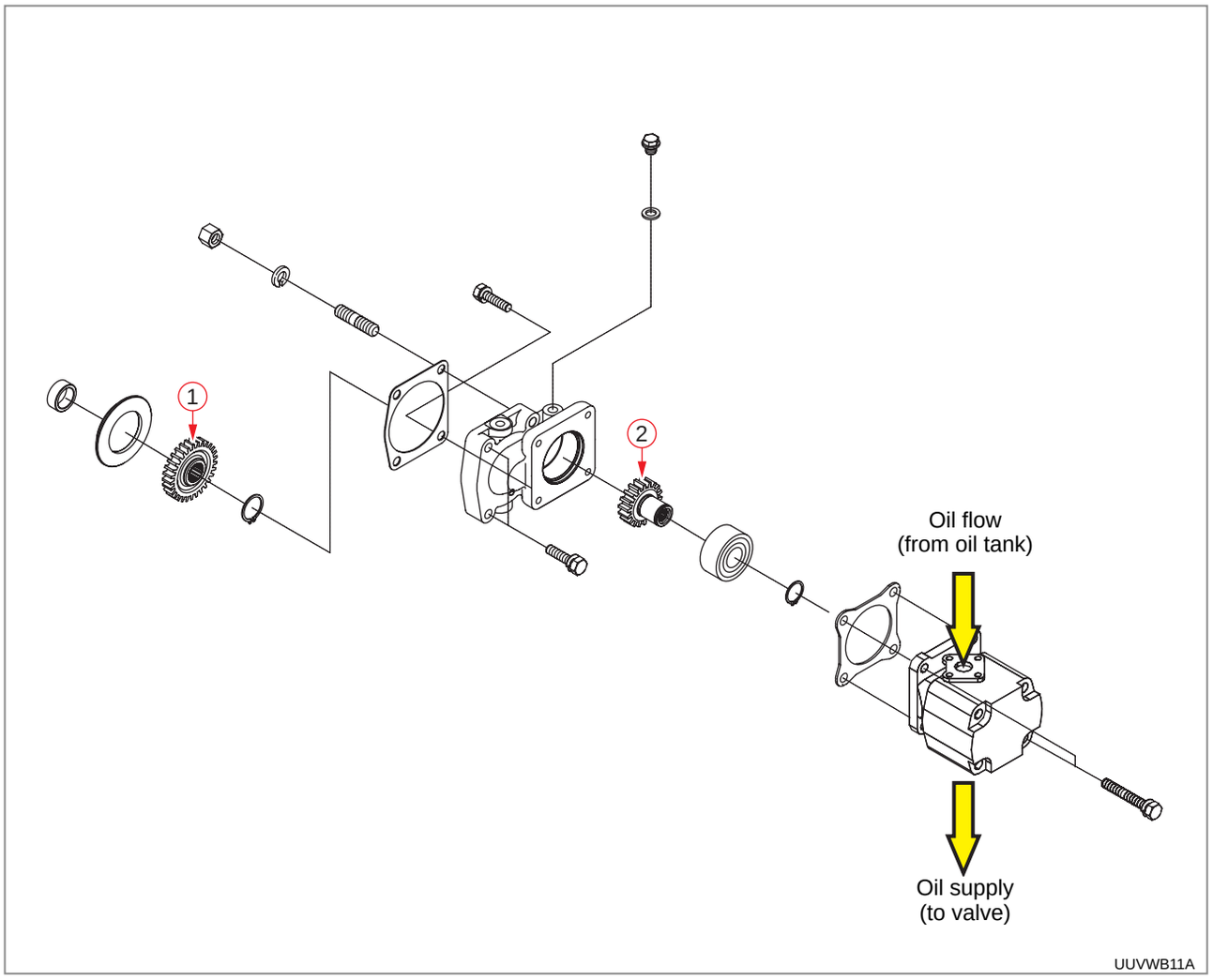
(1) REAR COVER
(2) SEAL BLOCK
(3) DRIVE GEAR SHAFT
(4) DRIVEN GEAR
(5) SEAL BLOCK
(6) CASE



- The hydraulic pump is driven by the fuel camshaft in the engine. The fuel camshaft rotates at half speed of the engine. However, the rotating speed is increased by the 29 gear (1) and 18 gear (2) to drive the hydraulic pump.

  Engine 2800rpm

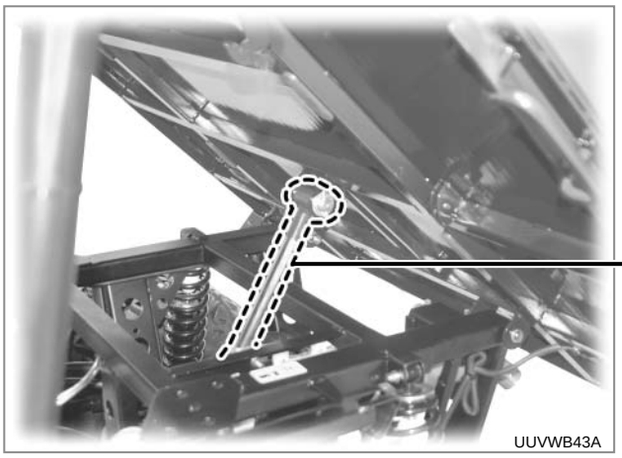
  Engine and gear pump speed ratio 1: 0.805

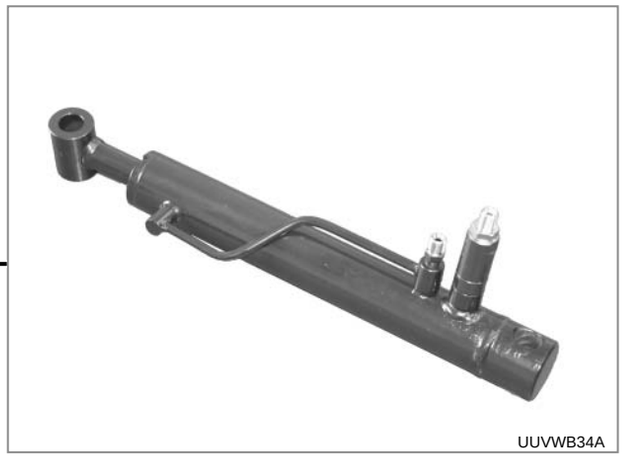
  2800 x 1/2 x 29/18 = 2255 rpm

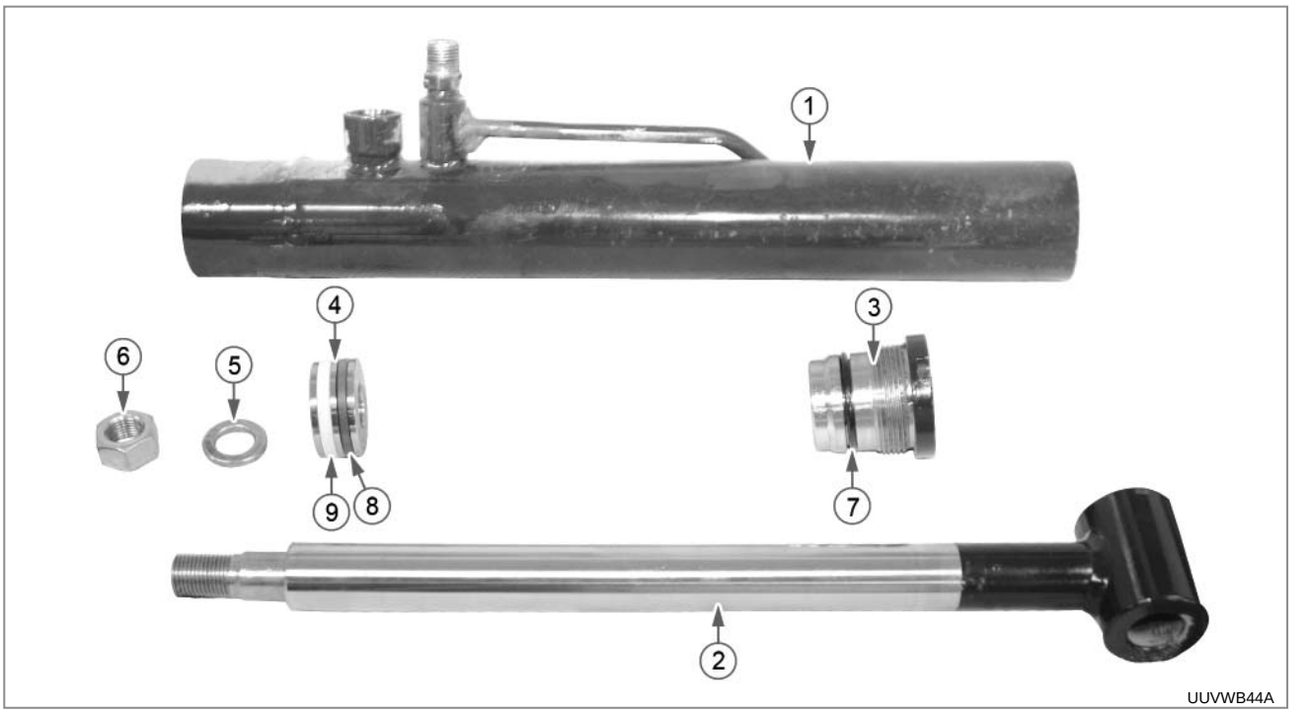
- The hydraulic pump is always driven as long as the engine is running to draw the oil from the oil tank through its top and supply it to the valve through its bottom port.

2.5 DUMPING CYLINDER

MOUNTING LOCATION AND STRUCTURE


UUVWB43A

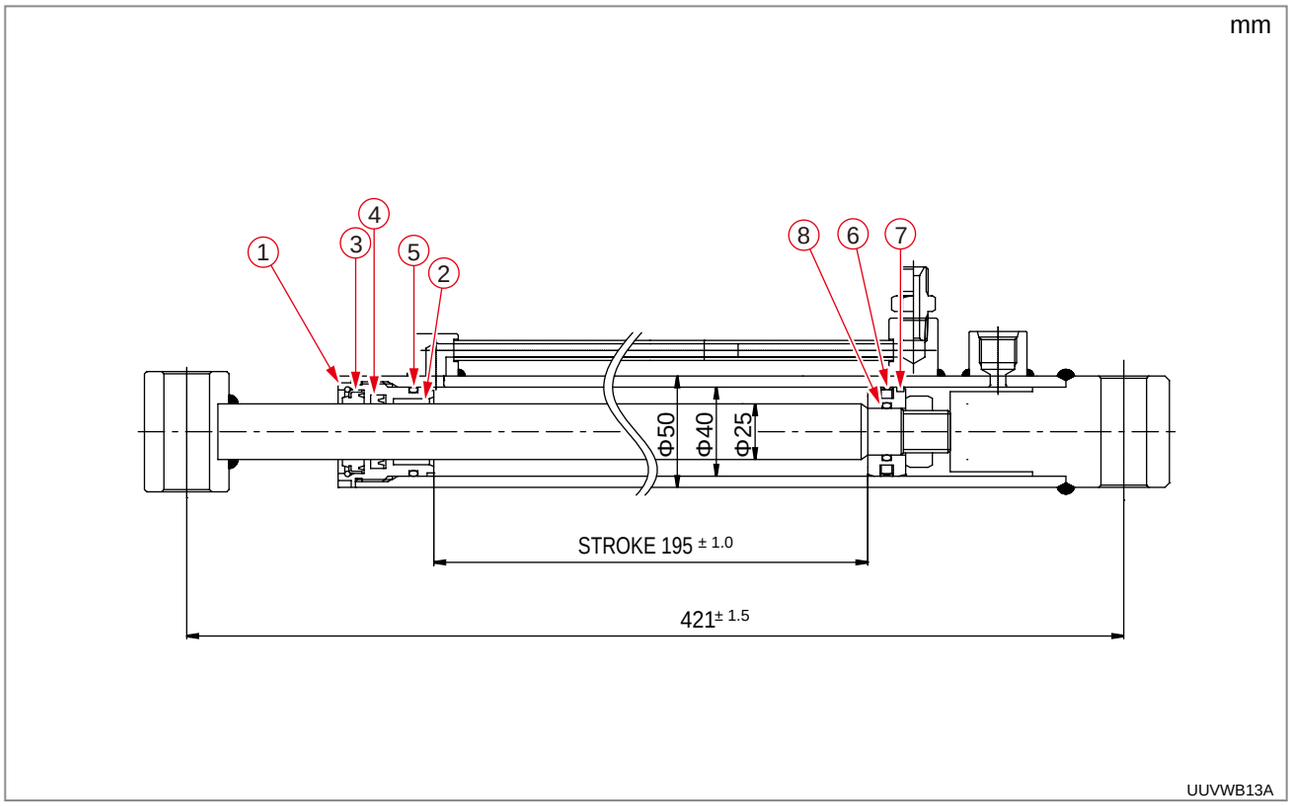

UUVWB34A



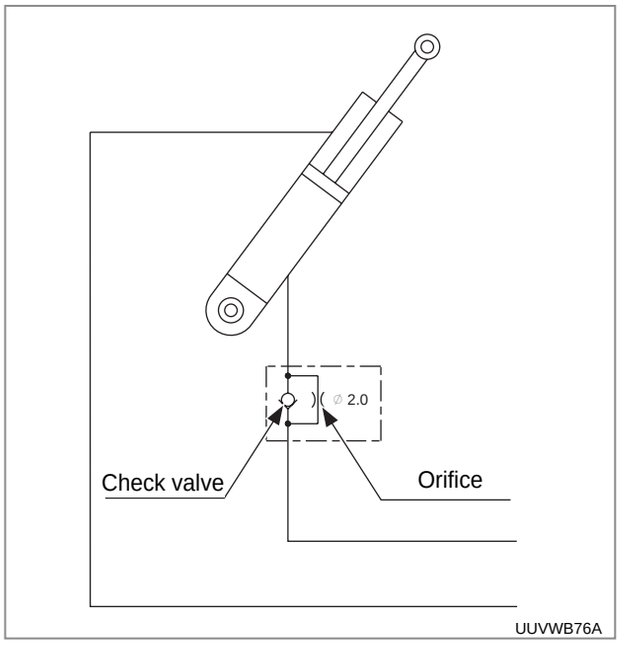
UUVWB44A

(1) TUBE
(2) ROD
(3) HEAD COVER
(4) PISTON
(5) SPRING WASHER
(6) NUT
(7) O RING
(8) PISTON PACKING
(9) WEAR RING

The dumping cylinder is a double acting single-rod cylinder. Its rod outside diameter is 25mm (0.984 in.), its inside diameter is 40mm (1.57 in.), its outside diameter is 50mm (1.97 in.) and its stroke is 195mm (7.68 in.).



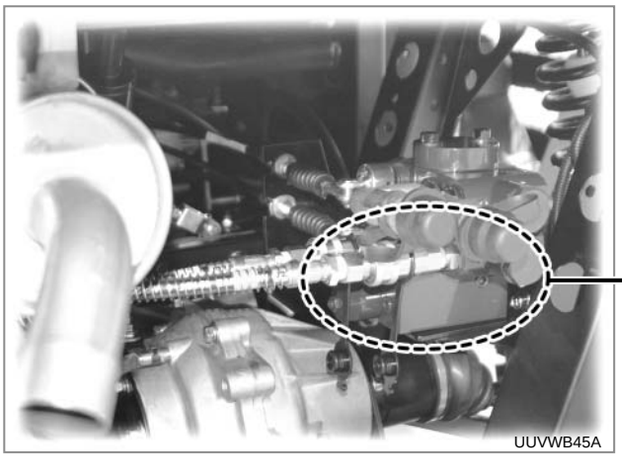
(1) Head cover
(2) DU bush
(3) Dust seal
(4) Rod seal
(5) O RING
(6) Piston packing
(7) Wear ring
(8) O RING



The hydraulic line on the lifting side of the dumping cylinder is equipped with the orifice and check valve. When the cylinder is extended (lifting), the check valve is opened to draw more oil into the cylinder. On the other hand, when the cylinder is retracted (lowering), the check valve is closed and the discharged oil passes through the orifice to slow the flow in order to slow down the lowering speed of the cargo bed.

2.6 FRONT BLOCK (DUMPING VALVE)

MOUNTING LOCATION ANDSTRUCTURE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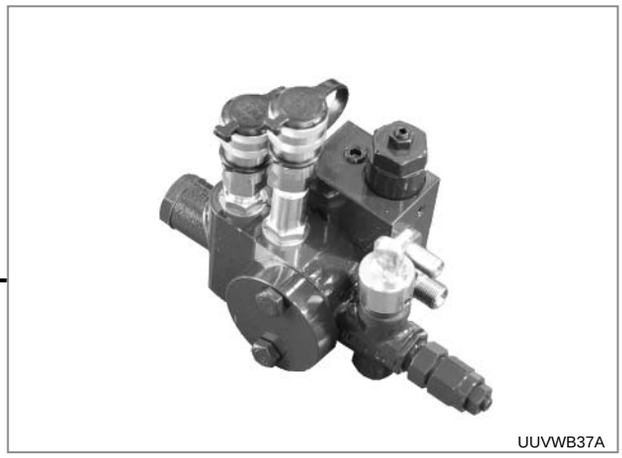
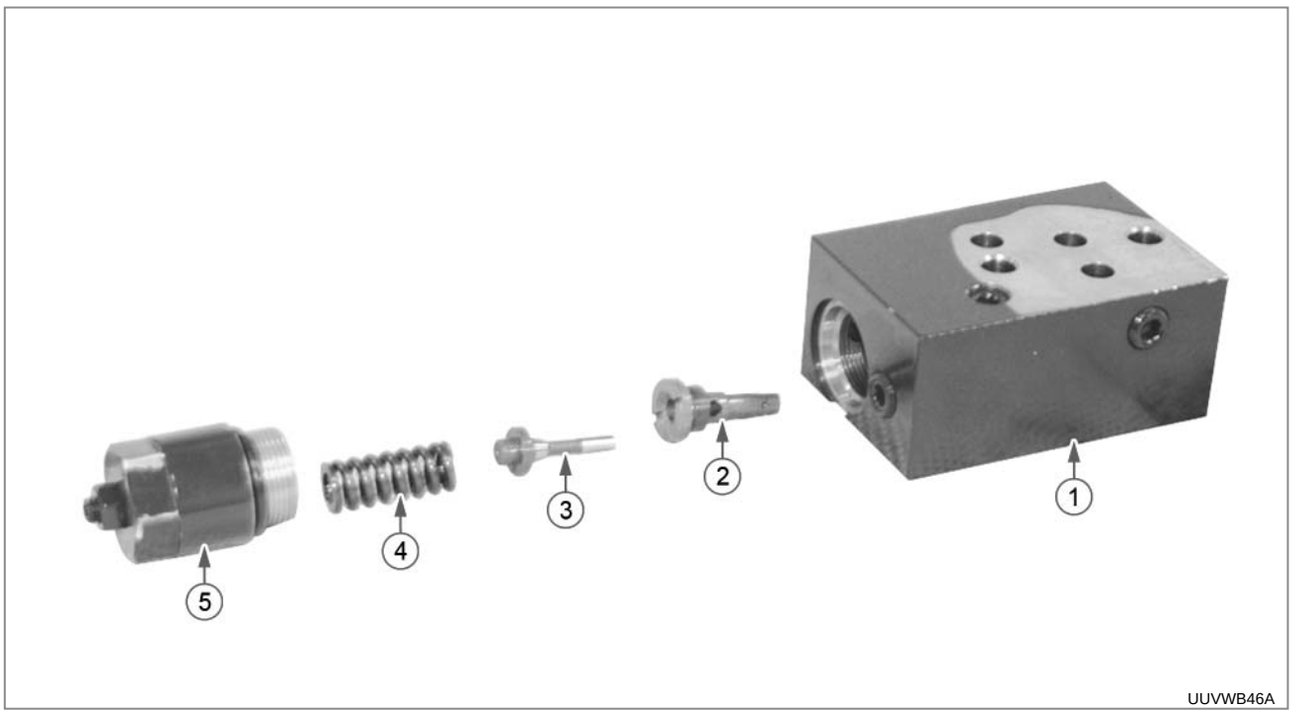

UUVWB37A

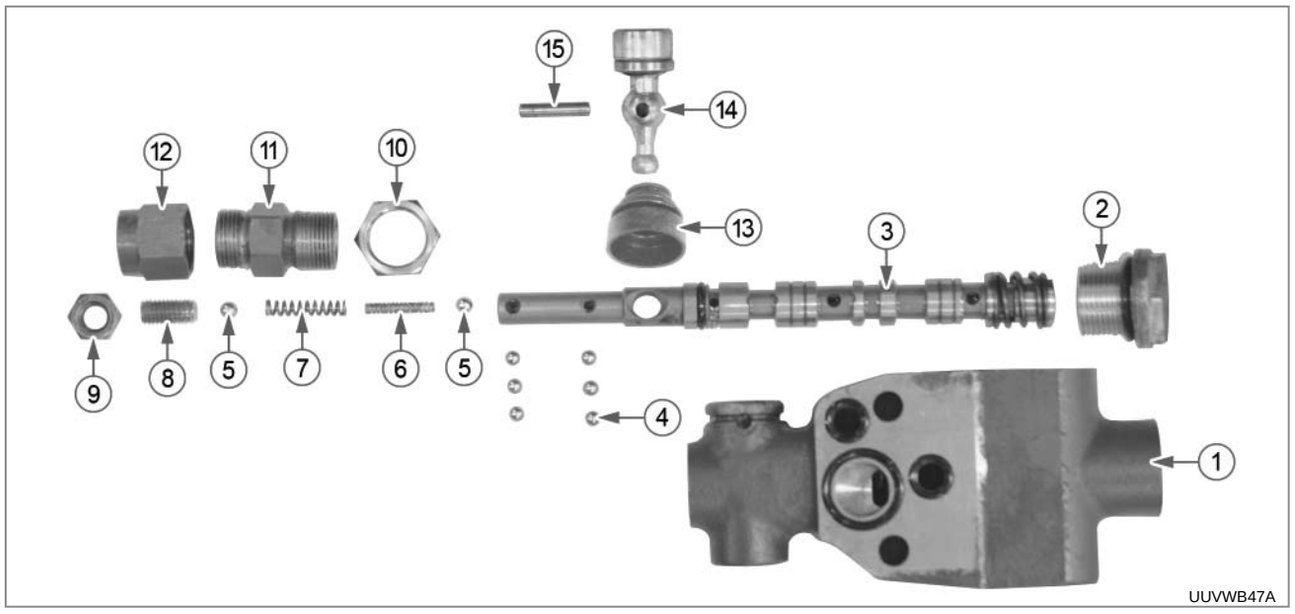
FRONT BLOCK



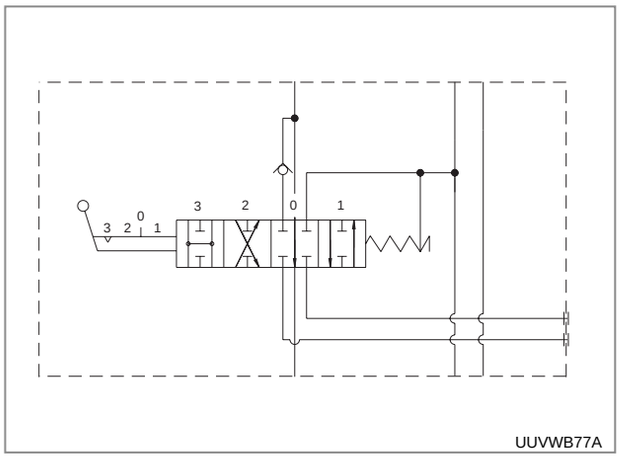
UUVWB46A

(1) BODY
(2) SPOOL
(3) POPPET
(4) SPRING
(5) COVER

DUMPING VALVE



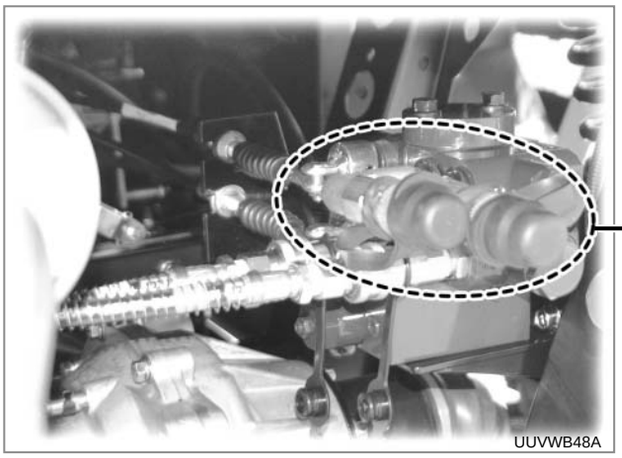
(1) BODY
(2) PLUG
(3) SPOOL ASSEMBLY
(4) BALL
(5) DETENT BALL
(6) INTERNAL SPRING
(7) EXTERNAL SPRING
(8) ADJUSTING SCREW
(9) ADJUSTING NUT
(10) MOUNTING NUT
(11) ADAPTER
(12) DETENT HOUSING
(13) BELLOWS
(14) LEVER
(15) PIN

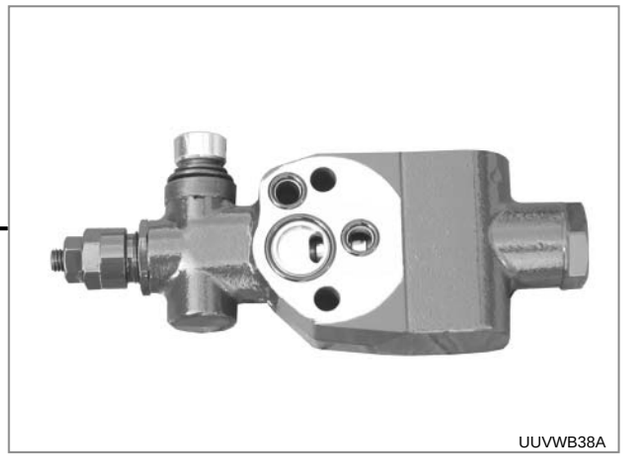


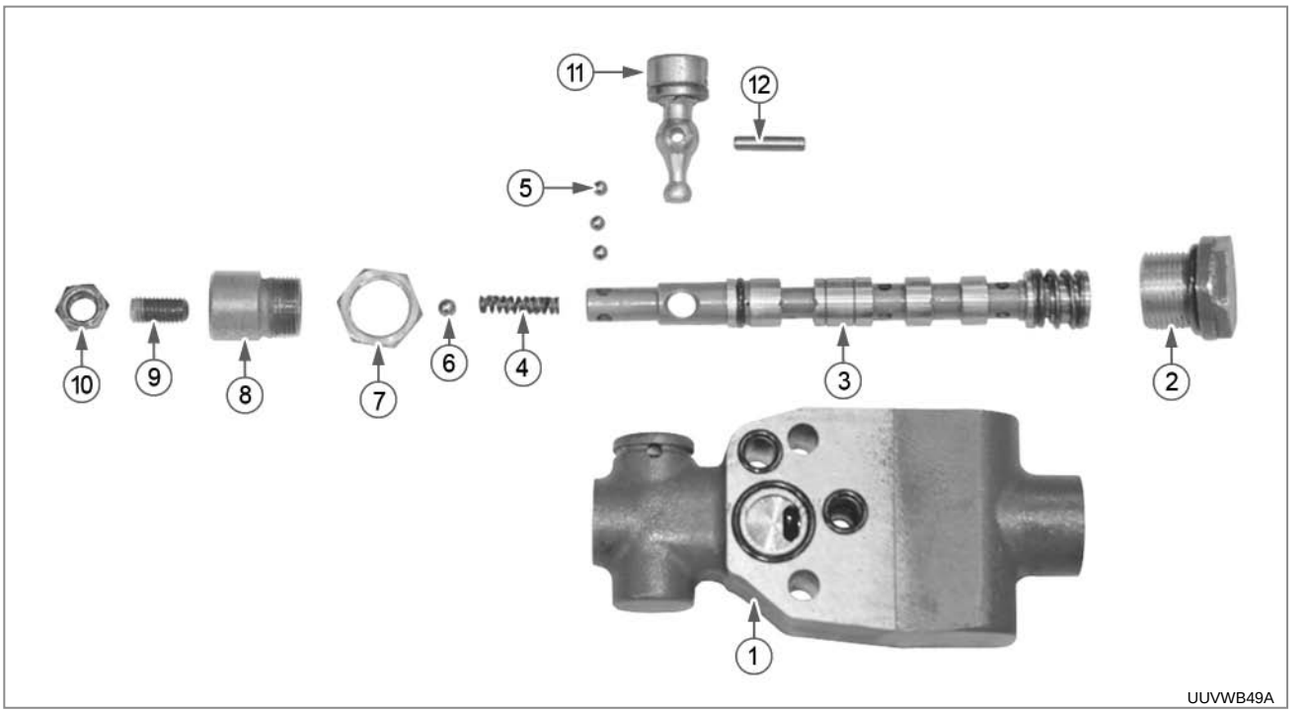
The dumping valve is a double acting type and has a detent-floating function. When the valve lever is operated to the cylinder extending direction, the cargo bed is lifted. Operating the valve lever to the cylinder retracting direction lowers the cargo bed. Also, pushing the valve lever to the one step further from the retracting position fixes the lever to the floating position. In the floating position, the engine doesn`t need to be started as the cargo bed can be lifted without the hydraulic oil.

2.7 AUXILIARY HYDRAULIC VALVE

MOUNTING LOCATION AND STRUCTURE

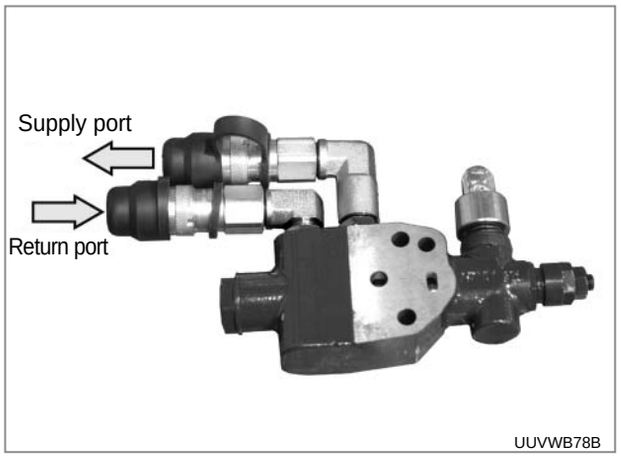

UUVWB48A


UUVWB38A

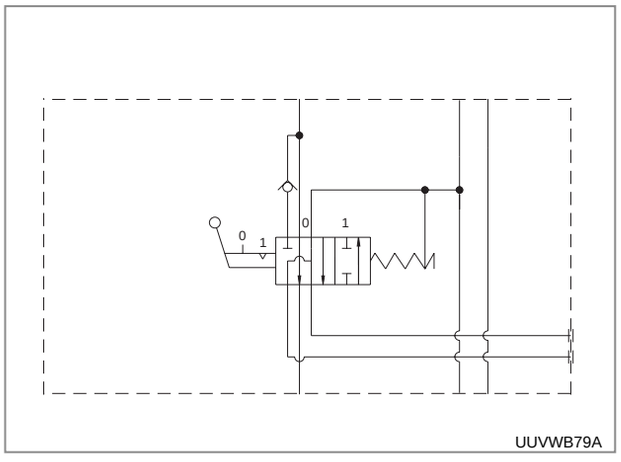


UUVWB49A

(1) BODY
(2) PLUG
(3) SPOOL ASSEMBLY
(4) SPRING
(5) BALL
(6) DETENT BALL
(7) MOUNTING NUT
(8) DETENT HOUSING
(9) ADJUSTING SCREW
(10) ADJUSTING NUT
(11) LEVER
(12) PIN



Even though the auxiliary hydraulic valve is a single acting type valve, it is equipped with one outlet port and one return port, which is distinct from the single acting valve in the tractor. This means that this single acting valve can operate the hydraulic motor by the hydraulic oil from its outlet port while the returning oil is returned to the oil tank through its return port.



The auxiliary hydraulic valve is a add-on type which can be assembled with the dumping kit installed.

3. TROUBLESHOOTING

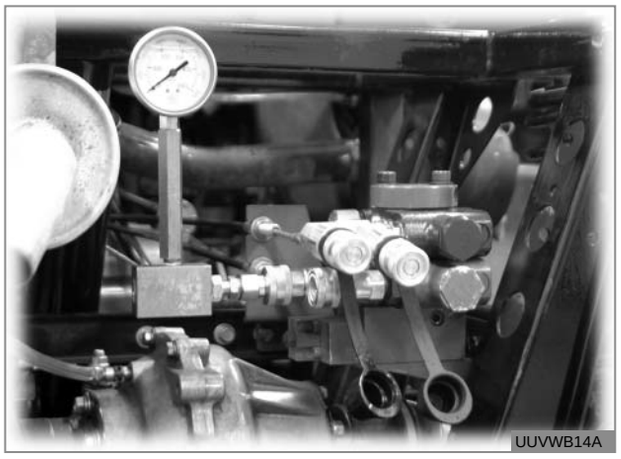
Symptom	Possible cause	Remedy
Impossible to extend dumping cylinder or slow extending speed	• Faulty hydraulic pump • Broken control valve or incorrect installation • Faulty relief valve • Faulty hydraulic piston seal • Insufficient operating oil	• Replace • Inspect or replace • Inspect or replace • Replace • Add oil
Impossible to retract dumping cylinder	• Faulty control valve or foreign material entered	• Inspect or, clean replace
Dumping cylinder retracted with no operation	• Faulty control valve • Faulty hydraulic piston seal • Worn cylinder	• Inspect or replace • Replace • Replace
Vibration and noise	• Insufficient operating oil • Relief valve operated	• Add oil • Adjust
Excessively hot oil temperature	• Insufficient operating oil • Faulty hydraulic pump • High relief pressure	• Add oil • Replace • Adjust

4. INSPECTION AND ADJUSTMENT

4.1 MAIN RELIEF VALVE PRESSURE

CAUTION

- **Make sure to check the oil level and add oil if necessary before the test as an insufficient oil level can cause malfunction in the hydraulic device during the test.**



1. Prepare the pressure gauge that its measurable pressure is over 200 kgf/cm^2 and is equipped with the quick coupler (3/8" male).
2. Disconnect the dumping cylinder hose of the dumping valve.
3. Attach the pressure gauge to the quick coupler to the lifting side of the dumpling valve hydraulic outlet port.

CAUTION

- **Make sure that the quick coupler is firmly tightened.**

REMARK

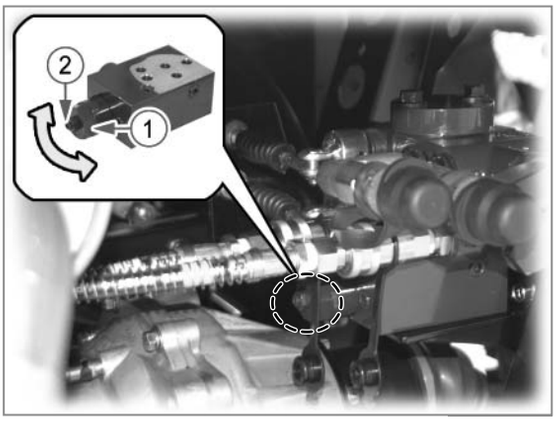
- **Stop the engine so that the pressure gauge can be easily attached. Then, move the double acting lever (dumping operation lever) forward and backward to remove pressure from the hydraulic line.**

4. Place the selector shift lever in the neutral position, start the engine and speed up the engine to its maximum.
5. Move the dumping operation lever to the operating position and check the pressure during the relief open with the pressure gauge
6. As the main relief valve is open, complete the measurement within 20 to 30 seconds and return the lever to the neutral position.

   Specified main relief pressure .....155 ~ 160 kgf/cm^2
   15.19 ~ 15.68 MPa
   2,204 ~ 2,275 psi
7. If the main relief valve pressure is below the specified pressure, it is possible that the main relief valve is malfunctioning and the pump efficiency is deteriorated.

REMARK

HOW TO ADJUST RELIEF VALVE PRESSURE



- **Adjust the relief valve pressure by unscrewing the adjusting nut (1) and turning the adjusting screw (2).**
- **Turning the adjusting screw clockwise with a hex. wrench increases the set pressure while turning it counterclockwise decreases the set pressure.**

5. DISASSEMBLY, SERVICE AND ASSEMBLY

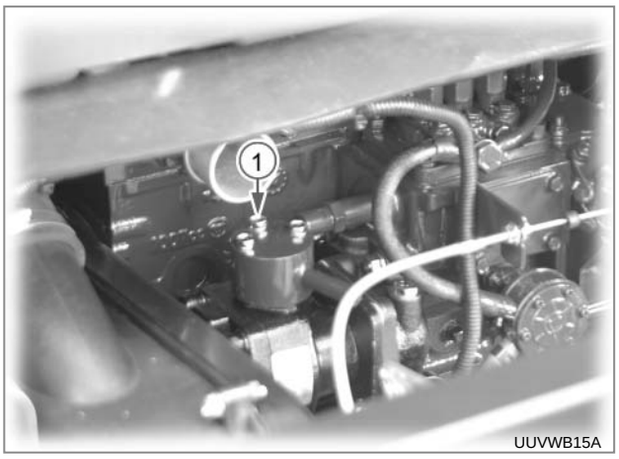
5.1 GEAR PUMP DISASSEMBLY AND ASSEMBLY

5.1.1 GEAR PUMP REMOVAL

1. Park the vehicle on level ground and apply the parking brake.
2. Lift the cargo bed using the dumping operation lever and stop the engine.

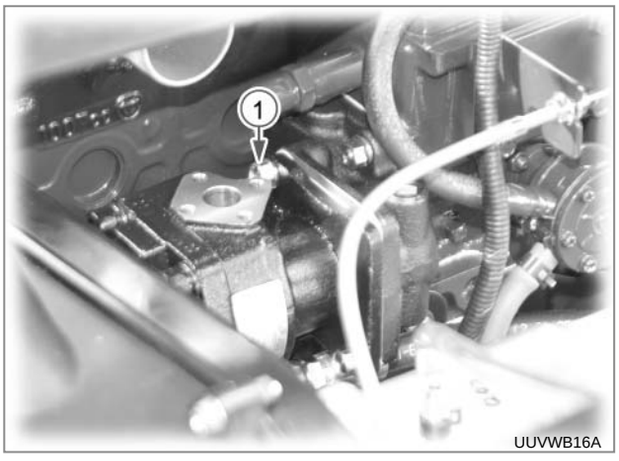
⚠ CAUTION

- **To prevent an injury by the falling cargo bed accidently, set the support between the cargo bed and frame.**



UUVWB15A

3. Disconnect the hose on the hydraulic flange side from the oil tank as well as the hydraulic hose P on the bottom of the gear pump. Then, unscrew the mounting bolt (1) to remove the hydraulic flange.



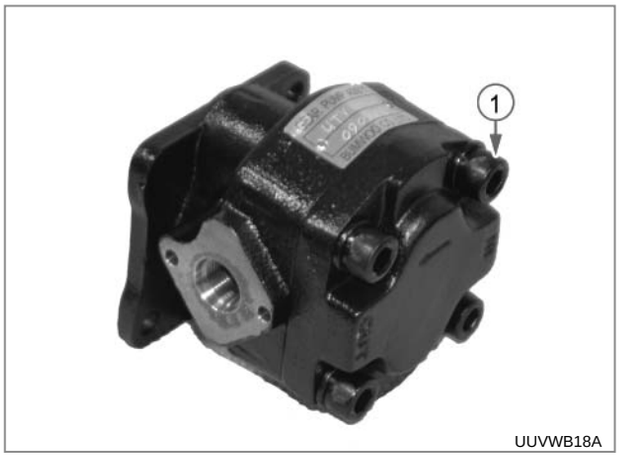
UUVWB16A

4. Unscrew the gear pump mounting bolts (1) to remove the gear pump assembly.

REMARK

- **Inspect the gasket. If it is not intact, replace it with a new one.**

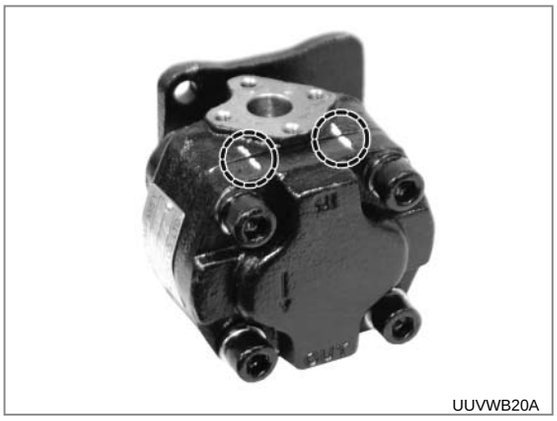
5.1.2 GEAR PUMP DISASSEMBLY



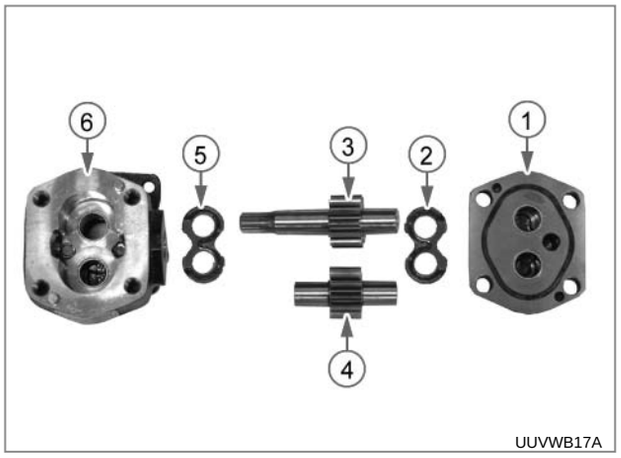
UUVWB18A

1. Unscrew the gear pump assembly mounting bolts (1).

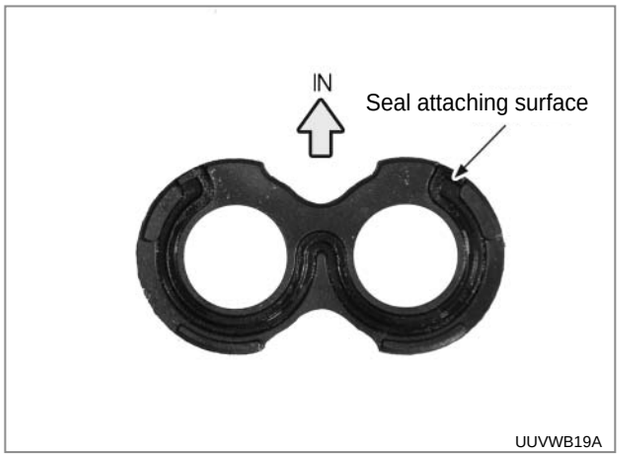
REMARK


UUVWB20A

- **Before disassembling the gear pump, mark a mating line between the rear cover and case to avoid faulty installation.**



2. Remove the rear cover (1), seal block (2), drive gear shaft (3), driven gear (4), seal block (5) and case (6) in order. If necessary, remove the snap ring and oil seal in the case.
3. Assemble in the reverse order of disassembly.

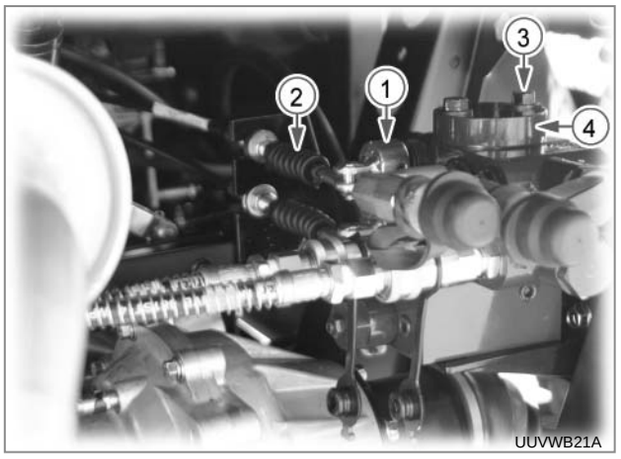


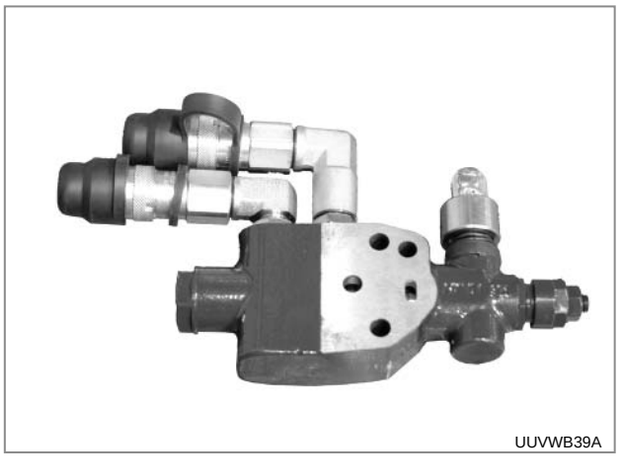
4. When installing the seal block, make sure that its opening is toward the mark "IN" (marked on the back of the rear case) and the seal attaching surface is toward the opposite of the gear.

5.2 AUXILIARY HYDRAULIC VALVE, DUMPING VALVE AND FRONT BLOCK (RELIEF VALVE) DISASSEMBLY AND ASSEMBLY

5.2.1 VALVE REMOVAL

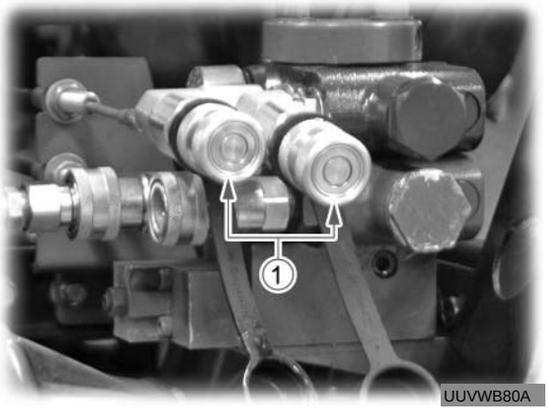
1. Park the vehicle on level ground, stop the engine and apply the parking brake.





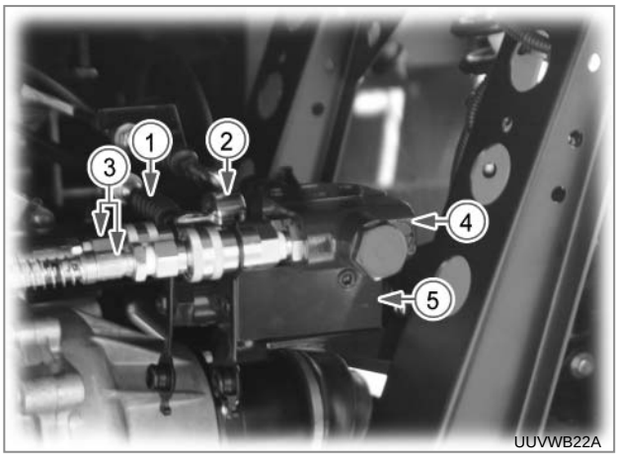
2. Disconnect the double acting cable (2) from the adapter (1) and unscrew the mounting bolts (3) (M8, 2 EA) to remove the cover (4) and double acting valve.

REMARK

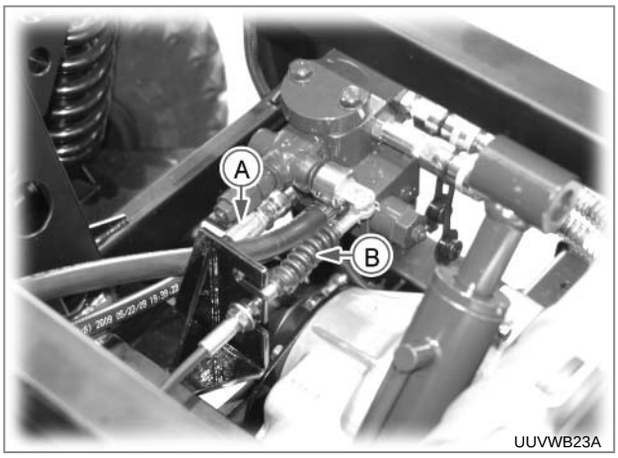


UUVWB80A

- **The hydraulic port for the auxiliary hydraulic valve is a flat-face type to prevent any foreign material from entering the hydraulic circuit through the hydraulic coupler during operation.**



UUVWB22A



UUVWB23A

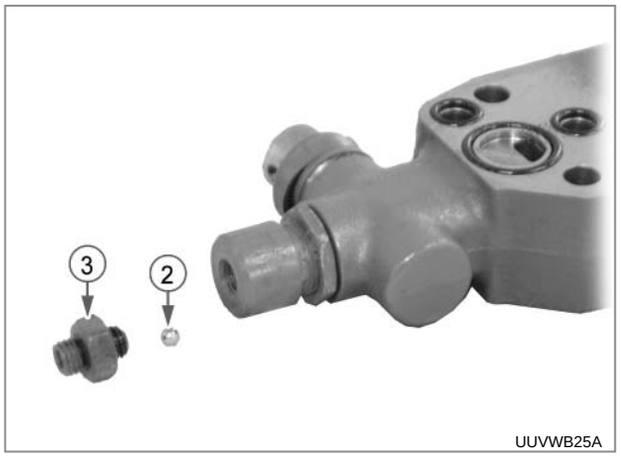
3. Disconnect the dumping cable (1) from the adapter (2) and the dumping cylinder hoses (3). Then, disconnect the hydraulic hose P (A) and hydraulic hose T (B) on the front block side and remove the dumping valve (4) and front block (5) in order.

CAUTION

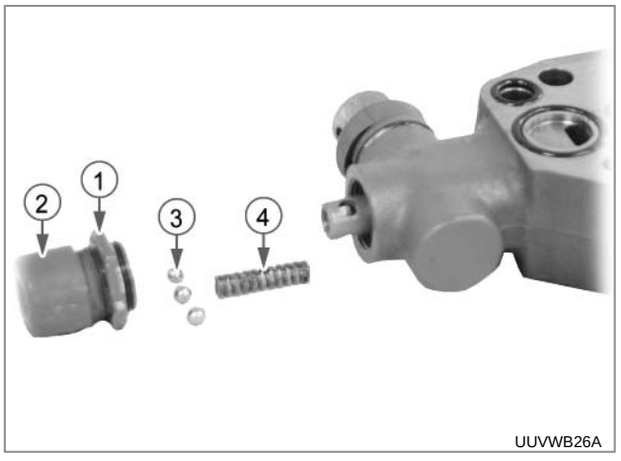
- **When disassembling or assembling the hydraulic valve or cover, be careful not to damage the O-ring and make sure to apply a sufficient amount of oil to the surface of the O-ring before installation.**

4. Assemble in the reverse order of disassembly.

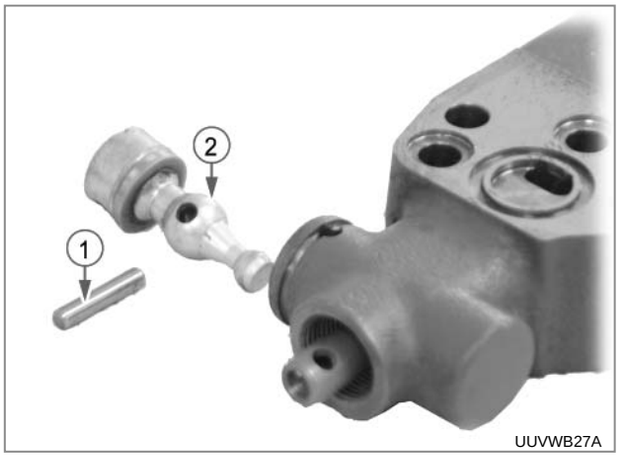
5.2.2 AUXILIARY HYDRAULIC VALVE DISASSEMBLY



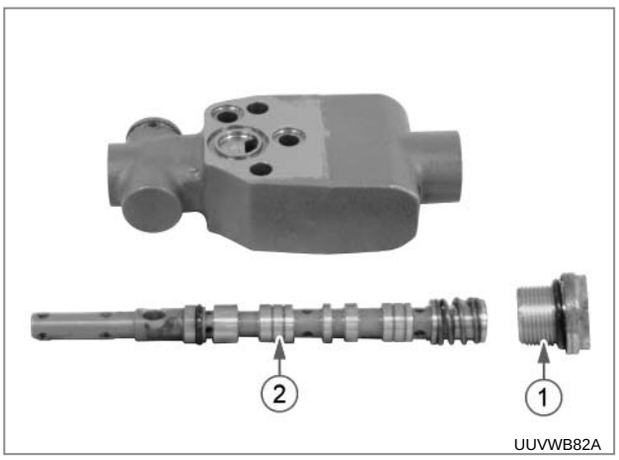
1. Unscrew the adjusting nut (1) and remove the adjusting screw (3) with the detent ball (2). Count the number of threads of the adjusting screw protruded from the nut (for later installation).



2. Unscrew the detent housing mounting nut (1) and remove the detent housing (2), ball (3) and spring (4).



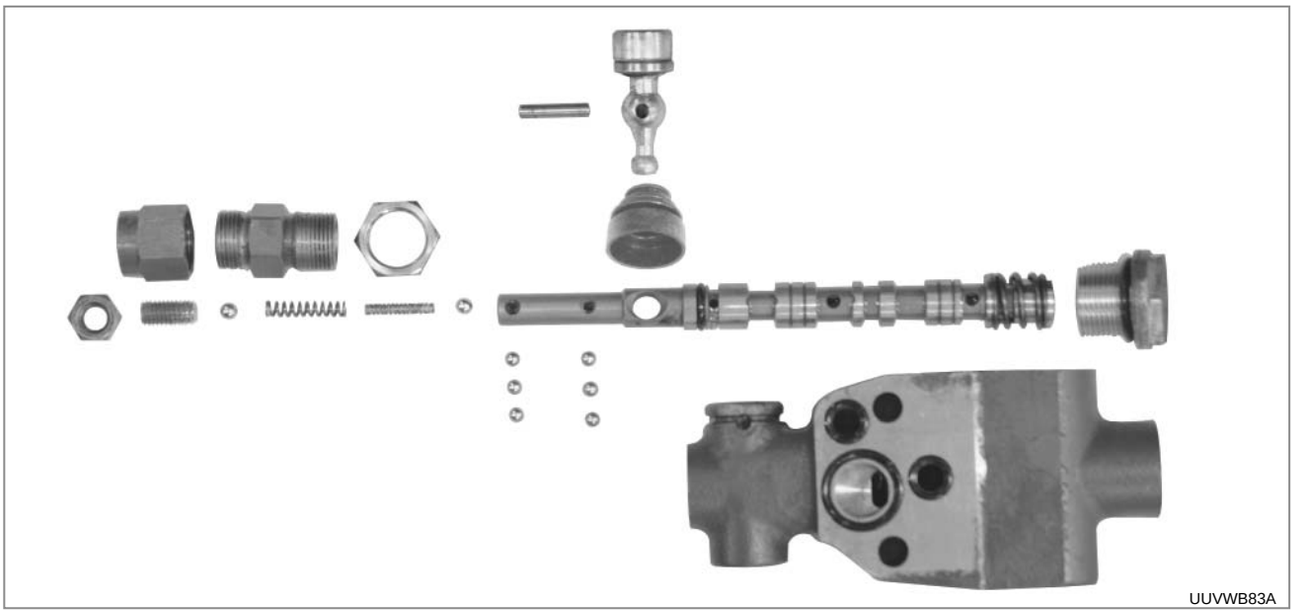
3. Pull out the lever fixing pin (1) and pull up the lever (2) to remove it.



4. Unscrew the plug (1) and pull out the spool (2).

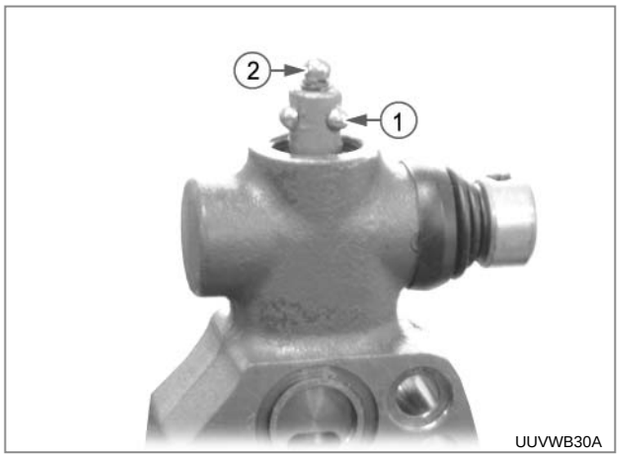
IMPORTANT

- **During disassembly and assembly, be careful not to damage the O-ring. If it is not intact, replace with a new one and apply a sufficient amount of oil on the new one before installation.**

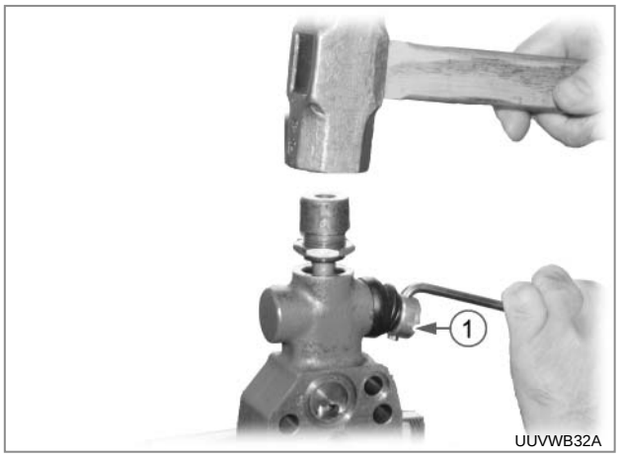


5. Assemble in the reverse order of disassembly.

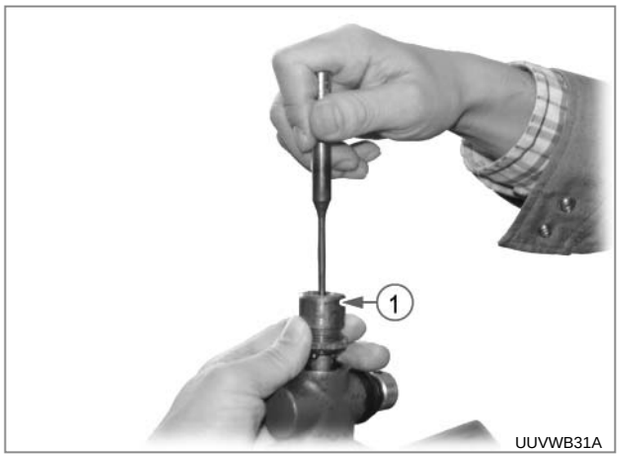
- **ASSEMBLY**



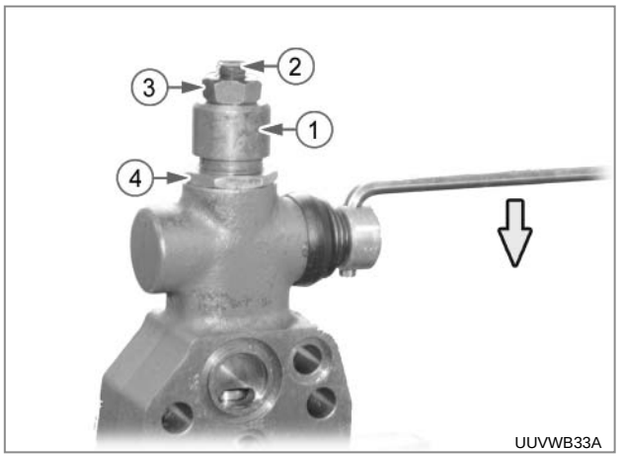
1. When installing the detent ball, insert the spring into the spool, apply grease to the balls (1) and insert them to the three holes of the spool. Then, place the detent ball (2) onto the spring.



3. Fit the tool into the hole of the lever (1) as shown in the figure to fix the spool in position. Then, tap the detent housing with a hammer to screw it to the valve body.

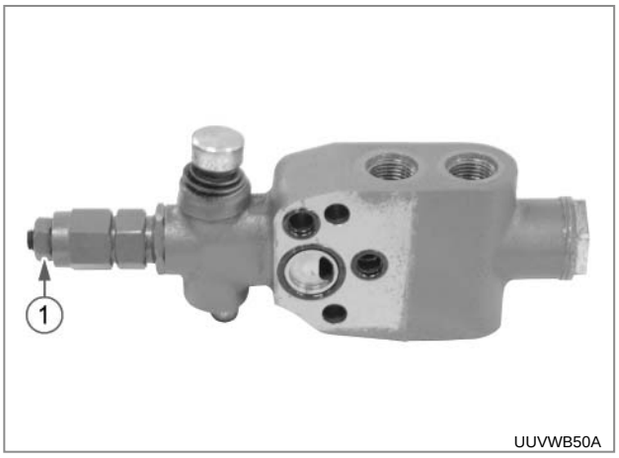


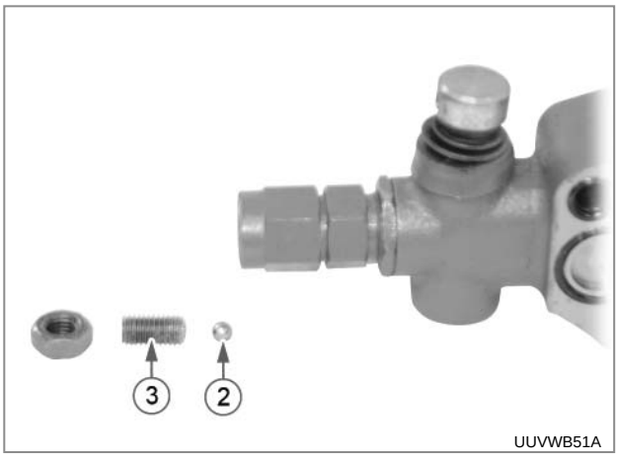
2. After installing the detent housing (1), press the detent ball into the position below the three balls in the spool with a tool to lower down the detent housing.



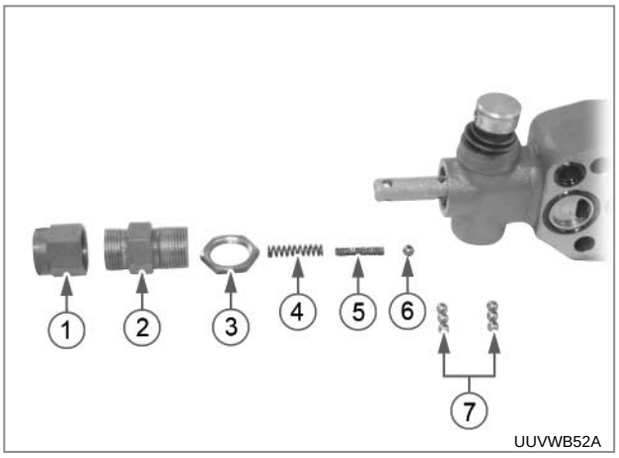
4. After screwing the detent housing (1) into the valve body, install the adjusting screw (2) and adjusting nut (3) and lower the lever in the arrow direction to the detent position (lever fixing (not returning) position). Then, tighten the detent housing mounting nut (4) to secure the housing.At this time, set the number of the adjusting screw threads protruded from the adjusting nut to be the same before its removal.

5.2.3 DUMPING VALVE DISASSEMBLY

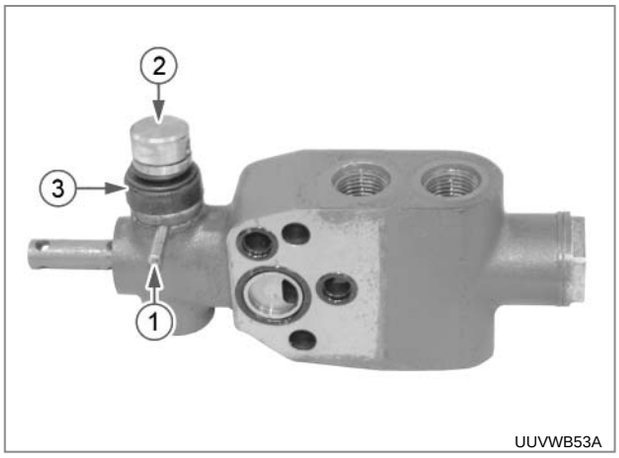




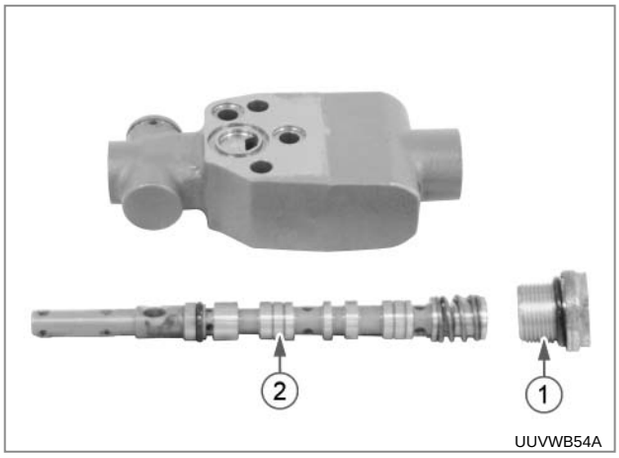
1. Unscrew the adjusting nut (1) and remove the adjusting screw (3) with the detent ball (2).



2. Unscrew the detent housing mounting nut and remove the detent housing (1), adapter (2), detent housing mounting nut (3), internal spring (4), external spring (5), detent ball (6) and balls (7) in order.



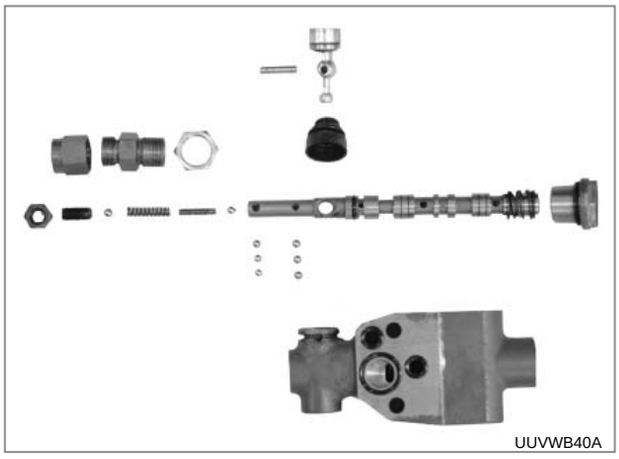
3. Pull out the lever fixing pin (1) and pull up the lever (2) to remove it with the bellows (3).



4. Unscrew the plug (1) and pull out the spool (2).

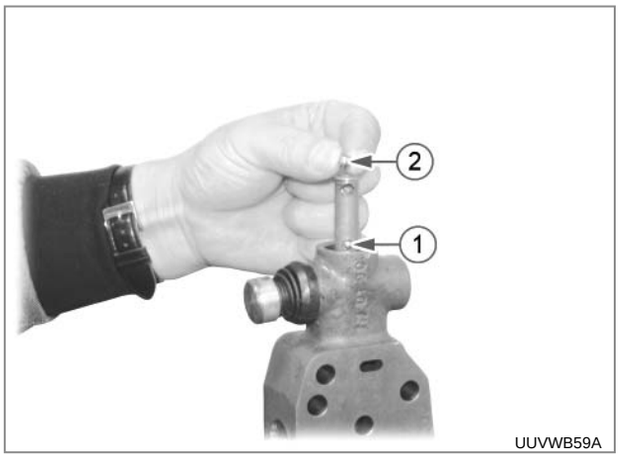
⚠ CAUTION

- **During disassembly and assembly, be careful not to damage the O-ring. If it is not intact, replace with a new one and apply a sufficient amount of oil on the new one before installation.**

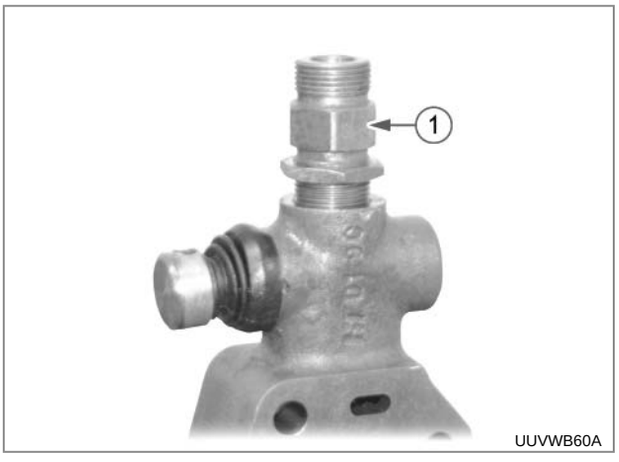


5. Assemble in the reverse order of disassembly.

- **ASSEMBLY**

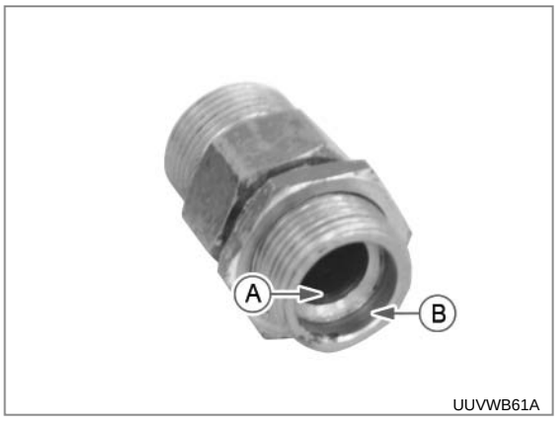


1. When installing the detent ball, apply grease to the three balls (1) and insert them to the three holes of the spool. Then, insert the detent ball (2) into the center.

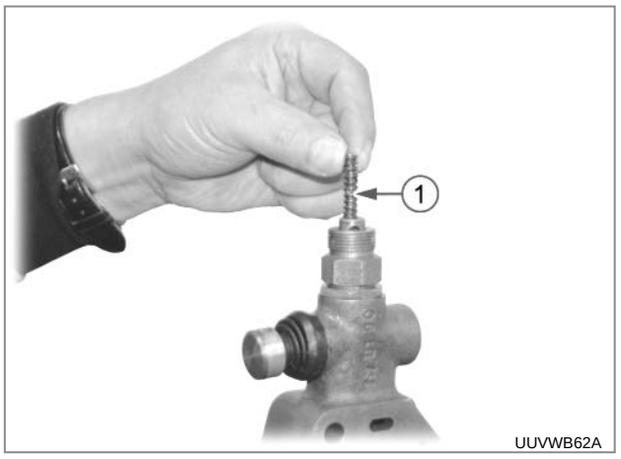


2. Install the adapter (1) as shown in the figure and tighten it fully with a hand.

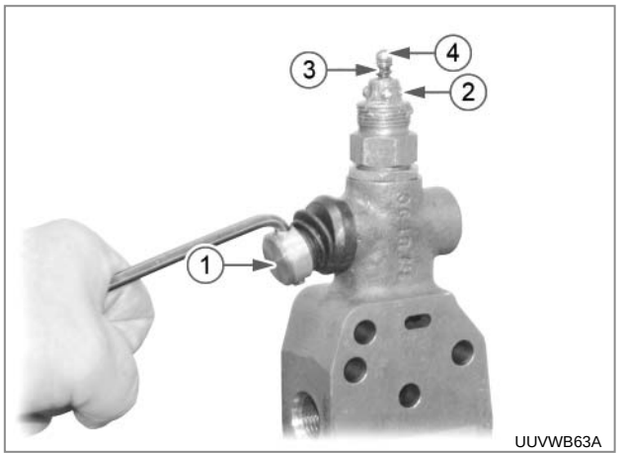
REMARK



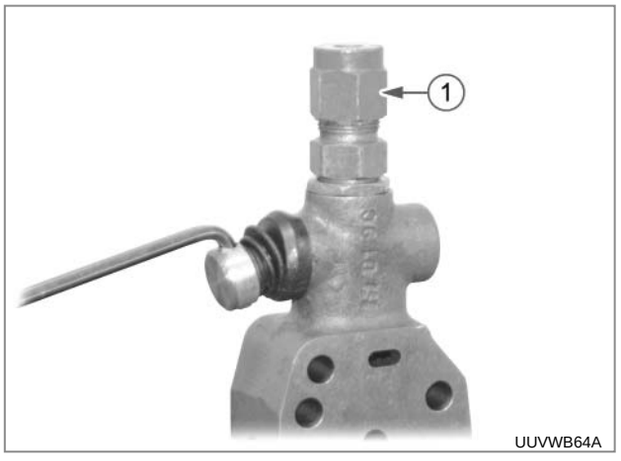
- **The ball is in the floating (detent) status when seating it onto the section (A) of the adapter and installing it completely to place it to the section (B).**



3. Insert the springs (double) (1) into the spool as shown in the figure.



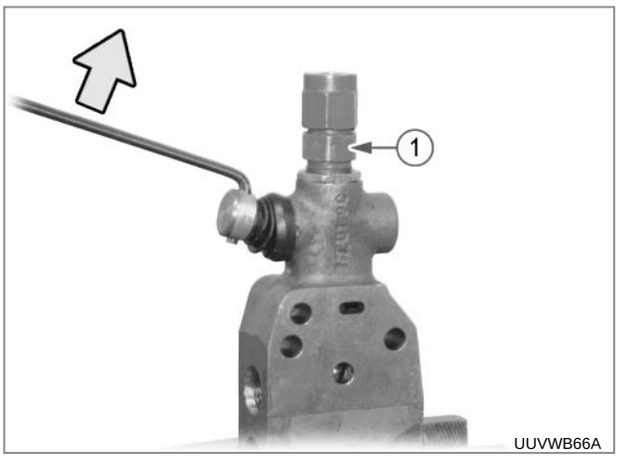
4. Fit the tool to the lever (1) and apply grease to the three balls (2). Then, with the lever pushed down, insert the three balls (2) into the three holes on the upper section of the spool and place the detent ball (4) onto the spring (3) in the center.



5. Fit the detent housing (1) and screw it in with a hand.

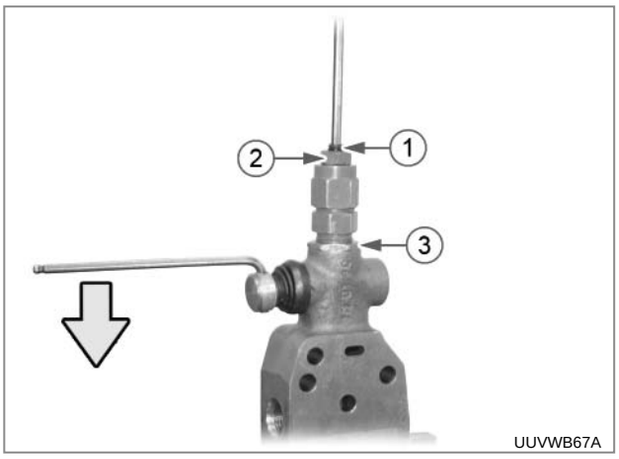

UUVWB65A

6. Push the top of the detent ball with a tool to pass it through the three balls in the spool. Then, tighten the detent housing completely.



UUVWB66A

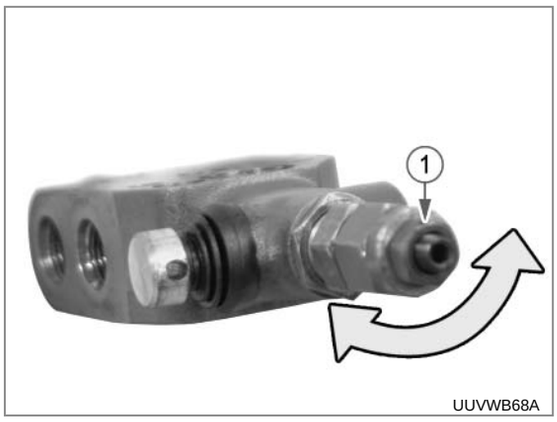
7. Fit the tool to the lever and lift the tool in the arrow direction completely. Then, unscrew the adapter (1) until the lever is not returned but fixed to the lifted position (detent position).



UUVWB67A

8. Install the adjusting screw (1) and lower the lever so that it can return. Then, secure it with the adjusting nut (2).
9. Tighten the adapter mounting nut (3) completely.

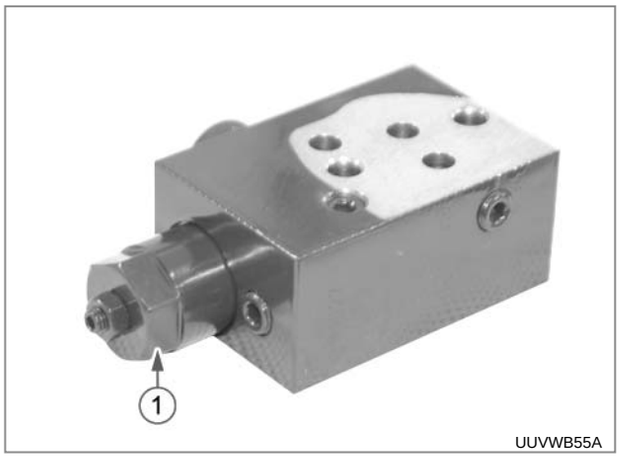
REMARK



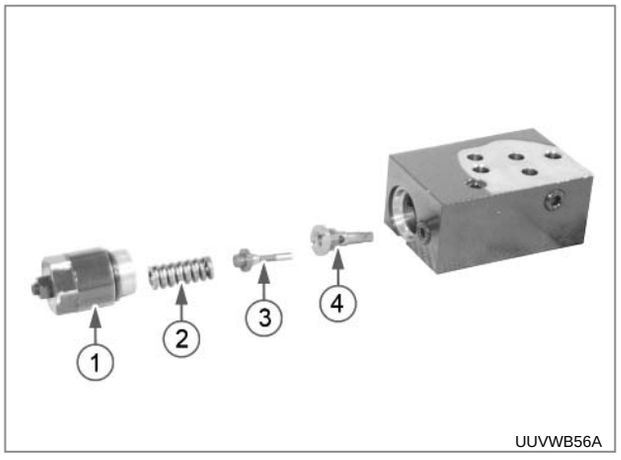
UUVWB68A

- **Turning the adjusting screw (1) counterclockwise increases the spool moving range, resulting in more oil flow and increase in the cargo bed lifting speed. Reversely, screwing it in clockwise decreases the spool moving range, resulting in less oil flow to slow down the cargo bed lifting speed.**

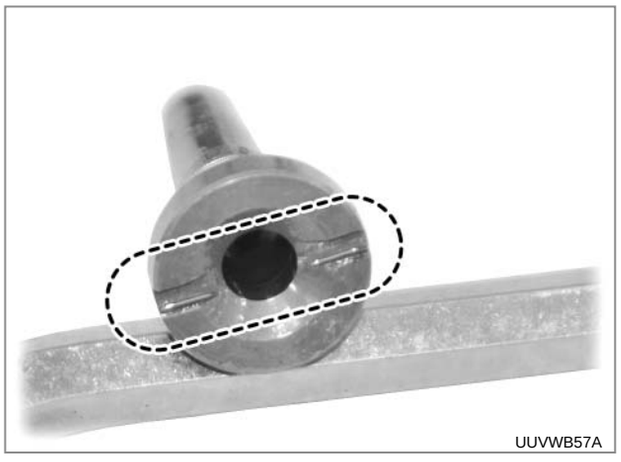
5.2.4 FRONT BLOCK (RELIEF VALVE) DISASSEMBLY



1. Unscrew the plug (1) on the relief adjusting screw.

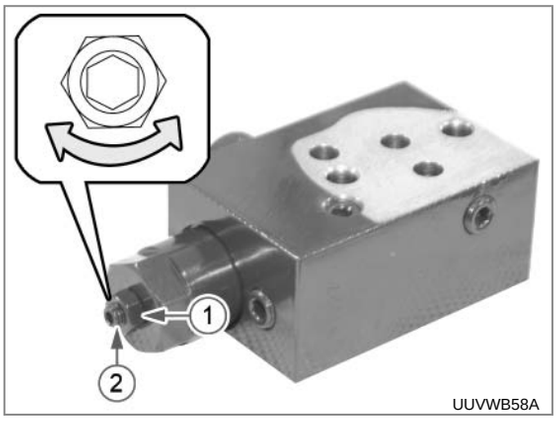


2. Remove the cover plug (1), spring (2), tappet (3) and spool (4) in order.



3. Remove the spool by turning it with a flat-bladed screwdriver.

REMARK



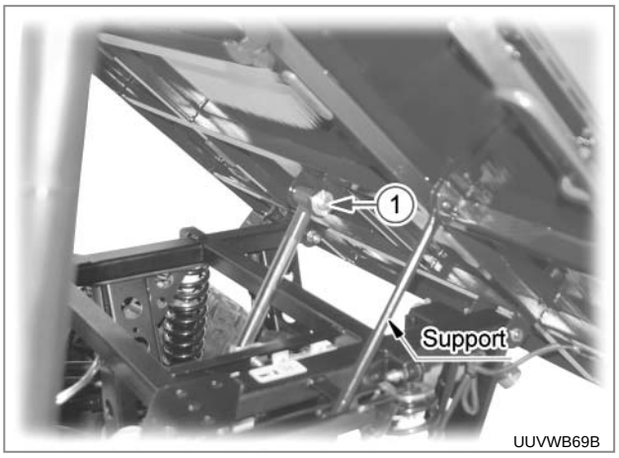
- **Adjust the relief valve pressure by unscrewing the adjusting nut (1) and turning the adjusting screw (2).**
- **Turning the adjusting screw clockwise with a hex. wrench increases the set pressure while turning it counterclockwise decreases the set pressure.**

4. Assemble in the reverse order of disassembly.

5.3 DUMPING CYLINDER DISASSEMBLY AND ASSEMBLY

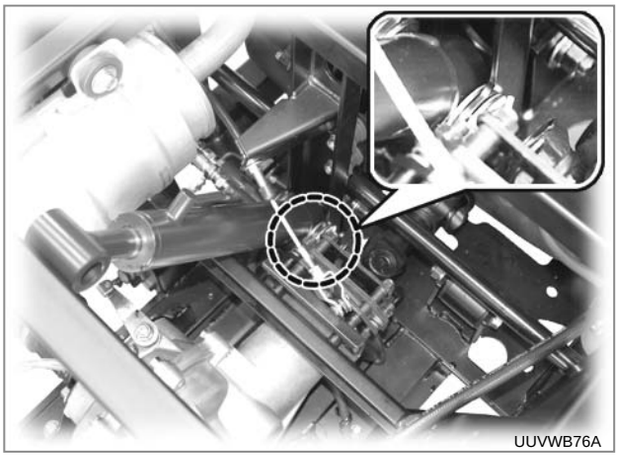
5.3.1 DUMPING CYLINDER REMOVAL

1. Park the vehicle on level ground and apply the parking brake.
2. Lift the cargo bed using the dumping operation lever and stop the engine.
3. Place the support between the cargo bed and frame so that the cargo bed does not fall down accidentally.

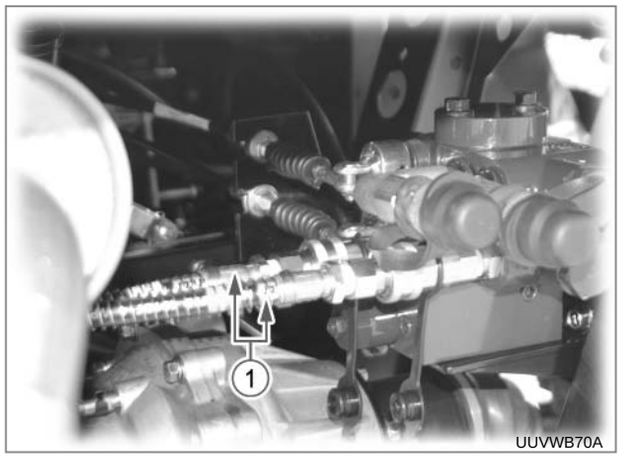


UUVWB69B

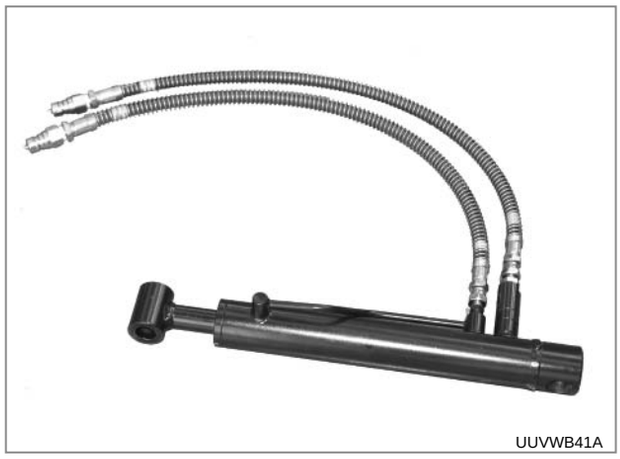
4. Remove the pin (1) from the dumping cylinder boss mounting bracket to separate the dumping cylinder.


UUVWB76A

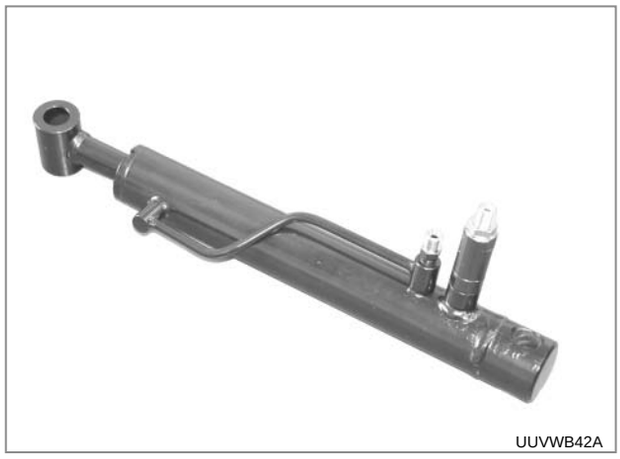
5. Remove the split pin from the outside of the frame bracket. Then, remove the plain washer.



UUVWB70A

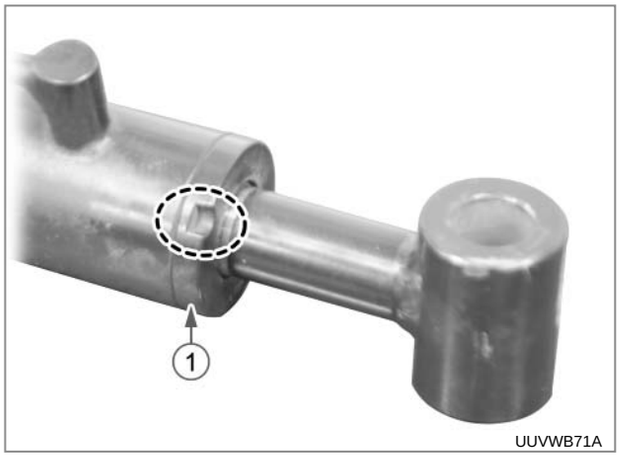

UUVWB41A

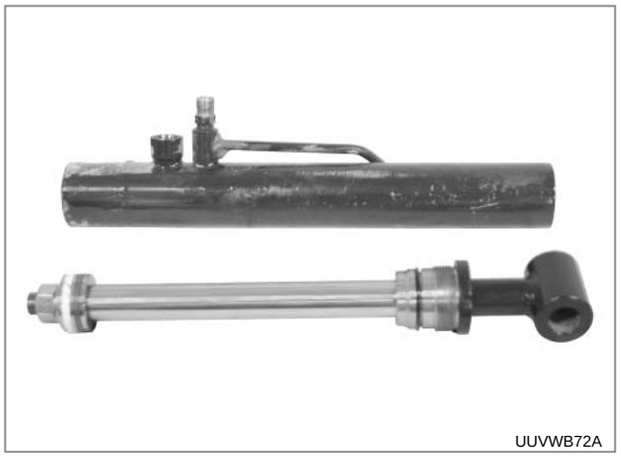
6. Disconnect the dumping cylinder hose (1) from the dumping valve.


UUVWB42A

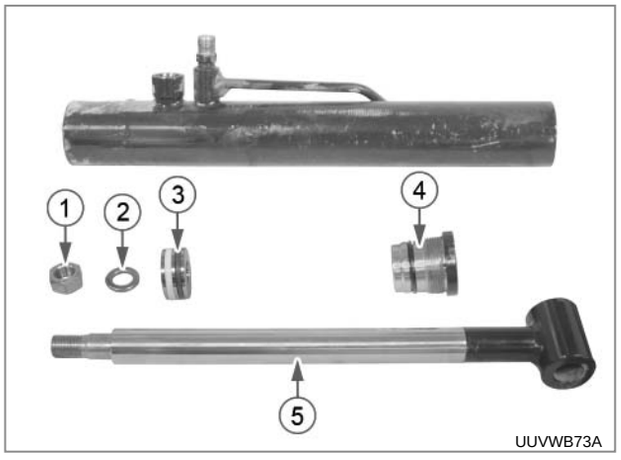
7. Remove the dumping cylinder hose to remove the dumping cylinder.

5.3.2 DUMPING CYLINDER DISASSEMBLY



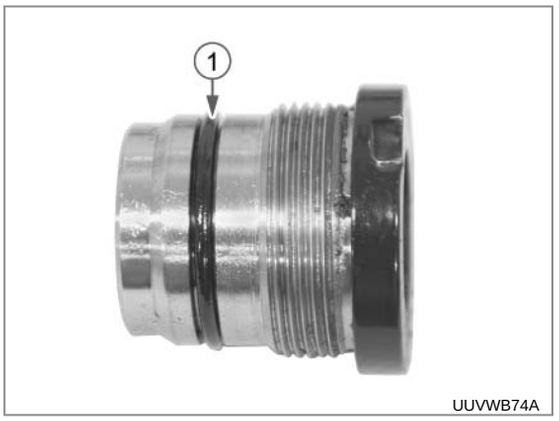


1. Turn the head cover (1) counterclockwise from the dumping cylinder to remove the piston rod assembly (using the notched groove).

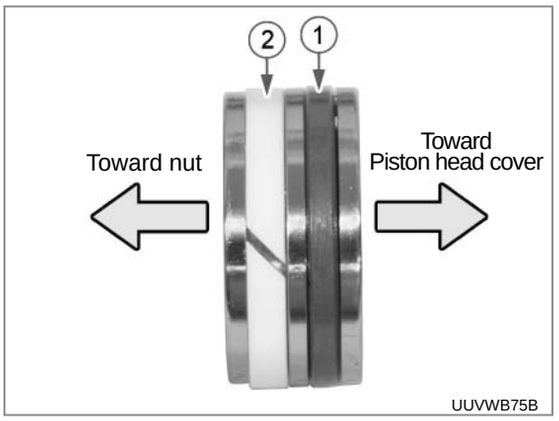


2. Secure the piston rod assembly in a vise and unscrew the nut to remove the nut (1), spring washer (2), piston assembly (3), head cover (4) and piston rod (5) in order.

IMPORTANT



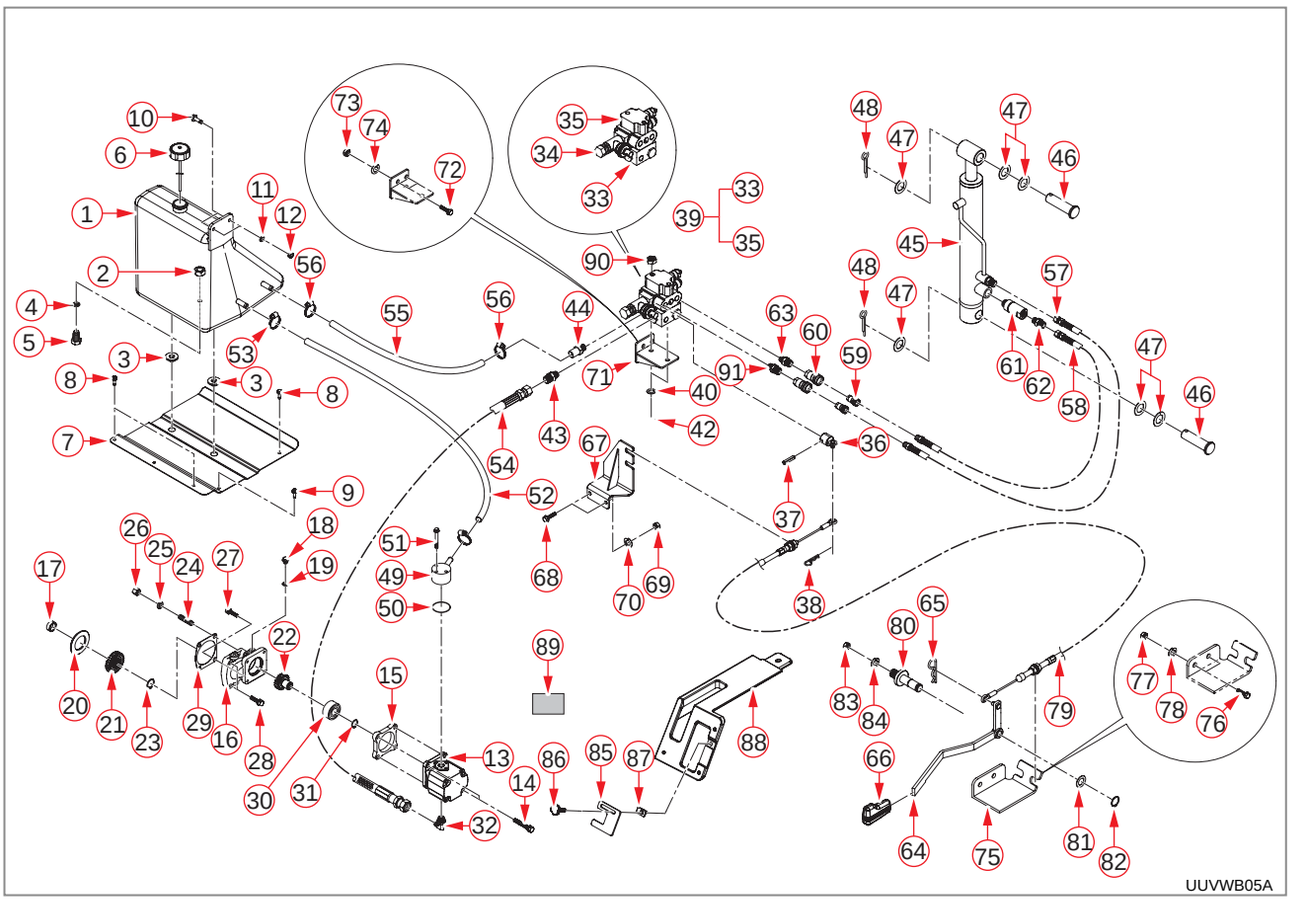
- **When installing the head cover, check the condition of the O-ring (1). If it is not intact, replace with a new one and apply a sufficient amount of oil on the new one before installation.**



- **When installing the piston, be careful not to switch the mounting locations of the piston packing (1) and wear ring (2). Also, be sure to install them in the correct direction.**

6. EXPLODED VIEW

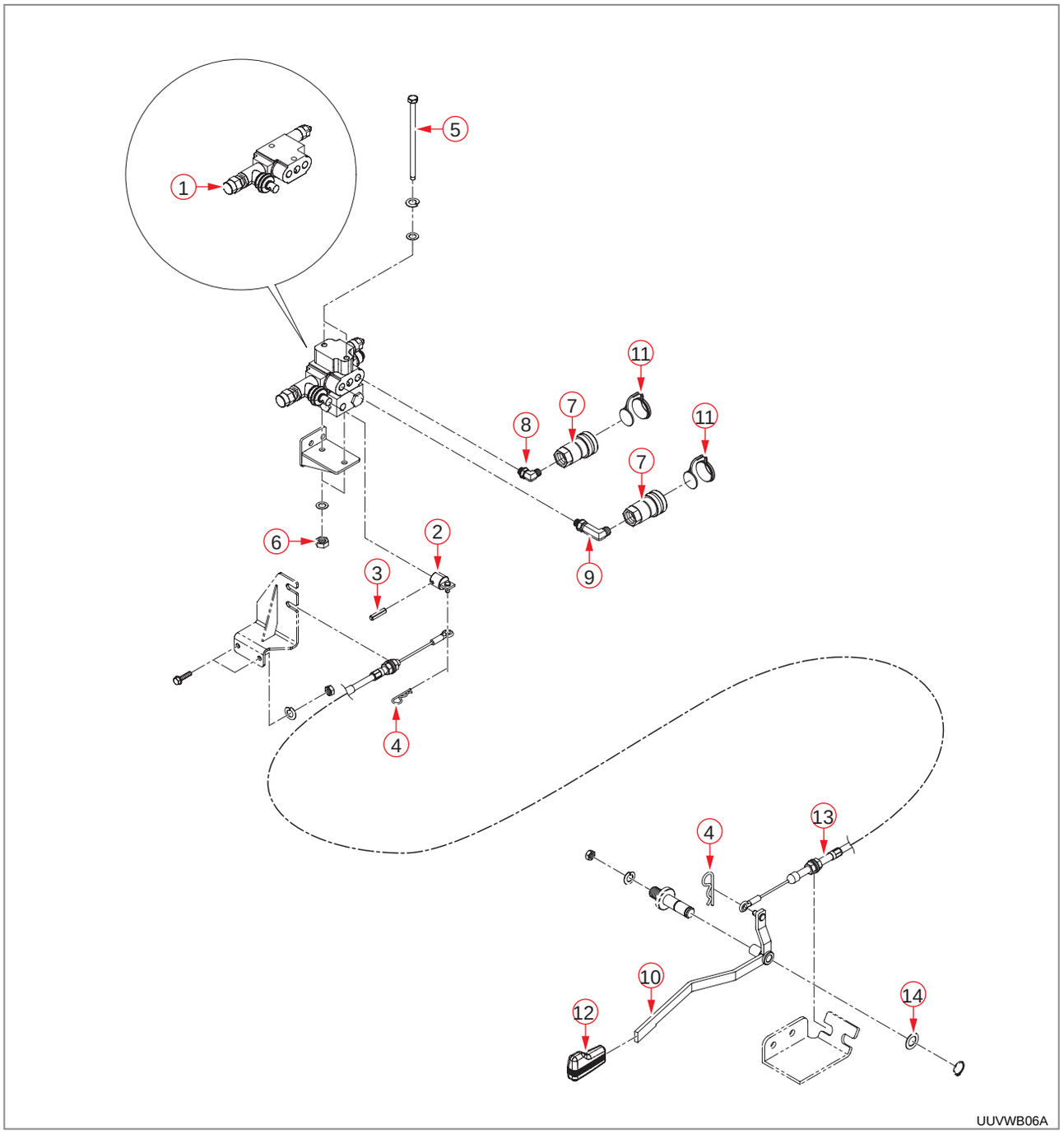
6.1 U1300A HYDRAULIC DUMPING



COMPONENTS

(1) TANK, HYD ASSY
(2) NUT
(3) BUSHING - RADIATOR
(4) WASHER, SEAL
(5) PLUG
(6) TANK CAP ASSY
(7) BRACKET HYD. TANK
(8) BOLT
(9) SCREW
(10) WASHER BOLT
(11) WASHER, PLAIN
(12) NUT
(13) HYDRAULIC O/P PUMP ASSY
(14) BOLT
(15) GASKET
(16) HOLDER, HYD. PUMP
(17) SPACER
(18) PLUG
(19) GASKET
(20) BUSH
(21) GEAR 29
(22) GEAR SHAFT 18
(23) SNAP RING
(24) STUD
(25) WASHER, SPRING
(26) NUT
(27) BOLT
(28) BOLT
(29) FUEL CAMSHAFT COVER GASKET
(30) BALL, BEARING
(31) RING, SNAP
(32) ELBOW
(33) BLOCK ASSY, FR
(34) DETENT FLOATING VALVE
(35) ADAPTOR, CONTROL VALVE
(36) ADAPTOR, CONTROL VALVE
(37) PIN, SPRING
(38) PIN, SNAP
(39) UDF VALVE ASSY
(40) WASHER, PLAIN
(41) WASHER, SPRING
(42) NUT
(43) CONNECTOR
(44) CONNECTOR
(45) CYLINDER, HYD
(46) JOINT PIN
(47) WASHER, PLAIN
(48) PIN, SPLIT
(49) HYD FLANGE, IN
(50) O RING
(51) BOLT
(52) HYD HOSE, IN
(53) BAND, HOSE
(54) HYD HOSE P, CONT. VALVE
(55) HYD HOSE T, CONT. VALVE
(56) BAND, HOSE
(57) HYD HOSE A, CYLINDER
(58) HYD HOSE B, CYLINDER
(59) COUPING 3/8" PLUG ASSY
(60) COUPLER SOCKET ASSY
(61) ORIFICE
(62) CONNECTOR
(63) CONNECTOR A
(64) LEVER 1
(65) PIN, SNAP
(66) GRIP
(67) BRACKET 1
(68) BOLT, FLANGE
(69) NUT
(70) WASHER, SPRING
(71) BRACKET 2
(72) BOLT, FLANGE
(73) NUT
(74) WASHER, SPRING
(75) BRACKET 2
(76) BOLT, FLANGE
(77) NUT
(78) WASHER, SPRING
(79) CABLE
(80) SHAFT LEVER MTG.
(81) WASHER, PLAIN
(82) RING, SNAP
(83) NUT
(84) WASHER, SPRING
(85) DECK LOCKING PLATE
(86) BOLT, GRIP
(87) NUT, SPRING
(88) COVER, LEVER
(89) LABEL
(90) NUT
(91) CONNECTOR, D

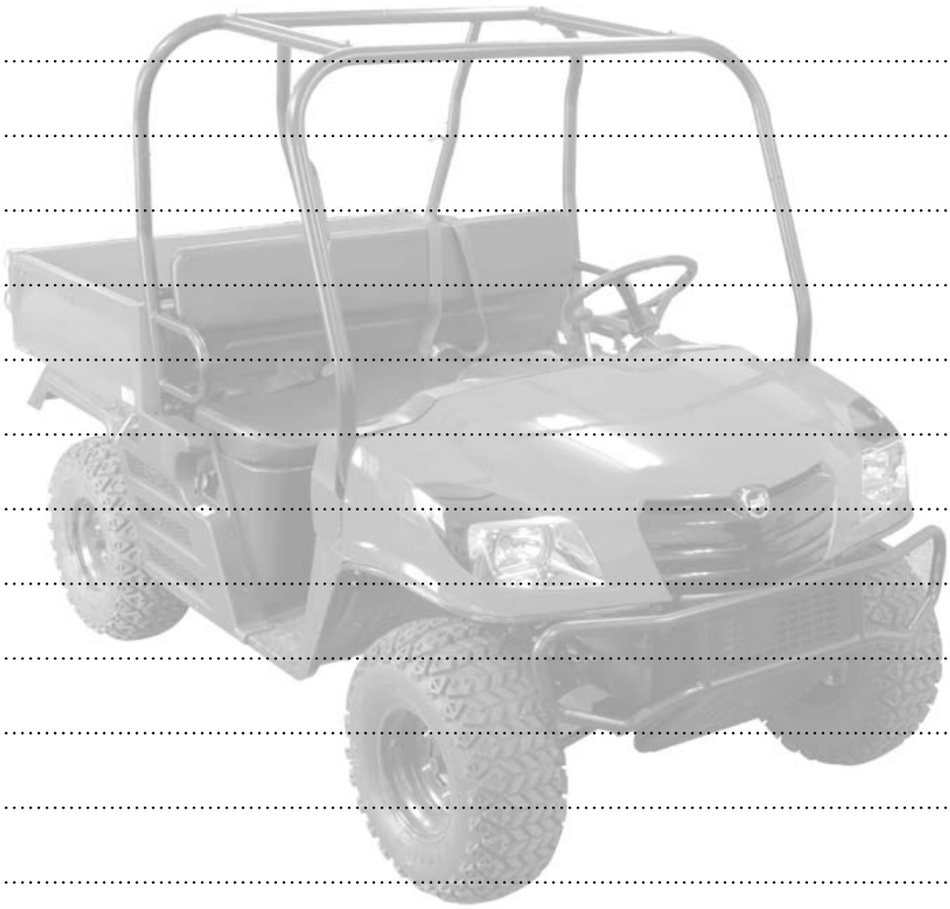
6.2 U1310A AUXILIARY HYDRAULIC VALVE



COMPONENTS

(1) DU SECTIONAL VALVE
(2) ADAPTOR, CONTROL VALVE
(3) PIN, SPRING
(4) PIN, SNAP
(5) BOLT
(6) NUT
(7) COUPLER,SELF-SEALING,AC,1-1/4
(8) CONNECTOR B
(9) CONNECTOR C
(10) LEVER 2
(11) CAP
(12) GRIP
(13) CABLE
(14) WASHER, PLAIN

MEMO



ELECTRIC SYSTEM CHAPTER 12

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1. SPECIFICATION

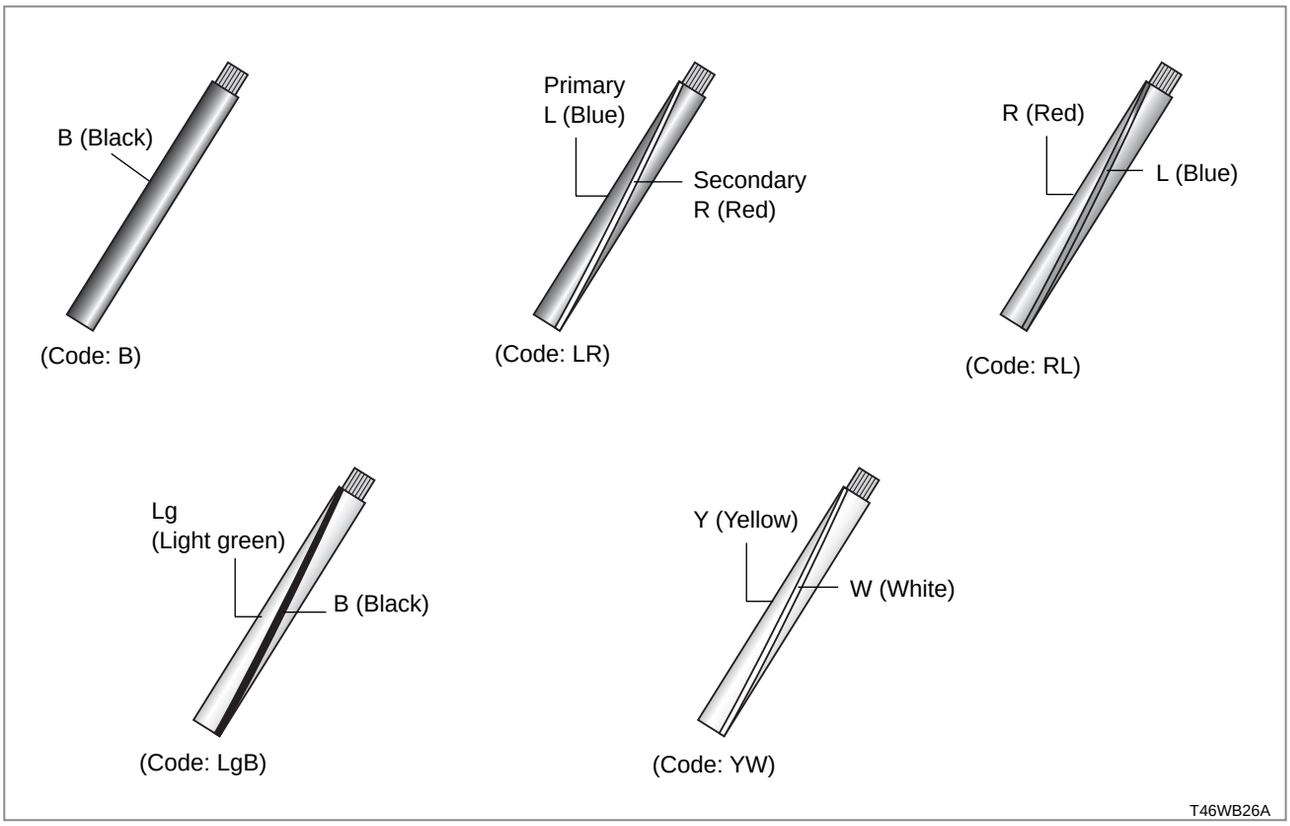
Item	Specification
Battery	12V, 80AH Cold Cranking Ampere at -18°C : 630CCA Reserve capacity : 135 minutes L x W x H = 259 x 172 x 240mm
Start motor	12V, 1.7kW, Overall lengt : 240mm Pinion : spur, Module 3, 9 teeth
Alternator	12V, 50A Practical voltage output : 13.5V Pulley diameter : 64.3mm, (crank shaft pulley : 139mm) IC regulator installed in the alternator.
Slow blow fuse	60A
Engine start relay	5P, 12V, 40~60A
Preheating relay	4P, 12V, 70A
Pull coil relay for engine stop solenoid	5P, 12V, 20~30A
Glow plug	12V, 20A, Resistance at room temperature : 430Ω
Micro switch for parking brake	N.O type
Brake lamp switch	N.C type
Safety start switch	N.C type
Coolant temperature sensor	For temp gauge : approx. 2.45kΩ at 20°C For preheating : approx. 125Ω at 60°C
Engine oil pressure switch	On at 0.5 ± 0.1 kgf/cm^2 (7 ± 1.4PSI) or below
Head lamp	12V, High beam:60W, Low beam:55W
Turn signal lamp	12V, 21W
Tail lamp	12V, 5W
Brake lamp	12V, 21W
Dash board bulbs	12V,1.4W
Fan motor	100W ± 10% (Max), 2060 rpm ± 10%
Fuel sender	“EMPTY” Position in 103 ~ 117 Ω “FULL” Position in 1 ~ 5 Ω
Speed sensor	Resistance between terminals : 2.2 ± 0.2 kΩ at 15°C
Flasher unit (option)	3P
Display unit	12V
Fan motor relay	5P, 12V, 40A
Twin relay (head lamp high, low beam)	12V
Twin relay (fog lamp, work lamp) (option)	12V
Power outlet	12 V, 10 A, Return time : 13 ± 5 sec. after pressing plug

2. CIRCUIT DIAGRAM

2.1 COLOR CODE OF WIRE

Code	Color	Code	Color	Code	Color
B	Black	BrR	Brown/Red	BY	Black/Yellow
L	Blue	RW	Red/White	LgR	Light Green/Red
W	White	YR	Yellow/Red	LgW	Light Green/White
Br	Brown	YW	Yellow/White	BL	Black/Blue
G	Green	WY	White/Yellow	LW	Blue/White
R	Red	Y	Yellow	GW	Green/White
BW	Black/White	Lg	Light Green	RB	Red/Black
BR	Black/Red	Gr	Gray	LR	Blue/Red
YG	Yellow/Green	O	Orange	LB	Blue/Black
YBr	Yellow/Brown	P	Pink	RL	Red/Blue

The following figures are examples for colors according to the codes.



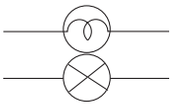
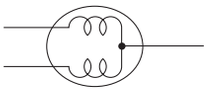
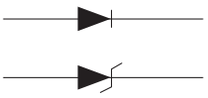
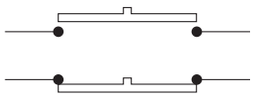
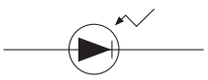
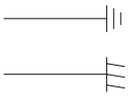
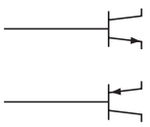
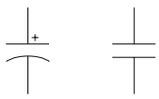
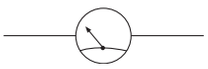
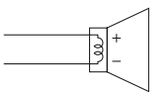
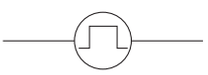
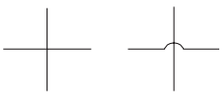
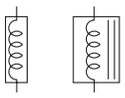
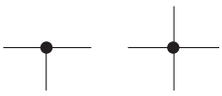
2.2 CROSS SECTION OF WIRE

Every wire has its own number for easy understanding and communication.

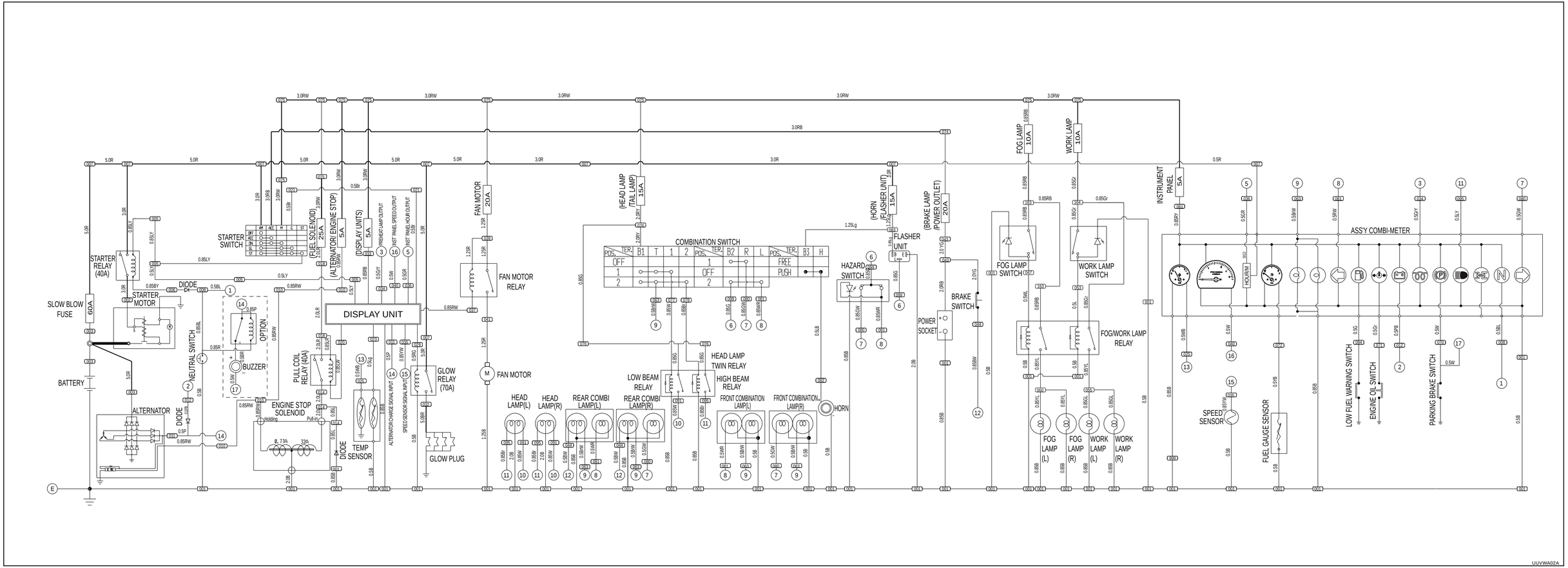
Every wire has its cross section area with color code ;

For instance “5.0 R” means red wire with 5 mm² cross section area, where, 5 mm²=π D² / 4, D= 2.523mm

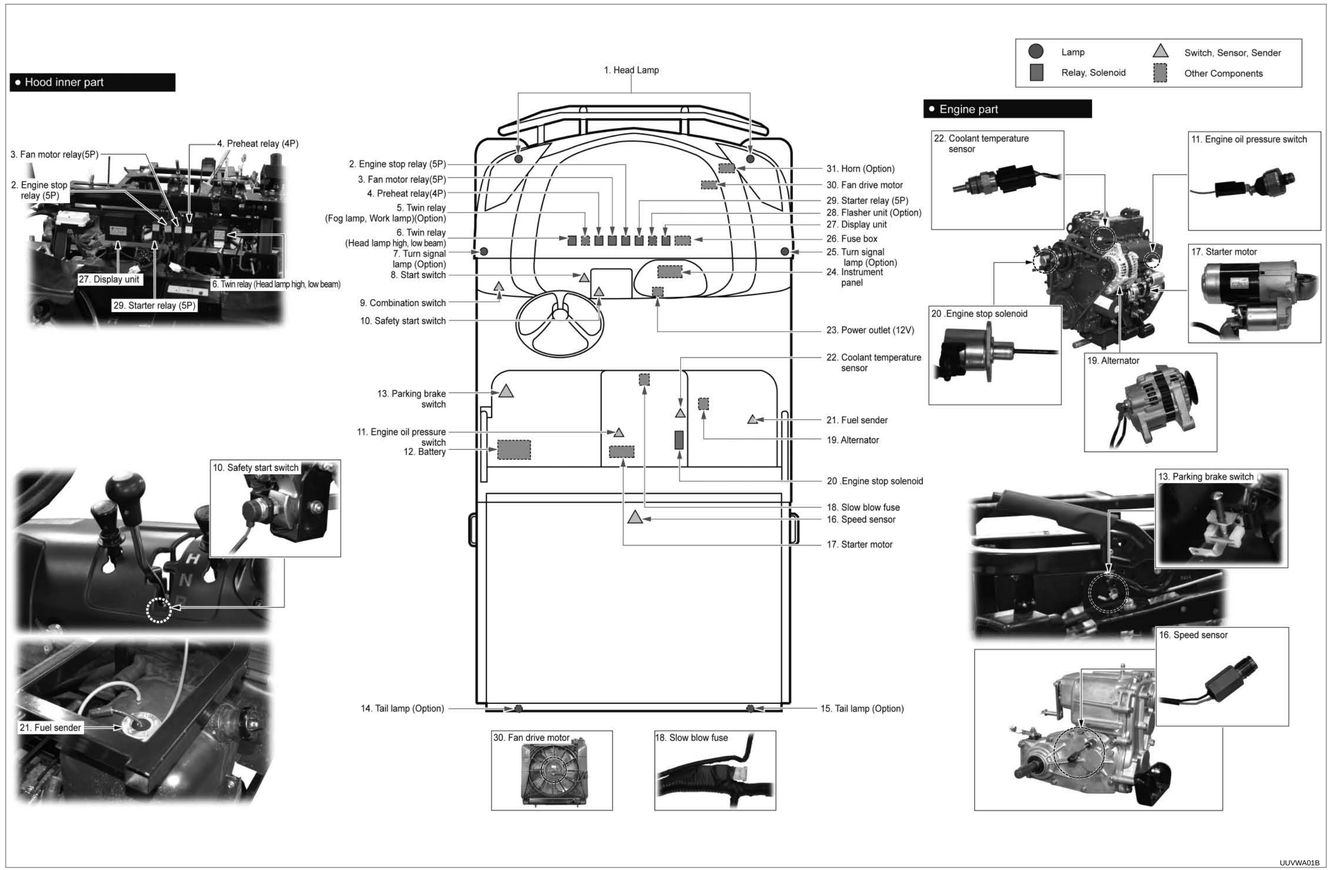
2.3 SYMBOLS FOR ELECTRIC COMPONENTS

Symbol	Description	Symbol	Description
	Fuse		Single bulb Lamp
	Slow-blow fuse		Double bulb
	Motor		Diode Zener-diode
	Switch (Normally Open Type) Switch (Normally Close Type)		LED (Light Emitting Diode)
	Compressor		Photo Diode
	Ground (Wire) Ground (Chassis)		N.P.N Transistor P.N.P Transistor
	Condenser/Capacitor		Meter
	Resistor		Thermistor
	Coil		Speaker
	Battery		Pick up sensor
	Disconnected wire		Solenoid
	Connected wire	–	–

2.4 OVERALL CIRCUIT DIAGRAM



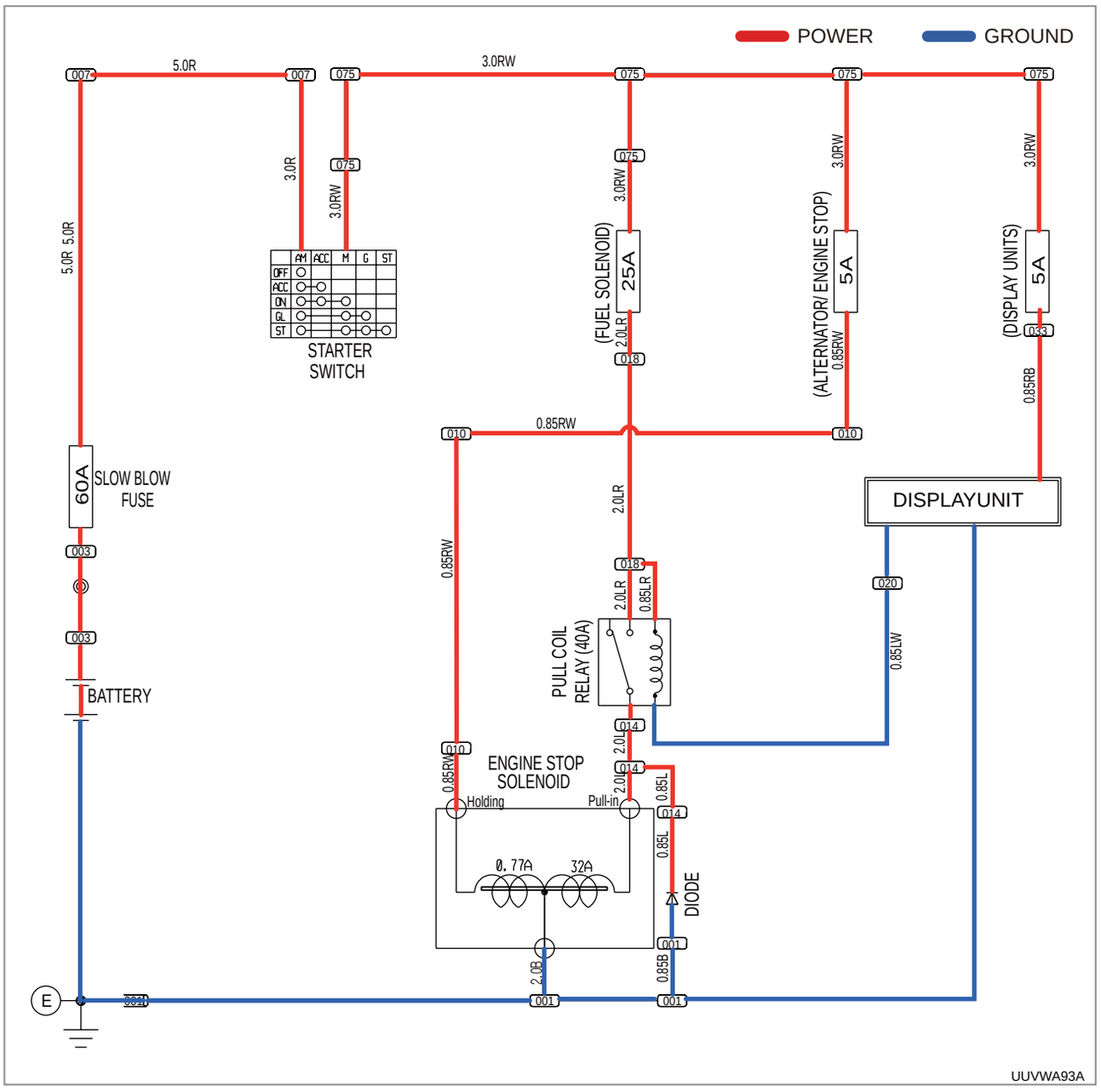
3. LOCATION OF ELECTRICAL DEVICES



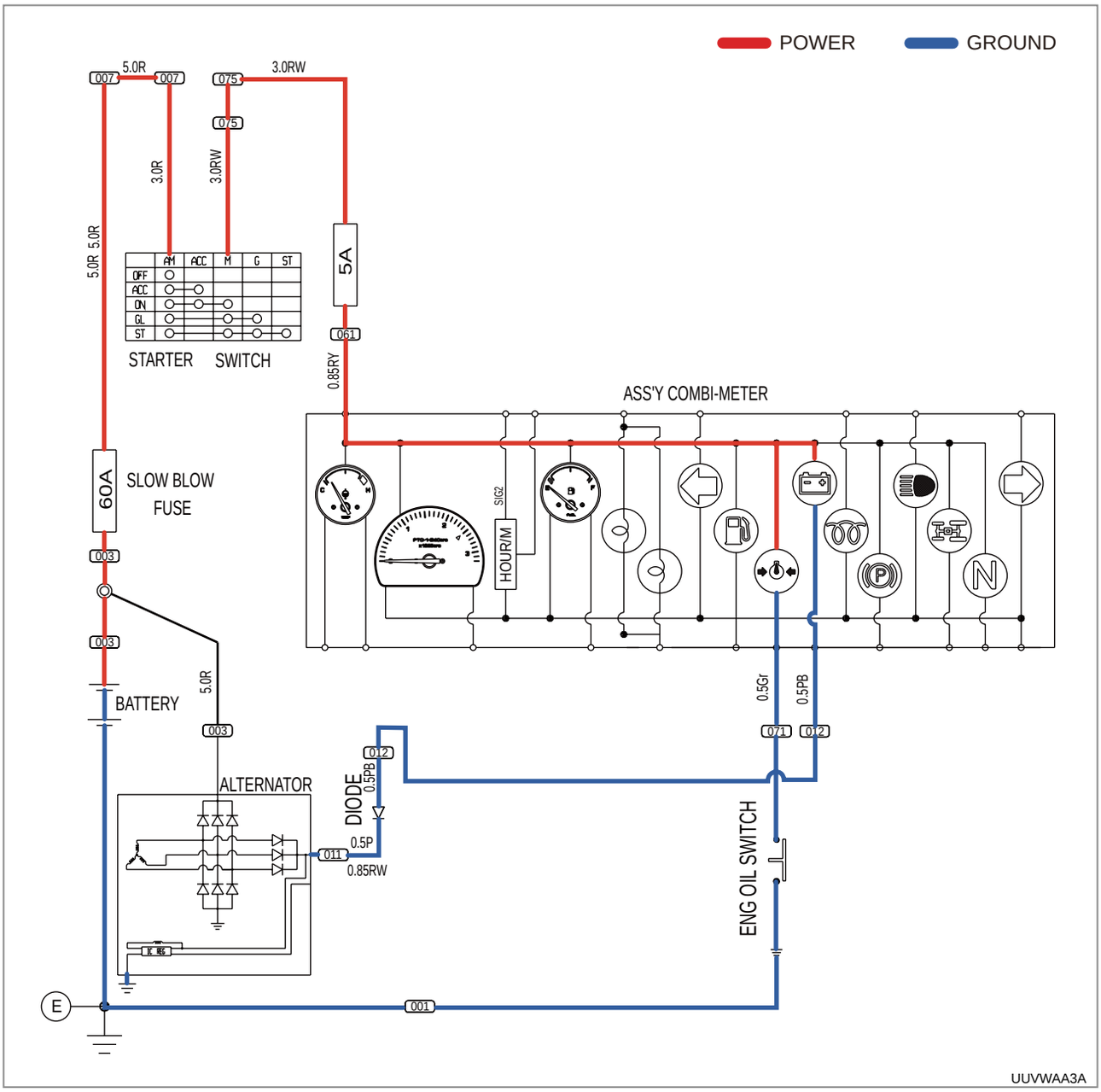
4. OPERATING PRINCIPLE

4.1 WHEN THE KEY SWITCH IS TURNED TO “ON” POSITION

- The power is supplied to display unit, holding coil of stop solenoid, IC regulator of alternator, combination switch, engine oil pressure sensor, dash board.



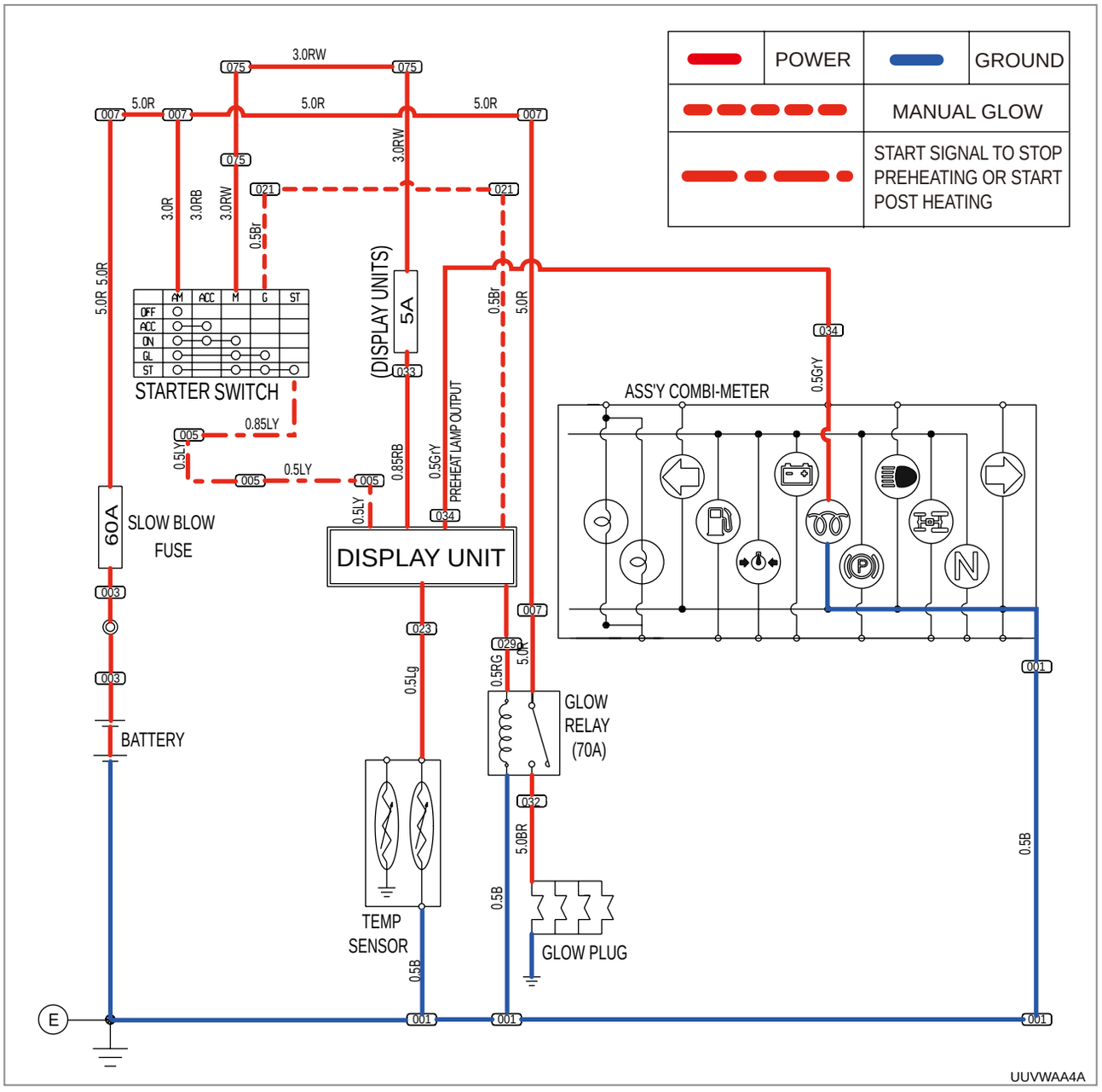
- Using this power, the display unit sends a signal to the pull coil relay for 1 second so that the pull coil of stop solenoid is pulled to open the fuel line and stay open by its hold coil.



- Power supplied to the combi-meter flows through the charge warning lamp and diode on through to ground in the alternator to turn the charge warning lamp on.This ground circuit changes to 12V when the alternator is operating.

- Power supplied to the engine oil pressure sensor (engine oil switch) will turn on the engine oil pressure warning lamp on the dash board because the pressure sensor circuit is closed when the oil pressure is 7 psi or less.

4.2 PREHEATING AND POST HEATING

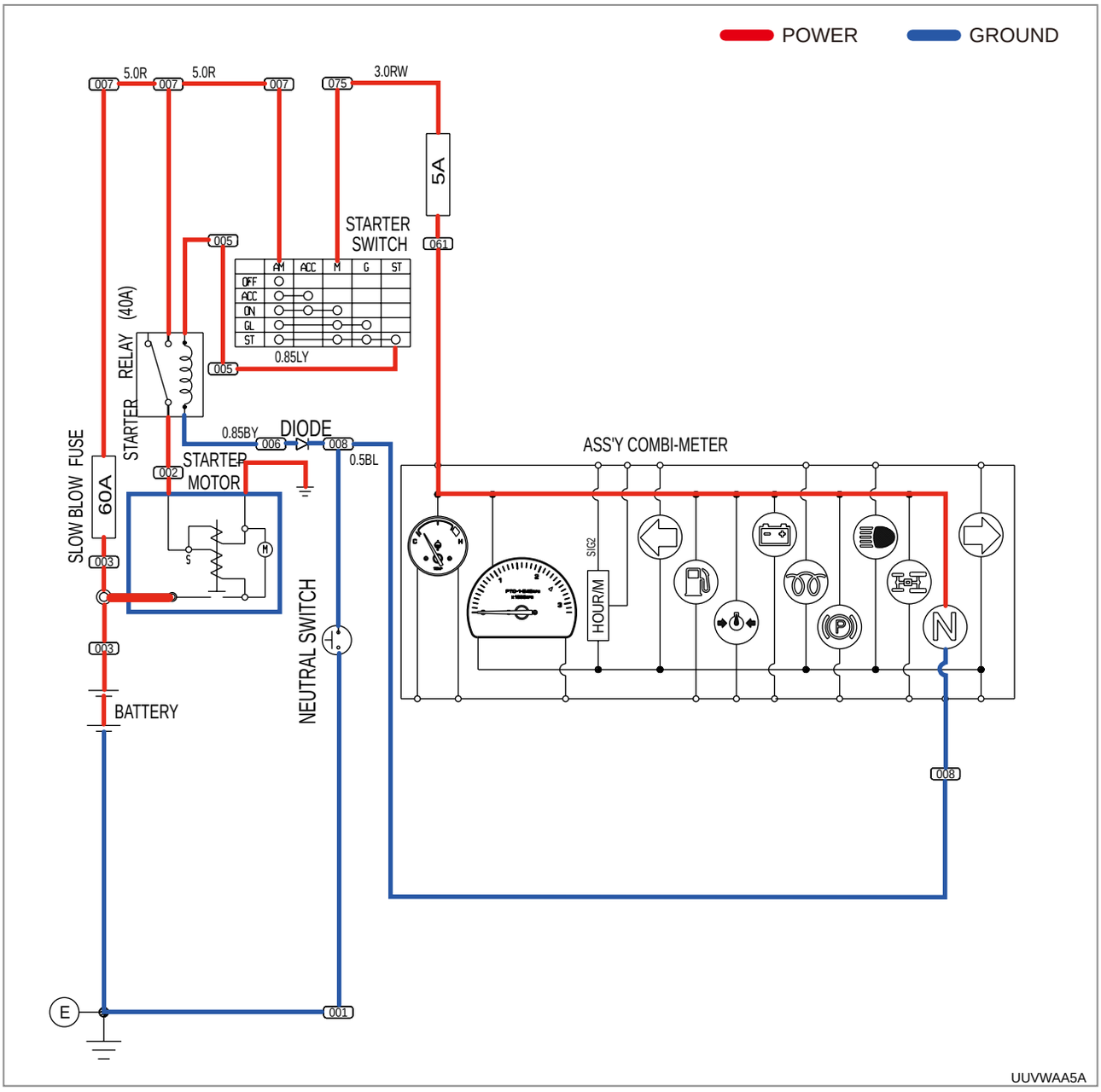


- When the key switch is turned to “ON” position, the display unit determines whether the preheating(or post heating) is necessary or not using temperature input signal from coolant temperature sensor. If the coolant is less than 30°C (86°F), the display unit gives the signal to glow relay to activate glow plugs for 15 seconds of preheating time. At the same time, the display unit also gives the power to glow indication lamp on the dash board for 8 seconds.
- The preheating seconds and indication seconds can be shortened by turning the key switch to start position and another 15 seconds of post heating starts when the key is returned to “ON” position. The indication lamp is not activated during the post heating period.
- The glow plugs can be activated manually by holding the key in between “ON” and “START” position.

REMARK

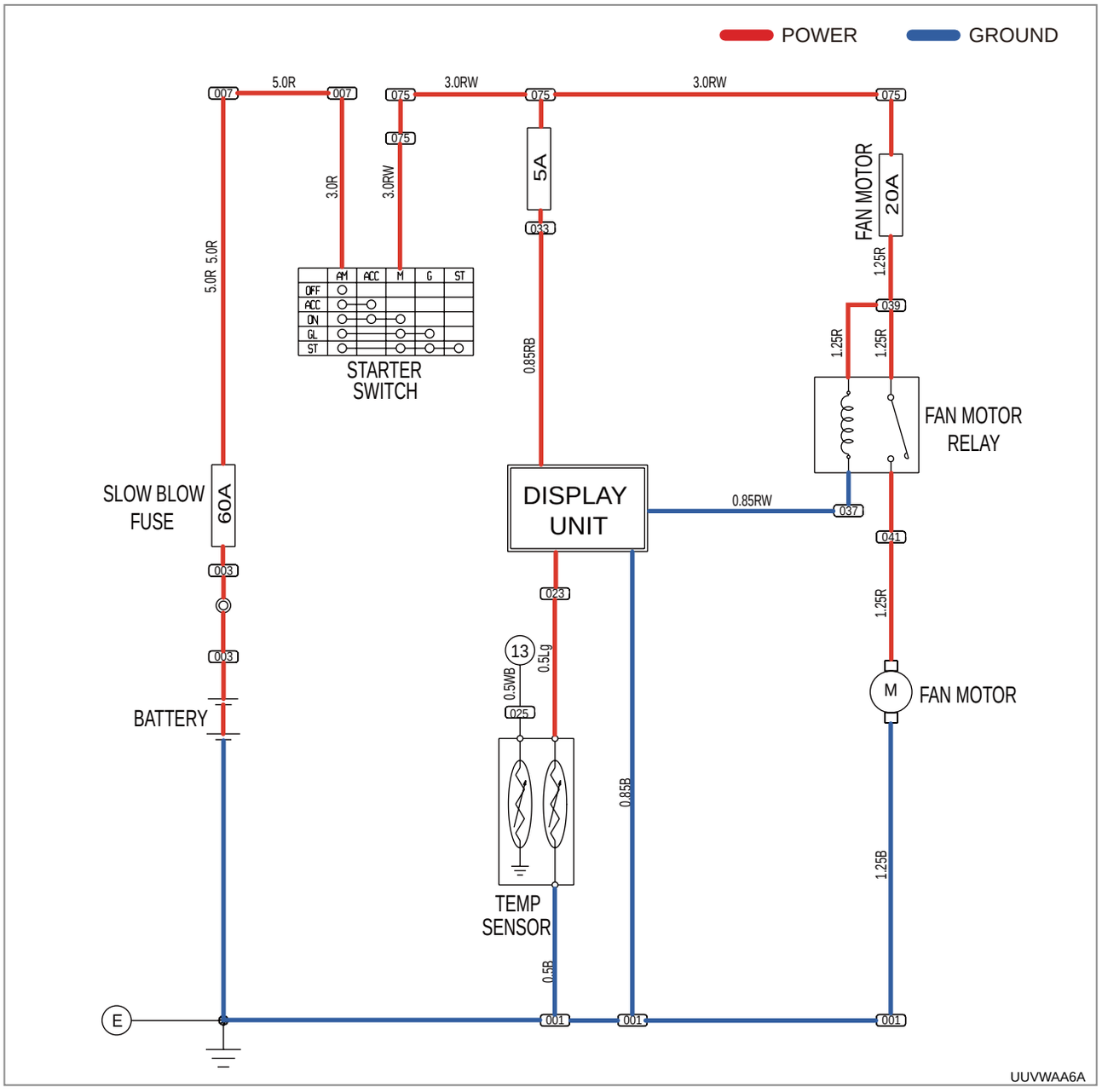
- **The post heating process makes the combustion condition of engine better to reduce harmful emissions which can be produced a lot right after engine start in cold weather. It also helps engine to reach its normal running condition faster by expediting the warm-up process.**

4.3 WHEN THE KEY SWITCH IS TURNED TO “START” POSITION



- The start signal from key switch activates start relay to engage start motor. However the start relay can not be activated when the negative line of start signal is open by the neutral switch which is mounted on the gear shift lever. The neutral switch is normally open and closed only when the gear shift lever is in its neutral position.

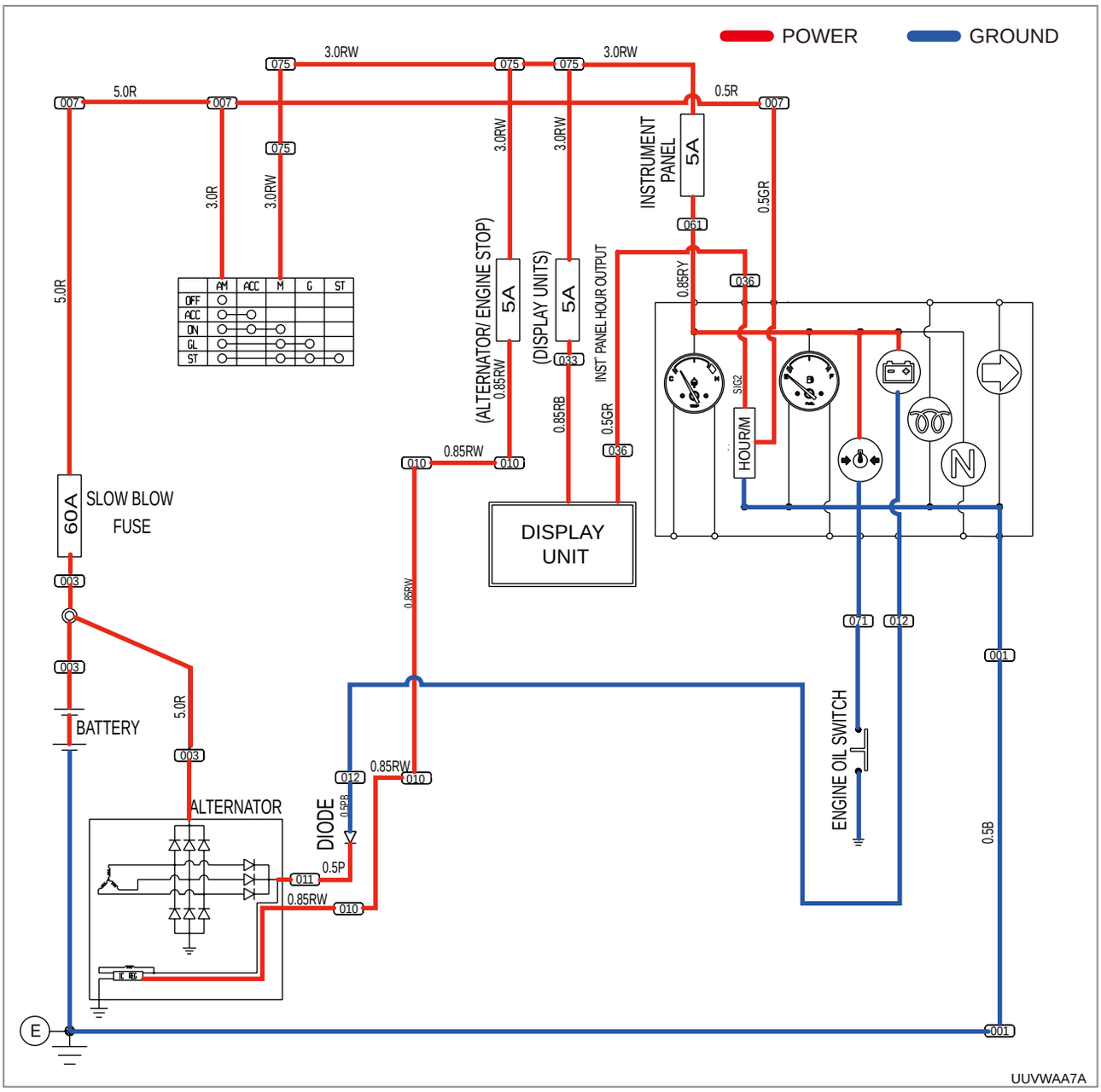
4.4 FAN MOTOR OPERATION



- When the key is in the “ON” position, the display unit controls radiator cooling fan motor in accordance with coolant temperature. It runs the fan motor when the coolant temperature raises over 80°C (176°F) and stops the fan motor when the coolant temperature drops below 75°C (167°F). The 5°C (41°F) gap between two points is to prevent continual “ON” and “OFF” operation of fan motor. The fan motor can run even when the engine is stopped if the key is in “ON” position and the coolant is still hot.

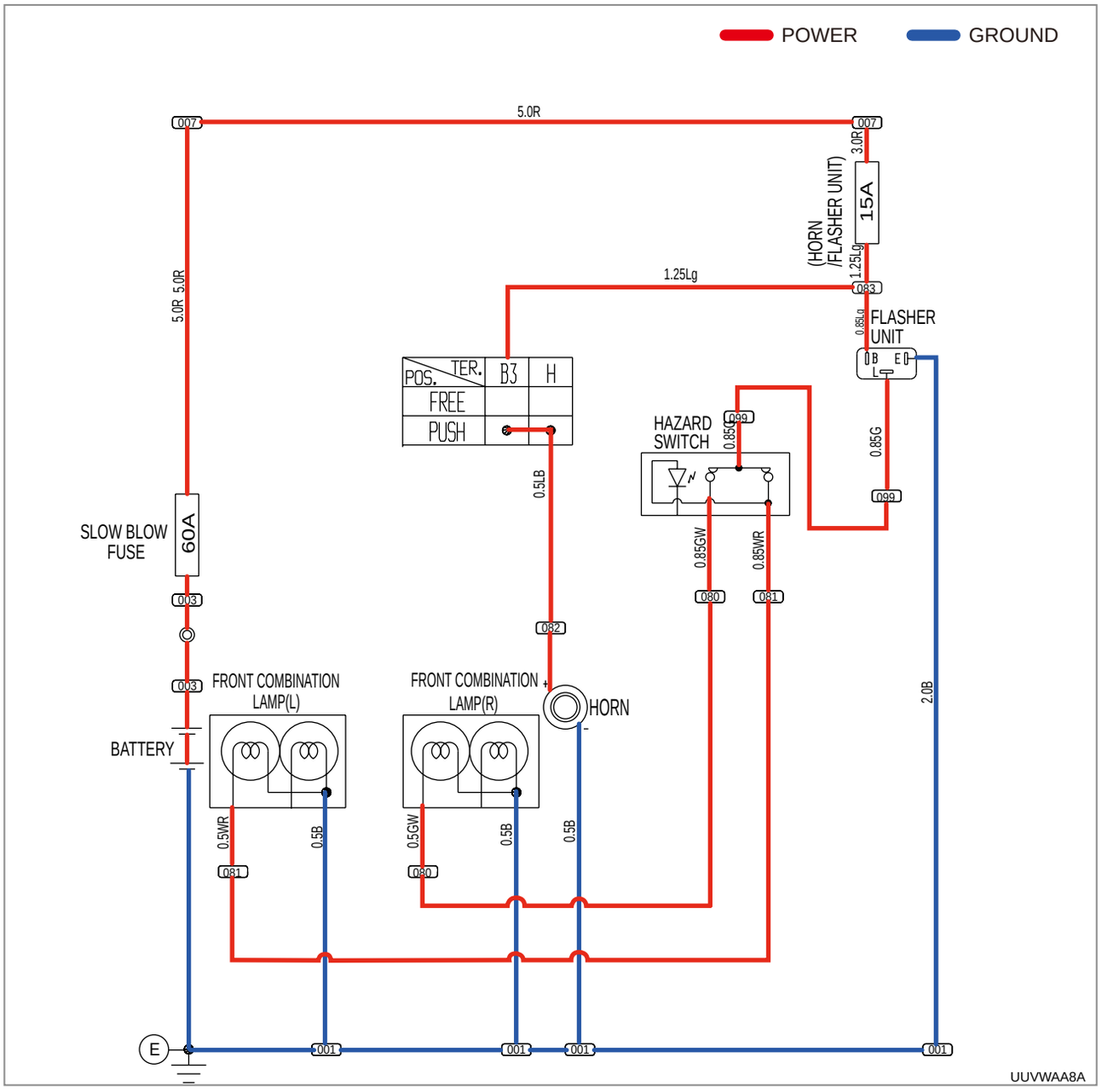
  To prevent engine failure, the display unit keeps running fan motor even if there is any short-circuit or disconnected wire on the temperature signal circuit.

4.5 RIGHT AFTER THE ENGINE STARTS



- The generator starts generating to supply the 13.5~14V to diode and charge warning lamp. However, the current can not flow through the diode then the charge warning lamp on the dash board turns off because the voltage difference between diode is almost 0V.
- When the generator is generating the power properly, the voltage to the display unit will be over 13.5V then the display unit starts to send the signal to hour meter on the dash board to operate it. Therefore the hour meter operates only when the generator runs properly.
- As the engine oil pressure builds up more than 7 psi, the engine oil pressure sensor circuit opens to turn off the engine oil pressure warning lamp on the dash board.

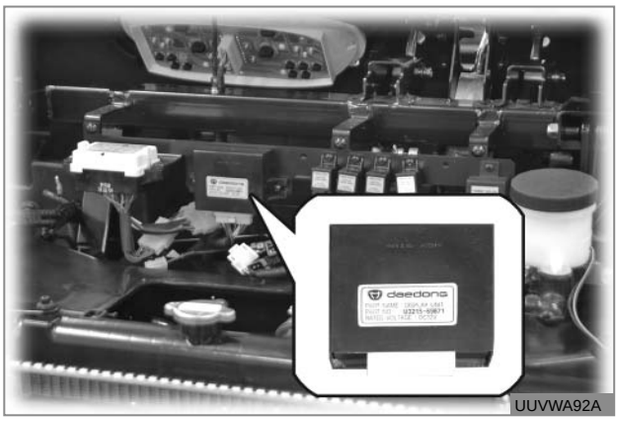
4.6 WHEN THE KEY SWITCH IS IN “OFF” POSITION (HORN AND TURN SIGNAL OPERATION)



- The engine stop solenoid will return by the return spring to block the fuel supply as the power on the holding coil of stop solenoid is eliminated.
- Hour meter stops as the voltage from generator to the display unit drops below 13V.
- However, the turning signal lamps, horn and flasher lamps (if equipped) can be operated while the key is in “OFF” position as the power line of those are directly connected to battery.

5. ELECTRICAL COMPONENTS

5.1 DISPLAY UNIT



The display unit is installed to the relay bracket under the hood.

FUNCTION

1. Hour meter operation:

   If the alternator in the vehicle operates normally to produce voltage of more than 13.5 V, the display unit supplies current to the hour meter on the instrument cluster to operate the meter.

2. Speedometer operation:

   It operates the speedometer on the instrument cluster by receiving waveform signals from the speed sensor which is mounted on the gear box.

3. Automatic preheat control:

   When the coolant temperature is below 30˚C (86˚ F), it operates the preheat relay to control the preheat operation as well as the preheat indicator on the instrument cluster. When the ignition switch is turned to the “ON” position, the preheat indicator on the instrument cluster comes on 8 seconds and the preheat relay is operated for up to 15 seconds to preheat the engine. The preheat operation is completed when the ignition switch is turned to the “ST” position and then released. Then, immediately, the post-heating operation is performed for 15 seconds. Therefore, the preheat time can be less than 15 seconds on occasion while the post-heating time is always 15 seconds.

4. Preheat system protection:

   If the voltage becomes over 16 V, the preheat and post-heating operations are stopped to protect the preheat system.

5. Manual preheating:

   When the ignition switch is turned to the “HEAT(GLOW)” position, between the “ON” and “ST” positions, and held in that position, the display unit operates the preheat relay and preheat indicator on the instrument cluster to heat the engine manually.

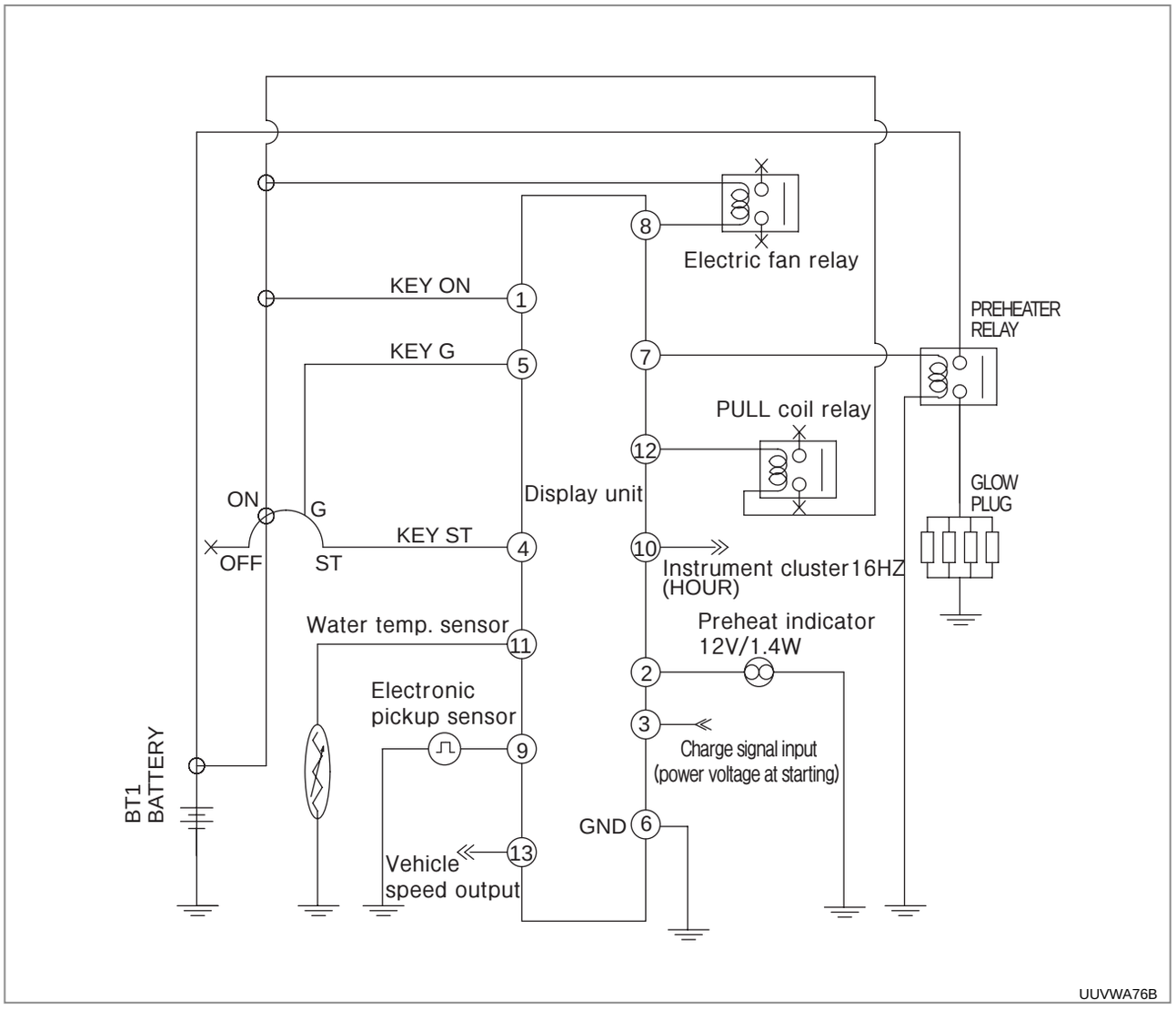
6. Stop solenoid pull-coil operation:

   When the ignition switch is turned to the “ON” position to start the engine, the display unit operates the pull coil (32 A) for 1 second to pull the stop solenoid. As the stop solenoid is pulled, the injection pump rack in the engine is moved from the stop position to the engine starting position. Once the stop solenoid is pulled, it is held in the fuel supply status by the hold coil (0.77 A) which is powered directly by the ignition switch.

7. Cooling fan operation:

   When the coolant temperature sensor detects the coolant temperature over 80 degrees, the cooling fan relay is operated to operate the cooling fan. When the coolant temperature drops below 75 degrees, the relay is stopped. The 5-degree difference between the activation and deactivation temperatures is set to protect the cooling fan from turning “ON” and “OFF” too frequently.

5.1.1 EXTERNAL WIRING DIAGRAM FOR DISPLAY UNIT

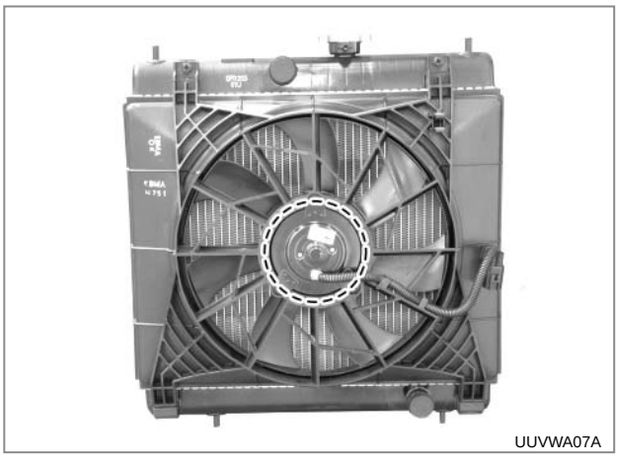


DISPLAY UNIT CONNECTOR DESCRIPTION

6	5	4		3	2	1
13	12	11	10	9	8	7

No.	Signal
1	key on + 12V
2	Preheat lamp output
3	Alternator charge signal input
4	Key switch ST input
5	Manual preheat signal input
6	GND
7	Preheat relay output
8	Fan motor output
9	Electronic pickup signal from ground speed
10	16 Hz output for hour meter
11	Coolant temperature sensor signal input
12	1 sec. output for pull coil
13	Speed signal output

5.2 COOLING FAN MOTOR


UUVWA07A

The cooling fan motor is installed on the back of the radiator under the hood.

MOTOR SPECIFICATIONS

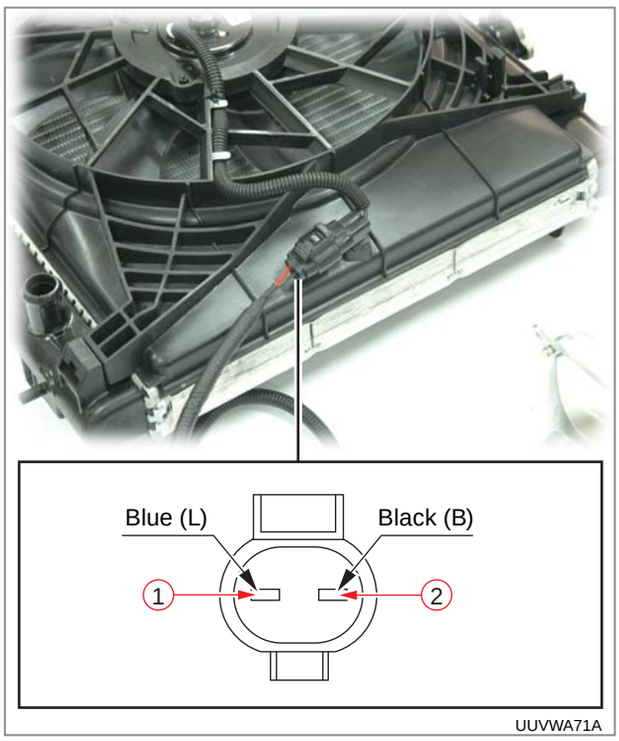
Power	100W ± 10% (Max)
Rated speed	2060 rpm ± 10%
Rated voltage	DC 12V
Rated current	5 ~ 10A
Rotating direction	Counterclockwise (seen from front)
Free play in motor shaft direction	0.1 ~ 0.3 mm

OPERATION

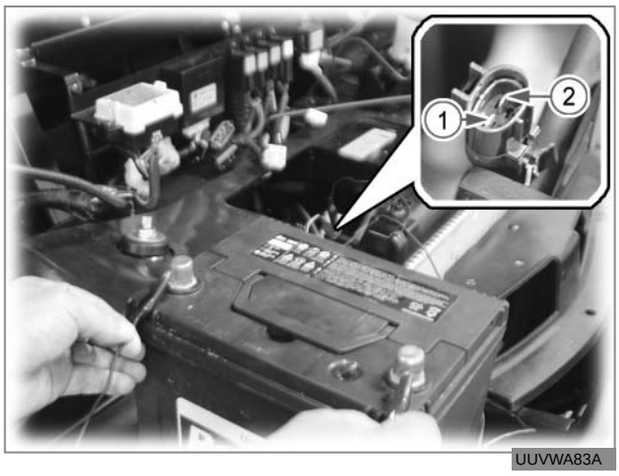
- The cooling fan motor is operated and stopped according to the preset coolant temperature.

FAN MOTOR operated	Coolant temperature over 80˚C (176˚F)
FAN MOTOR stopped	Coolant temperature below 75˚C (167˚F)

FAN MOTOR TEST



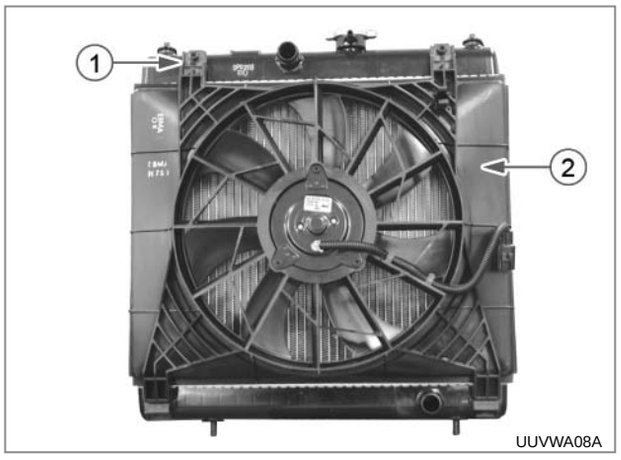
UUVWA71A



UUVWA83A

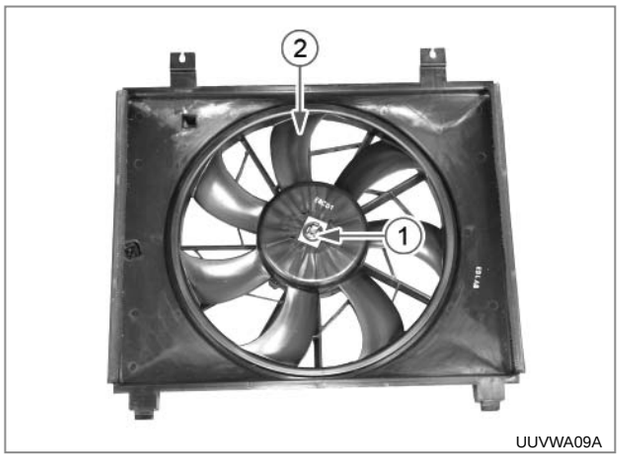
1. Turn the ignition switch to the “OFF” position and disconnect the electric motor connector.
2. Connect the terminal (1) to the positive battery terminal and the terminal (2) to the negative battery terminal using a jump leads.
3. If the fan motor does not operate, replace it with a new one.

REMOVAL



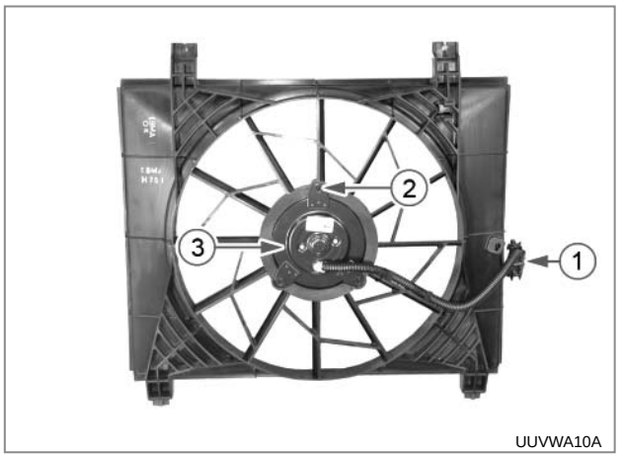
UUVWA08A

1. Unscrew the radiator cover mounting bolts (1) (M6, 2 EA) using the 10 mm socket wrench to remove the cover assembly (2).



UUVWA09A

2. Remove the clip (1) from the cooling fan side. Then, remove the cooling fan (2) by pulling it up.



UUVWA10A


UUVWA11A

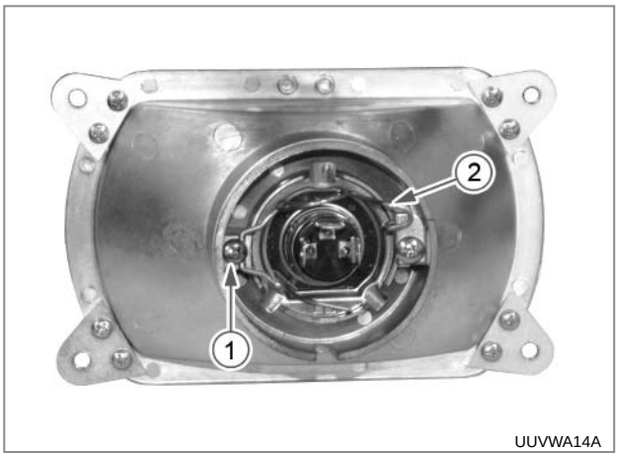
3. Turn the connector (1) to disconnect it. Then, unscrew the cooling fan motor mounting screws (2) to remove the cooling fan motor (3).

5.3 HEADLAMP

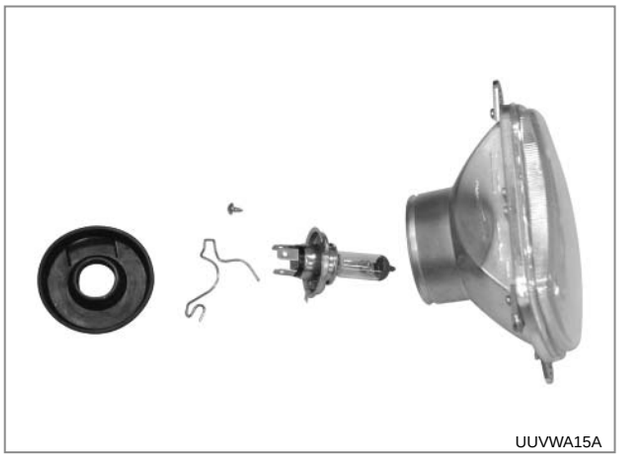
The headlamps are attached to the left and right of the hood.

REMOVAL

1. Unscrew the hex. screws (1) from the front of the lamp to remove the headlamp.



2. Remove the rubber cap and unscrew the screws (1) to separate the mounting spring (2).

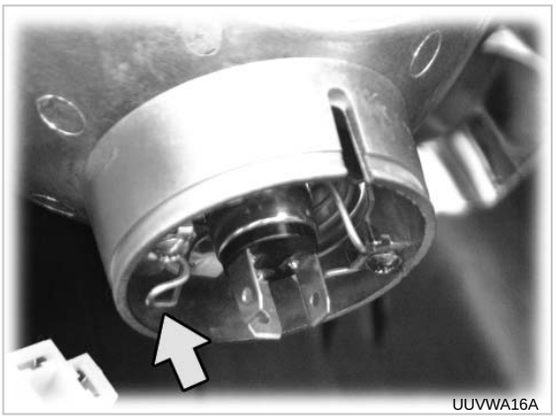


3. Pull out the bulb.

REMARK

HEADLAMP BULB REPLACEMENT

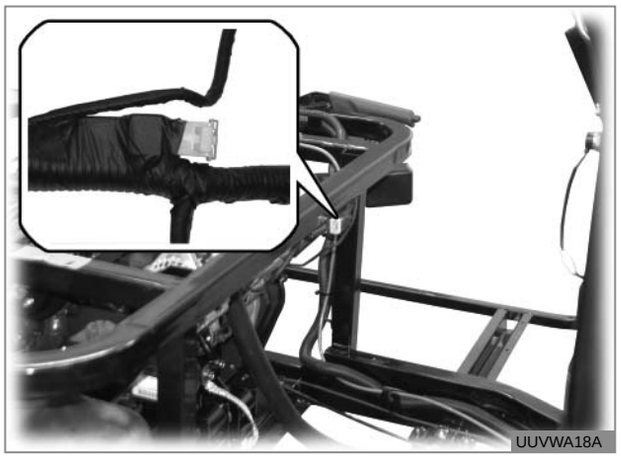
1. **Open the hood and disconnect the headlamp connector.**



2. **Remove the rubber cap. Press one side of the mounting spring and rotate it counterclockwise to separate it. Then, pull it out to the other side.**

3. **Remove the bulb and fit a new one.**
- **Bulb specification: 12 V 55/60 W**
- **Do not touch the glass of new bulb.**

5.4 SLOW-BLOW FUSE



The slow-blow fuse is attached on the frame under the seat.

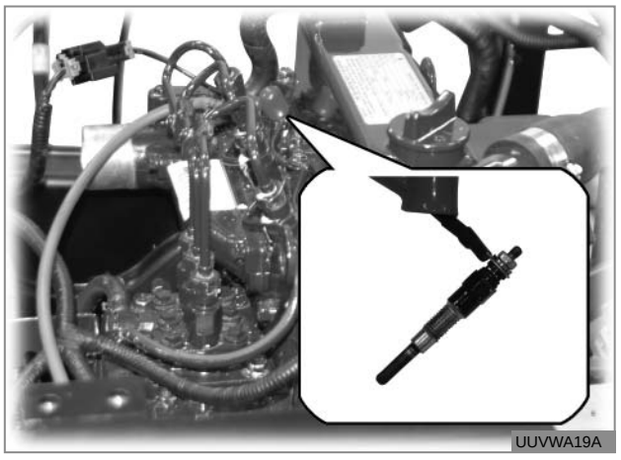
Capacity : 60A

If the slow-blow fuse is blown, all electric systems in the vehicle stop their operation.

If any electric system does not operate while the battery status good, the slow-blow fuse should be checked.

If the fuse is blown repeatedly, it is probable that B+ line (battery power) has a short circuit to body.

5.5 GLOW PLUG



The glow plug is installed in the engine cylinder head.

The glow plugs are used to warm the air in the combustion chamber before the engine is started.

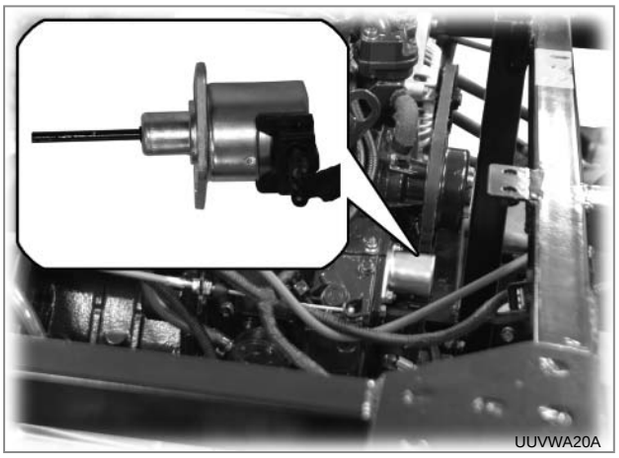
- Current: Max. 20 A of current flows through the glow plug in 4 seconds after voltage is engaged. The glow plug temperature rises up to 800° C (1,472°F) in 4 seconds.

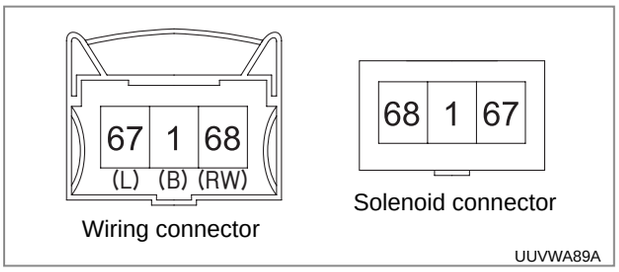
- Continuity test:
  Disconnect the leads and measure the resistance between the terminal and body. If the measurement is over the specification (approx. 0.43 Ω), replace the glow plug.


UUVWA84A

- Circuit test:
  Disconnect the glow plug connector and connect the positive test lead to the wiring connector terminal (red with black stripe) and negative test lead to the body. Check that the voltage is 12 V when the ignition switch is in the "HEAT" position (manual preheating condition).

5.6 ENGINE STOP SOLENOID

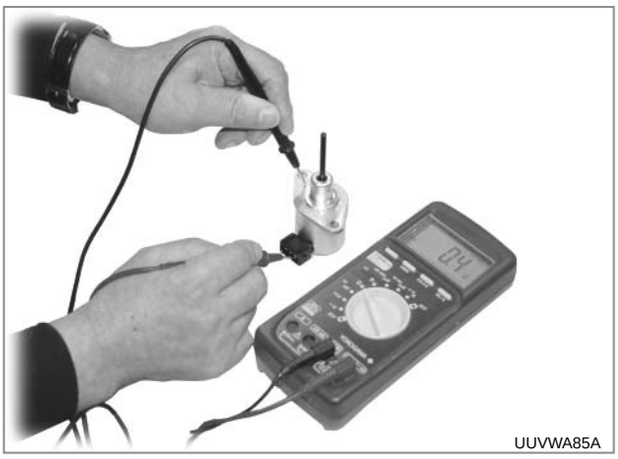

UUVWA20A



UUVWA89A

The engine stop solenoid is installed on the engine gear case.

The resistance of the engine stop solenoid should be measured when the wiring connector is disconnected.


UUVWA85A

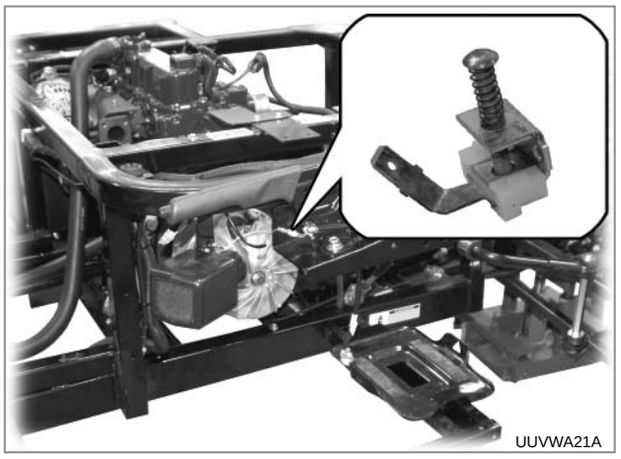
Tester selector	Tester's measuring point		Remarks	Result
	Red lead	Black lead		
Resistance	Connector (68)	Connector ① (GND)	Hold coil	Approx. 13.8 Ω
	Connector (67)	Connector ① (GND)	Pull coil	Approx. 0.4 Ω

- The voltage should be measured when turning the key switch to ON position when the wiring connector is installed.


UUVWA86A

Tester selector	Tester's measuring point		Remarks	Result
	Red lead	Black lead		
VDC	Connector ⑥⑧ (RW)	Connector ① (GND) (B)	Key switch ON	DC 12V
	Connector ⑥⑦ (L)	Connector ① (GND) (B)	Key switch OFF → ON : voltage generated for 1 second	DC 12V

5.7 PARKING BRAKE SWITCH


UUVWA21A

The parking brake switch is installed to the front of the parking brake lever on the left side from the driver's seat.

- N.O (Normally open) type:
  It is normally open (OFF) but it is closed (ON) when contact point is pressed.

CONTINUITY TEST

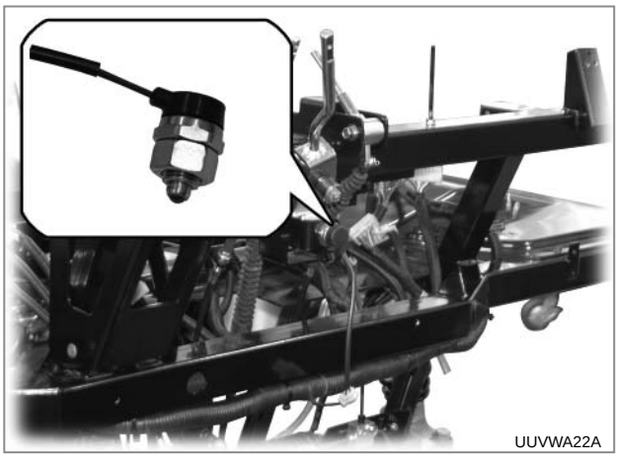

UUVWA87A

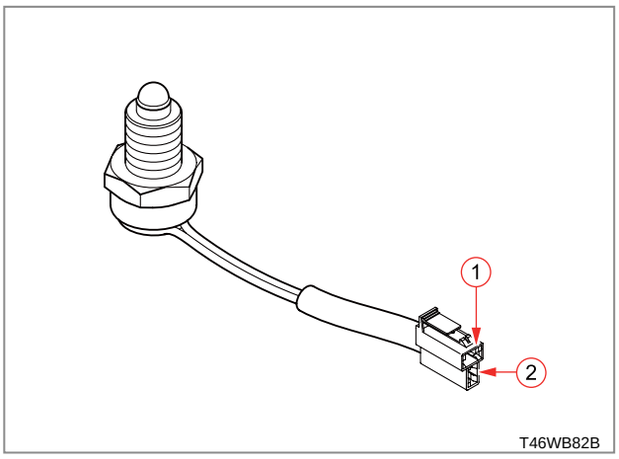
Disconnect the brake switch connector and measure the resistance between the switch terminal and chassis (ground).

Measure the resistance separately with the parking brake lever applied and released.

Tester selector	Tester's measuring point		Remarks	Result
	Red lead	Black lead		
Continuity	Switch terminal	Body (GND)	Parking brake released (switch Released)	No continuity
			Parking brake applied (switch pressed)	Continuity (beeping)

5.8 SAFETY START SWITCH


UUVWA22A



T46WB82B

The safety start switch is installed to the front of the shift selector lever in the main instrument panel.

This switch is installed to prevent the engine from starting when the shift lever is not in the neutral position.

- N.C (Normal Closed) Type

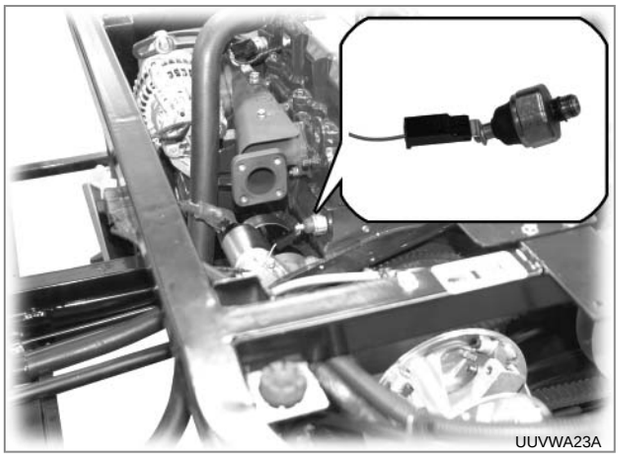
  It means that it is normally closed (ON), but it is open (OFF) when the contact point is pressed.

CONTINUITY TEST


UUVWA96A

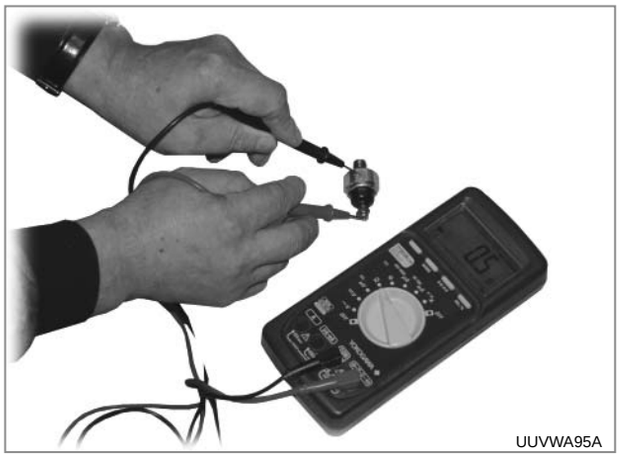
Range	Tester's measuring point		Remarks	Result
	Red lead	Black lead		
Continuity	No. 1 connector	No. 2 connector	Switch Released	Continuity (beeping)
	No. 1 connector	No. 2 connector	Switch Pushed	No continuity

5.9 ENGINE OIL PRESSURE SWITCH



The engine oil pressure switch is installed on the cylinder block.

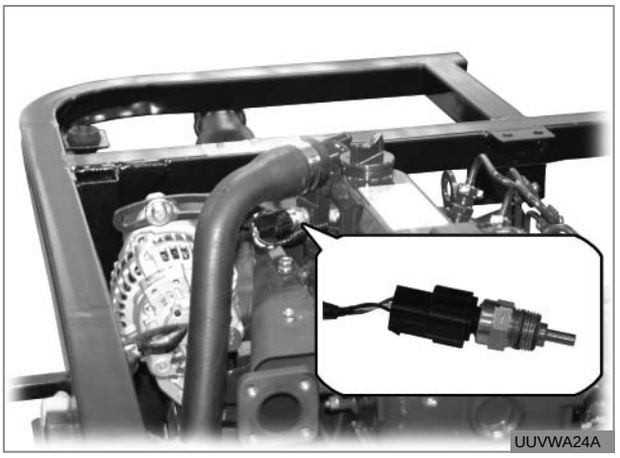
If the engine oil pressure drops below 0.5 ± 0.1 kg/cm^2 (7 psi ± 1.4 psi), the circuit in the sensor closed to send a signal to the oil pressure warning lamp on the instrument panel.



Disconnect the engine oil pressure switch connector and disassemble the engine oil pressure switch to measure its resistance.

Tester selector	Tester's measuring point		Remaks	Result
	Red lead	Black lead		
Resistance	Oil switch (+)	Body (GND)	No pressure applied	Continuity (0.5 Ω)

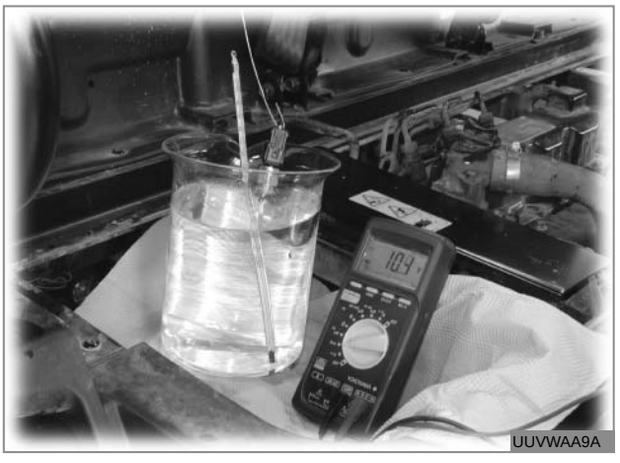
5.10 COOLANT TEMPERATURE SENSOR



The coolant temperature sensor is installed on the coolant flange.

It is not recommended to measure the resistence of temperature sensor separately. Measure the V(DC) on the display unit while the key is “ON” with the wire connected.

TEST



Disassemble the coolant temperature sensor and soak it in water in a test container. Prepare the water with its temperature according to the value in the table below, Make sure that only the tip of the sensor is soaked in water.


UUVWAB1A

Connect the positive test lead to the pin No. 2 and the negative test lead to the pin No. 3 of the cluster connector and measure the VDC with the ignition switch in the “ON” position.

INSTRUMENT PANEL WIRE CONNECTOR

WB B

1	2	3	4	5	6	7	8	9	10
20	19	18	17	16	15	14	13	12	11


UUVWAB2A

Connect the positive test lead to the pin No. 11 and the negative test lead to the pin No. 6 of the display unit connector and measure the VDC with the ignition switch in the “ON” position.

DISPLAY UNIT WIRE CONNECTOR

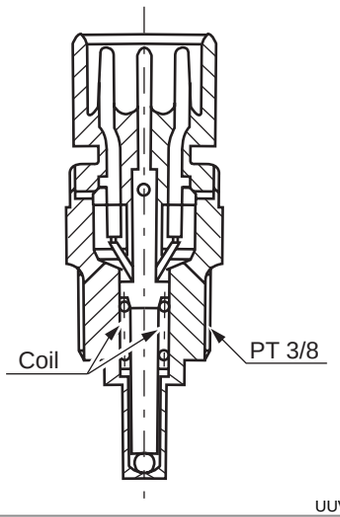
1	2	3		4	5	6	B
7	8	9	10	11	12	13	

LG

Temp. (°C)	15°	30°	60°	Remarks
To display unit input (VDC)	Approx. 3.2 V	Approx. 2.5 V	Approx. 1.4 V	Preheating or fan operation
To instrument cluster input (VDC)	Approx. 10 V	Approx. 10 V	Approx. 10 V	Temp. gauge operation

REMARK

- **The temperature sensor is a dual sensor and it has two purposes.**



UUVWAB5A

The coil with low resistance in the sensor is for temp. gauge. Therefore the voltage value does not change a lot as shown in the table above. However, the other coil with high resistance in the sensor is for supplying the signal to display unit so that it can determine when the fan motor or preheat relay should be activated. Therefore a voltages measurement is recommended for preheating and fan motor sensor testing as shown in the table above. A resistance measurement is recommended for temp. gauge check as below table.

1. SENSOR FOR TEMP. GAUGE

- Resistance

Temp. (°C)	60	85	110	125
Resistance (Ω)	(125)	48.4 ± 5.8	$24^{+2.2}_{-1.9}$	(15.2)

- ( ) : Reference value

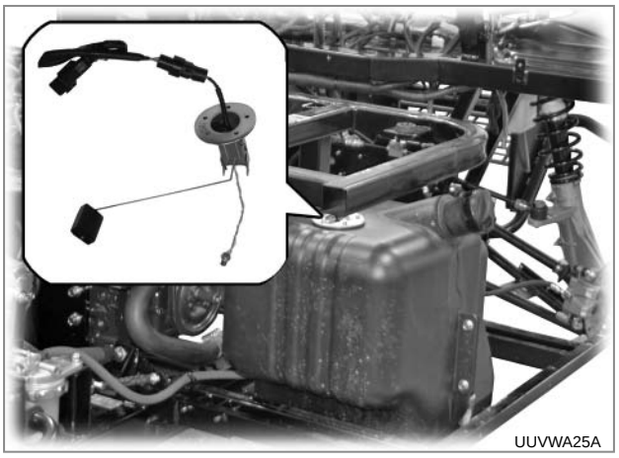
2. SENSOR FOR PRE-HEATING AND FAN MOTOR.

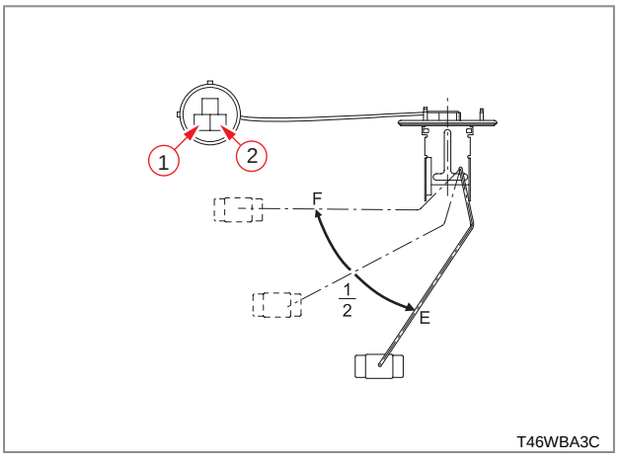
- Resistance

Temp. (°C)	- 40	- 20	0	20	40
Resistance (kΩ)	(48.14)	15.48 ± 1.35	(5.790)	2.45 ± 0.14	(1.148)
Temp. (°C)	60	80	100	110	120
Resistance (kΩ)	(0.5865)	(0.3222)	(0.1884)	0.1471 ± 0.002	(0.1163)

- ( ) : Reference value

5.11 FUEL SENDER


UUVWA25A

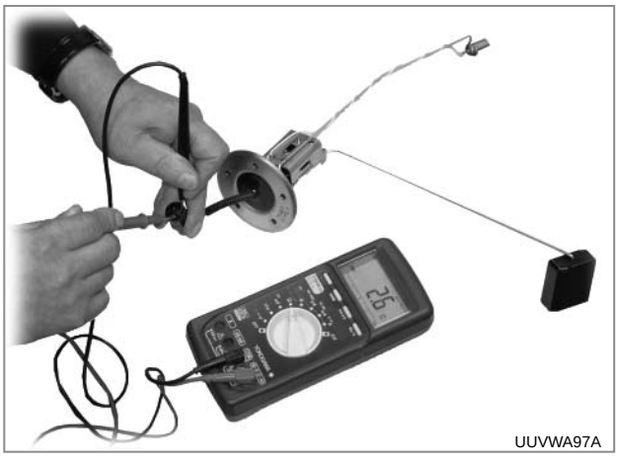


T46WBA3C

The fuel sender is installed on the top of the fuel tank.

The sender float moves with the fuel level in the fuel tank, changing resistance in the circuit of the fuel gauge.

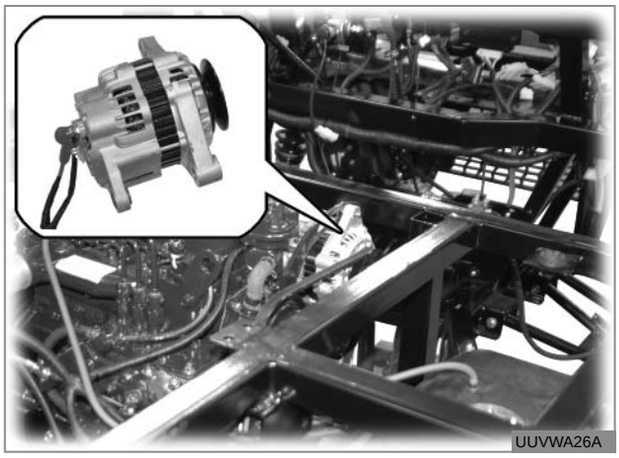
Level	Full	1/2	Empty
Resistance (Ω)	2.5	(32.5)	110
Tolerance (Ω)	± 2	-	± 7


UUVWA97A

Disconnect the fuel sender connector and disassemble the fuel sender to measure its resistance.

Tester selector	Tester's measuring point		Remaks	Result
	Red lead	Black lead		
Resistance	Connector ①	Connector ②	By fuel sender float position	See table above

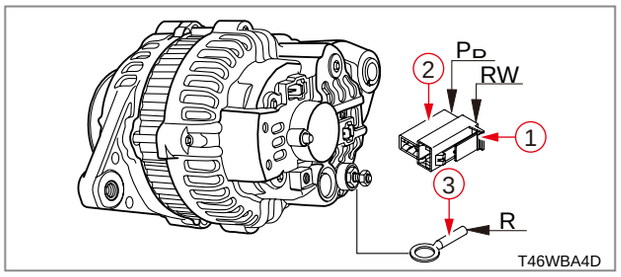
5.12 ALTERNATOR

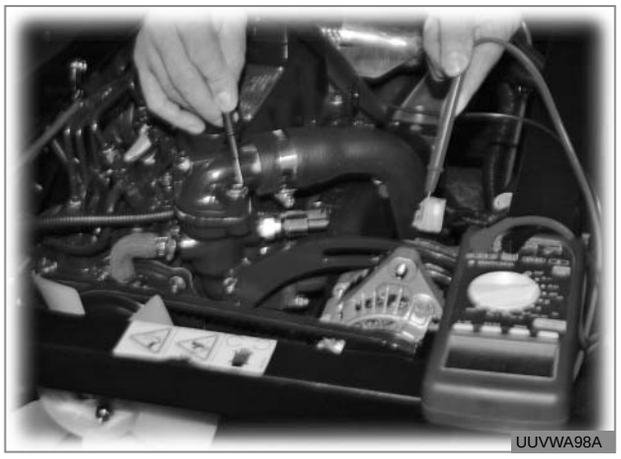

UUVWA26A

There are some components, such as headlamp, start motor, engine stop solenoid and glow plugs, which need a lot of electricity. The alternator supplies power to such components and charges the battery which stores electricity for the vehicle.

Therefore, the alternator correlates with the battery and electric loads and it is an original source of electricity for the entire vehicle.

TEST





Tester selector	Tester's measuring point		Operation	Result
	Red lead	Black lead		
DC Voltage	No.3 (R)	Body (GND)	OFF	DC 12.4 V
			ON	DC 12.3 V
			RUN	DC 14.5 V
	No. 1 (RW)	Body (GND)	OFF	DC 0 V
			ON	DC 12.1 V
			RUN	DC 14.4 V
	No. 2 (P)	Body (GND)	OFF	DC 0 V
			ON	DC 1.9 V
			RUN	DC 14.6 V

● PERFORMANCE CURVE OF ALTERNATOR

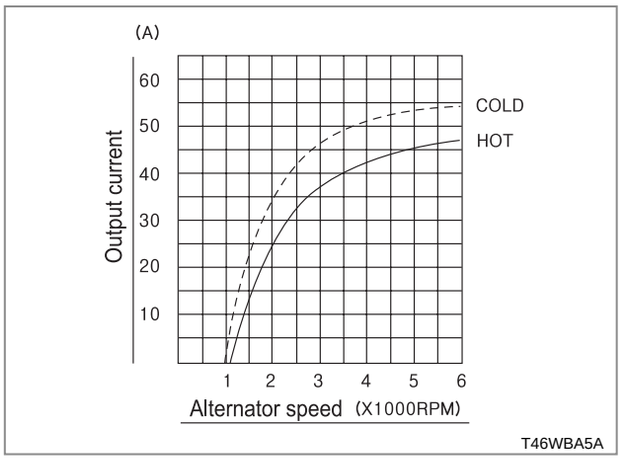
As shown in the performance curve below, the alternator does not generate the power until its speed reaches 1,200 rpm.

This minimum revolution speed is called "Cut In Speed".

If the alternator's speed is below the cut in speed, the alternator does not generate the power and the charge warning lamp does not go off.

Also, the power performance changes as the output current (A) changes according to the coil's temperature (cold and hot). Therefore, the average curve for the cold and hot conditions is presented as guaranteed performance.

In general, the alternator's pulley ratio is determined to maximize the alternator power in the rated speed of the engine.



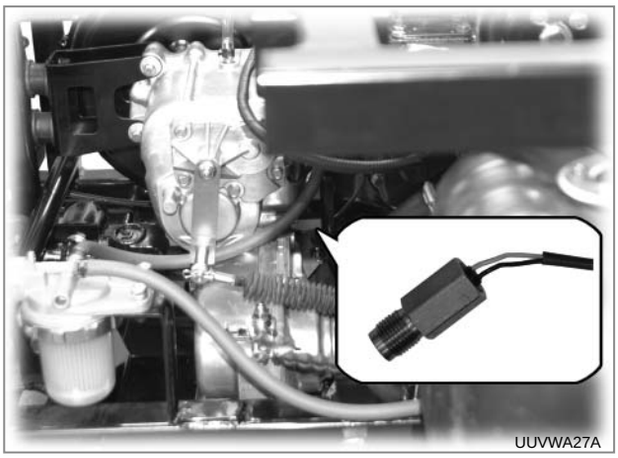
This engine's speed ratio between alternator pulley to crank shaft pulley is 2.16.

Therefore,the alternator pulley speed will be over 1800rpm while the engine is idling.

However,for the fast charge of battery run the engine at 1500rpm or faster.

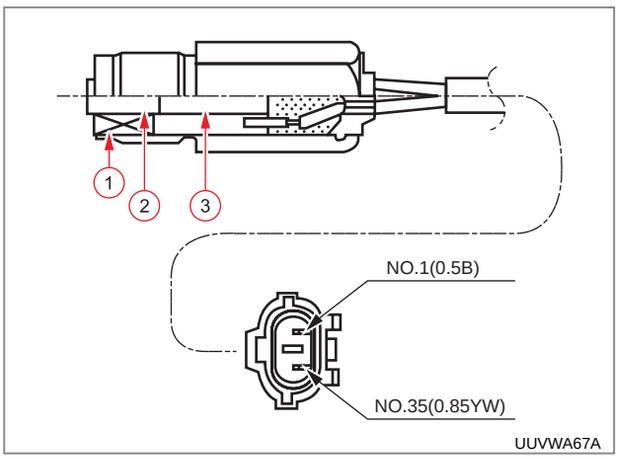
* Maximum output ampere : 50A

5.13 SPEED SENSOR


UUVWA27A

The vehicle speed sensor is attached to the side of the transmission case.

It detects the turning speed of the 31 bevel gear and sends this information to the speedometer on the instrument cluster through the display unit.



UUVWA67A

(1) COIL (2) CORE (3) MAGNET

As the 31 bevel gear rotates, the voltage waveform is generated in the coil in the vehicle speed sensor. Then, the waveform signal, which is proportional to the gear speed, is sent to the display unit which then converts this to the voltage and operates the speedometer on the instrument cluster.

SPECIFICATIONS

Resistance between terminals	2.2 ± 0.2 KΩ (at 15˚C)

TEST


UUVWAB3A

1. Connect the positive test lead to the pin No. 4 and the negative test lead to the pin No. 13 of the instrument cluster connector and measure the VDC. The measurement should be approx. 7 V at high ground speed and 0 V or approx. 14 V when the wheel is standing still.

INSTRUMENT PANEL WIRE CONNECTOR

W

1	2	3	4	5	6	7	8	9	10
20	19	18	17	16	15	14	13	12	11

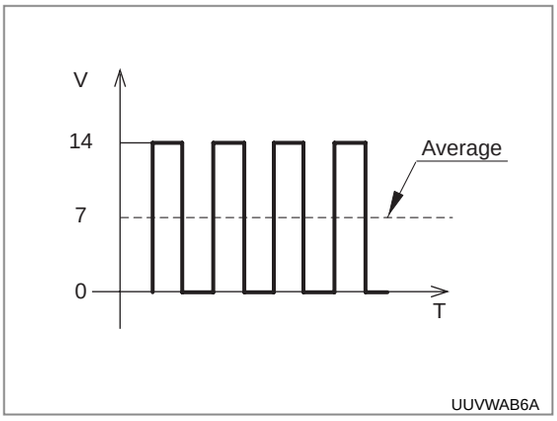
B

IMPORTANT

- **This test should be performed while the vehicle is supported by a stand, the four wheels are off ground and the shift lever is in the "H" position.**

REMARK

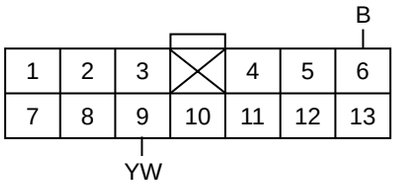
SPEED SIGNAL OUTPUT FROM DISPLAY UNIT



- **As the multi tester can not read exact voltage which is fluctuate with high frequency, it just shows average value(7V) as shown in the picture when the wheel is turning while it shows 0V or 14V when the wheel is stopped.**
- **The speed change can not be read by multi tester as the speedometer in the dash can read it according to the frequency(Hz) change.**

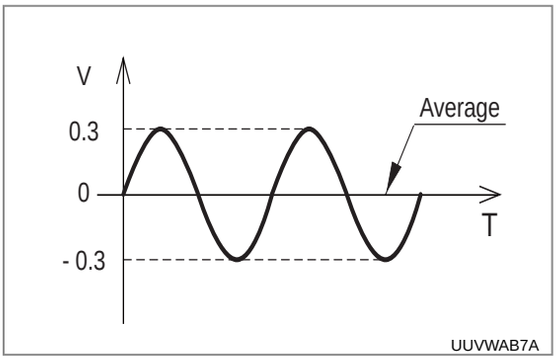
2. Connect the positive test lead to the pin No. 9 and the negative test lead to the pin No. 6 of the display unit connector and measure the VDC. The measurement should be approx. 0 V at full speed and at idle.

DISPLAY UNIT WIRE CONNECTOR



REMARK

SPEED SIGNAL OUTPUT FROM SPEED SENSOR



- **The output voltage from speed sensor is shown in the graph above. However, it is hard to read with normal multi tester as its average is zero and its peak voltage capacity is small due to its curved top and bottom. Therefore, it is recommended to measure the display unit output voltage or instrument panel input signal. Because the display unit amplifys this input signal to 0 ~ 14V and modulates the sine curve to a square wave as shown in the former remark box.**

5.14 KEY SWITCH

The key switch is installed on the right side of the steering wheel.

1. KEY SWITCH'S POSITION

1. OFF
2. ACC
3. ON
4. HEAT(GL) : Manual preheat
5. START

- The “START” position is spring loaded to return to the “ON” position.
- The “HEAT(GL)” position is spring loaded to return to the “ON” position.

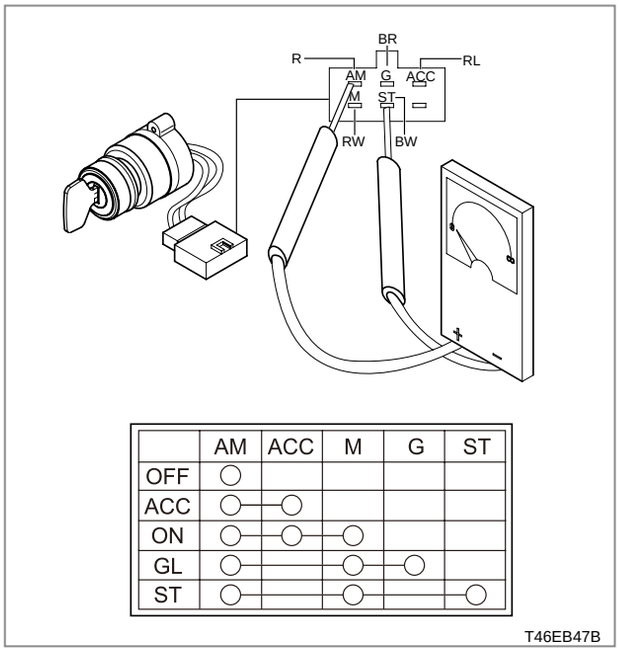
2. KEY SWITCH TEST

Disconnect the key switch from the wiring harness connector.

Use an ohmmeter (Ω) to test the switch.

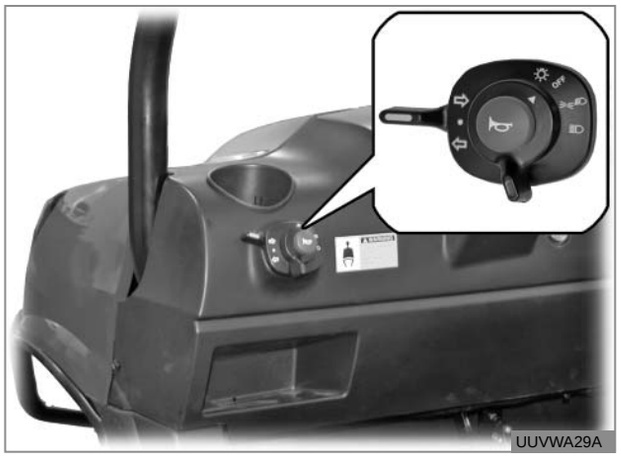
- With the key in "OFF" position, the continuity will not exist between any of the terminals. (resistance : ∝)
- With the key in "ACC" position, there will be continuity between the (AM) and (ACC) terminals. (resistance : 0Ω)
- With the key in "ON" position, there will be continuity between the (AM), (ACC) and (M) terminals. (resistance : 0Ω)
- With the key in "GL" position, there will be continuity between the (AM), (M) and (G) terminals. (resistance : 0Ω)
- With the key in "ST" position, there will be continuity between the (AM), (M) and (ST) terminals.(resistance : 0Ω)

※ If the test results are not as outlined above, replace the key switch.



	AM	ACC	M	G	ST
OFF	○				
ACC	○	○			
ON	○	○	○		
GL	○		○	○	
ST	○		○		○

5.15 COMBINATION SWITCH



The combination switch is installed on the left side from the steering wheel on the main instrument panel.

Six switch positions:

- OFF
- Tail/Head lamp (low beam)
- Head lamp (high beam)
- Turn signal lamp (LH)
- Turn signal lamp (RH)
- Horn

1. HEAD LAMP SWITCH:

When operating the switch to first position, the headlamps (low beam) and tail lamps are turned on.

When operating the switch to 2nd position, the headlamps (high beam) and tail lamps are turned on.

When the switch is in "headlamp (high)" position, the high beam indicator (blue lamp) comes on on the instrument panel.

2. TURN SIGNAL LAMP SWITCH:

The right turn signal lamp comes on when pushing the switch up.

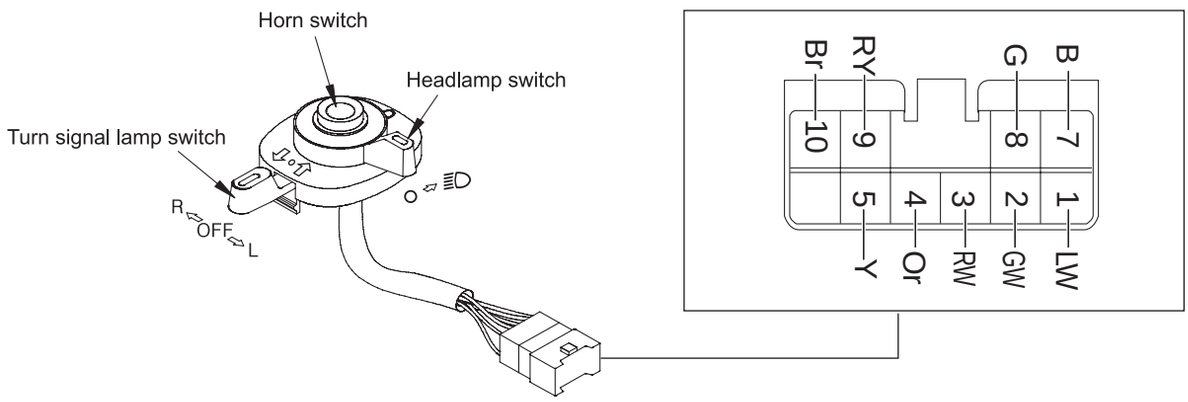
The left turn signal lamp comes on when pulling the switch down.

3. HORN SWITCH:

The horn sounds when pushing it.

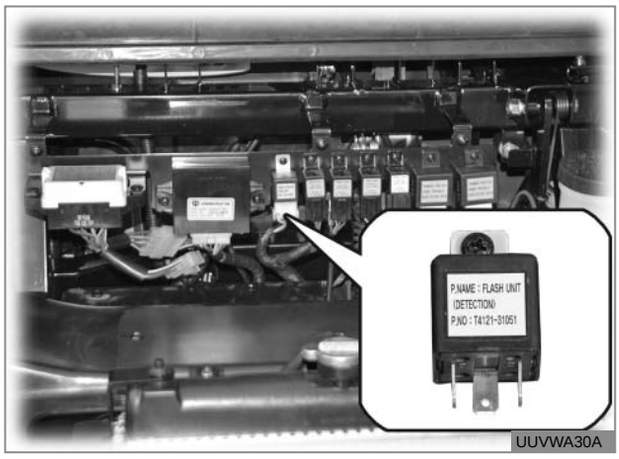
Combination switch

Headlamp switch					Turn signal switch				Horn switch		
Lever operation	B1	T	1	2	Lever operation	B2	R	L	Lever operation	B3	H
Wiring color	RY	Y	Or	Br	Wiring color	G	RW	GW	Wiring color	B	LW
Term. position	9	5	4	10	Term. position	8	3	2	Term. position	7	1
OFF					R ⇨	○—○			FREE		
≫0≪	○—○—○				OFF				PUSH	○—○	
	○—○			○	L ⇦	○		○			



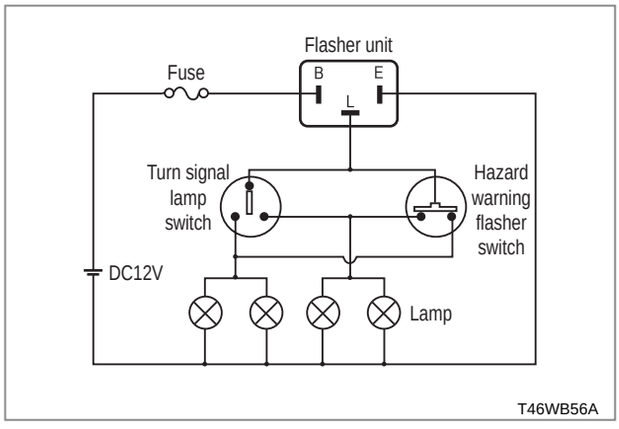
T46WB49D

5.16 FLASHER UNIT (OPTIONAL)



The flasher unit is attached to the relay bracket under the hood.

TERMINAL IDENTIFICATION AND CIRCUIT



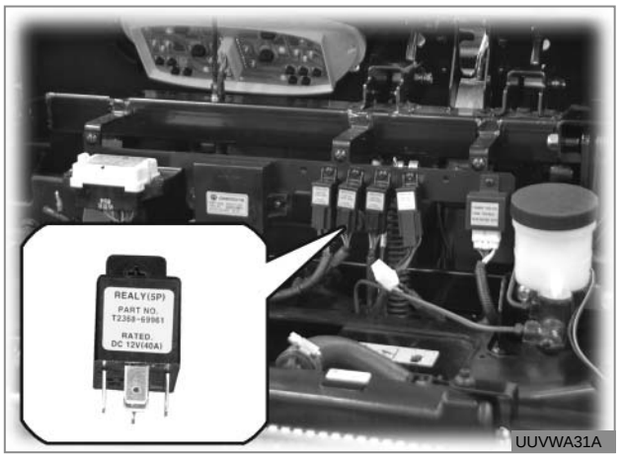
This shows terminals and circuit of the flasher unit.

FLASHER UNIT TEST

A 12-volt battery and auxiliary light are needed to test the flasher unit. Install the battery's positive cable to the terminal B of the flasher unit. Install the light's positive (+) lead to the terminal L of the flasher unit. Install the light' s negative (-) lead to the battery's negative terminal. The light will flash and the unit will make a clicking sound if the unit is functioning properly.

Replace the flasher unit if the test result does not match above.

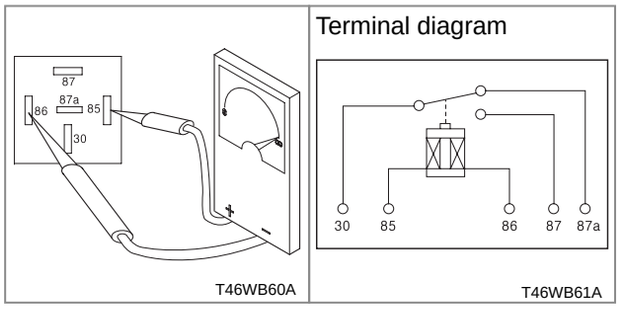
5.17 ENGINE STOP RELAY (5P)



The engine stop relay is attached to the relay bracket under the hood.

This relay is used as power supply to the pull coil of the engine stop solenoid.

RELAY TEST

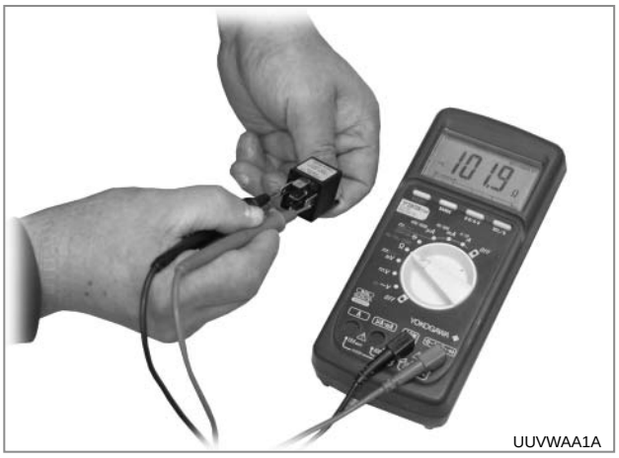


To perform the relay test, disconnect and remove the relay from the wiring.

Check the resistance and continuity within the resistance range (Ω) of a tester.

Numbers on the auxiliary relay terminals indicate corresponding coil and contact.

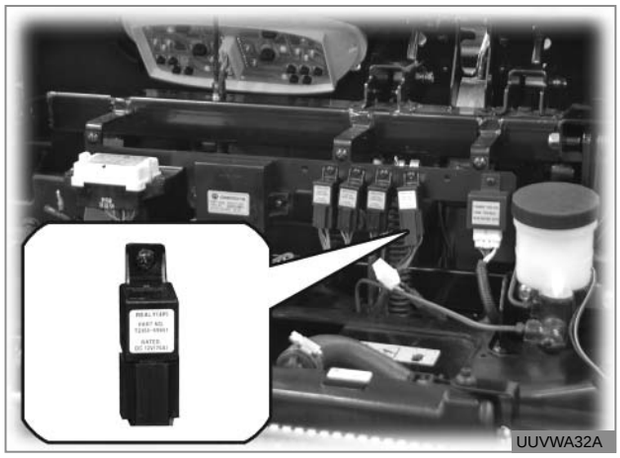
- Capacity: 40A


UUVWAA1A

Tester selector	Tester's measuring point		Result
	Red lead	Black lead	
Resistance	Relay 85	Relay 86	Approx. 105 Ω
	Relay 30	Relay 87a	Continuity
	Relay 30	Relay 87	No continuity

※ When measuring the resistance with a tester, it is OK to switch the leads (red and black).

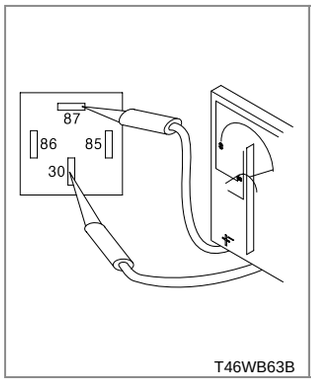
5.18 PREHEAT RELAY (4P)


UUVWA32A

The preheat relay is attached to the relay bracket under the hood.

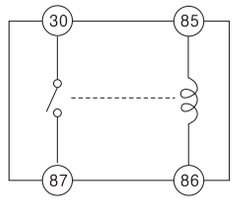
The preheat relay is used to activate the glow plugs.

RELAY TEST



T46WB63B

Terminal diagram



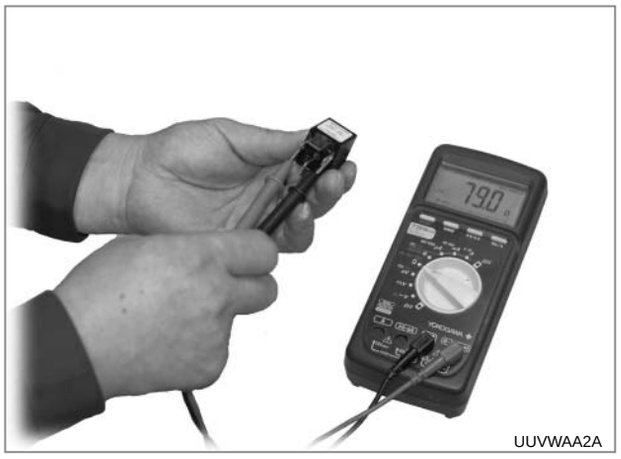
T46WB64A

To perform the relay test, disconnect and remove the relay from the wiring.

Check the resistance and continuity within the resistance range (Ω) of a tester.

Numbers on the auxiliary relay terminals indicate corresponding coil and contact.

- Capacity: 12 V, 70 A



Tester selector	Tester's measuring point		Result
	Red lead	Black lead	
Resistance	Relay 85	Relay 86	Approx. 84.6 Ω
	Relay 30	Relay 87	No continuity

※ When measuring the resistance with a tester, it is OK to switch the leads (red and black).

5.19 INSTRUMENT PANEL

- **COMPONENTS AND LOCATIONS**

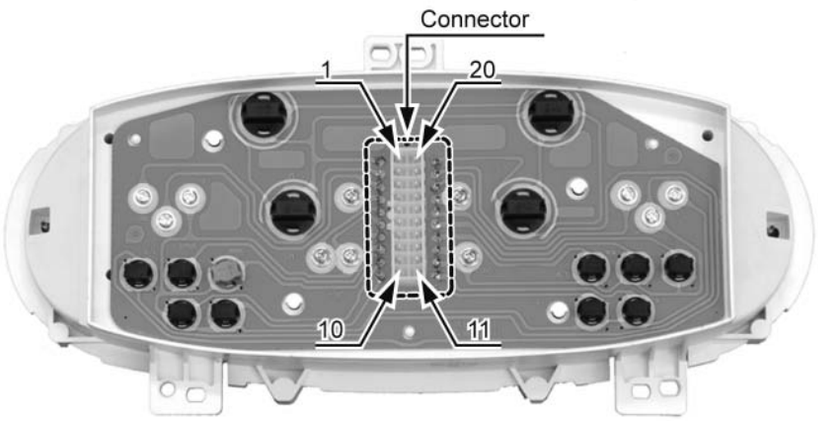
Front view

UUVWA33A

SYMBOL

Appearance										
Name	TURN/L	TURN/R	4WD	OIL	PARKING	CHARGE	FUEL	BEAM	GLOW	NEUTRAL
Lamp	14V 1.4W	14V 1.4W	14V 1.4W	14V 1.4W	14V 1.4W	14V 3W	14V 1.4W	14V 1.4W	14V 1.4W	14V 1.4W
Color	Green	Green	Amber	Red	Red	Red	Amber	Blue	Amber	Green

UUVWA34A

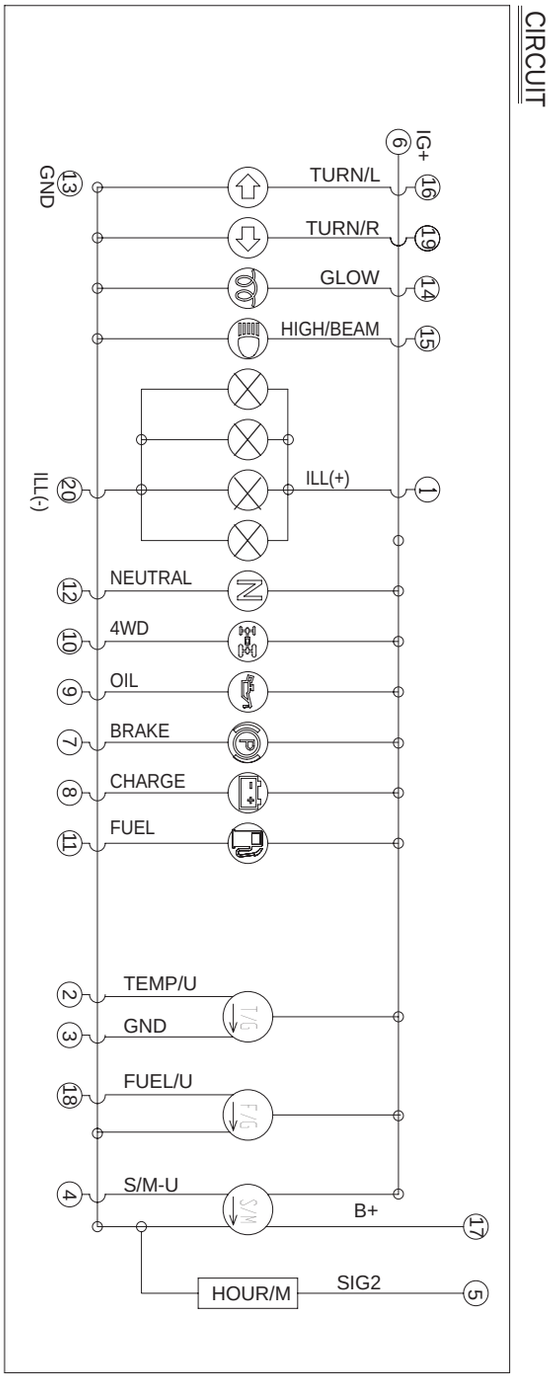


Rear view

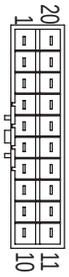
UUVWA35B

※ Don't leave the dash board upside down for long time.

- **CIRCUIT DIAGRAM OF INSTRUMENT PANEL**



CIRCUIT NAME	PIN No	CONNECTOR
ILL(+)	1	CONNECTOR (20P MOLEX P/No. 35205-2010)
TEMP - U	2	
TEMP GND	3	
SPEED - U	4	
HOUR - U	5	
IGN +	6	
BRAKE	7	
CHARGE	8	
OIL	9	
4WD	10	
FUEL WARNING	11	
NEUTRAL	12	
GND	13	
GLOW	14	
HI BEAM	15	
TURN - L	16	
B +	17	
FUEL - U	18	
TURN - R	19	
ILL(-)	20	



UUVWA36A

※ When test the dash board, remove the dash covers for easy access. However, do not disconnect the wires from the dash board. Pierce the tester probes to the rear side of wire connector in accordance with wire color.

- **GAUGES AND INDICATORS**

Speedometer and hour meter

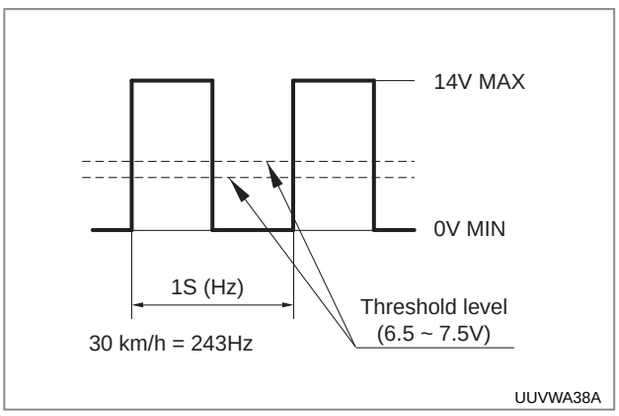
UUVWA37A

This indicates the vehicle speed and is operated by the speed sensor signal.

1. INDICATION TOLERANCE (UNIT : KM/H)

Standard revolutions	10	20	30	40
Tolerance	± 2	± 4	± 5	± 5

2. SPEEDOMETER SIGNAL

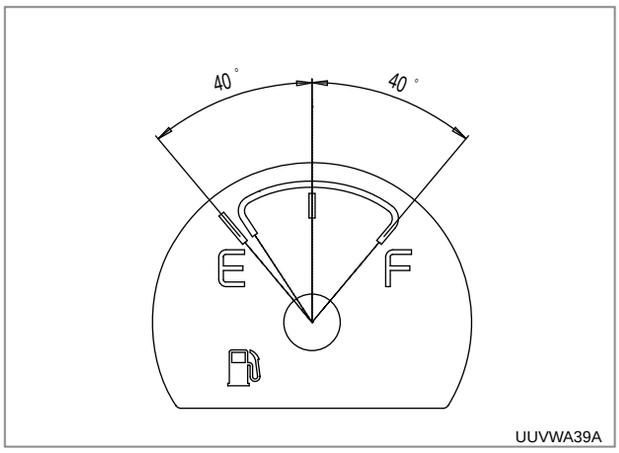


UUVWA38A

- Hour meter also has similiar patern of signal as speedometer does.
- Hour meter and speedometer signal as VDC can be measured on rear of dash board or at the display unit whlie engine is running.

* For details about the measurement method, refer to "TEST" of "Speed sensor" on page 12-30.

Fuel gauge



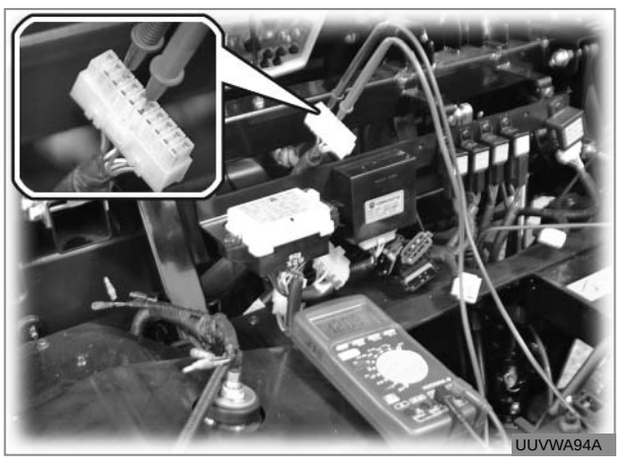
UUVWA39A

The fuel gauge's pointer is operated by variable input voltage.

The input voltage depends on the resistance of the fuel sender which adjusts its resistance in accordance with fuel level.

In case the indicating fuel level is not correct, inspect the fuel sender in advance.

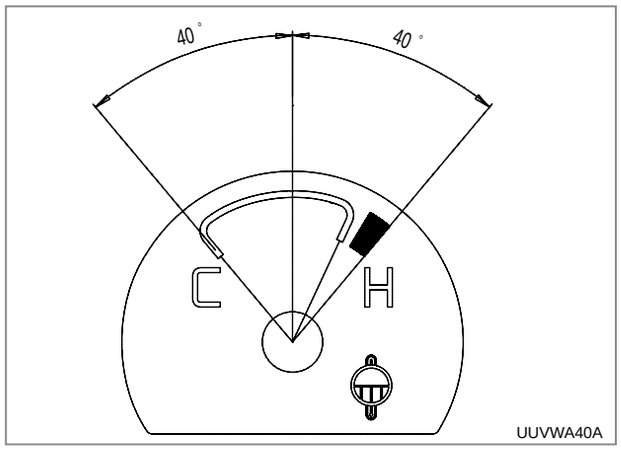
TEST


UUVWA94A

Tester selector	Tester's measuring point		Operation	Result
	Red lead	Black lead		
DC voltage	Connector, No. 6 (RW)	Connector, No. 18 (YB)	Fuel sender in operation key "ON"	DC 7.7 V (E) ~ 11.5 V (F) in accordance with fuel level

* See the pin number on the connector in the diagram on page 12-39.

Engine coolant temperature gauge



This gauge displays the engine coolant temperature.

When the gauge pointer is in the red zone, reduce the load to the vehicle and clean the front grill while idling the engine.

Check the thermostat and water pump before inspecting temperature gauge or temperature sensor.

In case the indicating temperature is not correct, inspect the temperature sensor in advance.

TEST

With the instrument cluster connector attached, connect the positive test lead to the pin No. 2 and the negative test lead to the pin No. 3. Then, turn the ignition switch to the “ON” position and measure the VDC.

Tester selector	Tester's measuring point		Operation	Result
	Red lead	Black lead		
DC voltage	Connector, pin No. 2 (WB)	Connector, pin No. 3 (B)	Temperature sensor	Approx. 10 V

* Refer to page 12-25 for more information.

* See pin number on the connector in the diagram on page 12-39.

Turn signal indicating lamps (LH, RH)

The turn signal lamp indicator comes on the instrument panel when operating the turn signal lamp switch.

Tester selector	Tester's measuring point		Operation	Result
	Red lead	Black lead		
DC voltage	Connector, pin No. 16 (WR)	Connector, pin No. 13 (B)	Operating turn signal lamp (LH)	DC 12V
	Connector, pin No. 19 (GW)	Connector, pin No. 13 (B)	Operating turn signal lamp (RH)	DC 12V

* See pin number on the connector in the diagram on page 12-39.

* For the test procedure, refer to the figure on page 12-40.

Preheat indicator

This comes on when you hold the key switch in the “HEAT” position.

During this period of time, the glow plugs warm up the combustion chambers so that the engine is started easier.

Tester selector	Tester's measuring point		Operation	Result
	Red lead	Black lead		
DC voltage	Connector, pin No. 14	Connector, pin No. 13	While the key is in “HEAT” position	DC 10 ~ 12V

* See 12-39 page for pin location

• For the test procedure, refer to the figure on page 12-40. .

Parking brake indicator

This indicator indicates the ON and OFF status of the parking brake. When the parking brake is applied, this indicator comes on. When the parking brake is not applied, this indicator goes off.

Tester selector	Tester's measuring point		Operation	Result
	Red lead	Black lead		
DC voltage	Connector, pin No. 6	Connector, pin No. 7	Parking switch ON	DC 12.5V

* See 12-39 page for pin location

• For the test procedure, refer to the figure on page 12-40. .

High beam indicator

This indicator indicates the operations of headlamp high beam. When the high beam is turned on, this indicator comes on. When the high beam is turned off, this indicator goes off.

Tester selector	Tester's measuring point		Operation	Result
	Red lead	Black lead		
DC voltage	Connector, pin No. 15	Connector, pin No. 13	High beam switch ON	DC 12V

* See 12-39 page for pin location

• For the test procedure, refer to the figure on page 12-40. .

Engine oil pressure warning lamp

This lamp comes on when the engine oil pressure is too low.

This comes on when initially turning the key switch to the "ON" position and it goes off when engine is running.

If this lamp comes on while driving, stop the engine and check the engine oil level.

Tester selector	Tester's measuring point		Operation	Result
	Red lead	Black lead		
DC voltage	Connector, pin No. 6	Connector, pin No. 9	Key switch ON	DC 12.5V

* See 12-39 page for pin location

• For the test procedure, refer to the figure on page 12-40. .

Charge warning lamp

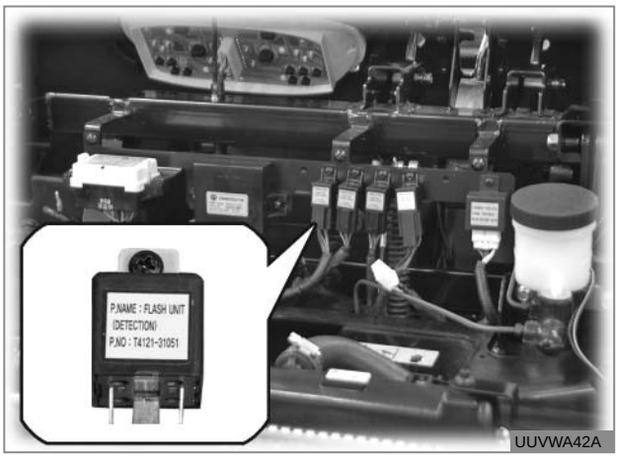
This lamp comes on when turning the key switch to "ON" position and goes off when the alternator is turning by the engine.

If this lamp comes on while driving, the charging system is malfunctioning. Check the charging system immediately.

Tester selector	Tester's measuring point		Operation	Result
	Red lead	Black lead		
DC voltage	Connector, pin No.6	Connector, pin No. 8	Key switch ON	DC 10.8V

* See 12-39 page for pin location
- For the test procedure, refer to the figure on page 12-40. .

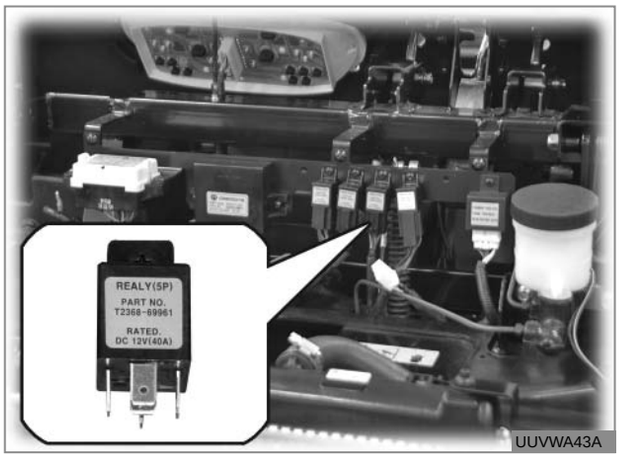
5.20 START RELAY (5P)



The start relay is attached to the relay bracket under the hood.

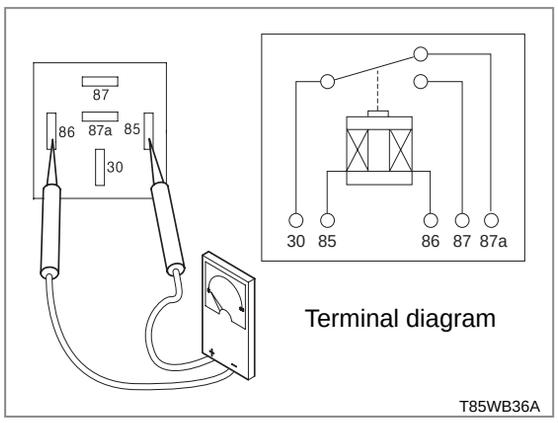
This relay supplies the magnet coil of the start motor with power when the key switch is turned to the "ST" position.

5.21 FAN MOTOR RELAY (5P)



The start relay is attached to the relay bracket under the hood.

RELAY TEST



To perform the relay test, remove the relay from the connector.

Check the resistance and continuity within the resistance range (Ω) of a tester.

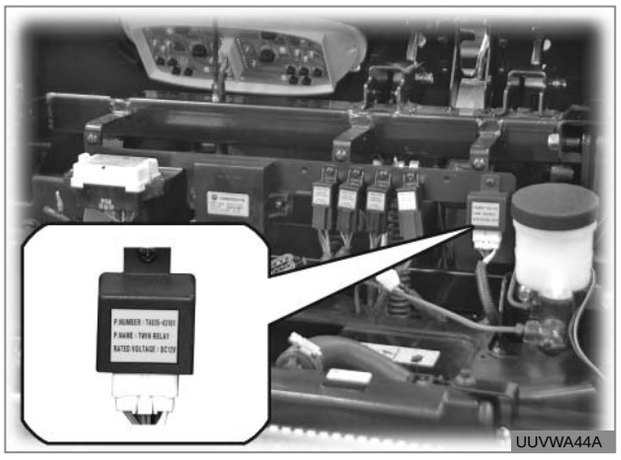
Numbers on the auxiliary relay terminals indicate corresponding coil and contact.

- Capacity: 40A

Tester selector	Tester's measuring point		Result
	Red lead	Black lead	
Resistance	Relay No. 85	Relay No. 86	Approx. 86.5 ~ 87.0Ω (15˚C)
	Relay No. 30	Relay No. 87a	Continuity
	Relay No. 30	Relay No. 87	No continuity

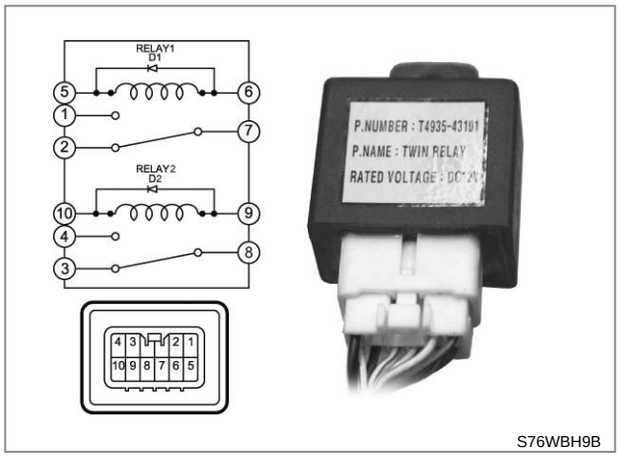
※ When measuring the resistance with a tester, it is OK to switch the leads (red and black).

5.22 TWIN RELAY (HIGH/LOW BEAM)

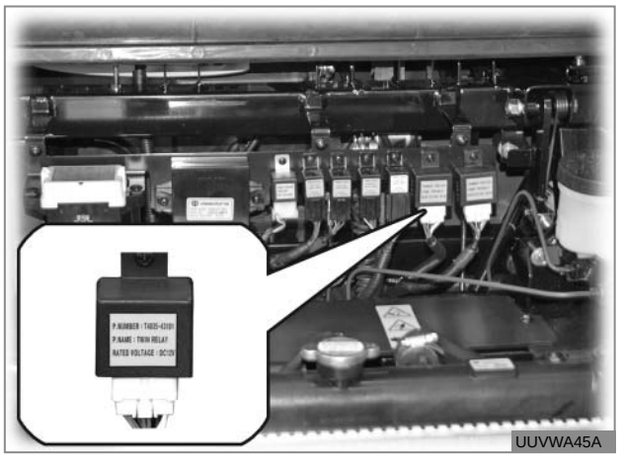


The twin relay (high/low beam) is attached to the relay bracket under the hood.

This relay supplies power to the high and low beams.

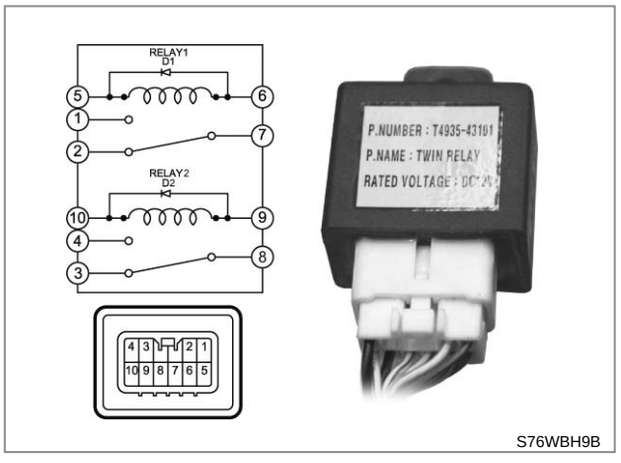


5.23 TWIN RELAY (WORK/FOG LAMP) (OPTIONAL)



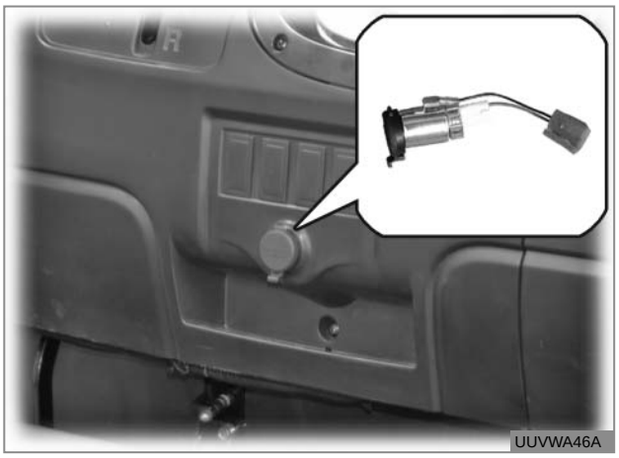
The twin relay (work/fog lamp) is attached to the relay bracket under the hood.

This relay supplies power to the work lamps and fog lamps.



Tester selector		Tester's measuring point		Result
		Red lead	Black lead	
Resistance	Relay 1	Relay 5	Relay 6	Approx. 250 Ω
		Relay 1	Relay 7	No continuity
		Relay 2	Relay 7	continuity
	Relay 2	Relay 10	Relay 9	Approx. 250 Ω
		Relay 4	Relay 8	No continuity
		Relay 3	Relay 8	continuity

5.24 POWER OUTLET



The power outlet (12 V) is installed to the lower side on the center of the main instrument panel.

SPECIFICATIONS

Rated voltage	DC 12V
Max. operating current (at rated voltage)	10A

5.25 FUSE BOX

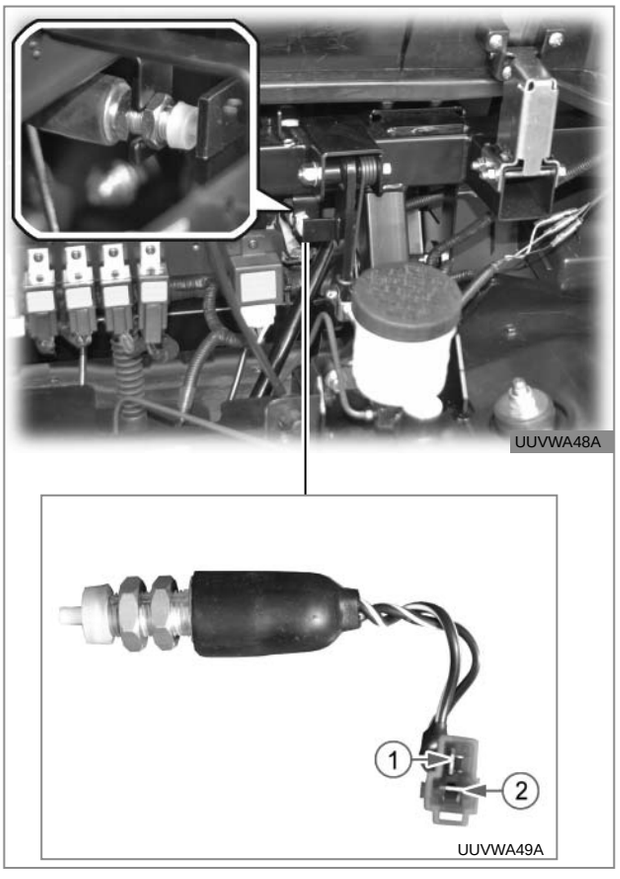
The fuse box is attached to the relay bracket under the hood.

- Function: It protects devices from excessive electric load.
- Operating principle: If the current through the fuse is over the specified capacity, the conductor of the fuse is blown to protect controller and circuit.

Conditions	Results
110% of rated current is applied	The fuse is not blown.
130% of rated current is applied	The fuse is blown within 60 seconds.
150% of rated current is applied	The regular fuse is blown within 15 seconds and the fuse for over 30 A is blown within 30 seconds.

Fuse 1 (25 A): engine stop solenoid
Fuse 2 (5 A): alternator & hold coil
Fuse 3 (5 A): display unit
Fuse 4 (20 A): radiator fan
Fuse 5 (15 A): headlamp
Fuse 6 (10 A): fog lamp (optional)
Fuse 7 (10 A): spare
Fuse 8 (10 A): work lamp (optional)
Fuse 9 (5 A): Combination meter
Fuse 10 (20 A): Brake lamp (optional)
Fuse 11 (15 A): horn, flasher unit (optional)
Spare fuse: 15 A, 20 A, 25 A

5.26 BRAKE LAMP SWITCH (OPTIONAL)



The brake lamp switch is attached to the main bracket under the hood.

The brake switch turns on the brake lamps of the tail lamps on the rear cargo bed when the brake pedal is depressed.

- N.C (Normally Closed) type:
  It is normally closed (ON) but it is open (OFF) when contact point is pressed.

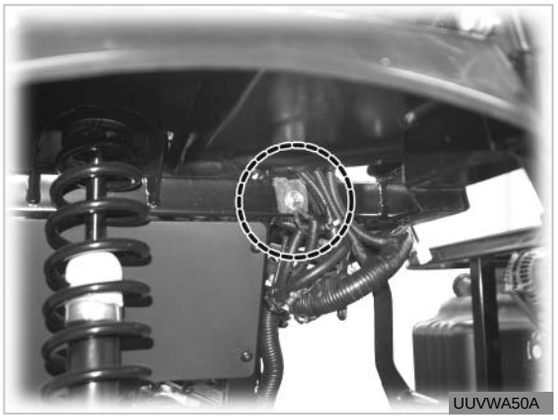
The brake pedal presses the switch when the brake is not applied.

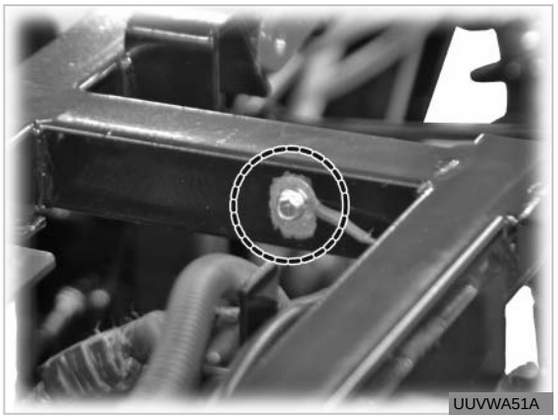
Tester selector	Tester's measuring point		Result	Remarks
	Red lead	Black lead		
Resistance	Connector ①	Connector ②	No operation (ON)	Continuity
	Connector ①	Connector ②	In operation (OFF)	No continuity

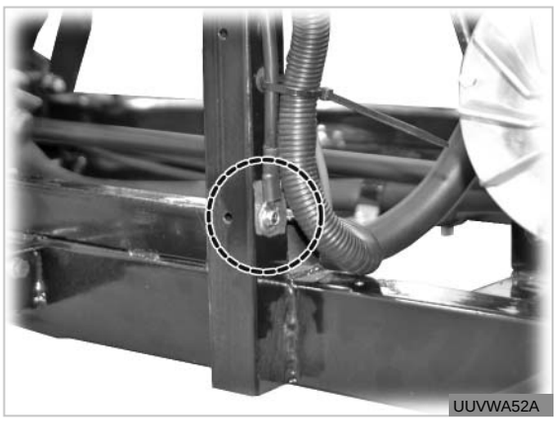
※ When measuring the resistance with a tester, it is OK to switch the leads (red and black).

REMARK

- **Body grounds**

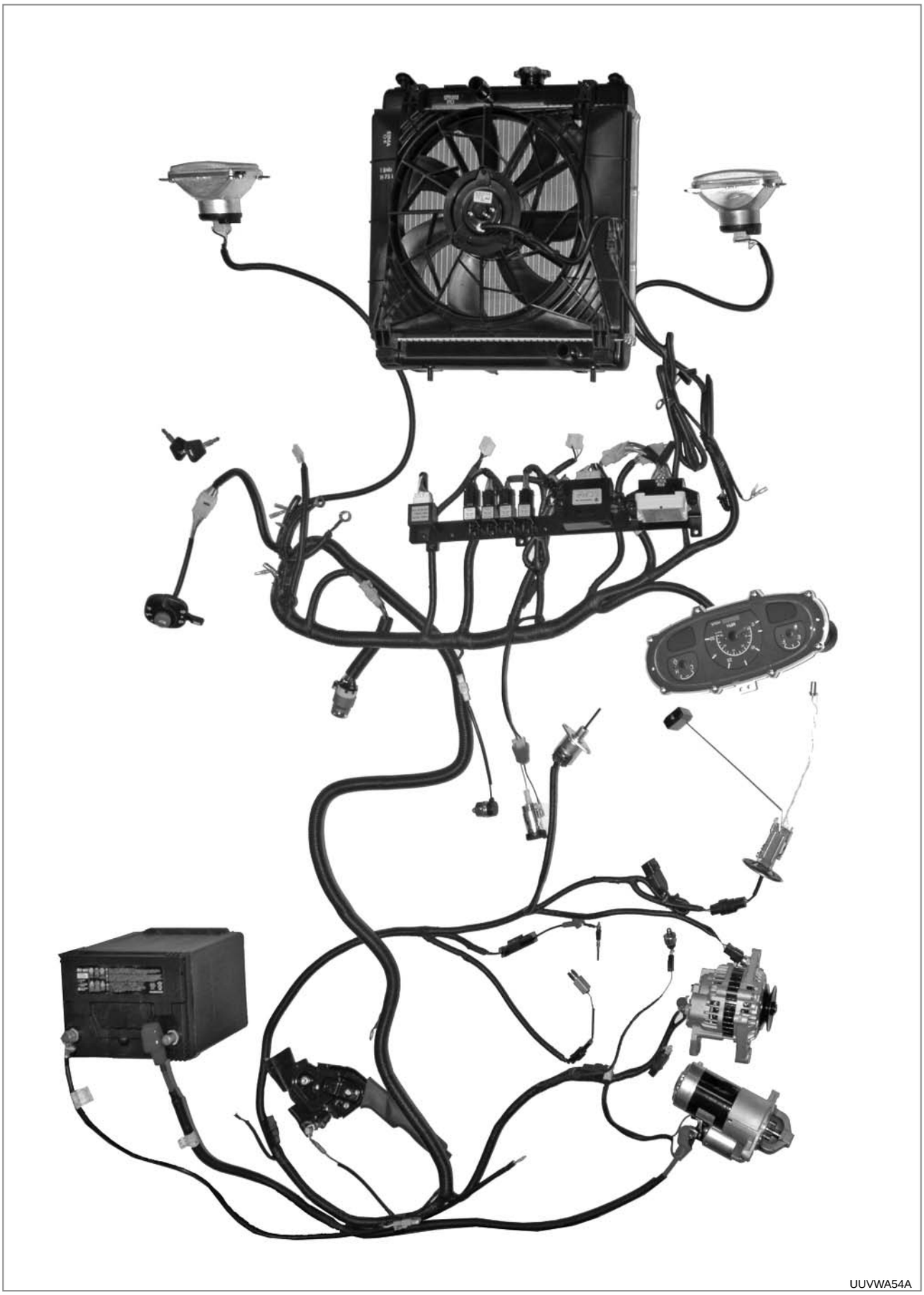






6. WIRING CONFIGURATION

6.1 WIRING DIAGRAM



UUVWA54A

7. DIAGNOSIS AND TROUBLESHOOTING

7.1 GENERAL TROUBLESHOOTING

7.1.1 BATTERY

This vehicle is equipped with 12 V battery with minimum cold cranking ability of 630 A at -18°C.

The battery is located in the middle fender on the left side of the seat. It should be firmly fixed with no corrosion.

If needed, clean the battery surface with baking soda and water and be careful not to get undistilled water into the battery.

After cleaning, rinse the battery and apply a small amount of grease to prevent the terminals from corroding.

The battery should maintain its charging status even at the freezing point. If the battery is discharged or the battery fluid is insufficient, the electrolyte may be diluted or frozen. This may lead to damage to the case.

- **CAUSES OF BATTERY EXPIRATION**

The causes for battery failure can be divided into the following three causes:

1. Overly discharged

The specific gravity of electrolyte is too low and the terminal voltage is not measurable.

Cause

- Self-discharge:
  If the battery is left unused for 2 ~ 3 months, it will fully discharge.
- Closed circuit (battery surface):
  Due to the electrolyte or water on the battery cover, a closed circuit is formed between the positive and the negative terminals and, consequently, the battery will fully discharge.

2. Over charging

If the battery is charged for over the specified time, the electrolyte's temperature rises and the amount of electrolyte decreases.

(If this happens frequently, the battery life is shortened.)

3. Battery life

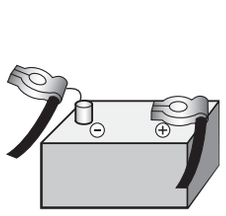
If the charged and discharged conditions are repeated, the amount of activated material and the specific gravity decrease due to the chemical reaction among the positive terminal, negative terminal and electrolyte.

7.1.2 WIRING

The negative battery cable should be disconnected if there is any possibility of short circuit when installing or removing the wiring and electric components.

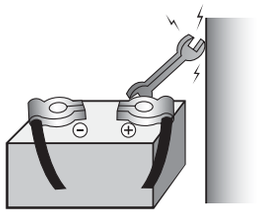
When disengaging the connectors, press both connector locks firmly to disengage them.

Refer to the below figures for disconnecting and connecting the battery terminals.



T46WB27A

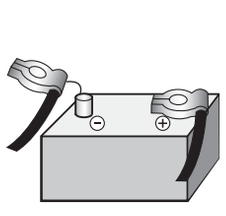
When disconnecting the battery terminals, disconnect the negative terminal first.



T46WB28A

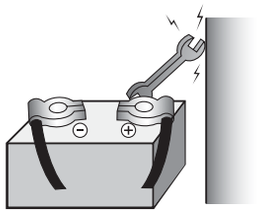
The battery can be damaged by spark if disconnecting the positive terminal first.

- When disconnecting the battery terminals, disconnect the negative terminal first.



T46WB27A

When connecting the battery terminals, connect the positive terminal first.



T46WB28A

The battery can be damaged by spark if connecting the negative terminal first.

- When connecting the battery terminals, connect the positive terminal first.

• CAUSES FOR BLOWN FUSE

There are three causes for blown fuse which can be inspected after blown.

1. Over-current due to a short circuit

   Can occur due to mechanical fault or electrical fault. For example, high current is applied to the motor if the wiper blades are frozen on the windshield.

   (The cause of blown fuse should be determined before replacing the fuse.)

2. Aged fuse

   As current is cycled through fuses from ON to OFF repeatedly, the fuse's temperature rises and drops and it is eventually blown. If the fuse is blown, replace it immediately.

3. Poor contact (heat produced)

   If the fuse is poorly seated, the fuse will blow due to the heat by resistance. Polish the fuse contact surface with sandpaper to prevent this problem.

• CHECKING CIRCUITS

In general, it is not hard to inspect an electric circuit in a logical and organized way. It is very import to collect as much information as possible before starting inspection. Also, you should understand the system's operation and be ready to follow proper inspection procedures using proper devices.

If necessary, the inspector can shake wiring or electric parts gently while testing them.

- Open circuit: There is a disconnected part in a circuit.
- Short circuit: There are two types of short circuit.
  - Short to circuit:
    The resistance changes as a circuit is contacted to another circuit.
  - Short to ground:
    A circuit is contacted to ground or ground part.

● GROUND TEST

The ground connection is critical for the electric and electronic circuits' operation. It is often exposed to several factors for corrosion such as humidity and dust.

Corrosion produces unnecessary resistance and this resistance can affect the circuit operation. Also, electrically controlled circuit is very sensitive to ground.

If the ground wiring is loose or corroded, it can greatly affect the electrically controlled circuit.

Even though the ground connection seems to be clean, there might be a thin corroded layer on the surface. Perform the following steps for inspecting the ground connection.

Remove any ground bolt and clip.

Check if there is dirt or corroded layer on the surface.

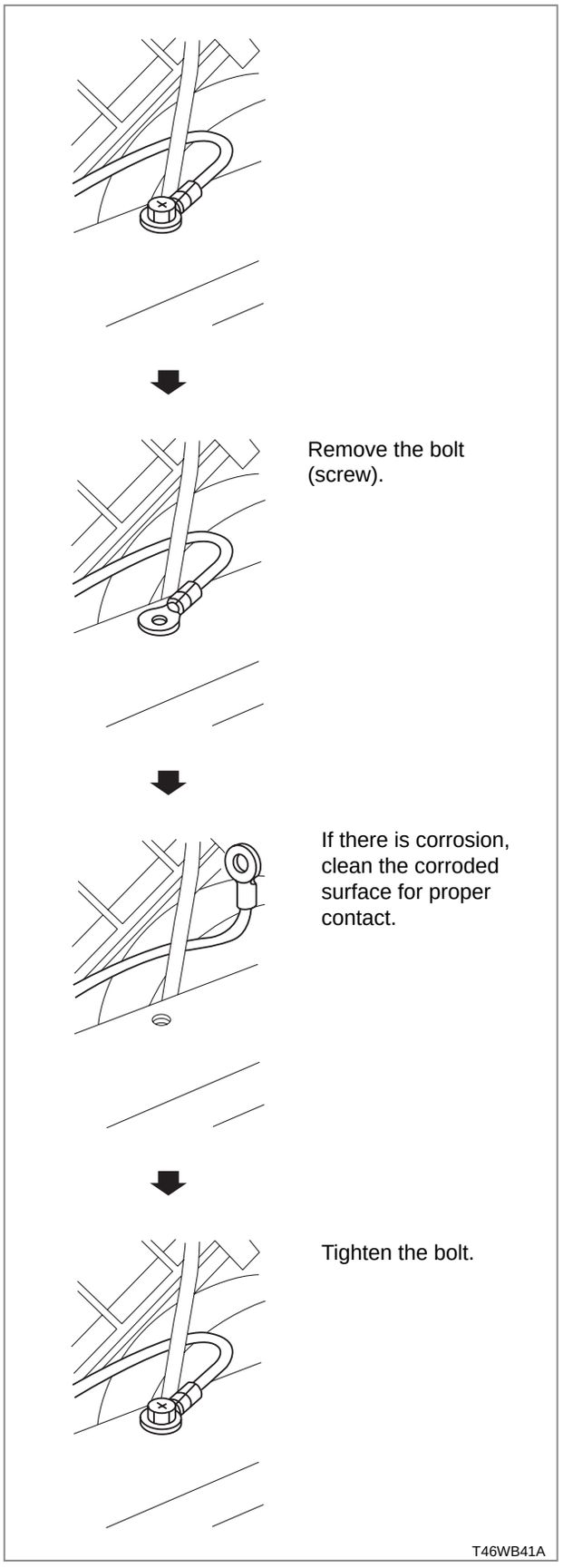
Clean the surface completely for proper connection.

Tighten bolts and screws firmly.

Check parts related to the ground circuit.

If several wirings are connected to one ground terminal, check for proper connection.

All wirings should be clean, securely tightened and properly grounded. Even the wirings connected to the one ground point should be cleaned before they are reinstalled.



7.1.3 GENERAL

● OVERVIEW

Sometime, a problem may be difficult to reproduce.

If this is the case, the conditions during failure may need to be reproduced. The following is how to reproduce conditions that can cause electrical problems.

The electric problems can be divided into the following 6 sections:

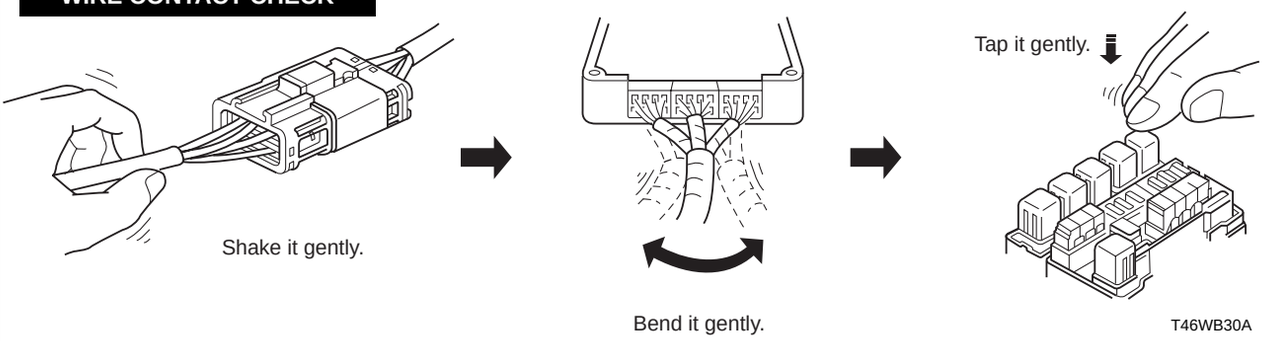
- Vibration
- Damage by heat
- Freezing
- Moisture
- Electric load
- Starting in frozen or overheated condition

Check the symptom by asking customer. This is a very important factor when reproducing the symptom.

● VIBRATION

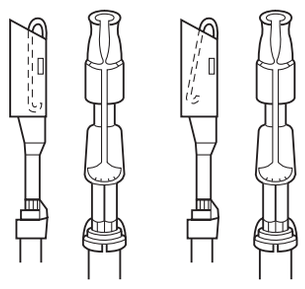
A problem may occur and the tractor's condition can get worse if driving the tractor on unpaved road or the engine vibrates harshly (when running A/C at idling). In this case, inspect the conditions related to the vibration.

WIRE CONTACT CHECK



T46WB30A

LOOSE PRONG CHECK

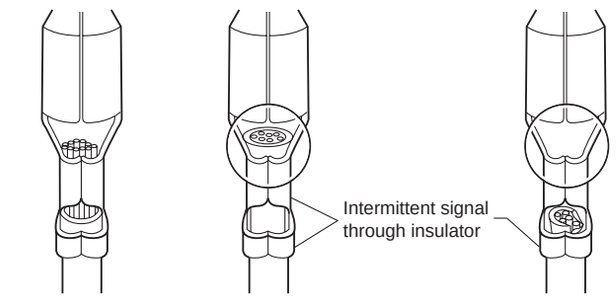


As the connector is installed and removed repeatedly, the aperture of contact spring can be bent.

Bent Standard

T46WB31B

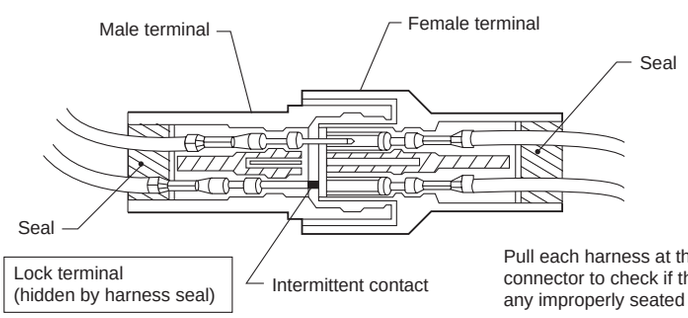
WIRE SEIZING CHECK



Properly folded Insulator not removed Missing harness

T46WB32A

CONNECTOR CHECK



T46WB33B

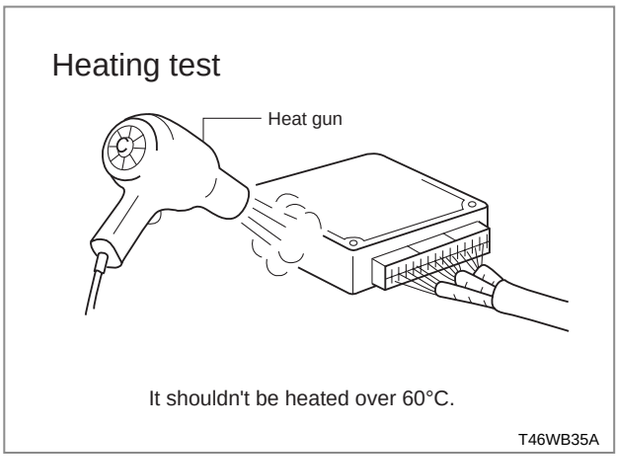
Improperly installed connector

- **DAMAGE BY HEAT**

If the problem in the tractor occurred in hot weather, the inspector should check the conditions affected by heat. Apply some heat to the parts with a heat gun to determine whether such electric parts are sensitive to heat.

Never let electric parts' temperature rise over 60°C (140 °F).

If a fault occurs while applying the heat, replace the part or insulate it.

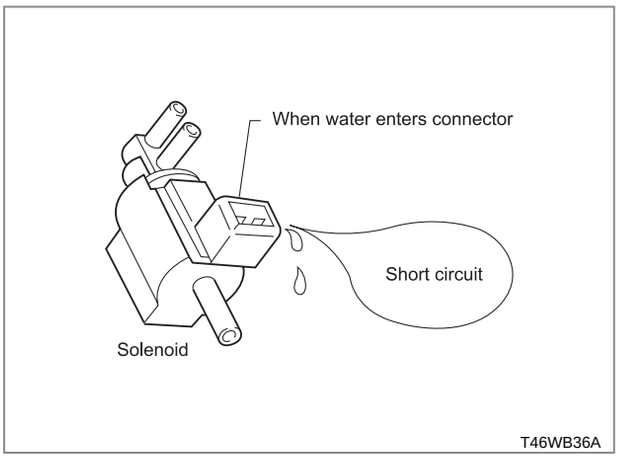


- **FAULT BY MOISTURE**

A fault may occur only in high humidity condition, rainy season or snow. In this case, a fault may occur when water enters into electrical parts.

Never spray water directly on the electric parts to reproduce the symptom.

Inspect the connectors if water enters in it, apply dielectric grease as needed.



- **FREEZING**

A fault may disappear after warming up the tractor (in cold weather).

In this case, a cause of such fault can be frozen wiring or electric parts. There are two methods to inspect such fault.

The first method is to ask the customer to park the tractor outside for over a night to cool it down and reproduce the symptom and inspect the relevant electric parts rapidly and thoroughly in the following morning.

The second method is to keep the relevant electric parts in a refrigerator for enough time to freeze, reinstall them and check if such fault is occurred again. If it is, repair or replace the corresponding part.

- **ELECTRIC LOAD**

A fault can occur in electric parts due to the reaction to electric load. Perform the inspection while turning on all electric devices (A/C, cigarette lighter, radio, headlamps, etc.).

- **ENGINE COLD OR HOT CONDITIONS**

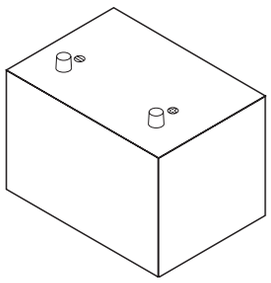
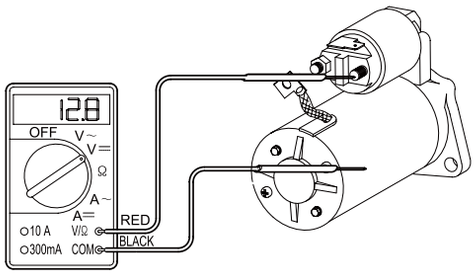
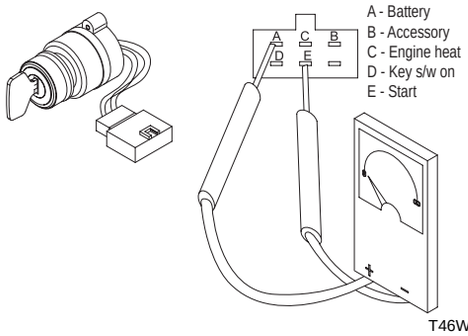
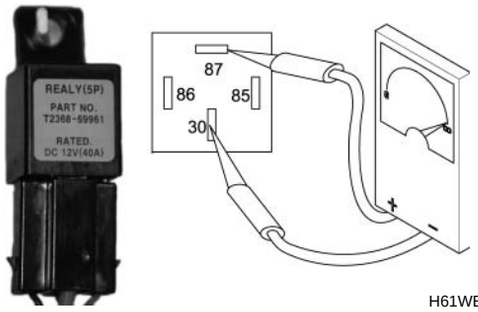
An electric fault can occur when the engine is cold or when the engine is hot.

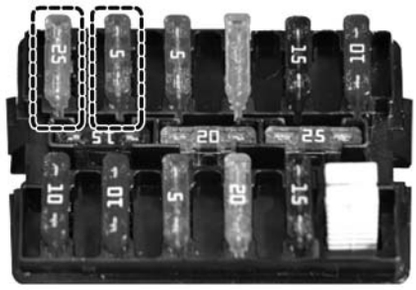
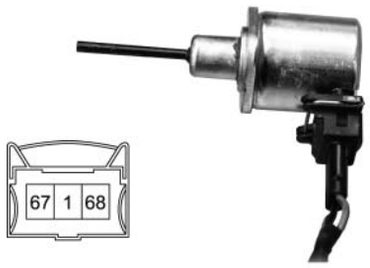
Inspect the tractor after leaving it outdoor over night for cold condition.

Inspect the tractor after run engine for a while for hot condition.

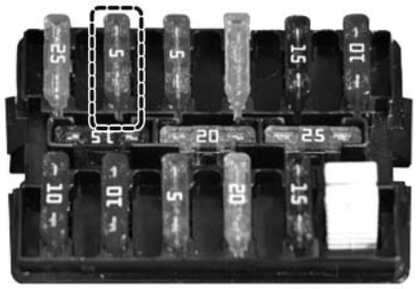
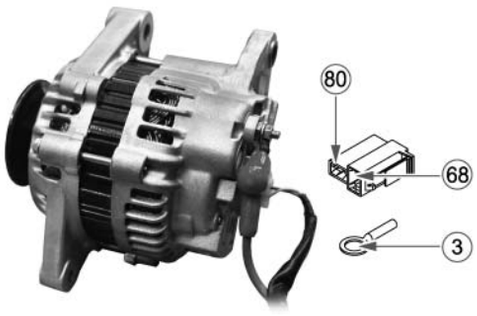
7.2 TROUBLESHOOTING

7.2.1 WHEN THE ENGINE CANNOT BE STARTED

Check point	Check item (method)	Remarks
1. Battery voltage	- Measure the voltage between battery (+) and (-) terminals using a tester. - Result: 11.8 ~ 12.9 V However, the voltage may be over this range if it is measured immediately after turning the engine off.	 T46WBB9A
2. Battery terminal of start motor	- Proper connection of battery cable - The voltage between M terminal of start motor and chassis should be approximately same to the battery voltage. - Check for corrosion. - Check connection of battery cable.	 T46WBC0A
3. Slow blow fuse	- Check fuse engagement. - Check main fuse for short circuit. Rated capacity: 60 A	 H61WB33A
4. Key switch	Check for proper connection. “OFF” position: No connection “ACC” position: A-B “ON” position: A-B-D "PREHEAT" position: A-C-D "ST" position: A-D-E	 T46WBC2A
5. Ignition relay, engine stop pull coil relay	1. Connecting the power to No. 85 and 86 terminals: No. 87 and 30 terminals connected 2. Not connecting the power to No. 85 and 86 terminals : No. 87 and 30 terminals open	 H61WB34B

Check point	Check item (method)	Remarks
6. Fuse	- Check No. 1 and 2 fuses for open circuit. (If it has a open circuit, replace it with new one with rated capacity.)	 UUVWA56B
7. Engine stop solenoid	1. Check the solenoid unit. Measure resistance on both ends of engine stop solenoid. Between No. 68 and ground: Approx. 0.4 Ω Approx. 32 A Between No. 67 and ground: Approx. 13.8 Ω Approx. 0.77 A * Clicking sound should be heard when turning the key switch to the "ON" position. 2. Check the wiring. Voltage between No. 67 and ground when turning key switch to "ON": 12 V Voltage between No. 68 and ground in 1 second after turning key switch to "ON": 12 V (only for 1 sec.)	 S76WBH3B

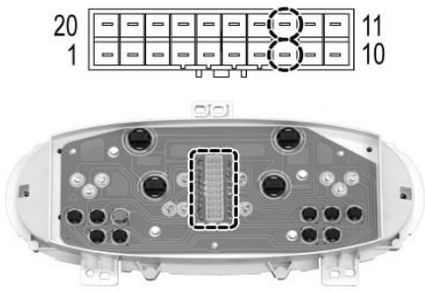
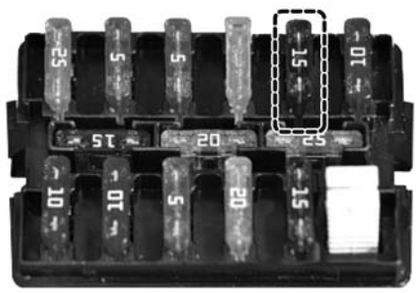
7.2.2 WHEN THE SYSTEM IS NOT CHARGED

Check point	Check item (method)	Remarks
1. Fuse	- Check the fuse No. 2 for open circuit. (If it has a open circuit, replace it with new one with rated capacity.)	 UUVWA57B
2. Regulator operating power (with the key switch "ON")	- Measure the voltage between No. 68 (RB) of 2P connector and alternator body (ground) with the key switch "ON". Normal: Over 12 V Abnormal: Below 10 V - Measure the voltage between No. 80 (P) of 2P connector and alternator body (ground) with the engine running. Normal: 14.0 ~ 14.7 V Abnormal: Below 12 V	 S76WBH5B

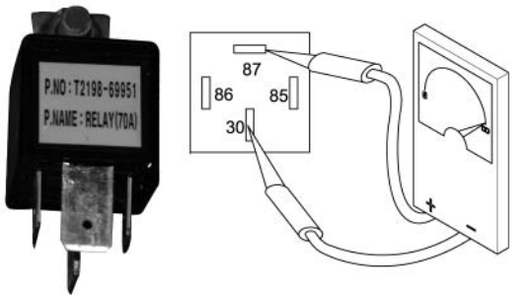
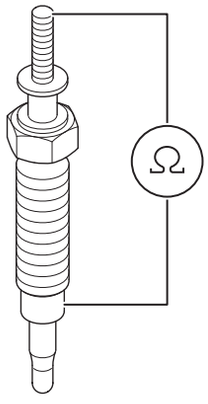
7.2.3 CHECK THE CHARGE WARNING LAMP FOR MALFUNCTION.

Normal operating condition

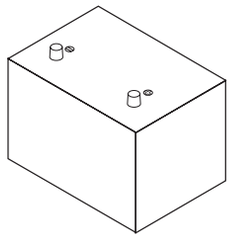
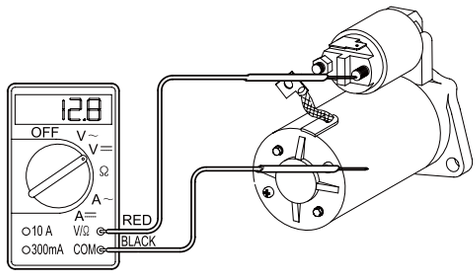
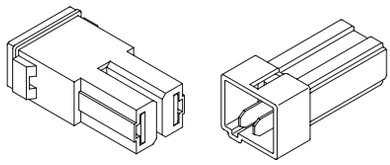
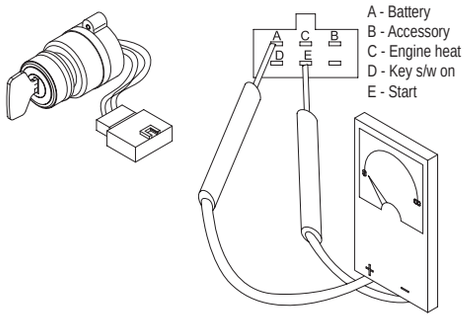
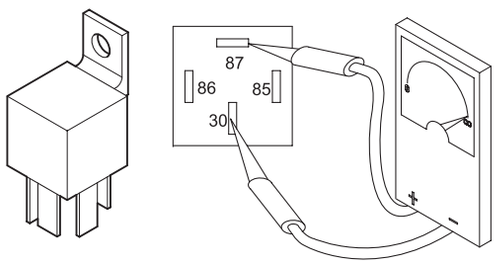
- Before starting the engine (key switch in "ON" position): Charge warning lamp ON
- After starting the engine: Charge warning lamp OFF

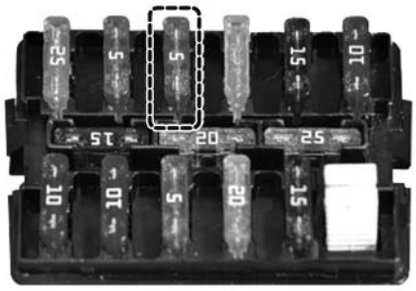
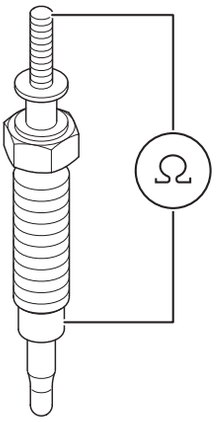
Check point	Check item (method)	Remarks
1. Charge warning lamp (on cluster)	1. Check voltage - The voltage between the Pin No. 8 of cluster and ground terminal (No. 13) should be below the battery voltage (approx. 3 V) when the key switch is in "ON" position. 2. Check the fuse 5 (headlamp)	 UUVWA58B
2. Charge warning lamp bulb	1. Check if the bulb filament is blown. (visual check)	 UUVWA59A
3. Fuse	1. Check the No. 5 fuse in the fuse box. (Rated capacity: 15A)	 UUVWA60B

7.2.4 WHEN THE SYSTEM IS NOT PREHEATED MANUALLY

Check point	Check item (method)	Remarks
1. Preheat relay	1. Connecting 12 V to the No. 85 and 86 terminals with the key ON : No. 87 and 30 terminals connected (closed circuit) 2. Not connecting power to No. 85 and 86 terminals : No. 87 and 30 terminals open	 S76WBI7B
2. Glow plug	1. Check if the resistance between the glow plug ring terminal and ground (chassis) is approx. 0.43 Ω. - If the measured resistance is “∞”: open circuit - If the measured resistance is “0”: short circuit 2. Check the voltage when in operation. - With the plug manually preheated, the voltage between the glow plug and ground should be 12 V. (Voltage fluctuation by operating time: 8 ~ 12 V)	 UUVWA72A

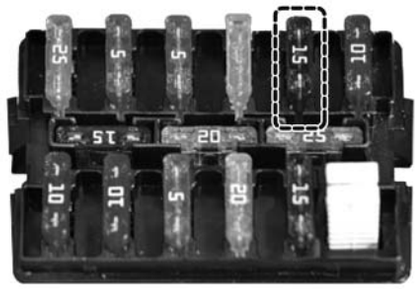
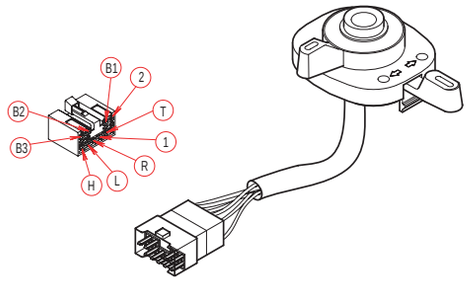
7.2.5 WHEN THE SYSTEM IS NOT PREHEATED AUTOMATICALLY

Check point	Check item (method)	Remarks
1. Check the battery voltage	- Measure the voltage between battery (+) and (-) terminals using a tester - Result: 11.8 ~ 12.9 V However, the voltage may be over this range if it is measured immediately after turning the engine off. - Continue to the next step.	 T46WBB9A
2. Battery terminal of start motor	1. Proper connection of battery cable - The voltage between start motor's M terminal and chassis should be approximately same as the battery voltage. 2. When voltage is not supplied - Check proper connection of battery cable - Check the corrosion - Continue to the next step.	 T46WBC0A
3. Slow blow fuse	- Fuse engagement - Short circuit of main fuse Rated capacity: 60A	 BP 1 T46WBC1A
4. Key switch	Check proper connection "ON" position: A-B-D "PREHEAT" position: A-C-D	 T46WBC2A
5. Preheat relay	1. With key ON, connect 12 V to No. 85 and 86 terminals : No. 87 and 30 terminals connected (closed circuit) 2. Not connecting 12 V to No. 85 and 86 terminals : No. 87 and 30 terminals open circuit	 T46WBC3A

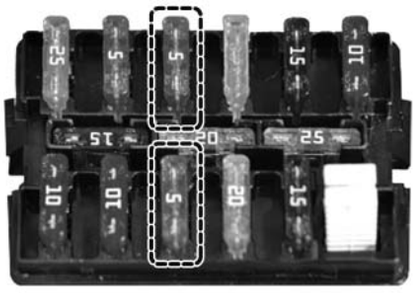
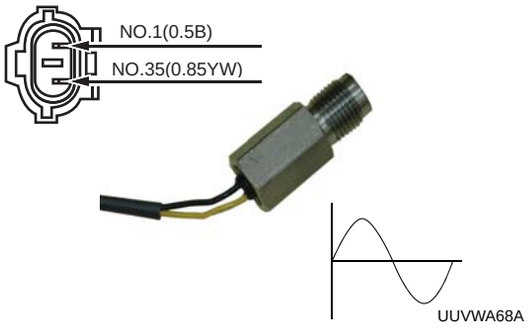
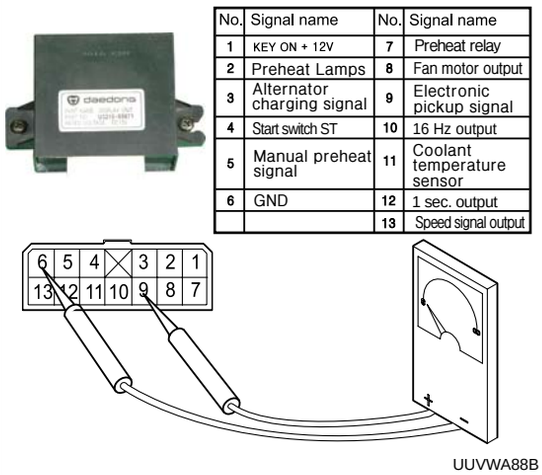
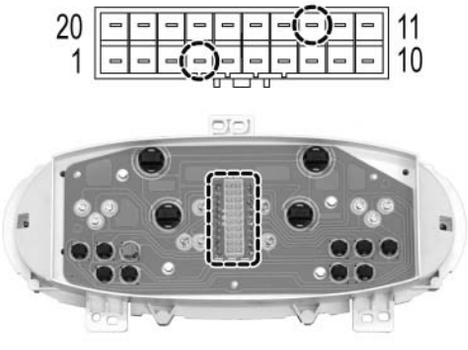
Check point	Check item (method)	Remarks
6. Fuse	1. Check method - Fuse 3 for open circuit - If it has a open circuit, replace it with new one with rated capacity (5A).	 (Fuse No.3) UUVWA63B
7. Display unit	1. Check the following - Check if the voltage at the No. 1 terminal is 12 V with the key switch in "ON" position - Check if the output voltage at the No. 7 terminal is 12 V with the coolant temperature below 30°C (86°F) - Check if the output voltage between No. 1 terminal and ground is 12 V (for 8 seconds) → Preheat lamp (No. 2)	 UUVWA91B
8. Glow plug	1. Glow plug ring terminal - The resistance between the terminal and ground (chassis) is approx. 0.43 Ω 1. If the measured resistance is “∞”: open circuit 2. If the measured resistance is “0”: short circuit 2. Check the voltage when in operation - With the plug automatically preheated, the voltage between the glow plug and ground should be 12 V. (Voltage fluctuation by operating time: 8~12V)	 UUVWA72A

No.	Signal name	No.	Signal name
1	KEY ON + 12V	7	Preheat relay
2	Preheat Lamps	8	Fan motor output
3	Alternator charging signal	9	Electronic pickup signal
4	Start switch ST	10	16 Hz output
5	Manual preheat signal	11	Coolant temperature sensor
6	GND	12	1 sec. output
		13	Speed signal output

7.2.6 WHEN HIGH AND LOW BEAMS CANNOT BE OPERATED

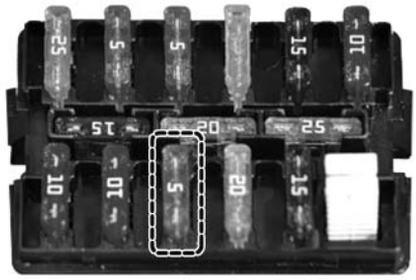
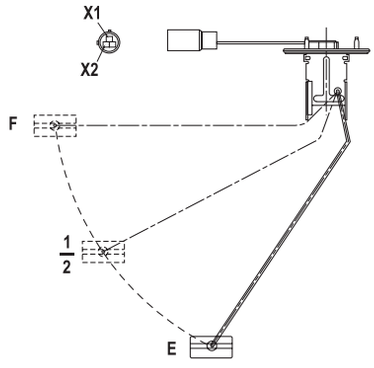
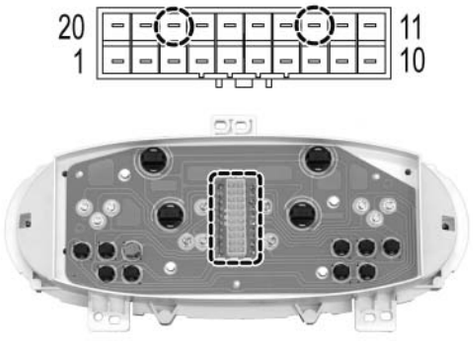
Check point	Check item (method)	Remarks
1. Fuse	- Check fuse engagement. - Fuse for open circuit : Fuse 5 (15 A)	 UUVWA60B
2. Combination switch	- Check the low beam for proper connection. B1-T-1: connected - Check the high beam for proper connection. B1-T-2: connected - Turn signal lamp (LH), B2-L: connected - Turn signal lamp (RH), B2-R: connected	 T46WBF8A

7.2.7 SPEEDOMETER OPERATION WITH THE ENGINE RUNNING

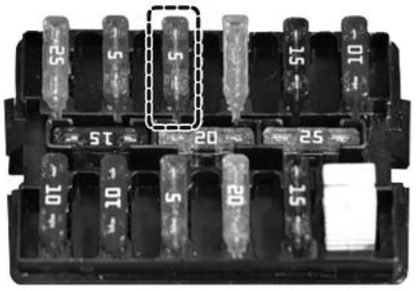
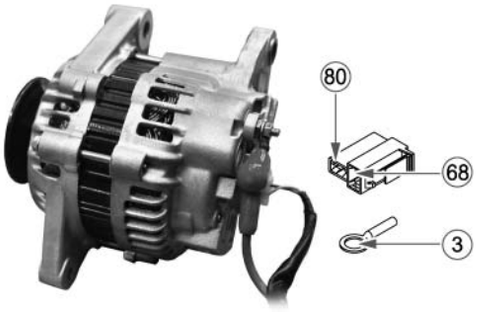
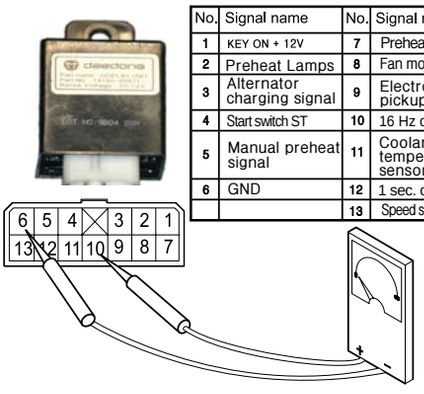
Check point	Check item (method)	Remarks
1. Fuse	- Check fuse engagement. - Fuse 3 for open circuit, rated capacity: 5 A - Fuse 9 for open circuit, rated capacity: 5 A	 UUVWA61B
2. Speed sensor	- Check the output of sine wave between the NO. 35 and 1 terminals using a voltmeter or oscilloscope for frequency reading.	 UUVWA68A
3. Display unit	- Check if the voltage between No. 6 and 9 terminals is 12 V. - Check the output of square wave, 10Vp-p, between No. 13 and 1 terminals using a voltmeter or oscilloscope for frequency reading.	 UUVWA88B
4. Speedometer on instrument panel	- Voltage between the Pin No. 4 and 13 (GND) terminals: 12.5V	 UUVWA69B

No.	Signal name	No.	Signal name
1	KEY ON + 12V	7	Preheat relay
2	Preheat Lamps	8	Fan motor output
3	Alternator charging signal	9	Electronic pickup signal
4	Start switch ST	10	16 Hz output
5	Manual preheat signal	11	Coolant temperature sensor
6	GND	12	1 sec. output
		13	Speed signal output

7.2.8 FUEL GAUGE OPERATION

Check point	Check item (method)	Remarks
1. Fuse	- Check fuse engagement. - Fuse 9 for open circuit Rated capacity: 5 A	 UUVWA62B
2. Fuel sender	Measure the resistance between two terminals of fuel sender connector after disconnecting wiring and connector. - E point: 110 Ω - F point: 2.5 Ω	 T46WBG5A
3. Fuel gauge on instrument panel	Measure the resistance between the Pin No. 13 and 18 terminals of instrument panel connector, referring to resistance value specified for each fuel sender position.	Instrument panel connector  UUVWA70B

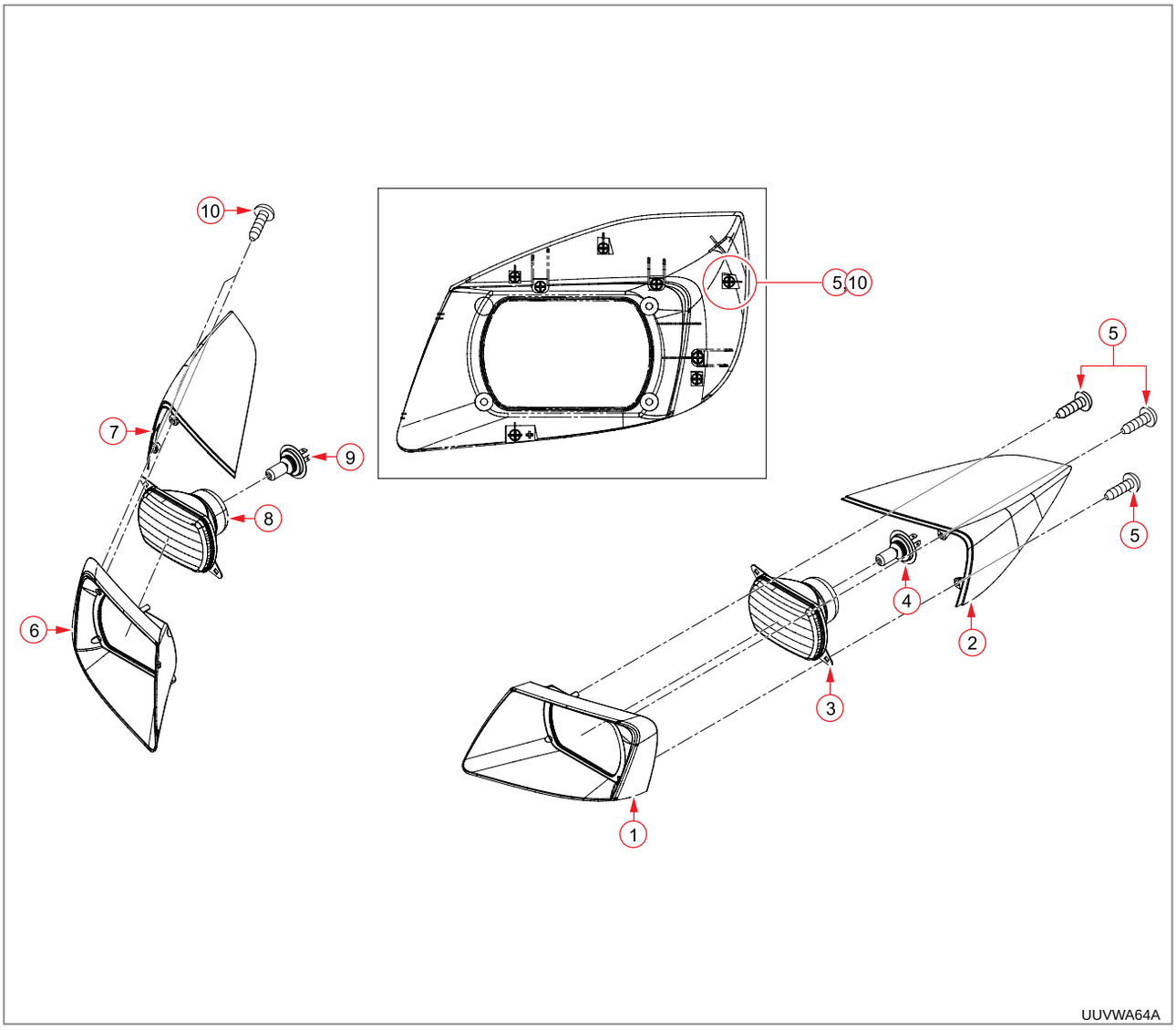
7.2.9 HOUR METER OPERATION

Check point	Check item (method)	Remarks
1. Fuse	- Check fuse engagement. - Fuse 3 for open circuit Rated capacity: 5 A	 UUVWA63B
2. Operating power of regulator (with key switch "ON")	- Measure the voltage between No. 68 (RB) of 2P connector and alternator body (ground) with the key switch "ON". Normal: Over 12 V Abnormal: Below 10 V - Measure the voltage between No. 80 (P) of 2P connector and alternator body (ground) with the engine running. Normal: 14.0 V ~ 14.7 V Abnormal: Below 12 V	 S76WBH5B
3. Display unit	- Check square wave output between No. 10 and 6 terminals of the display unit with an oscilloscope (16 Hz of output per 1 sec.).	 UUVWA90B

No.	Signal name	No.	Signal name
1	KEY ON + 12V	7	Preheat relay
2	Preheat Lamps	8	Fan motor output
3	Alternator charging signal	9	Electronic pickup signal
4	Start switch ST	10	16 Hz output
5	Manual preheat signal	11	Coolant temperature sensor
6	GND	12	1 sec. output
		13	Speed signal output

8. EXPLODED VIEW FOR THE COMPONENTS

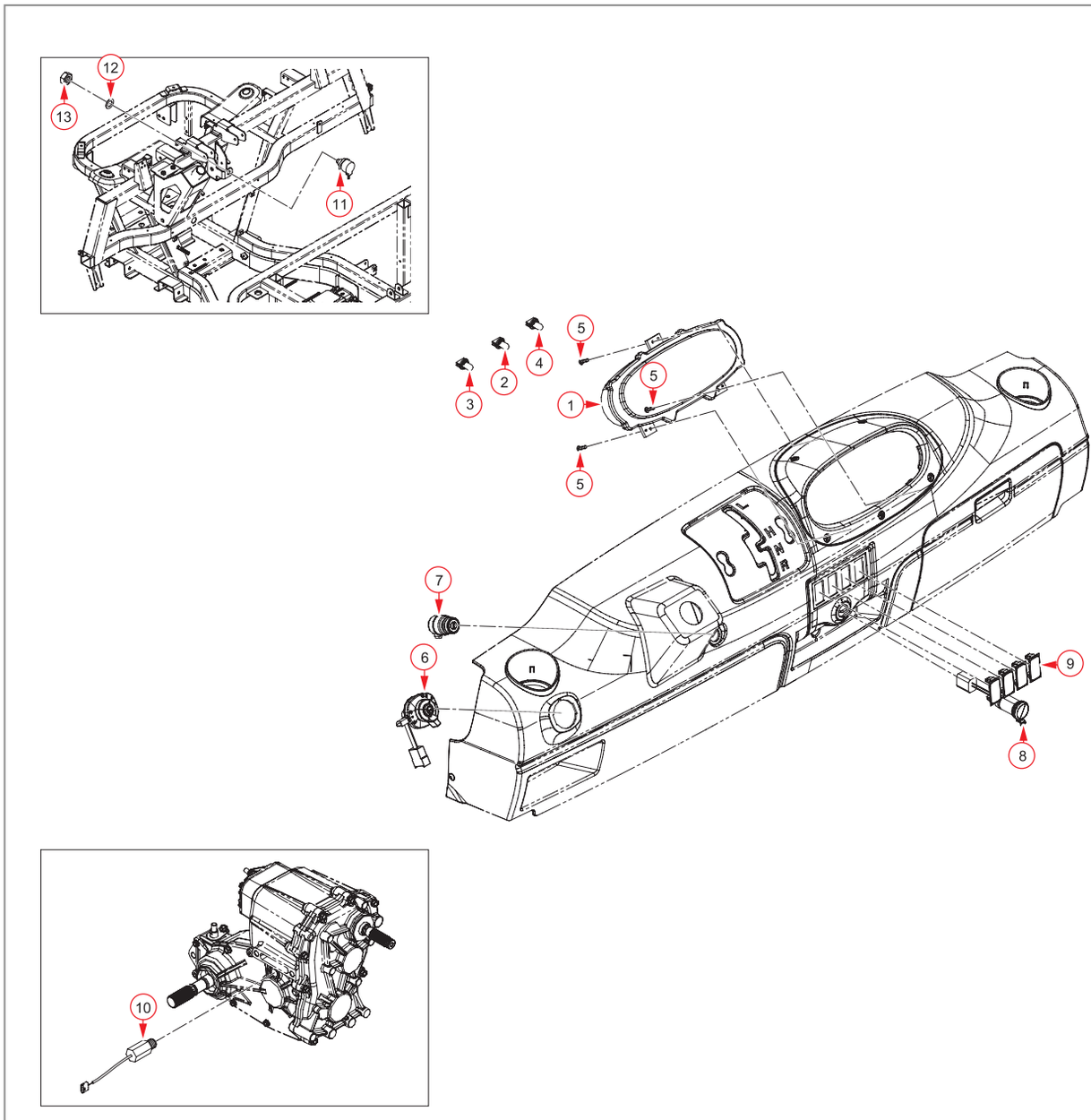
8.1 U500A LIGHT



COMPONENTS

(1) HEADLIGHT, BEZEL, FR LH
(2) HEADLIGHT, BEZEL, RR LH
(3) HEADLIGHT, LH
(4) BULB
(5) SCREW
(6) HEADLIGHT, BEZEL, FR RH
(7) HEADLIGHT, BEZEL, RR RH
(8) HEADLIGHT, RH
(9) BULB
(10) SCREW

8.2 U510A ELECTRICAL SYSTEM 1

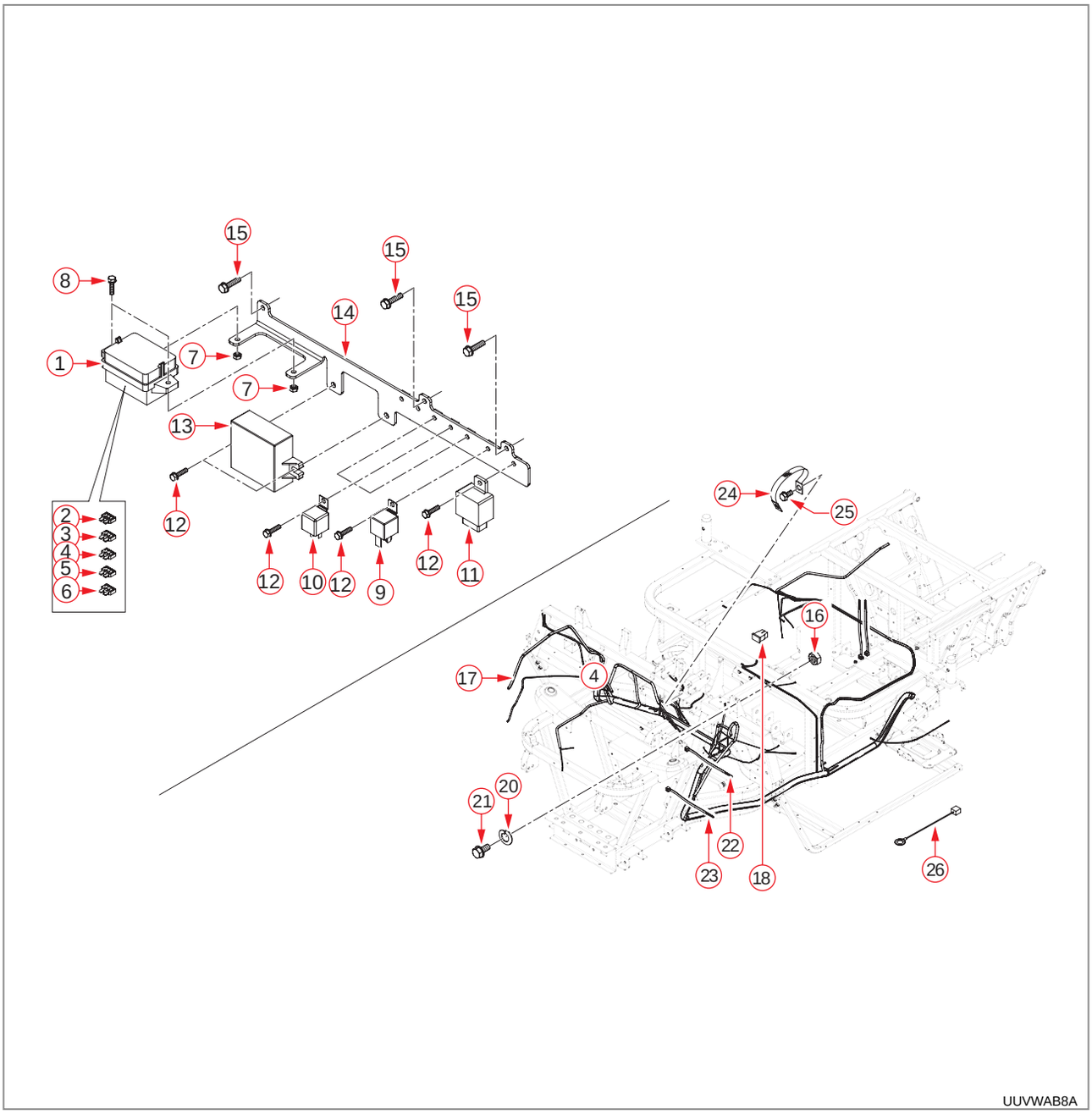


UUVWA65A

COMPONENTS

(1) INSTRUMENT CLUSTER ASSY
(2) BULB 12V 3W
(3) BULB 14V 3W
(4) BULB 14V 1.4W
(5) SCREW
(6) COMBINATION SWITCH ASSY
(7) SWITCH, STARTER
(8) SOCKET
(9) COVER
(10) PICK UP SENSOR
(11) SWITCH, SAFETY START
(12) WASHER, PLAIN
(13) NUT

8.3 U620A ELECTRICAL SYSTEM 2



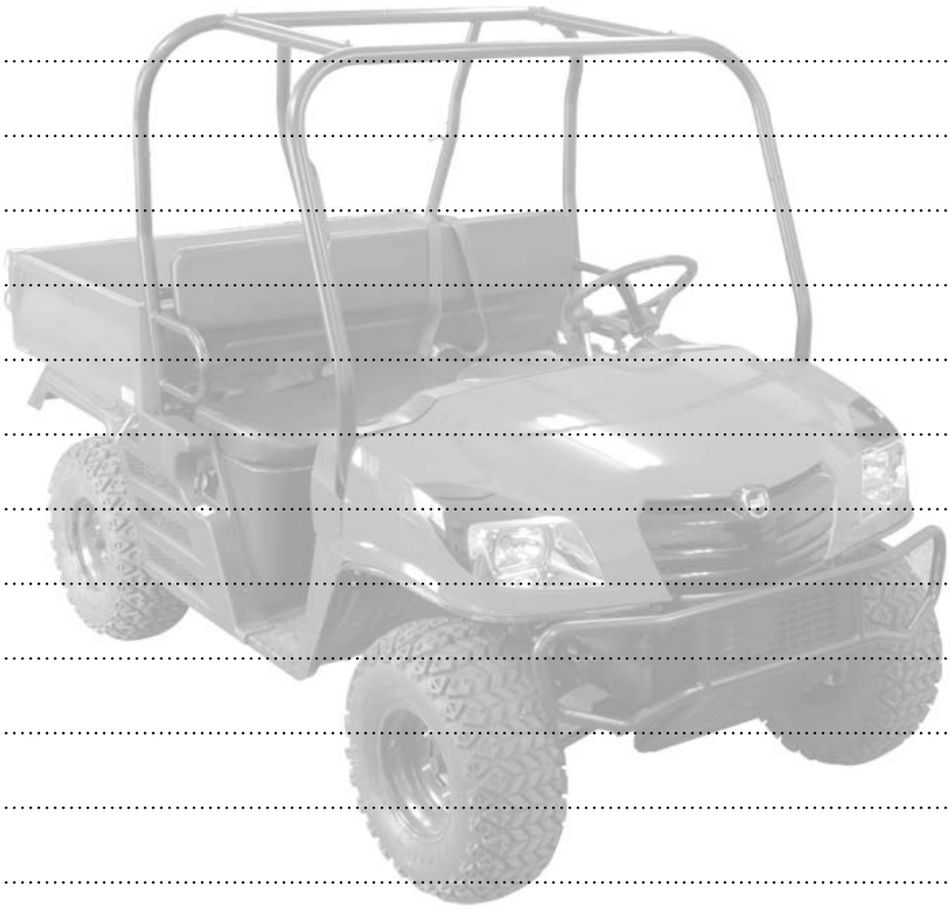
COMPONENTS

(1) FUSE BOX ASSY
(2) FUSE 5A
(3) FUSE 10A
(4) FUSE 15A
(5) FUSE 20A
(6) FUSE 25A
(7) NUT
(8) BOLT, FLANGE
(9) RELAY
(10) RELAY 5P
(11) ACCESSORY RELAY ASSY
(12) BOLT, FLANGE
(13) DISPLAY UNIT
(14) RELAY BRACKET ASSY
(15) BOLT, FLANGE
(16) NUT
(17) WIRE HARNESS-MAIN
(18) FUSE, 60A
(19) DIODE, 2P
(20) WASHER, SPRING
(21) BOLT, FLANGE
(22) BAND, CORD
(23) BAND
(24) CALBLE, GROUNDING
(25) BOLT, FLANGE
(26) WIRE HARNESS 3

INDEX

CHAPTER 13

MEMO



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1451 Marvin Griffin Road, Augusta, GA 30906
(800) 241-5855 I Fax (706) 796-4540 I www.ezgo.com
e-mail: ezgo@textron.com I