

FOREWORD	2
2020 XL Chassis 1_DT_ST_ABS	3
2020 XL Chassis 2_RA	498
2020 XL Chassis 3_EWD_SUSP_WT	1063
2020 XL ENGINE	1544
2020 XL Troubleshooting 1_ELEC_ENG	2110
2020 XL Troubleshooting 2_ENG	2742
2020 XL Troubleshooting 3_ENG	3267
2020 XL Troubleshooting 4_CAN_DEF_VCS_SUSP	3794

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Symptom	Possible cause	Remedy/Prevention
Noisy clutch.	Release bearing worn or dried.	Replace release bearing.
	Pilot bearing worn or dried.	Replace pilot bearing.
	Clutch disc distorted or warped.	Replace clutch disc.
	Flywheel housing misalignment.	Replace flywheel housing.
	Transmission input shaft or clutch disc spline worn.	Clean and lubricate or replace.
	Insufficient lubrication of pedal and its accessories.	Lubricate.
	Insufficient lubrication of release shaft and release bearing hub.	Lubricate.
	Transmission input shaft retainer rusted or soiled.	Clean or replace if rusted.
	Clutch pedal free-play incorrectly adjusted.	Adjust free-Play.
Clutch pedal cannot be depressed.	Clutch control incorrectly adjusted.	Adjust clutch control.
	Insufficient lubricant release shaft and release bearing hub.	Lubricate.
Change in clutch pedal give.	Air trapped in clutch fluid.	Bleed air.

TRANSMISSION CONTROL UNIT

TROUBLESHOOTING

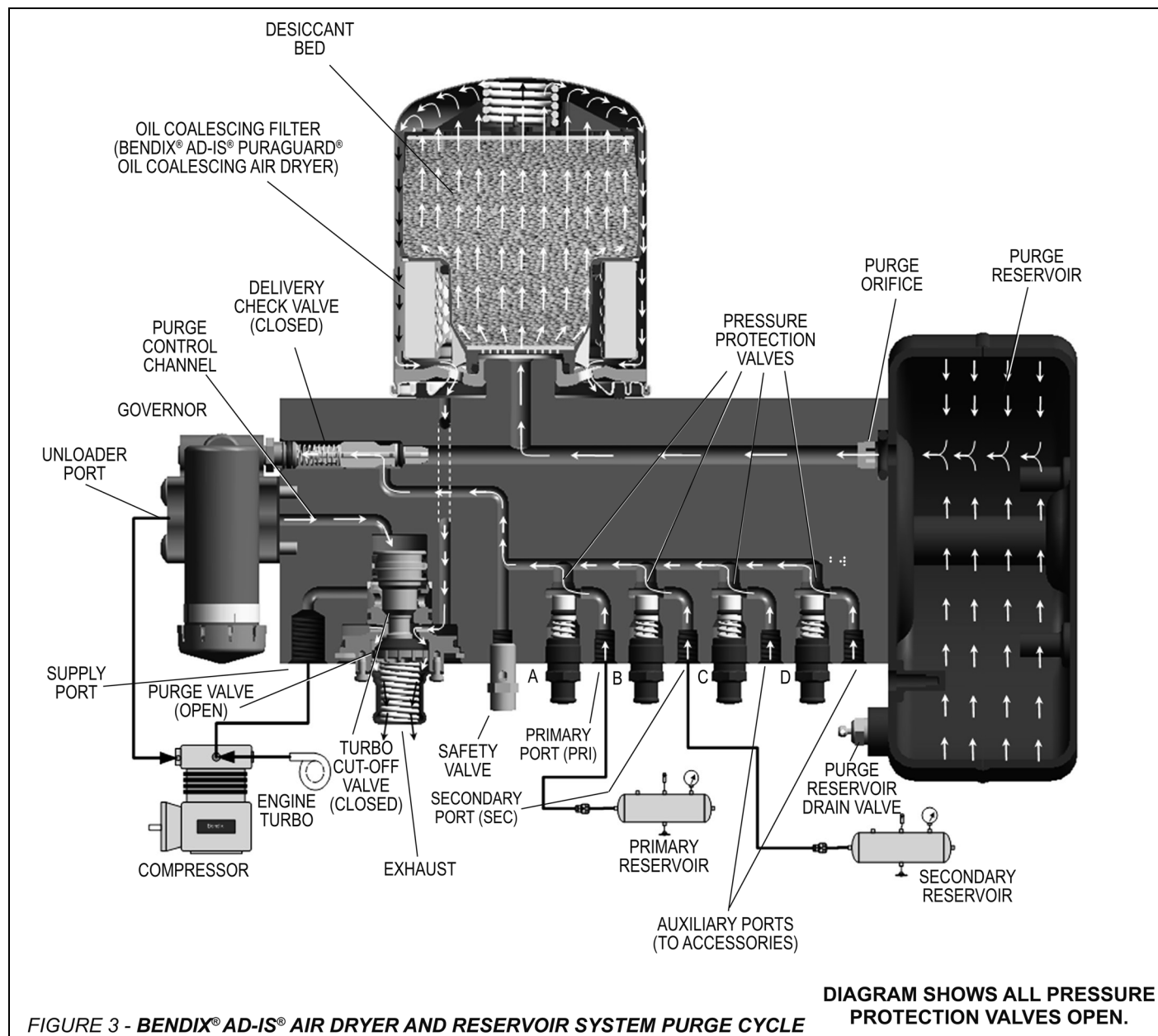
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1. MANUAL TRANSMISSION

Symptom	Possible cause	Remedy/Prevention
Unable to shift the gear or very difficult to shift when the engine is turned off.	Damaged shift lever assembly	Replace shift lever.
	Damaged or broken transmission upper cover (lever, spring, etc.)	Replace.
	The looseness of tightening bolt and nut	Inspect and tighten each bolt and nut.
Gear disengages when driving on bumpy roads.	Loose control lever joint	Tighten or replace.
The play of the lever is excessive.	A joint is seriously worn	Replace the joint.
	The looseness of tightening bolt and nut	Inspect and tighten each bolt and nut.

When the air pressure reaches approximately 106 psi, the four pressure protection valves will open and air will be supplied to the primary reservoir, secondary reservoir and accessories. If the pressure protection valves are preset to different values the valves will open—in order of lowest setting to highest setting—when charging a flat system.

The air dryer and reservoir system will remain in the charge cycle until the air brake system pressure builds to the governor cut-out setting of approximately 130 p.s.i.



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PURGE CYCLE (Refer to Figure 3.)

When air brake system pressure reaches the cut-out setting of the governor, the governor unloads the compressor activating the purge cycle of the air dryer and reservoir.

The governor unloads the compressor by allowing air pressure to fill the line leading to the compressor unloader mechanism. This suspends the delivery of compressed air to the Bendix® AD-IS® air dryer and reservoir system.

Similarly, the governor also supplies air pressure to the air dryer. The pressure also moves the air dryer purge piston down, opening the purge valve to atmosphere and closing off the compressor air supply to the turbo cut-off valve (covered in the Turbo Cut-off Feature section of this document). Water and contaminants captured are expelled immediately when the purge valve opens. In addition, air—which was flowing through the desiccant cartridge—changes direction and begins to flow toward the open purge valve. Contaminants collected by the air dryer are removed by air flowing from the purge reservoir through the desiccant drying bed to the open purge valve.

The initial purge and desiccant cartridge decompression lasts only a few seconds, evidenced by an audible burst of air at the air dryer exhaust.

diaphragm material is a compound of natural rubber with a fabric interior of nylon.

Different size brake chambers are identified by numbers, which specify the effective area of a diaphragm. For example, a Type 30/30 Spring Brake has 30 square inches of effective area on each diaphragm.

! WARNING

Spring brake chambers contain a loaded compression spring. Property damage, serious injury or death may occur if instructions are not followed completely.

When performing any maintenance on the spring brakes, make sure to block the wheels to prevent vehicle rollaway.

DO NOT SERVICE A SPRING BRAKE CHAMBER IF IT HAS STRUCTURAL DAMAGE OF ANY KIND. Replace the complete assembly. Dismount a damaged spring brake by first cutting the service push rod with an acetylene torch to relieve any force it might have.

Do not strike any part of a spring brake chamber for any reason. This may cause structural damage.

Be careful not to drop a spring brake chamber at any time. If dropped, inspect for signs of structural damage. Replace complete assembly if damaged.

Spring brake chambers cannot have the parking/emergency diaphragm replaced. Replace the whole spring brake chamber.

Always work from the side of the spring brake chamber. Never work from the front or back.

Important: Review the warranty policy before performing any maintenance procedures — note that only the service side diaphragm and spring are serviceable.

3.0 PREVENTIVE MAINTENANCE

Because no two vehicles operate under identical conditions, maintenance intervals will vary. Experience is a valuable guide in determining the best maintenance schedule.

NOTE: Whenever a piggyback assembly is removed during maintenance, open the dust-plug hole and – while shining a bright light source through the drain holes – inspect the spring, piston plate and diaphragm; ideally, use a video inspection scope, if available. Additionally, shake the assembly and listen for broken parts. Replace the assembly if a damaged spring, piston plate or parking/emergency diaphragm are found. If the piggyback assembly passes the inspection, reinstall the dust-plug.

3.1 EVERY 300 OPERATING HOURS, 8,000 MILES, OR ONE (1) MONTH:

3.1.1 See Figure 2. Consult the slack adjuster manufacturer's specifications and check that the push rod travel is permissible. Excessive push rod travel reduces braking efficiency, shortens diaphragm life, gives slow braking response, and wastes air.

3.1.2 Check the push rod-to-slack-adjuster alignment from release to full stroke position to be sure the push rod moves out and returns properly without binding at the non-pressure plate hole or with other structures. Also, check the angle formed by the slack adjuster arm and push rod. It should be greater than 90 degrees when the chamber is in the released position and approach 90 degrees at maximum readjustment stroke.

3.1.3 Check that the torque on the non-pressure plate mounting nuts is 133-155 ft. lbs.

3.1.4 Check the cotter pins to ensure they are in place.

3.1.5 Check that the hoses and lines are secure and in good condition with sufficient length to allow for axle movement.

3.2 EVERY 3,600 OPERATING HOURS, 100,000 MILES OR ONE (1) YEAR:

3.2.1 Carefully inspect all metal parts for cracks, distortion, or damage.

3.2.2 With the parking brake applied, open the dust-plug hole and – while shining a bright light source through the drain-holes – inspect the spring, piston plate and diaphragm; ideally, use a video inspection scope, if available. Replace the piggyback assembly if a damaged spring, piston plate or parking/emergency diaphragm are found. If the piggyback assembly passes the inspection, reinstall the dust-plug.

3.2.3 Perform the Leakage Test (Section 4.2). As necessary, install a new service side diaphragm or any other parts if they are worn or deteriorated. All diaphragm sealing surfaces should be smooth and clean. Perform the steps outlined in Section 12 (Replacing the Service Diaphragm). When the service diaphragm, service return spring, or both, are replaced, they should be replaced as an axle set.

3.3 END OF PRODUCT-LIFE TEST

3.3.1 All spring brakes eventually deteriorate with age. Typical end of product-life signs are corrosion, and the presence of rattling sounds caused by broken power springs – *perform the visual inspection in 3.2.2, above.*

For advice on the carefully de-powering and disposal of spring brakes, see BW7450 - available on the document library at www.bendix.com.

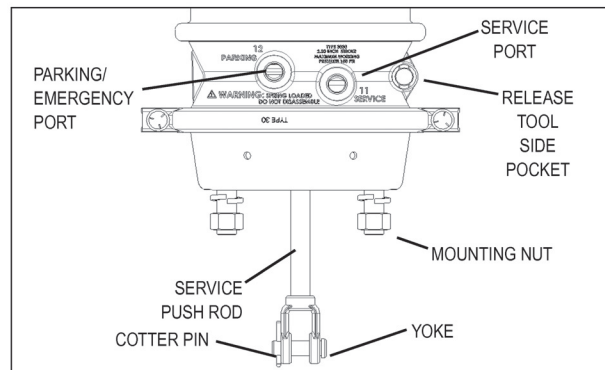


FIGURE 2 - SPRING BRAKE EXTERNAL VIEW



Shoe And Lining Installation

6. For ES-165 5/6/7/8D, L, F, ES-150-4D, ES-150-8D, F & 6D only:

Assemble roller retainer on ends of roller as shown in Figure 64.

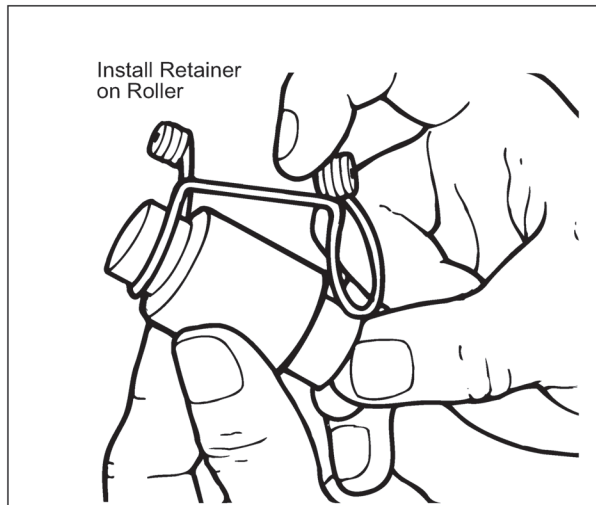


Figure 64. Roller Retainer Installation

7. Using a lever or large screwdriver, stretch shoe return spring to allow insertion of new pin and roller, (or roller and retainer assembly) on the lower shoe web. Refer to Figure 65.

NOTE: If drums are oversized, use oversize rollers, see **Inspection-Drum Inspection**.

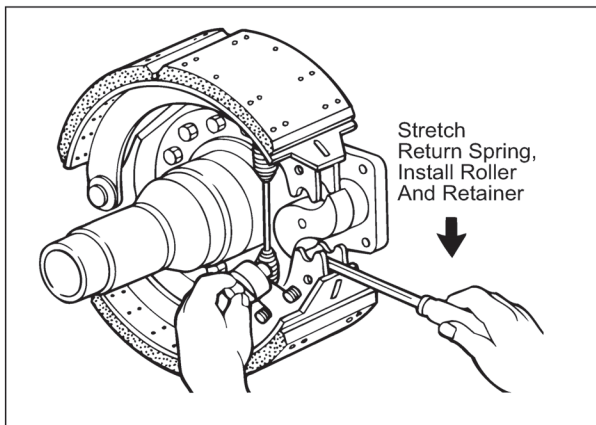


Figure 65. Shoe Return Spring Installation

8. For ES-165 5/6/7/8D, L, F, ES-150-4D, ES-150-8D, F & 6D only:

Position assembly in roller recess as shown. Squeeze loops and swing retainer into position to snap loops into web holes. Refer to Figure 66. Verify that both retainer loops are engaged in web holes before proceeding.

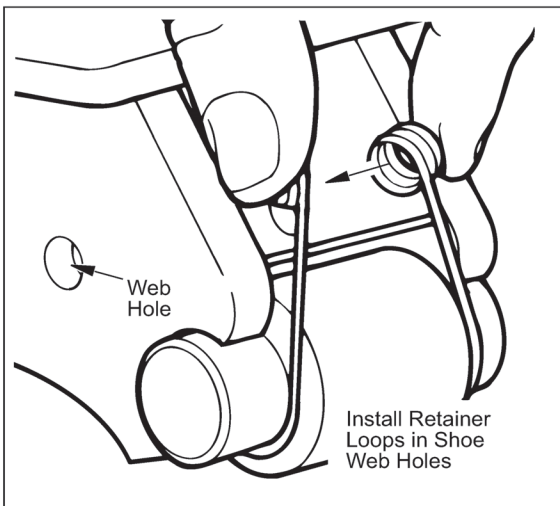


Figure 66. Retainer Installation

9. Repeat process on upper shoe.

NOTE: For all EB Models a roller retainer is not used.

5.7 BENDIX® SPLINED DISC® HUB ROTOR

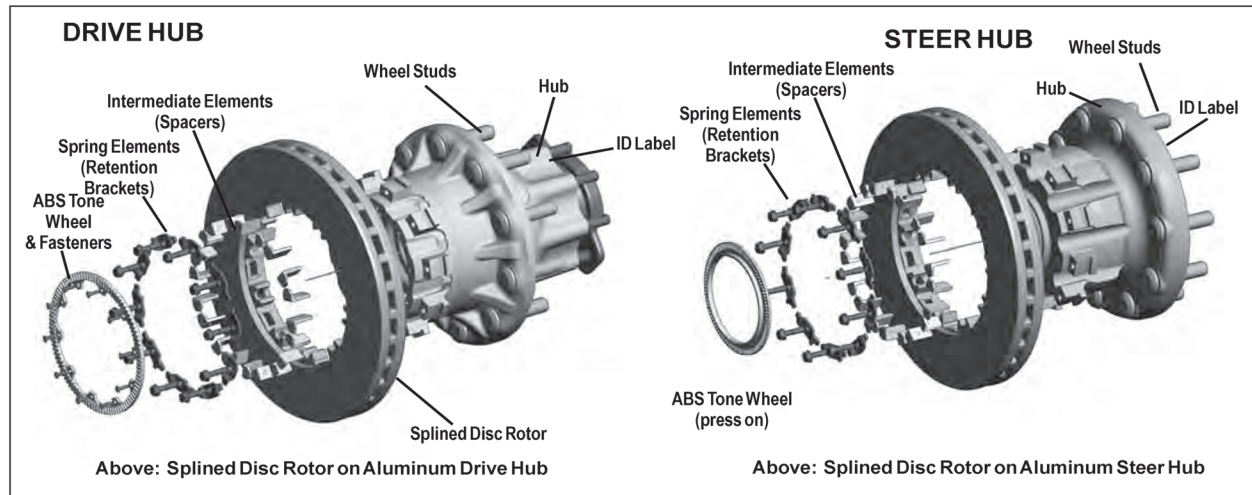


FIGURE 86 - SPLINED DISC ROTOR EXAMPLES - EXPLODED VIEWS

Bendix® Splined Disc® Hub Rotors are designed to assist vehicle maintenance by typically allowing the rotor to be serviced without requiring the entire hub/rotor assembly be replaced.

Periodic inspection of the Splined Disc attachment hardware is recommended to ensure optimum braking performance. Bendix recommends verifying the torque on the spring element fasteners whenever a brake inspection is performed.

NOTE: *Anytime that the entire hub/rotor assembly is removed, Bendix recommends that the wheel seal also be replaced at the same time, USING A HIGH-TEMPERATURE SEAL. Follow the wheel seal and/or vehicle manufacturer's guidelines for full installation instructions. Adjust the bearings and refill bearing oil to vehicle manufacturer's specifications.*

When replacing a Splined Disc Rotor, Bendix strongly recommends that the brake pads be replaced (as an axle set.) Contact 1-800-AIR-BRAKE for appropriate brake pad kit. Rotor replacement necessitates the removal of the pads.

CAUTION: Follow all safe maintenance practices, including those listed on page two of this document. Park the vehicle (by other means than the foundation brakes) on level ground and chock the wheels. Also read the vehicle manufacturer's recommendations. When installing pads, where appropriate, use heavy duty gloves and always keep fingers away from potential pinch hazard areas.

Bendix Air Disc Brakes are precision-engineered braking mechanisms. The "friction couple" braking characteristics have been carefully optimized and the rotor design and materials have been matched with special formulation brake pads for optimal performance, therefore use only genuine Bendix® brand parts and brake pads.

Rotor Replacement

- 5.7.1 Before removing the brake pads it is strongly recommended that the air disc brake adjuster mechanism be checked for correct operation (See Section 4.1). When replacing brake pads, Bendix strongly recommends that the pads be replaced as an axle set.
- 5.7.2 Refer to the vehicle manufacturer's recommendations and release (or cage) spring brakes and remove the wheel.
- 5.7.3 Remove the pads (See Section 5.2).
- 5.7.4 Remove the air disc brake (See Section 5.3).
- 5.7.5 Remove the hub rotor assembly.

Note: *Follow the vehicle manufacturer's guidelines for removal of the wheel hub and rotor assembly from the vehicle in lieu of these instructions, where available.*

CAUTION: Be sure to secure both the rotor and hub before removing the retention clips.

- 5.7.6 Remove and discard the ten spring elements.
- 5.7.7 On drive axles, the ABS tone ring must also be removed. (See Figure 86.) Retain for re-installation.
- 5.7.8 Use suitable hand tools to remove the intermediate elements (spacers). Remove all the right-hand intermediate elements (spacers) of each set first and then the rotor can be turned slightly to release

DTC SPN FMI	Failure Detection Name	Failure Detection Description	Warning and System Reaction	Repair
703 - 4 = Trailer Modulator IV - voltage below normal or shorted low	Failure detection 'ShortGnd' at Auxiliary Output (Position A)	A short circuit to GND of the relevant actuator is detected in active and inactive states. The detection time is 200 ms. Remark: A shorted load also leads to a short to GND failure. A shorted load is detected: - After 200 ms after ignition-on and also if valve is activated. - After 1000 ms if valve is not activated.	Yellow Driver Warning, ABS fully available	- Check wiring of relevant valve/actuator. (Is there a short circuit?) - Check relevant valve/actuator. (Is there an internal short circuit?) - Contact the Meritor OnTrac™ Customer Call Center at 866-OnTrac1 (668-7221).
703 - 5 = Trailer Modulator IV - current below normal or open circuit	Failure detection 'Interruption' at Auxiliary Output (Trailer Modulator IV)	An interruption of the relevant actuator is detected in active and inactive states. The detection time is 200 ms.	Yellow Driver Warning, ABS fully available	- Check for correct parameter setting. (Is the relevant valve/actuator equipped?) - Check wiring of relevant valve/actuator. (Is there an interruption?) - Check relevant valve/actuator (Is there an internal interruption?) - Contact the Meritor OnTrac™ Customer Call Center at 866-OnTrac1 (668-7221).
703 - 13 = Trailer Modulator IV - out of calibration	Failure detection 'OverEquipped' at Auxiliary Output (Trailer Modulator IV)	A failure is detected if a component is connected to the ECU, but it is not activated in the parameter settings.	Yellow Driver Warning, ABS completely switched off	- Check for correct parameter setting. (Is the relevant valve/actuator equipped?) - Check wiring of relevant valve/actuator. (Is ECU pin open?) - Contact the Meritor OnTrac™ Customer Call Center at 866-OnTrac1 (668-7221).
704 - 3 = Trailer Modulator OV - voltage above normal or shorted high	Failure detection 'ShortUp' at Auxiliary Output (Trailer Modulator OV)	A short circuit to UB of the relevant actuator is detected in active and inactive states. The detection time is 200 ms.	Yellow Driver Warning, ABS fully available	- Check wiring of relevant valve/actuator. (Is there a short circuit?) - Contact the Meritor OnTrac™ Customer Call Center at 866-OnTrac1 (668-7221).
704 - 4 = Trailer Modulator OV - voltage below normal or shorted low	Failure detection 'ShortGnd' at Auxiliary Output (Trailer Modulator OV)	A short circuit to GND of the relevant actuator is detected in active and inactive states. The detection time is 200 ms. Remark: A shorted load also leads to a short to GND failure. A shorted load is detected: - After 200 ms after ignition-on and also if valve is activated. - After 1000 ms if valve is not activated.	Yellow Driver Warning, ABS fully available	- Check wiring of relevant valve/actuator. (Is there a short circuit?) - Check relevant valve/actuator. (Is there an internal short circuit?) - Contact the Meritor OnTrac™ Customer Call Center at 866-OnTrac1 (668-7221).
704 - 5 = Trailer Modulator OV - current below normal or open circuit	Failure detection 'Interruption' at Auxiliary Output (Trailer Modulator OV)	An interruption of the relevant actuator is detected in active and inactive states. The detection time is 200 ms.	Yellow Driver Warning, ABS fully available	- Check for correct parameter setting. (Is the relevant valve/actuator equipped?) - Check wiring of relevant valve/actuator. (Is there an interruption?) - Check relevant valve/actuator. (Is there an internal interruption?) - Contact the Meritor OnTrac™ Customer Call Center at 866-OnTrac1 (668-7221).
704 - 13 = Trailer Modulator OV - out of calibration	Failure detection 'OverEquipped' at Auxiliary Output (Trailer Modulator OV)	A failure is detected if a component is connected to the ECU, but it is not activated in the parameter settings.	Yellow Driver Warning, ABS completely switched off	- Check for correct parameter setting. (Is the relevant valve/actuator equipped?) - Check wiring of relevant valve/actuator. (Is ECU pin open?) - Contact the Meritor OnTrac™ Customer Call Center at 866-OnTrac1 (668-7221).
705 - 3 = 3/2 Valve Governor - voltage above normal or shorted high	Failure detection 'ShortUp' at Auxiliary Output (3/2 Valve Governor)	A short circuit to UB of the relevant actuator is detected in active and inactive states. The detection time is 200 ms.	Yellow Driver Warning, ABS fully available	- Check wiring of relevant valve/actuator. (Is there a short circuit?) - Contact the Meritor OnTrac™ Customer Call Center at 866-OnTrac1 (668-7221).

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DTC SPN FMI	Failure Detection Name	Failure Detection Description	Warning and System Reaction	Repair
520530 - 0 = OverHeating - Pressure Modulation Valve ABS (Front Axle Left) - data valid, but above normal operation range (most severe level)	Overheating at ABS Valve (Front Axle Left)/High Level	An overheating failure of the relevant ABS valve is set if the ABS valve was activated for a long time so the temperature limit (critical second level) was reached. Time for critical level: - 200 s (12V System)	Yellow Driver Warning, ABS fully available	• ABS valves were overheated. Reduce activation time especially of hillholder and haltbrake function.
520530 - 15 = OverHeating - Pressure Modulation Valve ABS (Front Axle Left) - data valid, but above normal operation range (least severe level)	Overheating at ABS Valve (Front Axle Left)/Low Level	An overheating failure of the relevant ABS valve is set if the ABS valve was activated for a long time so the temperature limit (prewarning level) was reached. Time for prewarning level: - 180 s (12V System)	Yellow Driver Warning, ABS fully available	• ABS valves were overheated. Reduce activation time especially of hillholder and haltbrake function.
520531 - 0 = OverHeating - Pressure Modulation Valve ABS (Front Axle Right) - data valid, but above normal operation range (most severe level)	Overheating at ABS Valve (Front Axle Right)/High Level	An overheating failure of the relevant ABS valve is set if the ABS valve was activated for a long time so the temperature limit (critical second level) was reached. Time for critical level: - 200 s (12V System)	Yellow Driver Warning, ABS fully available	• ABS valves were overheated. Reduce activation time especially of hillholder and haltbrake function.
520531 - 15 = OverHeating - Pressure Modulation Valve ABS (Front Axle Right) - data valid, but above normal operation range (least severe level)	Overheating at ABS Valve (Front Axle Right)/Low Level	An overheating failure of the relevant ABS valve is set if the ABS valve was activated for a long time so the temperature limit (prewarning level) was reached. Time for prewarning level: - 180 s (12V System)	Yellow Driver Warning, ABS fully available	• ABS valves were overheated. Reduce activation time especially of hillholder and haltbrake function.
520532 - 0 = OverHeating - Pressure Modulation Valve ABS (Drive Axle Left) - data valid, but above normal operation range (most severe level)	Overheating at ABS Valve (Drive Axle Left)/High Level	An overheating failure of the relevant ABS valve is set if the ABS valve was activated for a long time so the temperature limit (critical second level) was reached. Time for critical level: - 200 s (12V System)	Yellow Driver Warning, ABS fully available	• ABS valves were overheated. Reduce activation time especially of hillholder and haltbrake function.
520532 - 15 = OverHeating - Pressure Modulation Valve ABS (Drive Axle Left) - data valid, but above normal operation range (least severe level)	Overheating at ABS Valve (Drive Axle Left)/Low Level	An overheating failure of the relevant ABS valve is set if the ABS valve was activated for a long time so the temperature limit (prewarning level) was reached. Time for prewarning level: - 180 s (12V System)	Yellow Driver Warning, ABS fully available	• ABS valves were overheated. Reduce activation time especially of hillholder and haltbrake function.
520533 - 0 = OverHeating - Pressure Modulation Valve ABS (Drive Axle Right) - data valid, but above normal operation range (most severe level)	Overheating at ABS Valve (Drive Axle Right)/High Level	An overheating failure of the relevant ABS valve is set if the ABS valve was activated for a long time so the temperature limit (critical second level) was reached. Time for critical level: - 200 s (12V System)	Yellow Driver Warning, ABS fully available	• ABS valves were overheated. Reduce activation time especially of hillholder and haltbrake function.

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ON-VEHICLE SERVICE

EN07Z0803C100003

1. FILLING AND AIR BLEEDING THE SYSTEM

CAUTION

Make sure poppets are set correctly before beginning this procedure.

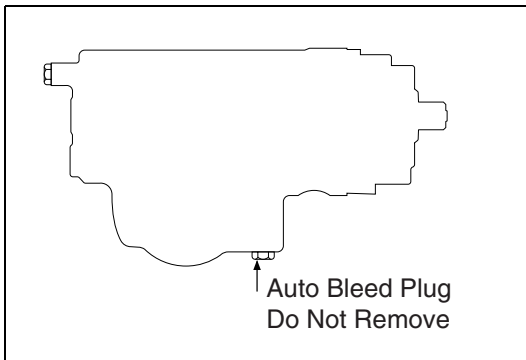
- (1) Fill the reservoir nearly full. Do not steer. Start and run the engine for 10 seconds, then shut it off. Check and refill the reservoir. Repeat at least three times, checking the reservoir each time.

CAUTION

Do not allow the fluid level to drop significantly or run out of the reservoir. This may induce air into the system.

- (2) Start the engine and let it idle for 2 minutes. Do not steer. Shut off the engine and check the fluid level in the reservoir. Refill as required.
- (3) Start the engine again. Steer the vehicle from full left to full right several times. Add fluid, as necessary, to the full line on the dip stick.

Automatic bleed systems should now be free from trapped air.

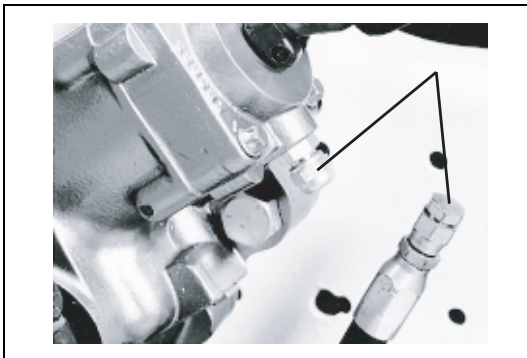


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2. INPUT SHAFT SEAL REPLACEMENT

This procedure uses the vehicle's power steering pump to force out the input shaft seal. To use this procedure, the power steering pump should have a minimum of 1,500 psi available.

- (1) Disconnect return line from the steering gear and plug the line. Also cap the return port of the gear with a high pressure fitting.



SAPH07Z080300009

POWER STEERING PUMP

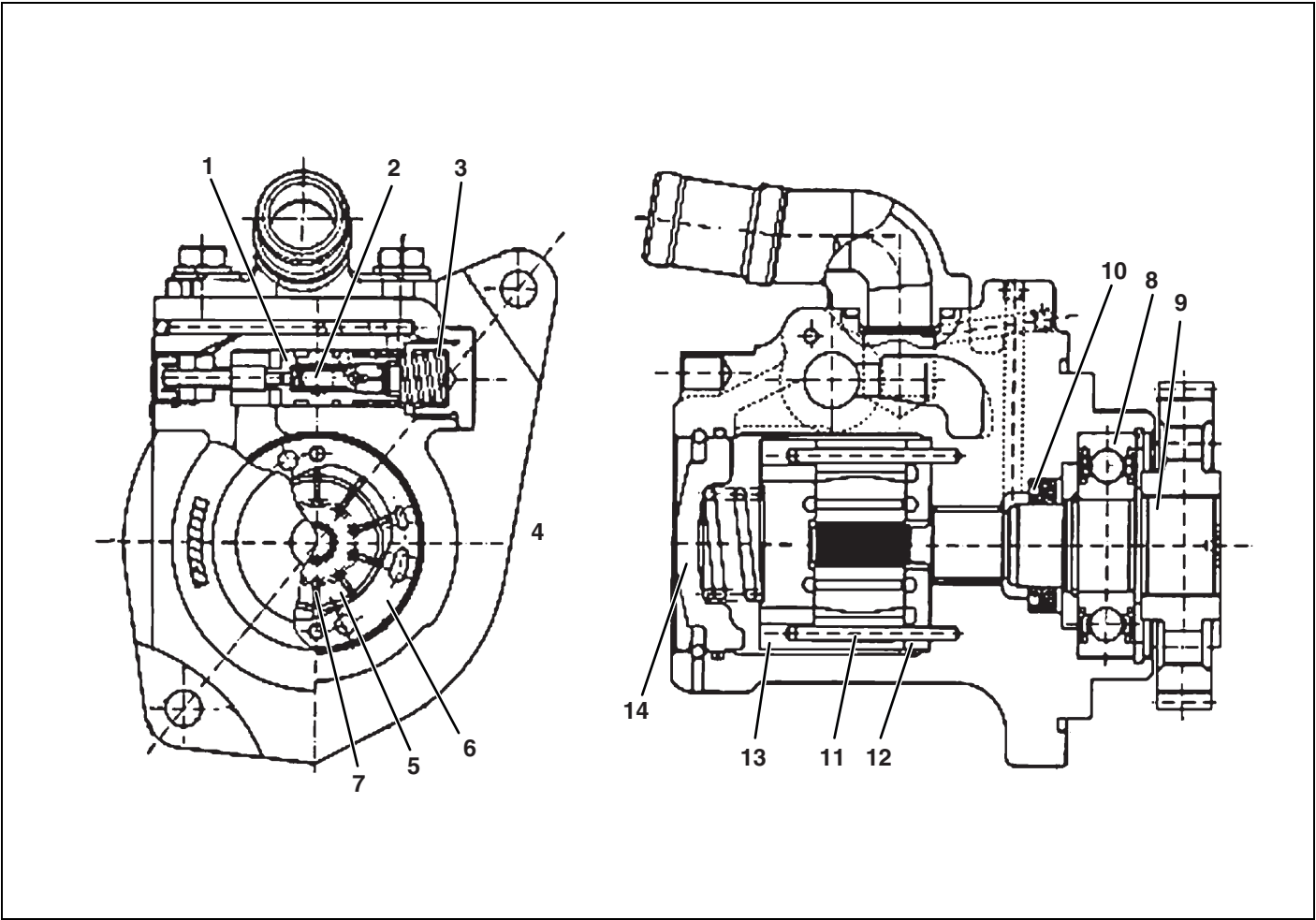
DATA AND SPECIFICATIONS

EN07Z0803I200002

Type	Vane type
Relief pressure	14.0-14.7 MPa {142.76-149.89 kgf/cm ² , 2030.54-2132.05 lbf/in ² }
Flow rate	15.4-18.4 L/min {4.07-4.86 U.S. gal/min}

DESCRIPTION

EN07Z0803C100004



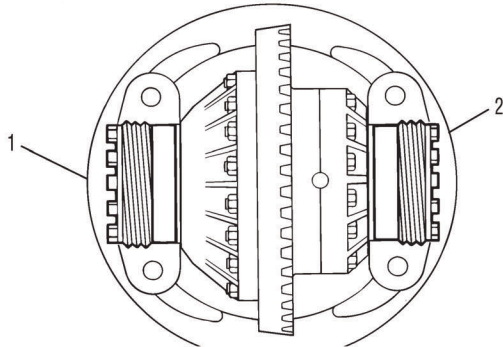
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1	Flow control valve assembly	8	Ball bearing
2	Relief valve	9	Pump shaft
3	Spring	10	Oil seal
4	Pump body	11	Dowel
5	Rotor	12	Front plate
6	Cam ring	13	Rear plate
7	Vane	14	Pump cover

Measure and Adjust Carrier Assembly

Adjust Backlash and Preload

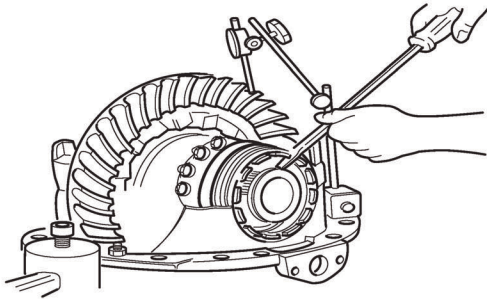
1. Turn the flange half-bearing adjuster in until the ring gear contacts the pinion (zero backlash) then back the adjuster out two (2) notches from the adjuster lugs.



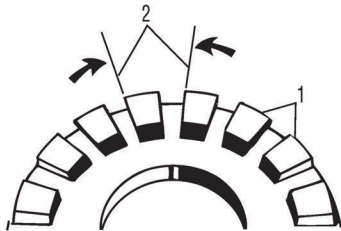
1 - Flange half

2 - Plain half

2. Tighten the plain half-adjuster until the bearing cup just starts to turn, this is a zero bearing preload.



3. Tighten the plain half-adjuster two lug notches. Start with the notch at the top, count two notches counterclockwise on the adjuster, turn the adjuster so that the notch is facing straight up. You now have a two-notch preload.



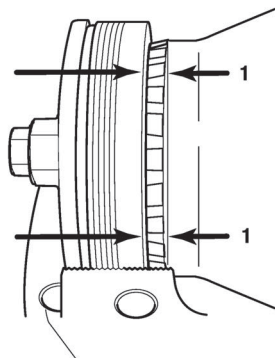
1 - Lugs

2 - One notch

4. Use a rubber mallet to make certain that both bearing adjusters are fully seated.
5. Measure backlash. Make sure it is within specification of .008"-.018" (.15-.46 mm).

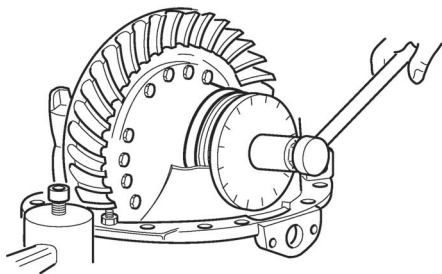
TIP: To give yourself room to adjust contact pattern, set it between .012"-.014" (.30-.36 mm).

4. Make sure that the bearings cage is parallel to the edge of the threaded cup.

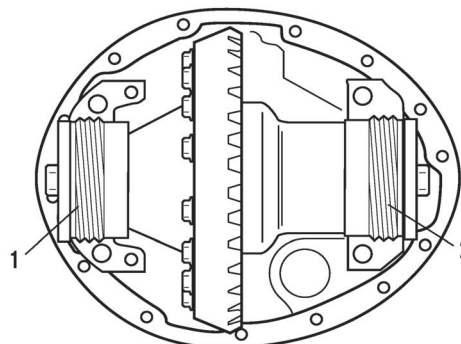


1 - Parallel

5. Use a ratchet or breaker bar and a 1¼" deep wall socket to turn the flange half threaded bearing cup in until the ring gear contacts the pinion (zero backlash). Back the cup out two notches of the adjustment plate.

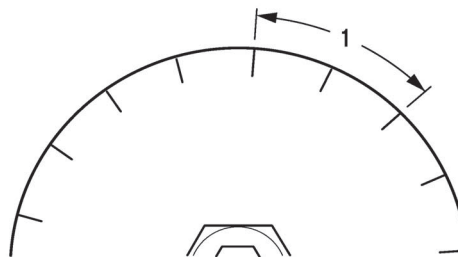


6. Turn the plain half adjuster ring until there is zero preload on the bearings. This is done by turning the adjuster plate clockwise until you feel the threaded cup gain resistance. The threaded bearing cup should only be slightly snugged to achieve a zero preload condition.



1 - Flange Half
2 - Plain Half

7. Obtain two notches of preload by tightening the plain half adjustment ring two notches. Start with the notch at the top, count two notches counter-clockwise on the adjuster ring, turn the adjuster ring so that the notch is facing straight up.



1 - Two Notches

Fastener Torque Specifications

Location	Size	Lbs. Ft.	N•m
POWER DIVIDER			
Input Cage Locking Bolt	M8 x 1.0 x 30	20 ± 5	25 ± 5
IAD Shift End Cap	2.375 - 16 UN-2A	65 ± 10	85 ± 15
Power Divider Cover Capscrews	M14 x 1.5 x 45	175 ± 10	235 ± 10
Input Shaft Nut	M48 x 1.5	900 ± 100	1220 ± 135
WHEEL DIFFERENTIAL AND GEARING			
Front Pinion Helical Nut	M48 x 1.5	900 ± 100	1220 ± 135
Output Shaft Nut	M42 x 1.5	900 ± 100	1220 ± 135
Rear Pinion Nut	M48 x 1.5	900 ± 100	1220 ± 135
Ring Gear, Diff. Case Bolts	M20 x 1.5 x 55	500 ± 25	675 ± 30
CARRIER			
Carrier Diff. Bearing Cap	M18 x 1.5 x 85	265 ± 15	360 ± 20
Carrier to Housing Capscrews	M16 x 1.5 x 85	250 ± 15	335 ± 20
	M16 x 1.5 x 55	250 ± 15	335 ± 20
Carrier to Housing Nuts	M16 x 1.5	250 ± 15	335 ± 20
Pilot Bearing Web	M16 x 1.5 x 70	210 ± 10	285 ± 15
Differential Lock Switch	M14 x 1.5	10 ± 1	15 ± 3
Differential Lock End Cap	2.375 - 16 UN-2A	65 ± 10	85 ± 15
HOUSING			
Rear Cover Capscrews	M16 x 1.5 x 70	250 ± 15	335 ± 20
	M16 x 1.5 x 55	250 ± 15	335 ± 20
Rear Cover Nuts	M16 x 1.5	250 ± 15	335 ± 20
Magnetic Plug (Fill)	1 x 11.5 NPTF	50 ± 5	72 ± 5
Drain Plug	0.750 - 14 NPTF	50 ± 5	72 ± 5
Housing Breather	0.375 - 18 NPTF	20 - 26	27 - 35
Temperature Sending Plug	0.500 - 20 NPTF	50 ± 5	72 ± 5
Axle Shaft to Wheel Hub Nut	0.625 - 18	180 ± 10	245 ± 15
	0.750 - 16	315 ± 30	425 ± 40
Wheel Diff. Lock Caps	2.37 - 16UN-2A	65 ± 10	85 ± 15

Change Lube

Drain

Drain when the lube is at normal operating temperature (150°–200°F). It will run freely and minimize the time necessary to fully drain the axle, this insures the axle is flushed.

Unscrew the magnetic drain plug on the underside of the axle housing and allow the lube to drain into a suitable container.

NOTE: Dispose of all used lubricants properly by following disposal methods approved for mineral or synthetic based oils.

After initial oil change, inspect drain plug for large quantities of metal particles. These are signs of damage or extreme wear in the axle. Clean the drain plug and replace it after the lube has drained completely. Inspect breather for clogging or corrosion. Clean or replace as necessary.

Fill

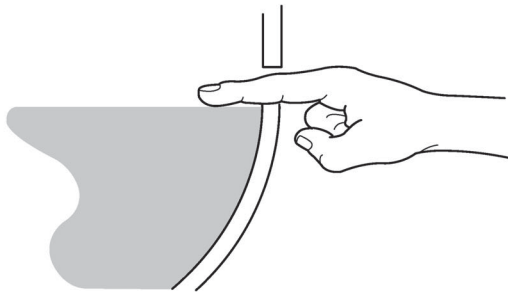
Front Axle

a. With vehicle on level ground, remove the filler hole plug from the axle housing cover and fill the axle with approved lubricant until level with the bottom of the hole.

Rear Axle

a. Remove the filler hole plug from the axle housing cover and fill the axle with the approved lubricant until level with the bottom of the hole.

b. If wheel ends were removed, follow instructions in wheel end servicing section.

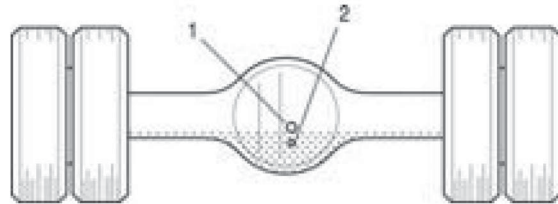


Correct lube level at bottom of filler hole

Always use the filler hole as the final reference. If lube is level with the bottom of the hole, the axle is properly filled.

NOTE: Lube fill capacities (see chart) are basic guidelines and will vary based on the angle the axle is installed in a particular chassis. Torque fill plug to 40–60 lbs. ft. (54–82 N•m).

TIP: The axle can be filled through the axle housing breather hole. Fill until lube level is even with the bottom of filler hole in axle housing rear cover.



1 - With axle on level surface, fill housing with oil to bottom of plug

2 - Temperature sensor mounting hole

Disassemble, Assemble, and Overhaul Power Divider

Assemblies built AFTER 11/02/98 – Out of Vehicle

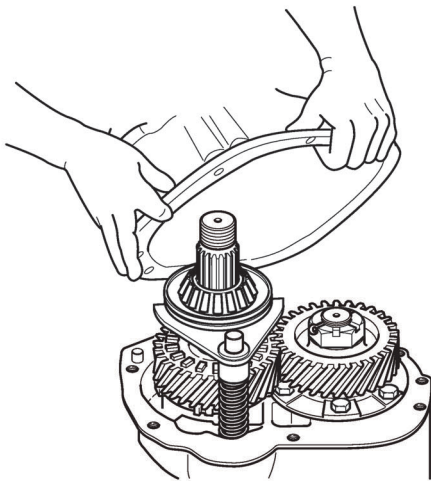
The power divider cover comes off as a unit followed by the input shaft and then the helical side gear.

The power divider can be replaced with the axle assembly both in or out of the chassis and with the differential carrier assembled to the axle housing.

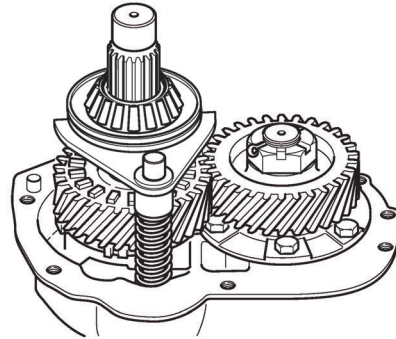
CAUTION

During removal of power divider cover, the inter-axle differential (IAD), input shaft assembly or IAD shift system parts may fall from the carrier if not careful. Use caution to prevent injury or damage.

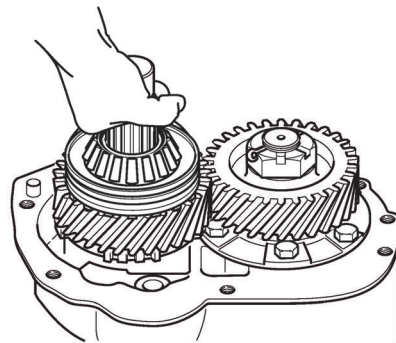
1. Disconnect the main driveline.
2. Disconnect the lockout air line.
3. Remove input yoke.
4. Remove input seal.
5. Position a drain pan under the power divider unit.
6. Remove PDU capscrews.
7. Remove power divider cover.



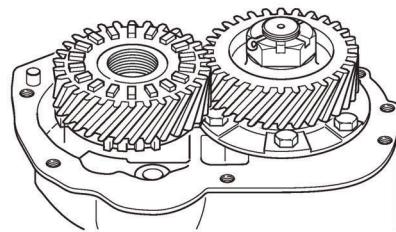
8. Remove shift fork, compression spring and shift rod.



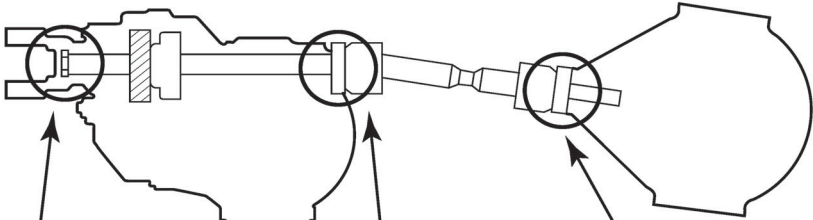
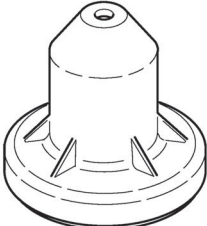
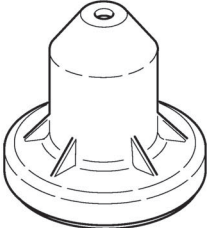
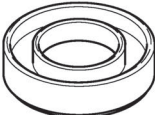
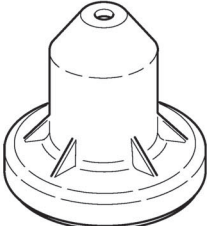
9. Remove **input shaft and helical thrust washer** from the carrier.



10. Remove helical side gear.



Service Kit 217414

	D-Input	D-Output	R-Pinion
Location			
Tool	 126917	 126917 +  128706	 126917

New Welded D-Housing Cover

Lube Quantity Difference

0 (zero)

Standout of Output Shaft Yoke

Length increased by 6mm (.25”), this should not have any significant impact on inter-axle driveline length or drive line angles.

Interchangeability of Parts

A cross reference chart of “OLD” axle housing to “NEW” axle housings with welded on covers will be published in a separate bulletin. The bolt on D-Housing covers will remain available for service.

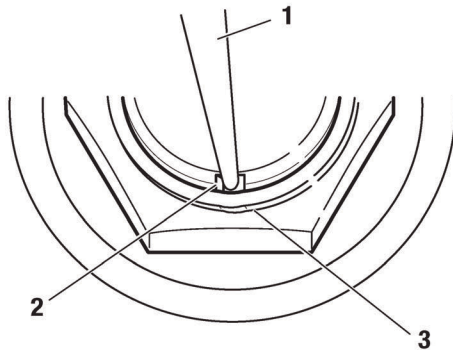
Power Divider Disassembly - Forward Carrier Assembly

Use these instructions with the carrier assembly in or out of the vehicle.

1. Disconnect the main driveline.
2. Disconnect the lockout airline.
3. Drain the axle lubricant into a clean oil pan.
4. Remove the input yoke nut and yoke.
5. To de-stake the nut, use a chisel or drift with a round tip. The flange of the nut must be pushed far enough outward so that the staked area will not interfere with the input shaft threads when the nut is removed. See diagrams below.



Failure to de-stake the pinion nut will result in damage to the drive pinion threads when removed. The pinion nut should never be reused, always replace with new.

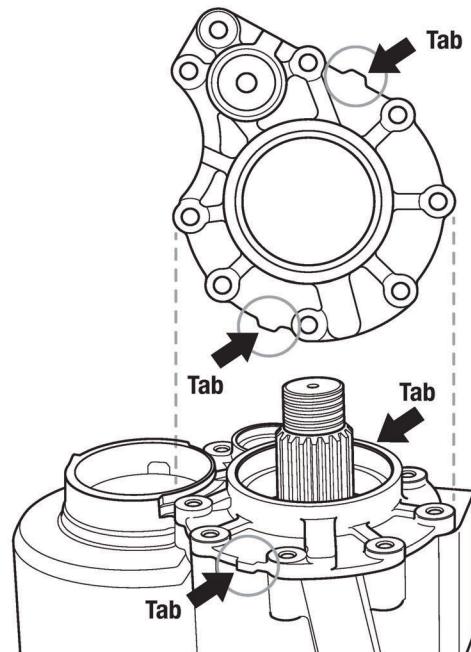


- 1 - Round Tipped Chisel
2 - Machined Slot In Pinion
3 - Nuts Staking Flange

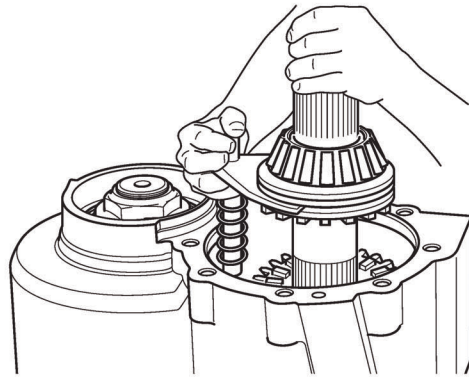
6. Remove the input seal.

Note: Do not reuse the seals after disassembly.

7. Remove the power divider cover assembly. Use the tabs provided to free the cover from the carrier assembly.



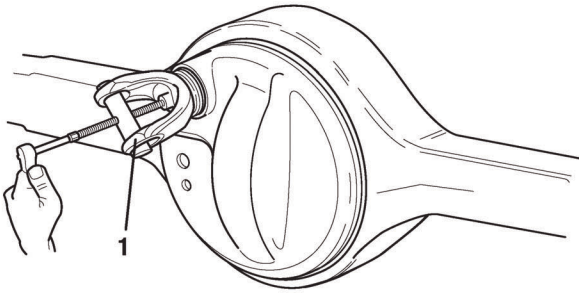
8. Remove the input shaft, sliding clutch, shift fork and spring as an assembly.



Remove Output Shaft Assembly

Note: For forward axle rear covers that are removable the output shaft may be removed when the cover is in or out of the axle assembly.

1. Disconnect the inter-axle driveline at the forward axle rear cover position.
2. Remove yoke nut (shoulder nut).
3. Remove yoke from output shaft using appropriate tool.

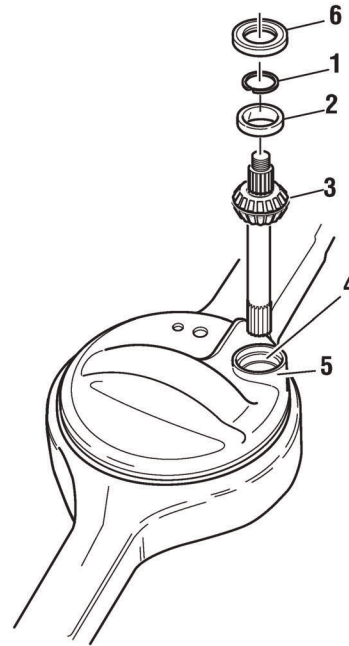


1 - Yoke Puller Tool

TIP: A yoke puller tool may be made from the center section of most gear puller tools, or may be purchased from your tool distributor.

4. Remove oil seal.
5. Remove snap ring.

6. Remove output shaft and outer bearing cup as an assembly.



- 1 - Snap Ring
- 2 - Outer Bearing Cup
- 3 - Output Shaft Assembly
- 4 - Inner Bearing Cup
- 5 - Rear Cover Assembly
- 6 - Output Seal

TIP: It may be helpful to loosely reinstall the yoke and shoulder nut giving the technician more of an area to grip when removing the output shaft.

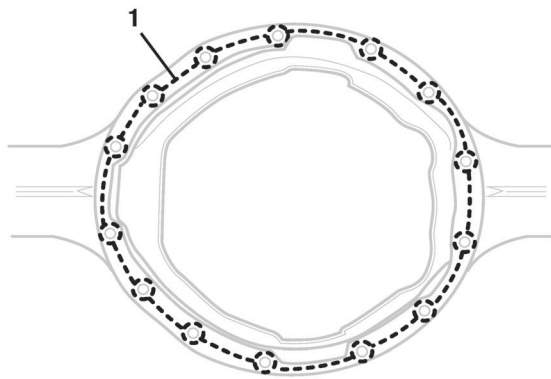
7. Remove the inner bearing cup from rear cover assembly. This may be removed from inside the axle housing when the carrier is removed, or by removal of the forward axle rear cover.

Install Differential Carrier (Forward and Rear)

⚠ IMPORTANT

Before installing carrier assembly, inspect and thoroughly clean interior of axle housing using an appropriate solvent and clean rag.

1. Apply Spicer approved RTV compound on axle housing mating surface as shown in the illustration. Completely remove all old gasket material prior to applying new material. Compound will set in 5 minutes. Install carrier before compound sets or reapply.



1 - Apply silicone gasket in this pattern

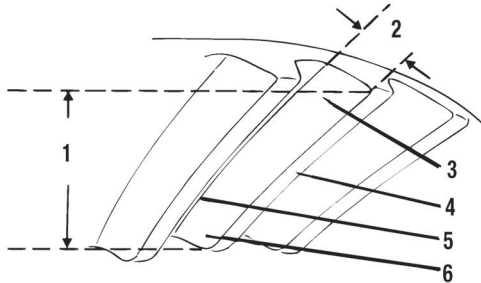
Tip: To assist in installing complete differential carrier use two pieces of threaded rod (M16 X 1.5) threaded into carrier capcrew holes. Rod should be approximately 6" long. Use these to pilot the carrier into the housing.

2. Install carrier to housing, lock washers, capscrews and nuts. Torque to proper specification. Torque to 250–290 lbs. ft. (339–393 N•m).
3. Install axle shafts and axle stud nuts. (If used, also install lock washers and tapered dowels.)
4. Add axle lubricant. Fill to bottom of filler hole.
5. **Rear Only:** Connect inter-axle driveline, making sure all yokes are in phase. Lubricate u-joints.
6. **Front Only:** Connect main driveline, making sure all yokes are in phase. Lubricate u-joints.
7. **Front Only:** Connect differential lockout air line.

Adjust Tooth Contact Position

Adjust Ring and Pinion Tooth Contact Pattern

Note: Rear axle gearing is shown in the following instructions. Correct tooth contact patterns and adjustments are the same for forward and rear axles.



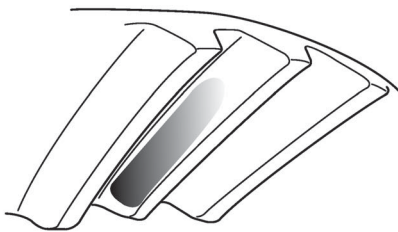
- 1 - Face width
- 2 - Tooth depth
- 3 - Heel
- 4 - Top land
- 5 - Root
- 6 - Toe

1. Identify if new or used gearing.
2. Check tooth contact pattern (new or used gearing).

New Gearing - Correct Pattern

Paint six ring gear teeth 180° apart with marking compound and roll the gear to obtain a contact pattern. The correct pattern is slightly below center on the ring gear tooth with lengthwise contact up off the toe. The length of the pattern in an unloaded condition is approximately one-half to two-thirds of the ring gear tooth in most models and ratios.

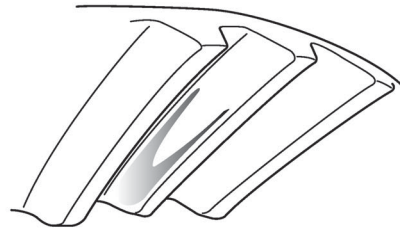
The pattern could vary in length and should cover 1/2 tooth or more (face width). The pattern should be evenly centered between tooth top land and root and should be up off the tooth toe.



Used Gearing - Correct Pattern

Used gearing will not usually display the square, even contact pattern found in new gear sets. The gear will normally have a "pocket" at the heel end of the gear tooth. The more use a gear has had, the more the line becomes the dominant characteristic of the pattern.

Adjust used gear sets to display the same contact pattern observed before disassembly. A correct pattern is up off the toe and centers evenly along the face width between the top land and root. Otherwise, the length and shape of the pattern are highly variable and is considered acceptable as long as it does not run off the tooth at any point.



- 1 - Pattern along the face width could be longer

Inspection

Failure Analysis

Failure analysis is the process of determining the original cause of a component failure in order to keep it from happening again. Too often, when a failed component is replaced without determining its cause, there will be a recurring failure. If a carrier housing is opened, revealing a ring gear with a broken tooth, it is not enough to settle on the broken tooth as the cause of the carrier failure. Other parts of the carrier must be examined. For a thorough understanding of the failure and possible insight into related problems, the technician needs to observe the overall condition of the vehicle.

No one benefits when a failed component goes on the junk pile with the cause unknown. Nothing is more disturbing to a customer than a repeat failure. Systematically analyzing a failure to prevent a repeat occurrence assures quality service by avoiding unnecessary downtime and further expense to the customer.

The true cause of a failure can be better determined by knowing what to look for, determining how a piece of the equipment was running and learning about previous problems. In the case of a rebuilt rear axle, mismatched gears may have been installed. The more successful shops prevent repeat equipment failures by developing good failure analysis practices. Knowing how to diagnose the cause of a premature failure is one of the prerequisites of a good heavy-equipment technician.

How to Diagnose a Failure

The following five steps are an effective approach to good failure diagnostics.

1. Document the problem.
2. Make a preliminary investigation.
3. Prepare the parts for inspection.
4. Find the cause of the failure.
5. Correct the cause of the problem.

Document the Problem

Here are some guidelines for starting to learn about a failure, including questions to ask:

1. Talk to the operator of the truck.
2. Look at the service records.
3. Find out when the truck was last serviced.

4. Ask: In what type of service is the truck being used?
5. Ask: Has this particular failure occurred before?
6. Ask: How was the truck working prior to the failure?

You need to be a good listener. Sometimes, insignificant or unrelated symptoms can point to the cause of the failure:

7. Ask: Was the vehicle operating at normal temperatures?
8. Ask: Were the gauges showing normal ranges of operation?
9. Ask: Was there any unusual noise or vibration?

After listening, review the previous repair and maintenance records. If there is more than one driver, talk to all of them and compare their observations for consistency with the service and maintenance records. Verify the chassis Vehicle Identification Number (VIN) number from the vehicle identification plate, as well as the mileage and hours on the vehicle.

Make a Preliminary Investigation

These steps consist of external inspections and observations that will be valuable when combined with the results of the parts examination.

1. Look for leaks, cracks or other damage that can point to the cause of the failure.
2. Make note of obvious leaks around plugs and seals. A missing fill or drain plug would be an obvious cause for concern.
3. Look for cracks in the carrier housing (harder to see, but sometimes visible).
4. Does the general mechanical condition of the vehicle indicate proper maintenance or are there signs of neglect?
5. Are the tires in good condition and do the sizes match?
6. If equipped with a torque-limiting device, is it working properly?

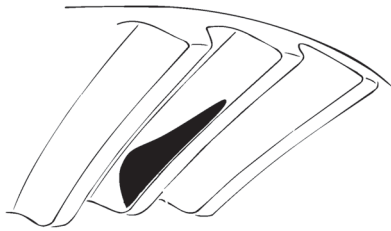
During the preliminary investigation, write down anything out of the ordinary for later reference. Items that appear insignificant now may take on more importance when the subassemblies are torn down.

Adjust Pinion Position

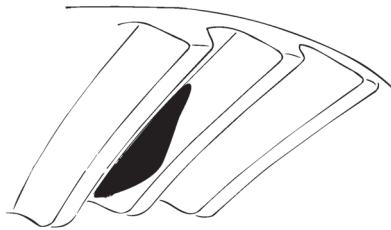
If the gear pattern shows incorrect tooth depth contact, change drive pinion position by altering the shim pack. Used gears should achieve proper contact with the same shims removed from the axle at disassembly.

Note: Check ring gear backlash after each shim change and adjust if necessary to maintain the 0.006" to 0.018" specifications.

If the pattern is too close to the top land of the gear tooth, remove pinion shims. Move pinion toward the ring gear.



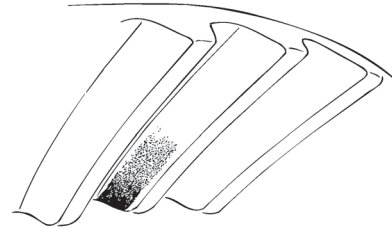
If the pattern is too close to the root of the gear tooth, add pinion shims. Move pinion away from the ring gear.



Adjust Ring Gear Position (Backlash)

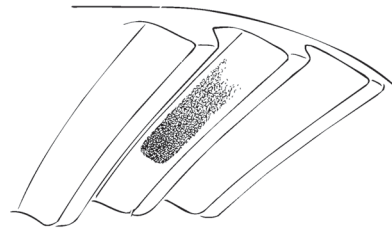
If the gear pattern shows incorrect face width contact, change backlash by adjusting the ring gear.

If the pattern is too close to the edge of the tooth toe, move the ring gear away from the pinion to increase backlash.



3. Loosen the bearing adjuster on the teeth side of the ring gear several notches.
4. Loosen the opposite adjuster one notch.
5. Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup.
6. Continue tightening the same adjuster 2 or 3 notches and recheck backlash.

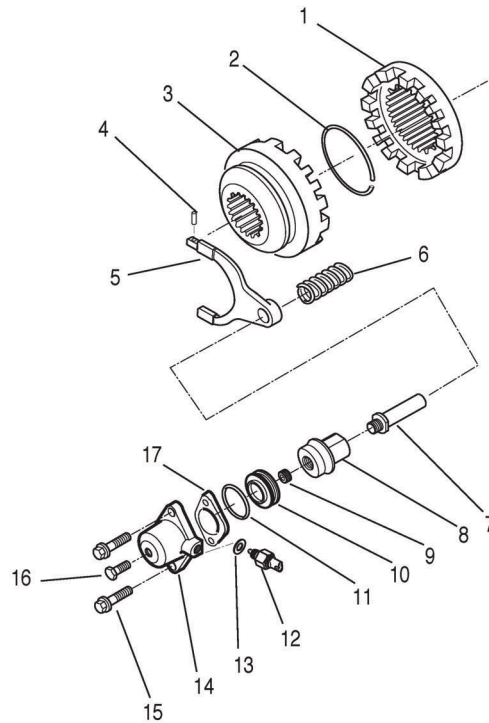
If the pattern is concentrated at the heel (too far up the tooth), move the ring gear toward the pinion to decrease backlash.



7. Loosen the bearing adjuster on the teeth side of the ring gear several notches.
8. Tighten the opposite adjuster one notch.
9. Return to adjuster on teeth side of ring gear and tighten adjuster until it contacts the bearing cup.
10. Continue tightening the same adjuster 2 or 3 notches and recheck backlash.

Wheel Differential Lock Assembly

Parts Exploded View



1— Fixed curvic clutch gear
 2— Snap ring
 3— Curvic clutch gear
 4— Spring pin
 5— Shift fork
 6— Compression spring

7— Push rod
 8— Piston driver
 9— Set screw
 10— Piston
 11— O-ring
 12— Switch

13— Plastic washer
 14— Piston cover
 15— Cap screw- flange head
 16— Cap screw- manual engagement
 17— Gasket

AIR SUSPENSION ASSEMBLY

DATA AND SPECIFICATIONS

EN09Z1002I200002

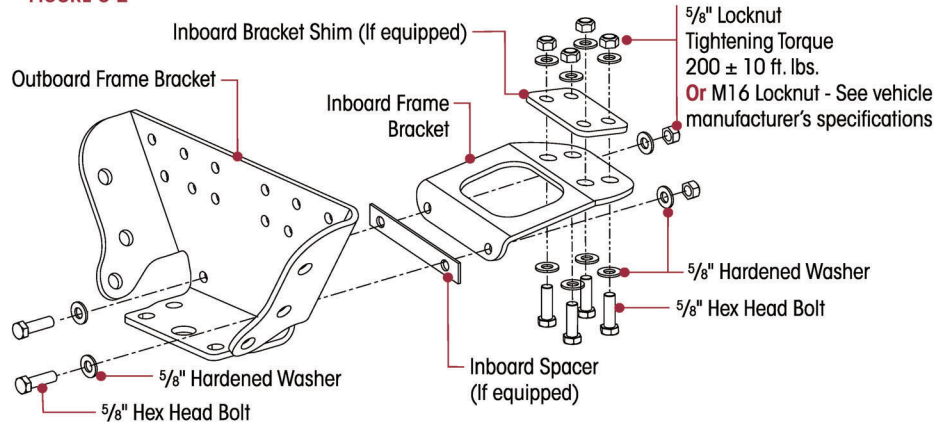
REAR SUSPENSION (4 x 2 Model)

Model	HINO NV1A, NH1A	HINO NV1A, NH1A, TH1A
Type	HENDRICSON COMFORT-AIR	HENDRICSON COMFORT-AIR-SD (SD: SEVERE DUTY)
Option	WITH HEIGHT CONTROL DEVICE	

(6 x 4 Model)

Model	HINO NM1A, TM1A	HINO NM1A, NH1A, TM1A
Type	HENDRICSON COMFORT-AIR 40K LB	HENDRICSON COMFORT-AIR 46K LB
Option	WITH HEIGHT CONTROL DEVICE	

FIGURE 8-2



5. Tighten the (4) four vertical fasteners first then the remaining (6) six M20 fasteners to 310 ± 30 foot pounds torque, see Figure 8-1.
6. Remove wheel chocks.

INBOARD FRAME BRACKET

DISASSEMBLY

1. Chock the **FRONT** wheels of the vehicle.

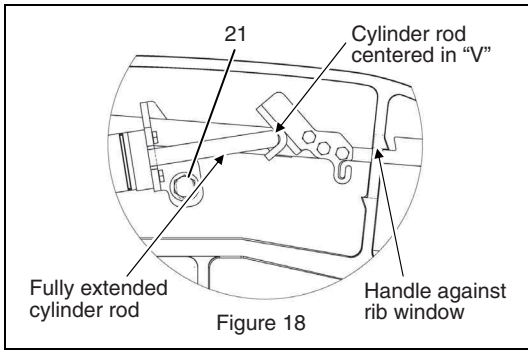
NOTE

When servicing the inboard frame bracket to vehicle cross member connection, it is important to remove all weight from the suspension to maintain the frame rail's integrity and vertical position after service.

2. Raise the rear of the vehicle until the suspension is fully extended with the tires completely off the ground. Support the frame at this height.
3. Remove fasteners from the inboard frame bracket to the cross member. Remove inboard bracket shim if equipped.
4. Remove fasteners from the inboard frame bracket to the outboard bracket. Remove inboard spacer if equipped.
5. Remove the inboard frame bracket and inboard spacer (if equipped).

ASSEMBLY

1. Mount the inboard frame bracket to the vehicle's cross member and snug the fasteners. **DO NOT** tighten at this time.
2. Install the new inboard frame bracket to outboard frame bracket fasteners and inboard spacer (if equipped), and tighten to specifications, see Figure 8-2.
 - M16 locknuts tighten to vehicle manufacturer's specifications.
 - $\frac{5}{8}$ " Locknuts tighten to 200 ± 10 foot pounds torque.
3. Tighten the fasteners securing the inboard frame bracket to the vehicle manufacturer's cross member, see Figure 8-3.
 - M16 locknuts tighten to vehicle manufacturer's specifications.
 - $\frac{5}{8}$ " locknuts tighten to 200 ± 10 foot pounds torque.
4. Remove the frame supports.
5. Remove the wheel chocks.

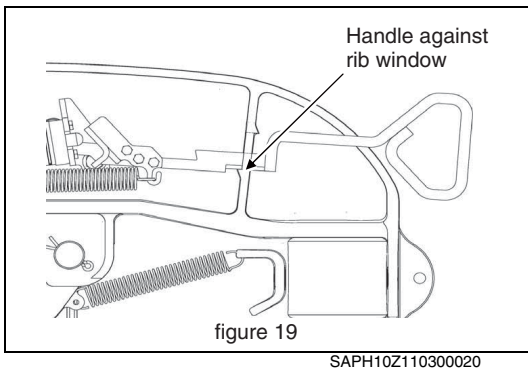


(2) Refer to Figure 18 for the following 4 steps:

- Turn on the air supply to pressurize the air cylinder such that the release handle is fully extended.
- Position the loosely bolted air cylinder such that the release handle is against the rib window of the fifth wheel and the air cylinder rod is centered in the "V" of the air cylinder pickup (Item 19).
- Keeping the air cylinder in place, tighten the two 1/2-20 x 3/4" bolts (Item 21) to 40-50 ft.-lbs.
- Release the pressure from the air cylinder and verify that the cylinder rod retracts fully. Replace air cylinder if it is faulty.

⚠ WARNING

- Failure to replace a faulty air cylinder may result in tractor trailer separation which, if not avoided, could result in death or serious injury.**



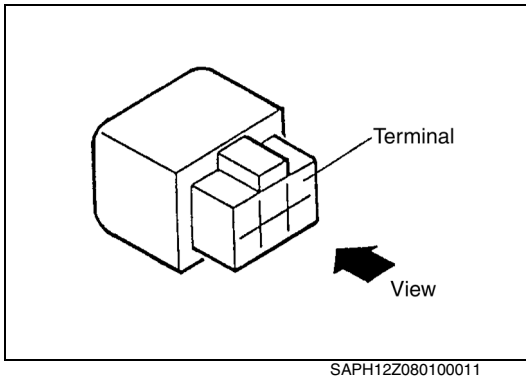
- Verify that the release handle contacts the rib window when the handle is in the locked position (Figure 19).

1	Upper panel	14	Switch base
2	Instrument panel cross member	15	Card holder
3	Gusset	16	Instrument panel box No.1
4	Lower center cover	17	Instrument panel box plate
5	Lower right cover	18	Instrument lower panel No.3
6	Panel upper cover	19	Instrument lower center cover
7	Switch board panel	20	Instrument lower RH pad
8	Cluster finish panel	21	Instrument panel box No.2
9	Cluster housing	22	Instrument lower panel No.3
10	Cluster bezel	23	Instrument panel box No.1
11	Upper right cover	24	Instrument panel under cover No.2
12	Lower cover	25	Table
13	Cup holder (If so equipped)		

Tightening torque

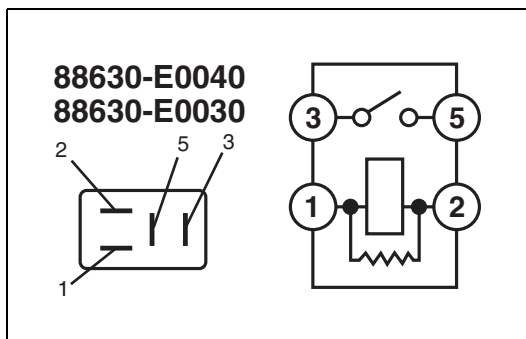
Unit: N·m {kgf·cm, lbf·ft}

A	2.1-3.9 {21-40, 1.6-2.9}	C	7.5-16.5 {76-168, 5.5-12}
B	1.5-2.5 {15-25, 1.1-1.8}		



RELAY (TYPE, NAME AND INSPECTION)

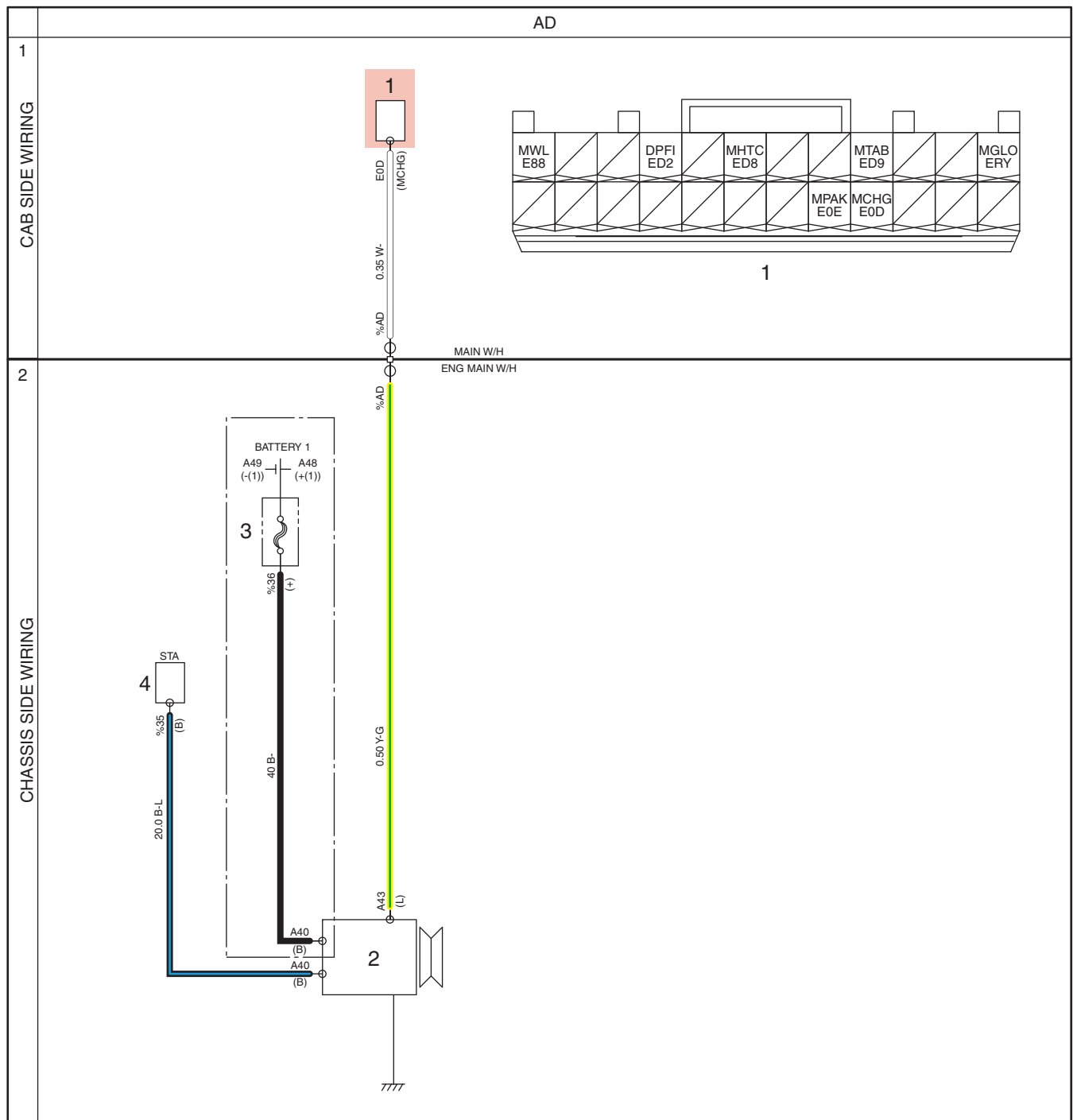
- TYPE-1:**
- Air suspension dump relay
 - Power relay No.1
 - Power relay No.2
 - Power relay No.3
 - Power relay No.4
 - Power accessory relay No.1
 - Mirror heater relay
 - Heater relay
 - TRANS stop dummy relay
 - TRANS back light relay
 - Head light main relay
 - Head light dimmer relay
 - Daytime running light relay No.1
 - Daytime running light relay No.3
 - Clutch relay
 - Horn relay
 - Air horn relay
 - Tail light relay No.1
 - Daytime running light tail relay No.1
 - Daytime running light tail relay No.2
 - TRANS starter relay
 - Engine ECU main relay
 - Engine ECU actuator power relay
 - Urea tube heater relay
 - Fuel heater relay
- TYPE-2:**
- Vehicle control system relay
 - Air conditioner relay
- TYPE-3:**
- ABS stop light relay
 - Differential lock dummy relay No.1
 - TRANS stop NC relay
 - Daytime running light relay No.2
 - Starter cut relay
- TYPE-4:**
- Stop light relay No.1
 - Stop light relay No.2



SAPH12Z080100012

1. TYPE-1 AND TYPE-2 INSPECTION

- (1) Apply voltage to terminals;
12 V to terminal 1,
Ground to terminal 2.
- (2) Under normal condition, terminals 3 and 5 switch on.

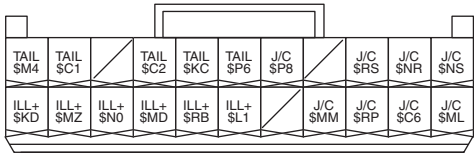


SAPH12Z080200032

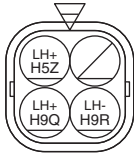
AD CHARGING CIRCUIT

- 1 Combination meter (Charge light)**
- 2 Alternator**
- 3 Mega fuse 350A**
- 4 Starter**

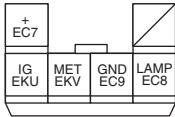
EI



1

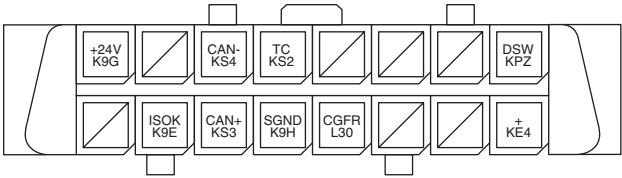


2

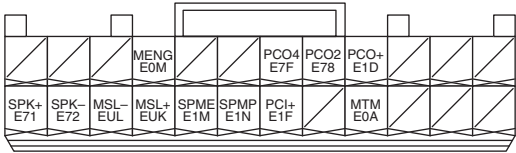


3

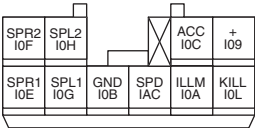
GR



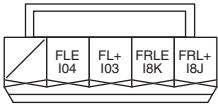
4



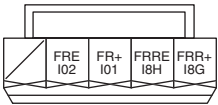
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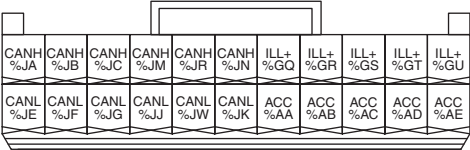
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7

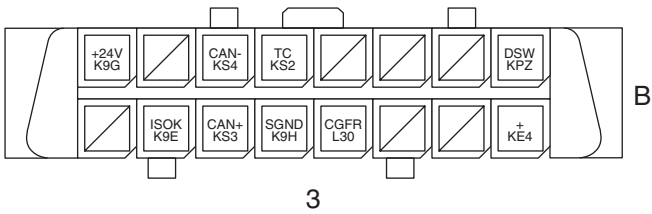
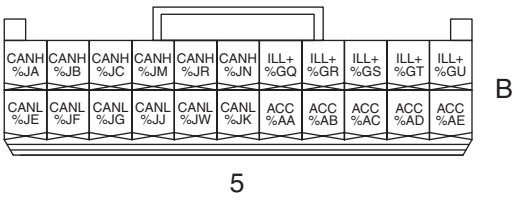
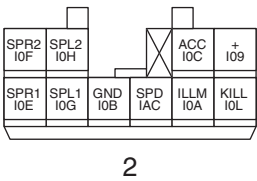
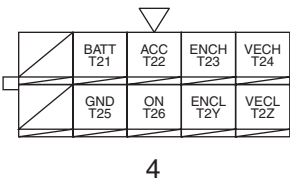
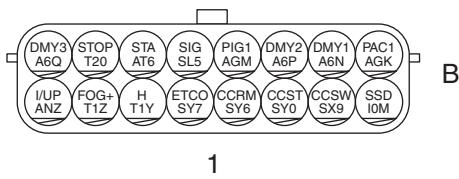


8



9

KI



OnGuard™ Warnings, Cautions and Operating Guidelines

Driver-Related Information

WARNING

The OnGuard™ Collision Mitigation System (CMS) is a driver aid only. It is designed to assist the vehicle operator in maintaining a safe following distance and, if needed, provide limited initial braking to reduce the severity of a possible collision. It is not an auto-pilot system for operating the vehicle.

The OnGuard™ CMS is no substitute for the most important factor in vehicle safety, which is a safe, conscientious driver. Use of OnGuard™ CMS cannot compensate for a driver that is distracted, inattentive or impaired by fatigue, drugs or alcohol.

As always, it is the driver's responsibility to:

- Use safe driving techniques
- Exercise proper judgment for the traffic, road and weather conditions
- Maintain a safe distance between vehicles
- Apply the brakes when needed to maintain control of the vehicle

Whether OnGuard™ CMS is in use or not, the driver is responsible for the vehicle's speed, distance between other vehicles and braking the vehicle, if necessary, to avoid a collision. Never wait for an OnGuard™ CMS warning before applying the brakes. Failure to do so can result in serious personal injury or death, and/or severe property damage.

WARNING

The driver is responsible for understanding the operation and limitations of the OnGuard™ CMS before operating the vehicle. Failure to do so can result in serious personal injury or death, and/or severe property damage.

Environment-Related Information

WARNING

The driver should consider the benefit/risk of using OnGuard™ Collision Mitigation System (CMS) under the following conditions.

- Weather such as rain, sleet, snow, ice, heavy fog, as well as smoke or dust. These conditions can make roads slippery which can cause a spinout, or block or limit the radar's distance sensing ability.
- Construction zones, off road, dirt roads or muddy roads with loose surface. These conditions can cause the wheels to lose traction and limit OnGuard™'s ability to provide appropriate warning and adequate braking.
- Curvy or winding roads, roads with sharp turns. Curvy roads can make it difficult for the OnGuard™ CMS radar to track vehicles in it's path. While in a sharp turn or if the preceding vehicle is in a sharp turn, OnGuard™ may no longer track a vehicle in front of you. Your vehicle could then unexpectedly accelerate to the previously selected speed.
- Heavy or complicated traffic, entry and exit ramps, downhill, cross traffic and intersections. OnGuard™ CMS is not capable of taking into account these complex traffic situations and respond to each scenario. It cannot track traffic and objects traveling perpendicular to it's path.

Driving in these conditions with OnGuard™ CMS active can produce false warnings, unexpected braking or no response at all. Serious personal injury or death, and/or severe property damage can result.

WARNING

The OnGuard™ Collision Mitigation System (CMS) is designed to monitor only the distance between your vehicle and the vehicle moving in the same direction directly ahead of it. It may not identify a vehicle moving TOWARDS it or stationary objects in the road, such as a vehicle that is stopped in traffic or disabled. As such, the OnGuard™ System will not provide engine torque control or braking. The driver must always be aware of the objects in front of his vehicle and be ready to apply the brakes, if required. Failure to apply the brakes when needed can result in an accident.

What objects does OnGuard™ warn on or actively brake on?

OnGuard™ warns and reacts to objects such as cars, trucks or buses that are moving in the same direction as the vehicle on the road. In addition, OnGuard™ provides only visual and audible warnings on stationary objects (such as disabled cars) that are in the path of the vehicle to alert the driver of potential obstruction. The system will not apply the brakes on stationary objects. OnGuard™ will not warn or react to oncoming traffic or traffic crossing the vehicle's driving lane.

Is OnGuard™ active while at very low speeds? Will the system react to stop and go traffic?

OnGuard™ will not react to objects when the vehicle is travelling at speeds below 15 mph to prevent slow-speed activation in heavy traffic, truck stops and rest areas.

Do the brake lights come on when OnGuard™ activates the brakes?

Yes, the vehicle brake lights will come on when OnGuard™ requests application of the brakes.

What are Meritor WABCO's Roll Stability Control (RSC) and Electronic Stability Control (ESC) systems? Why is either one required for OnGuard™ to be installed?

RSC and ESC are active vehicle safety systems that assist drivers in maintaining control of the vehicle. RSC monitors conditions that can lead to a rollover, and it automatically intervenes if a high rollover risk is detected by reducing engine torque, engaging the engine retarder and if necessary, applying drive axle and trailer brakes. ESC combines RSC with the added capability of directional or rotational control to reduce the potential of jack-knifing and drift out conditions. OnGuard™ utilizes the stability control systems on the vehicle to ensure the vehicle's stability during active braking in all weather conditions.

How much braking power does OnGuard™ apply? Will the system override the ABS and lock up the brakes?

OnGuard™ requests application of the brakes during ACC to maintain a safe following distance and during collision mitigation when a rear-end collision is deemed unavoidable. Depending on the speed of the vehicle and the vehicle ahead, OnGuard™ will calculate the braking required and will apply up to 50% of a vehicle's braking power to help in avoiding or mitigating a collision.

The system utilizes the vehicle's ABS and stability system to prevent wheel lock-up and maintain control.

How does the system adjust for severe and slippery weather conditions that could cause sliding or jackknifing?

OnGuard™ works with the Anti-Lock Braking System (ABS) and stability control systems on the vehicle and therefore the braking initiated by the system is not likely to cause the vehicle to slide or jack-knife.

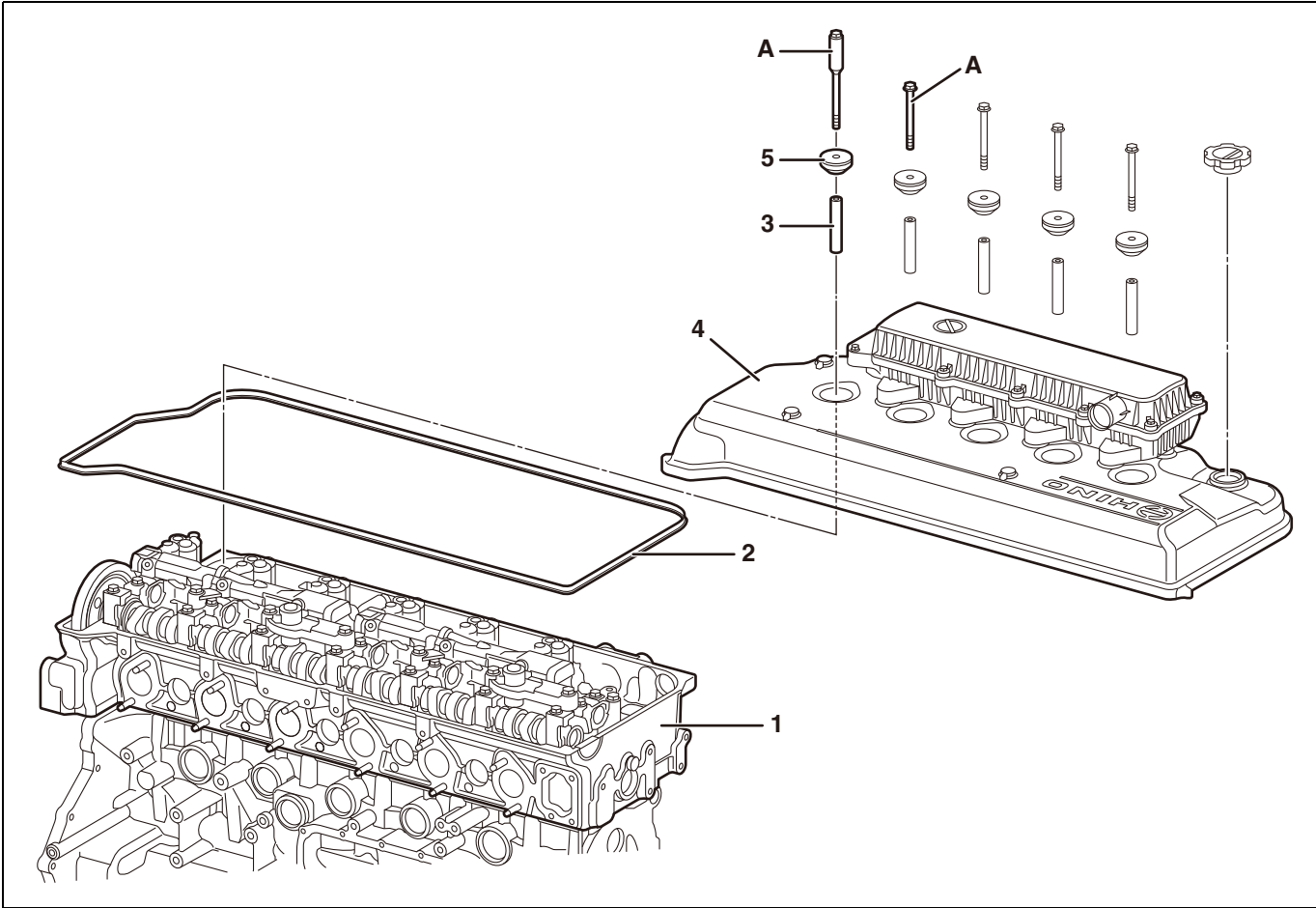
Sometimes when cruise control is set, the vehicle slows down on its own while going around a curve even though there is no vehicle ahead, why?

Vehicles equipped with OnGuard™ are also equipped with a sophisticated stability control system, either SmartTrac Electronic Stability Control System (ESC) or SmartTrac Roll Stability Control System (RSC). These systems monitor the vehicle's speed and weight to determine the threshold of a potential loss of control. When the stability control system determines the vehicle is going around a curve at a speed that can cause a potential loss of control, it will reduce engine torque, apply engine brakes and, if necessary, apply the service brakes of the vehicle. This type of intervention can happen whether cruise control is set or not.

HEAD COVER

COMPONENT LOCATOR

EN01F01105020H01009001



SAPH011050200001

1	Semicircle plugs	4	Head cover
2	Head cover gasket *	5	Cushion
3	Spacer		

*: Nonreusable part

Tightening torque		Unit: N·m {kgf·cm, lbf·ft}	
A	28.5 {291, 21}		

HEAD COVER

EN01F01105020H01009002

GREASE AND OTHERS

Name	Remarks
Liquid gasket (ThreeBond TB1207B: Black or equivalent)	Apply to the mating area of the half-round plug.

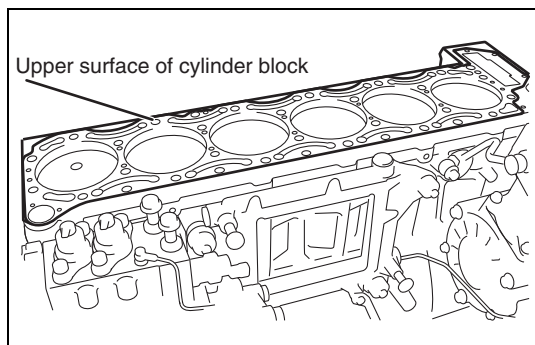
MOUNTING THE CYLINDER HEAD ASSEMBLY

1. MOUNTING THE HEAD GASKET

- (1) Clean the upper surface of cylinder block.

NOTICE

Before working, remove dirt, water or oil on the cylinder head and cylinder block.



SAPH011050200104

- (2) Set a new head gasket to the dowel pin and place the gasket on the upper surface of cylinder block.

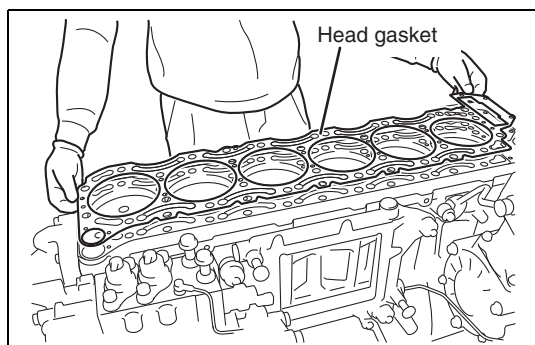
NOTICE

- **Never reuse the gasket, or the engine will be broken.**
- **Before mounting the head gasket, check the seal ring for falling or damage.**

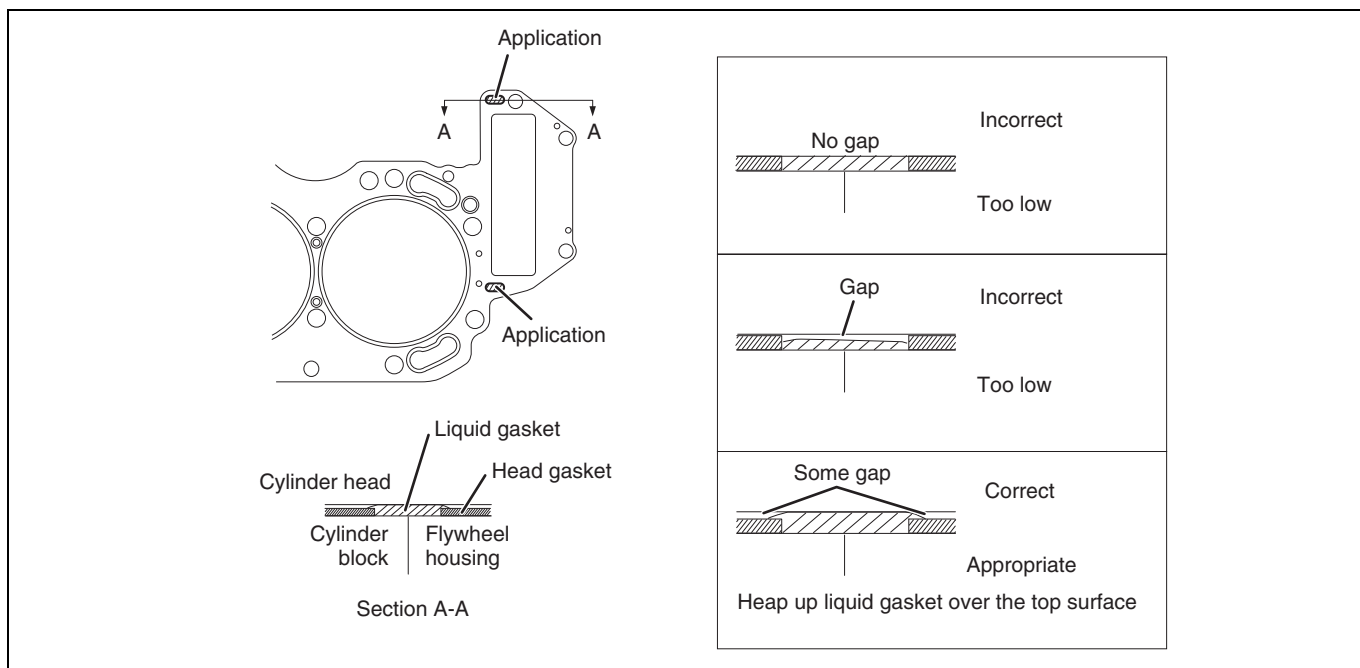
- (3) Apply liquid gasket (ThreeBond TB1211: White or equivalent) to the mating area of the flywheel housing head gasket and cylinder block upper surface rear end (2 locations).

NOTICE

- **Apply liquid gasket so that it hangs over the upper surface of the head gasket.**
- **Mount the case within 20 minutes after applying the liquid gasket.**



SAPH011050200105



SAPH011050200106

MOUNTING FRONT TIMING GEAR AND END PLATE

1. MOUNTING END PLATE

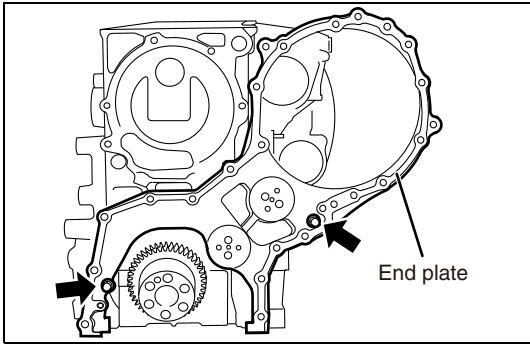
- (1) Remove dirt on the joint surface of the end plate and cylinder block.
- (2) Replace with a new gasket, and mount the end plate with the bolts (2 pcs.).

Tightening Torque:

28.5 N·m {290 kgf·cm, 21 lbf·ft}

HINT

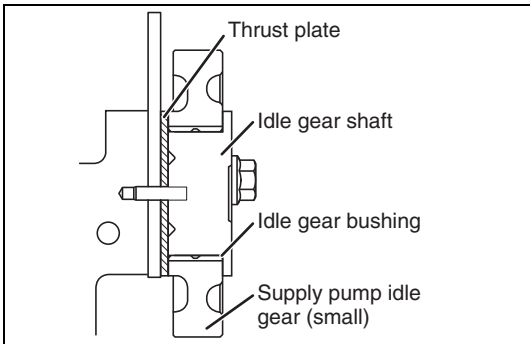
Use guide bolts to facilitate the work.



SAPH011050200203

2. MOUNTING FRONT TIMING GEAR

- (1) Apply engine oil to the seating surface and threads of the idle gear shaft mounting bolt, idle gear shaft, thrust washer, and idle gear bushing of the supply pump idle gear (small). Assemble them as shown in the figure.



SAPH011050200204

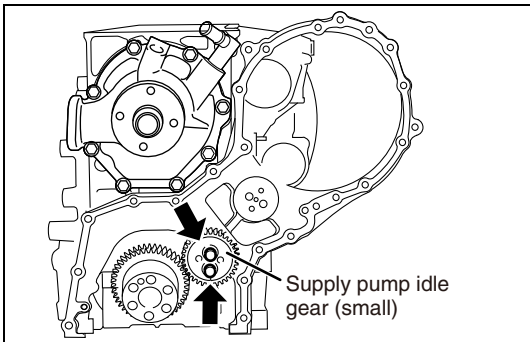
- (2) Mount the assembled idle gear shaft, idle gear (small) and thrust plate to the end plate with the bolts (2 pcs.).

Seating Torque:

20 N·m {204 kgf·cm, 15 lbf·ft}

NOTICE

Temporarily tighten the bolts until the thrust plate comes in contact with the end plate and then tighten them with the specified torque.

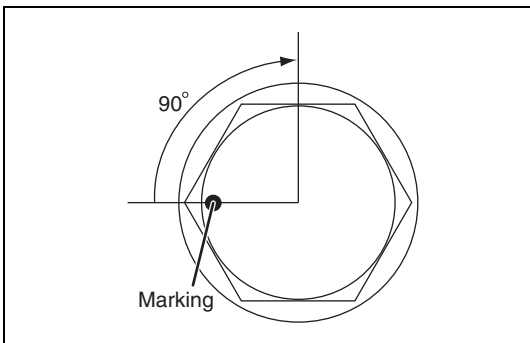


SAPH011050200205

- (3) Use paint to mark the heads of the idle gear shaft mounting bolts in the same direction.
- (4) Retighten the bolts by 90° (1/4 rotation) and check that all paint marks face in the same direction.

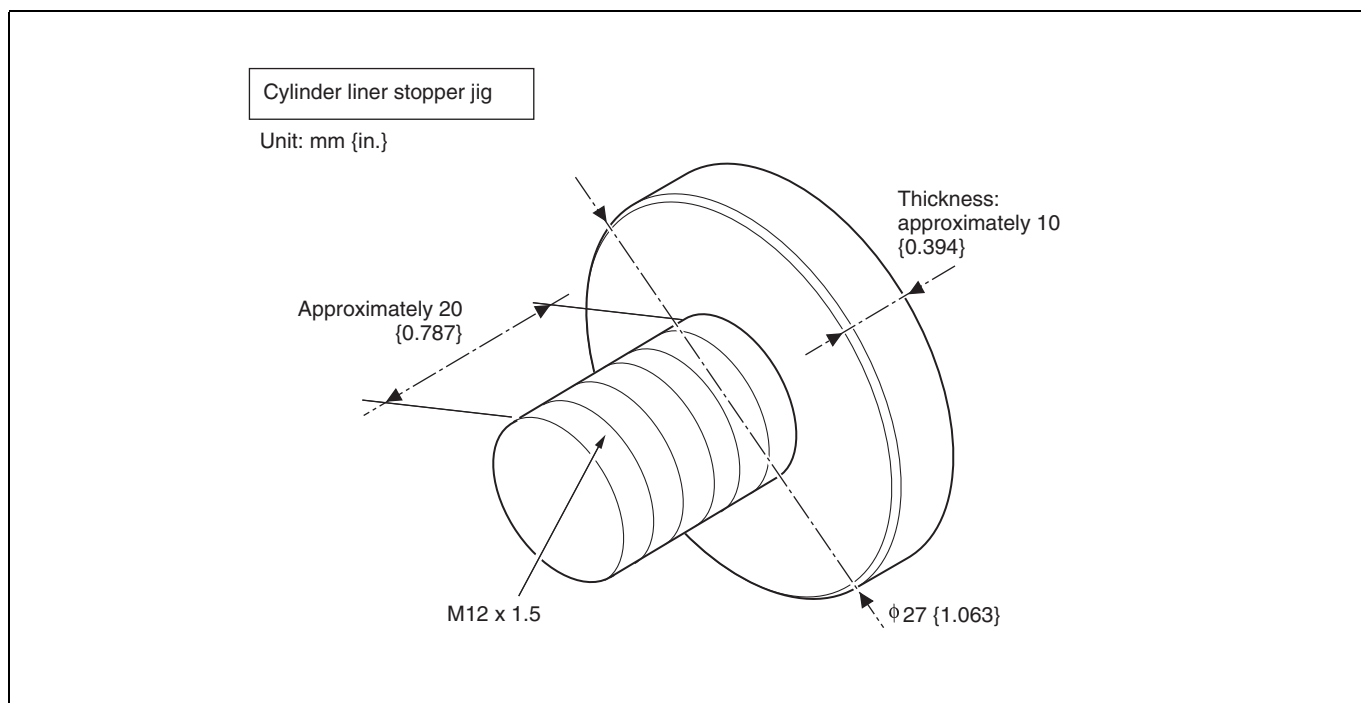
NOTICE

Do not loosen the bolt even if it is overtightened.



SAPH011050200206

PROPOSAL TOOL



CRANKSHAFT

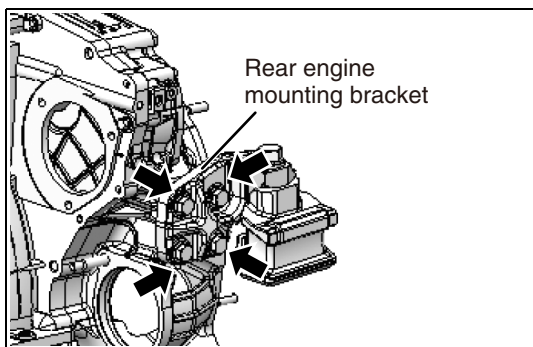
EN01F01105020H01022003

INSTRUMENT

Name	Remarks
Dial gauge	For measuring crankshaft end play and crankshaft rotation runout
Micrometer	For measuring the outer diameters of the crankshaft journal and crankpin
Vernier calipers	For measuring the under-head length of the main bearing cap bolt
Cylinder gauge	For measuring the crankshaft bearing inner diameter

GREASE AND OTHERS

Name	Remarks
Dye penetrant (red check)	For inspecting the crankshaft for cracks



SAPH011050200427

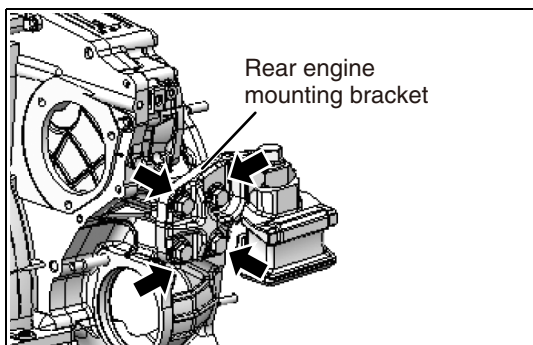
- (4) Remove the bolt and then remove the rear engine mounting bracket from the flywheel housing.

MOUNTING THE ENGINE MOUNTING AND BRACKET

1. MOUNTING THE ENGINE MOUNTING AND BRACKET

- (1) Reinstall the rear engine mounting bracket in the flywheel housing with the bolts.

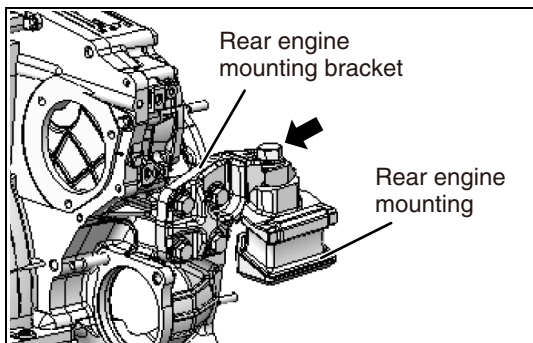
Tightening Torque:
300 N·m {3,059 kgf·cm, 221 lbf·ft}



SAPH011050200428

- (2) Reinstall the rear engine mounting in the rear engine mounting bracket with the nuts.

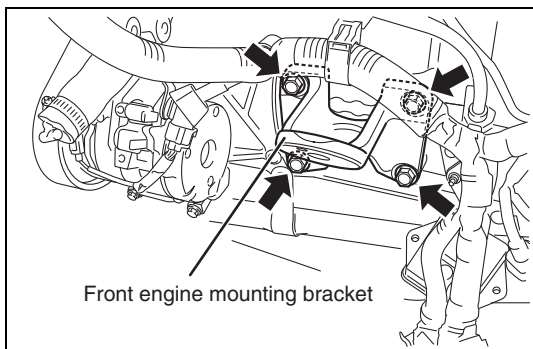
Tightening Torque:
360 N·m {3,671 kgf·cm, 265 lbf·ft}



SAPH011050200429

- (3) Fasten a bolt to secure the front engine mounting bracket on the cylinder block.

Tightening Torque:
125 N·m {1,275 kgf·cm, 92 lbf·ft}



SAPH011050200430

REPLACEMENT OF ATC

EN01F01105040H01003003

REMOVE THE EXHAUST PIPE No.1 (ATC)

NOTICE

The ATC will have to be replaced together with the exhaust pipe No.1 (ATC).

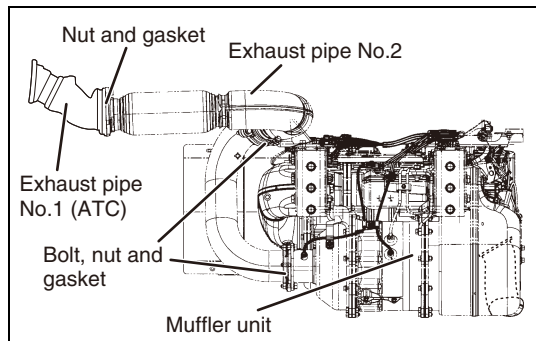
1. REMOVE THE EXHAUST PIPE No.2

- (1) Remove the nuts (3 pcs.) on the flange on the muffler unit side.

2. REMOVE THE AFTERTREATMENT FUEL INJECTOR

- (1) Remove the aftertreatment fuel injector.

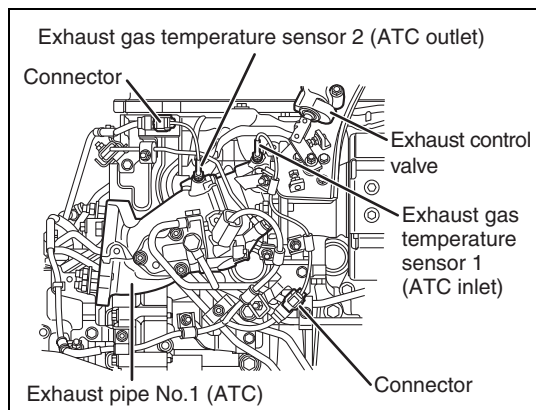
Reference: EXHAUST SYSTEM (A09C), AFTERTREATMENT FUEL INJECTOR



SAPH011050400012

3. DISCONNECTING THE EXHAUST GAS TEMPERATURE SENSOR 1 (ATC INLET) OF CONNECTOR AND EXHAUST GAS TEMPERATURE SENSOR 2 (ATC OUTLET) OF CONNECTOR

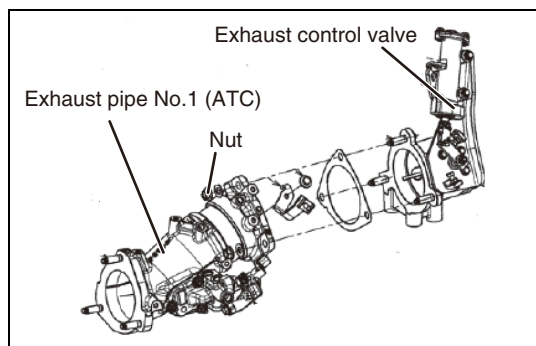
- (1) Disconnect the exhaust gas temperature sensor 1 (ATC inlet) of connector and exhaust gas temperature sensor 2 (ATC outlet) of connector.



SAPH011050400013

4. REMOVE THE EXHAUST PIPE No.1 (ATC)

- (1) Unfasten the nuts (3 pcs.) to remove the exhaust pipe No.1 (ATC) and gasket from the exhaust control valve.



SAPH011050400142

SPECIAL TOOL

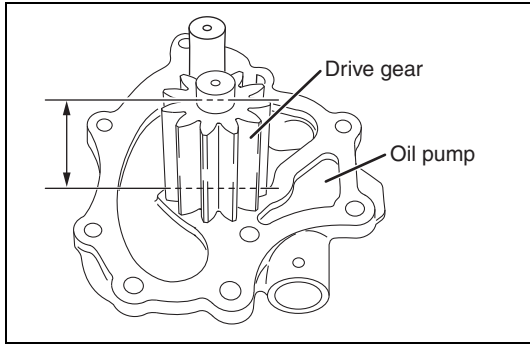
EN01F01105040H01006002

Configuration	Part Number	Name	Remarks
	S0826-E3065	CARBON CLEANER	

INSPECTING THE COMPONENT PARTS

1. INSPECTING THE END PLAY OF THE DRIVE GEAR AND CYLINDER BLOCK

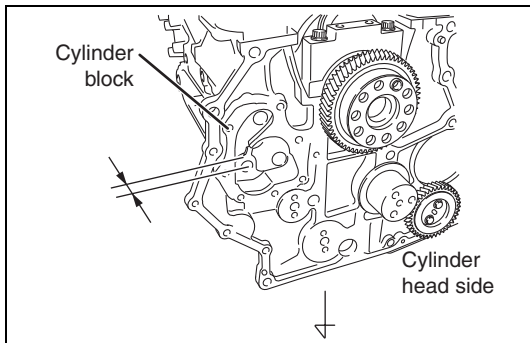
- (1) Using a depth gauge, measure the drive gear width.



SAPH011050500041

Standard value (mm {in.})	68.5 {2.696}
---------------------------	--------------

- (2) Using a depth gauge, measure the pump chamber depth on the cylinder block side.



SAPH011050500042

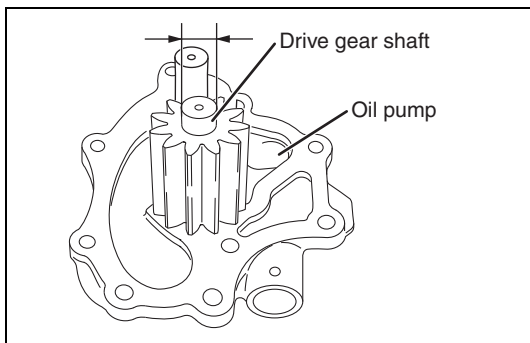
Standard value (mm {in.})	68.5 {2.696}
---------------------------	--------------

- (3) Calculate the difference between the drive gear width and pump chamber depth on the cylinder block side. If exceeding the service limit, replace the oil pump.

Standard value (mm {in.})	Service limit (mm {in.})
0.013-0.050 {0.0005-0.0019} (Without gasket)	—
0.047-0.150 {0.0019-0.0059} (With gasket)	0.15 {0.0059}

2. INSPECTING THE CLEARANCE BETWEEN THE DRIVE GEAR SHAFT OUTER DIAMETER AND BUSHING INNER DIAMETER ON THE CYLINDER BLOCK SIDE

- (1) Using a micrometer, measure the drive gear shaft outer diameter.



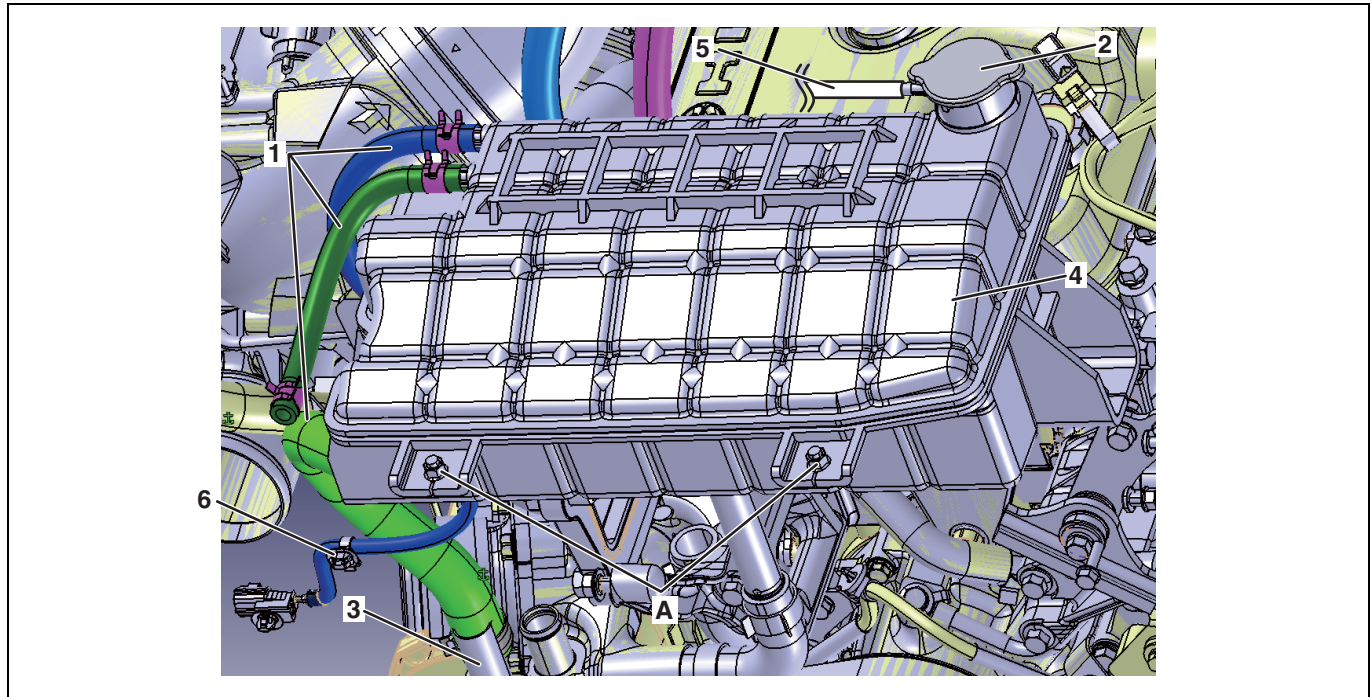
SAPH011050500043

Standard value (mm {in.})	18.00 {0.709}
---------------------------	---------------

HEADER TANK AND WATER LEVEL SWITCH

COMPONENT LOCATOR

EN01F01105060H01010001



SAPH011050600046

1	Coolant hose	4	Header tank
2	Radiator cap	5	Overflow hose
3	Coolant pipe	6	Coolant level switch

Tightening torque

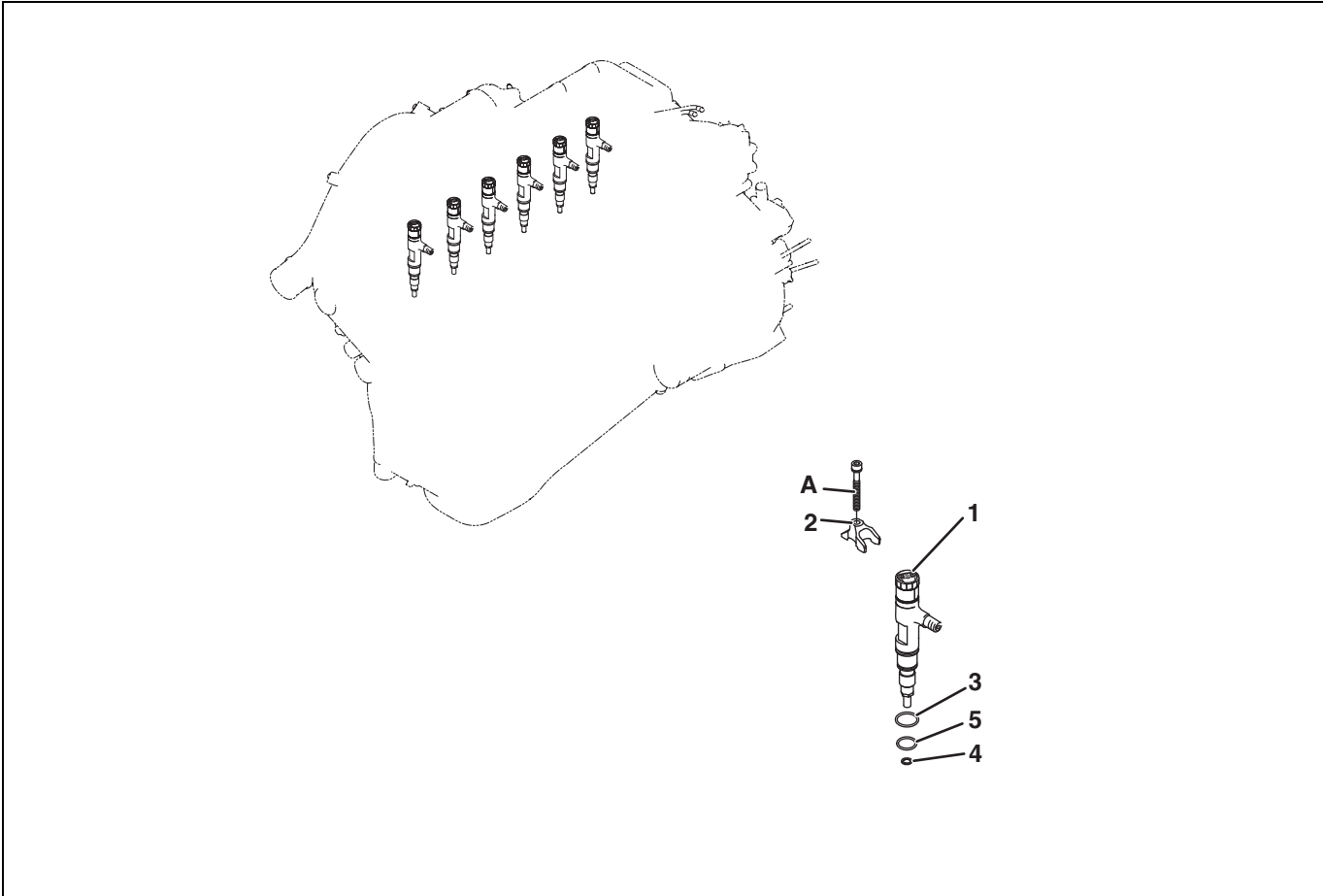
Unit: N·m {kgf·cm, lbf·ft}

A	19-25 {194-255, 14-18}	
---	------------------------	--

INJECTOR

COMPONENT LOCATOR

EN01F01105070H01005001



SAPH011050700089

1	Injector	4	Gasket *
2	Injector clamp	5	O-ring (black) *
3	O-ring (red) *		

*: Nonreusable part

Tightening torque

Unit: N·m {kgf·cm, lbf·ft}

A	34 {347, 25}	
---	--------------	--

DISMOUNTING AND MOUNTING

EN01F01105100H01001004

IMPORTANT POINTS - DISMOUNTING

1. CHECK BEFORE START OF MAINTENANCE WORKS.

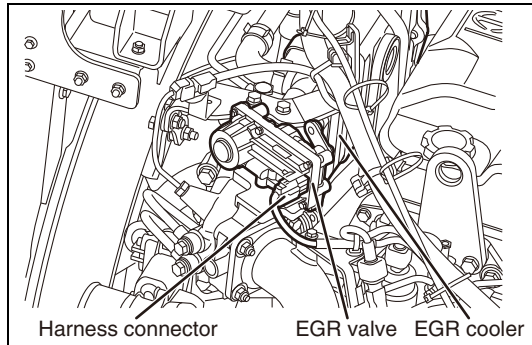
- (1) Use the HINO DX II to check the air flow sensor.
- (2) Use the HINO DX II to check operation of the onboard EGR valve.

2. REMOVE THE EGR VALVE AND EGR COOLER.

NOTICE

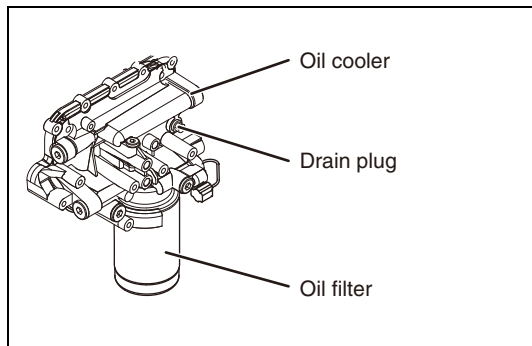
To prevent burns ensure the engine is cold before changing the valve. (At least 30 minutes after switching off the engine)

- (1) Disconnect the harness connector.



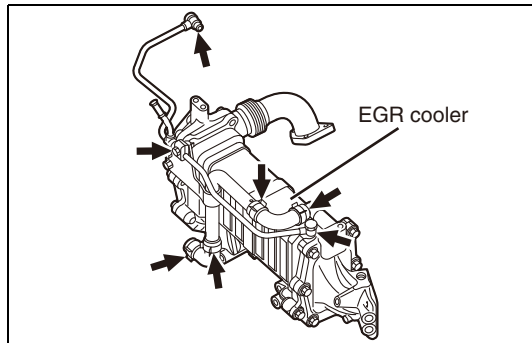
SAPH011051000008

- (2) Drain the coolant out of the drain plug of oil cooler situated on the right side of the engine.



SAPH011051000009

- (3) Disconnect and remove all water pipes connected to the EGR cooler as well as coolant hose and related parts.



SAPH011051000010

STARTER

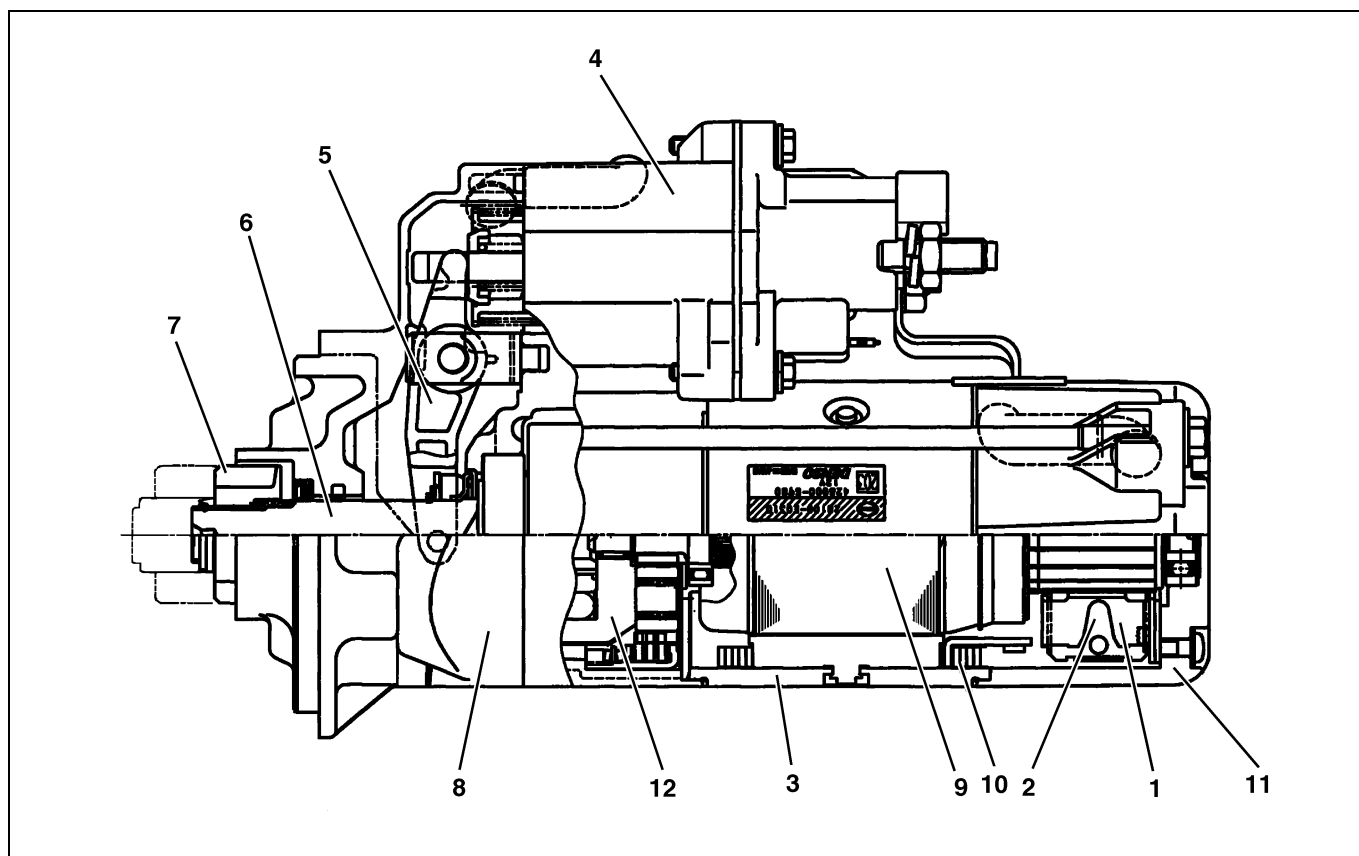
DATA AND SPECIFICATIONS

EN01F01105120H01001001

Type	Planetary reduction gear type
Rated output	12 V, 4.8 kW
Number of teeth of pinion	9
Module	3
Rotating direction	Clockwise (Seen from pinion side)

COMPONENT LOCATOR

EN01F01105120H01001002



SAPH011051200001

1 Starter	7 Pinion gear
2 Brush	8 Drive housing assembly
3 Yoke assembly	9 Armature assembly
4 Magnetic switch assembly	10 Field coil
5 Lever	11 Commutator end frame
6 Drive shaft	12 Clutch assembly

GENERAL INTRODUCTION

1-001

GENERAL INTRODUCTION	1-2
GENERAL PRECAUTIONS	1-2
IDENTIFICATION INFORMATION	1-5
HOW TO USE THIS WORKSHOP MANUAL	1-9
INTRODUCTION TO DESCRIPTIONS	1-9
PRECAUTIONS	1-12
SEALANT ON THE TAPERED SCREW FOR PIPING	1-15
METRIC INFORMATION	1-16
SPECIFIED TORQUE FOR STANDARD BOLTS AND NUTS	1-18
SPECIFIED TORQUE FOR FLANGE BOLTS AND NUTS	1-19
RECOMMENDED LUBRICANTS	1-20
GLOSSARY	1-22
GLOSSARY OF SAE AND HINO TERMS	1-25

9. Table 1-9 Troubleshooting Procedures Notes

A	Refer to engine manufacturer's service manual for inspection requirements and replacement specifications.
B	With engine stopped, check duct clamping devices for tightness.
C	With engine running at idle speed, lightly spray duct connections with starting fluid. Leaks at connections will be indicated by an increase in engine speed due to the starting fluid being drawn into the compressor and pumped into the engine combustion chambers.
D	With engine running at idle speed, check duct connections for leaks by applying lightweight oil or liquid soap to areas of possible leakage and checking for bubbles. Exhaust gas leakage between the engine block and the turbocharger inlet will also create a noise level change.
E	With engine running at idle speed, check for unusual noise and vibration. If either condition is noted, shut down the engine immediately to protect the turbocharger and engine from further damage. With the engine stopped, check the turbocharger shaft wheel assembly for damage as outlined Note I, below.
F	With engine running, a change in the noise level to a higher pitch can indicate air leakage between the air cleaner and the engine or a gas leak between the engine block and the turbocharger inlet.
G	Exhaust gas leakage may be indicated by hat discoloration in the area of the leak.
H	With the engine running, noise level cycling from one level to another can indicate a plugged air cleaner, a restriction in the air-cleaner to compressor duct, or a heavy build-up of dirt in the compressor housing or on the compressor wheel.
I	Internal inspection of the center housing can be accomplished by removing the oil drain line and looking through the oil drain opening. When a sluggish or cocked condition exists, a heavy sludge build-up will be seen on the shaft between the bearing journals and in the center housing from the oil drain opening back to the turbine end.
J	Thorough cleaning of the air intake system is essential following compressor wheel damage due to foreign object impact. In many cases, metal pieces from the wheel become embedded in the air cleaner element. If the element is not changed, these metal pieces can be drawn into the replacement turbocharger and cause it to fail in the same manner as the original unit.
K	With the air inlet and exhaust gas ducting removed from the turbocharger, examine both the compressor and turbine wheels for blade damage. Examine the outer blade tip edges for evidence of rubbing on housing surfaces.

- Turn the rotating assembly by hand and feel for dragging or binding. Push the rotating assembly side-ways while rotating to feel for wheel rub. If there is any indication of rubbing, perform the bearing clearance inspection procedure. If the rotating assembly rotates freely and there is no evidence of binding or rubbing, it can be assumed that the turbocharger is serviceable.

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BASIC PROCEDURE FOR TROUBLESHOOTING

BASIC PROCEDURE FOR TROUBLESHOOTING

EN01H16ZZZ020F02002001

HINT

Follow the diagnostic procedure described below and troubleshoot the problem. Only the basic procedure is described herein. For the detailed procedure, refer to the specific section of each system, where more accurate methods are described for each circuit.

1	Bring the faulty vehicle into the service area
---	--

Go to next step

2	Interview the user and analyze the trouble
---	--

1. Verify with the customer the circumstances and conditions surrounding the trouble occurred, and write down the information.

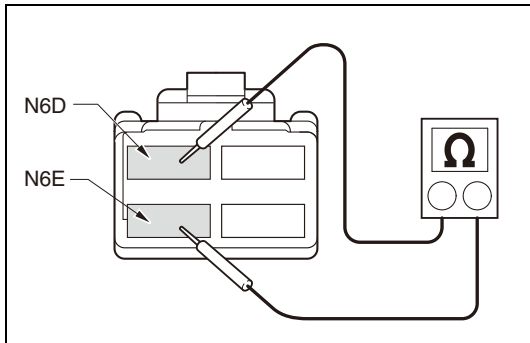
HINT

- In troubleshooting, confirm that problem symptoms have been accurately identified. Preconceptions should be discarded in order to make an accurate judgment. To clearly understand what the problem symptoms are, it is extremely important to ask the customer about the problem and the conditions at the time the malfunction occurred.
- Gather as much information as possible for reference. Past problems that seem unrelated may also help in some cases.
- The following 5 items are important points in the problem analysis.

What	Vehicle model, system name
When	Data, time, occurrence frequency
Where	Road conditions
Under what conditions?	Running conditions, driving conditions, weather conditions
How did it happen?	Problem symptoms

Go to next step

DIAGNOSTIC TROUBLE CODE (DTC) TABLE						
MIL	SVS LIGHT	DTC NO.	2 DIGIT DIAGNOSIS CODE	DIAGNOSIS ITEM	INSPECTION ITEM	REFER PAGE
Light	No light	P007B	—	Intake air temperature sensor (intercooler outlet) - rationality	- Intake air temperature sensor (intercooler outlet) - Intake air temperature sensor (Air flow sensor built-in) - ECU (ECU connector) - Boost pressure sensor - Wire harness	4-130
Light	No light	P007C	—	Intake air temperature sensor (intercooler outlet) - out of range (Out of range low)	- Intake air temperature sensor (intercooler outlet) - ECU (ECU connector) - Wire harness	4-143
Light	No light	P007D	—	Intake air temperature sensor (intercooler outlet) - out of range (Out of range high)	- Intake air temperature sensor (intercooler outlet) - ECU (ECU connector) - Wire harness	4-143
No light	No light	P0088	—	Excessive common-rail pressure	- PCV - Supply pump - Pressure limiter - Crankshaft position sensor - Common rail pressure sensor - Fuel filter - Fuel tank breather - Fuel pipe - Fuel high-pressure pipe - Wire harness	4-151
Light	No light	P0096	—	Intake air temperature sensor (intake manifold) - rationality	- Intake air temperature sensor (intercooler outlet) - Intake air temperature sensor (air flow sensor intercooler outlet) - ECU (ECU connector) - Boost pressure sensor - Wire harness	4-160
Light	No light	P0097	—	Intake air temperature sensor (intake manifold) - out of range (Out of range low)	- Intake air temperature sensor (intercooler outlet) - ECU (ECU connector) - Wire harness	4-171
Light	No light	P0098	—	Intake air temperature sensor (intake manifold) - out of range (Out of range high)	- Intake air temperature sensor (intercooler outlet) - ECU (ECU connector) - Wire harness	4-171

11 Inspect the clutch interlock switch

SAPH16F090300062

1. Set the starter switch to the "LOCK" position.
2. Disconnect the clutch interlock switch connector.
3. Use the electrical tester to measure the resistance between the terminals of the clutch interlock switch.

Measurement conditions	Tester connections
Starter switch: LOCK	Clutch interlock switch terminals: push button is free N6D – N6E
	Clutch interlock switch terminals: push the button N6D – N6E

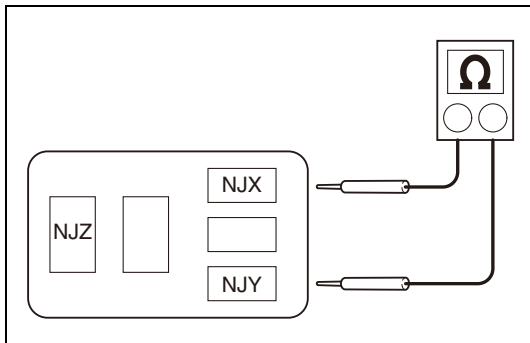
Was any failure found?

YES

Replace the engine ECU.

NO

Replace the clutch interlock switch.

12 Inspect the automatic transmission starter relay

SAPH16F090300063

1. Set the starter switch to the "LOCK" position.
2. Disconnect the automatic transmission starter relay.
3. Use the electrical tester to measure the resistance between the terminals of the starter cut relay.

Measurement conditions	Tester connections
Starter switch: LOCK	Automatic transmission starter relay terminals NJX – NJY
	Automatic transmission starter relay terminals NJZ – NK0

Was any failure found?

YES

Replace the engine ECU.

NO

Replace the automatic transmission starter relay.

INSPECTION PROCEDURE: P0049**1 Inspecting the turbocharger revolution sensor connector**

1. Inspect the connector connection of the turbocharger revolution sensor (improper fitting or connection).

Is any defect found?

YES

Connect securely. Repair it if necessary.

NO

Go to step 2.

2 Inspecting the turbocharger revolution sensor

1. Inspect the installation status of the turbocharger revolution sensor (backlash, looseness).
2. Check the sensing part of the turbocharger revolution sensor for dirt, clogging and damage.

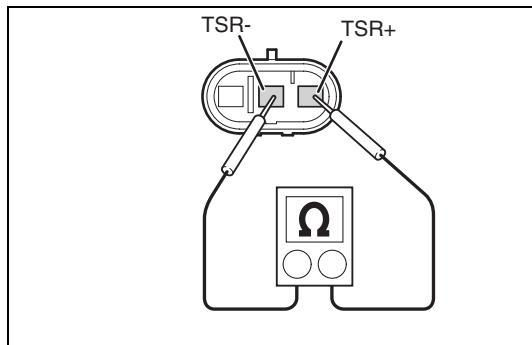
Is any defect found?

YES

Replace the turbocharger revolution sensor if there is dirt, clogging or damage in the sensing part.

NO

Go to step 3.

3 Inspecting the turbocharger revolution sensor (single unit inspection)

SAPH16F090300110

1. Set the starter switch to the "LOCK" position.
2. Disconnect the connector of the turbocharger revolution sensor.
3. Using the electrical tester, measure the resistance between terminals of the turbocharger revolution sensor.

Measurement conditions	Tester connections	Standard values
Starter switch: ON	Turbocharger revolution sensor 1st terminal – 2nd terminal	829 – 871 Ω

Do the measurements meet the standard value?

YES

Go to step 4.

NO

Replace the turbocharger revolution sensor.

2. DTC set condition**(1) DTC detection condition**

- Engine revolution is more than 1,200 r/min.
 - Fuel injection quantity $\geq 75 \text{ mm}^3/\text{st. cyl.}$
 - Battery voltage is in the range of 10 V to 16 V.
 - Engine speed fluctuation $< 664 \text{ r/min.}$
 - Fuel injection quantity fluctuation $< 87 \text{ mm}^3/\text{st. cyl.}$
 - Atmospheric pressure $\geq 75 \text{ kPa}$ {10.8 psi}
 - Vehicle speed $\geq 21 \text{ km/h}$ {13 mph}.
 - Intake quantity $\geq 45 \text{ g/sec.}$
 - Intake temperature sensor (with built-in air flow sensor) is at least $-10 \text{ }^\circ\text{C}$ {14 $^\circ\text{F}$ }.
- The above conditions continue for at least 40 seconds.

(2) Judgment criteria

- The calculated intercooler efficiency, which is derived from the intake air temperature sensor, boost pressure sensor, intake air temperature sensor (intercooler outlet), and atmospheric pressure sensor, exceeds 45 – 65 % (for vehicle speeds 21 and 40 km/h {13 and 25 mph}).
- And: The calculated EGR cooler efficiency, which is derived from the engine speed, fuel injection rate, EGR gas outlet temperature, and coolant temperature, either exceeds 105 % or is less than 80 %.
- And: The estimated EGR quantity calculated from the engine speed and fuel injection rate, the estimated intake manifold temperature calculated from the EGR gas outlet temperature sensor and intake air temperature sensor (intercooler outlet), and the absolute value of the actual intake manifold temperature are at least $60 \text{ }^\circ\text{C}$ {140 $^\circ\text{F}$ }.

3. Reset condition

- After restoration to normal condition.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON
- SVS light: OFF

5. Symptoms on the vehicle when the DTC is set**<Symptoms on the vehicle due to backup control (fail safe function)>**

- –

<Symptoms on the vehicle due to malfunction>

- –

6. Pre-inspection work

- Check that the battery voltage is in the normal range.

7. After-inspection work

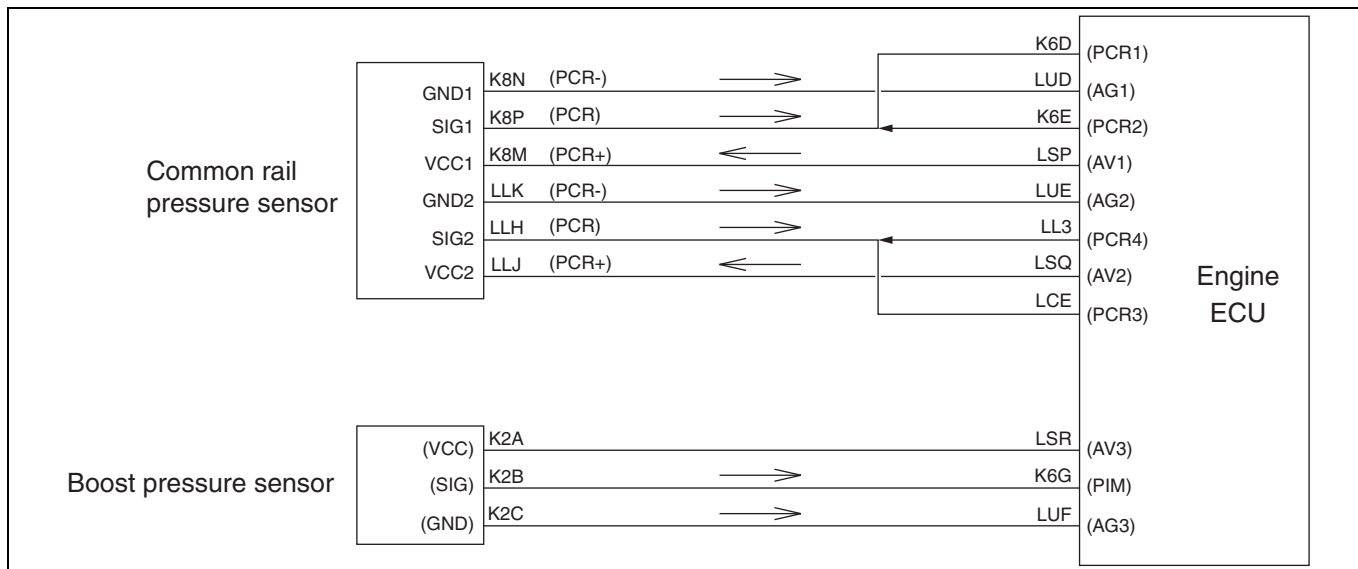
- Clear all past DTCs.
- Check that no DTC is stored after test drive.

8. Estimated failure factors

- Failure of intake air temperature sensor (intercooler outlet)
- Failure of intake air temperature sensor (with built-in air flow sensor)
- Failure of intake air temperature sensor (intake manifold)
- Failure of boost pressure sensor
 - Sensor is disconnected from measuring site or sensing unit is malfunctioning (due to dirt, clogging, damage, etc.)
 - Faulty resistance (due to sticking)
- Malfunction of ECU sensor power supply

DTC: P0108

EN01H16F09030F03001038

P0108: Boost pressure sensor - out of range (Out of range high)**INFORMATION**

SAPH16F090300199

1. Technical description

- The boost pressure sensor installed at the outlet of the Diesel throttle (intake throttle valve) consistently measures boost pressure.

<Description of malfunction>

- The boost pressure cannot be correctly recognized.

2. DTC set condition**(1) DTC detection condition**

- Starter switch ON.
 - Battery voltage is in the range of 10 V to 16 V.
- The conditions described above remain for 5 seconds or longer.

(2) Judgment criteria

- Output of the boost pressure sensor remains greater than 3.67 V (327.4 kPa {47.5 psi}) for 3 seconds or longer.

3. Reset condition

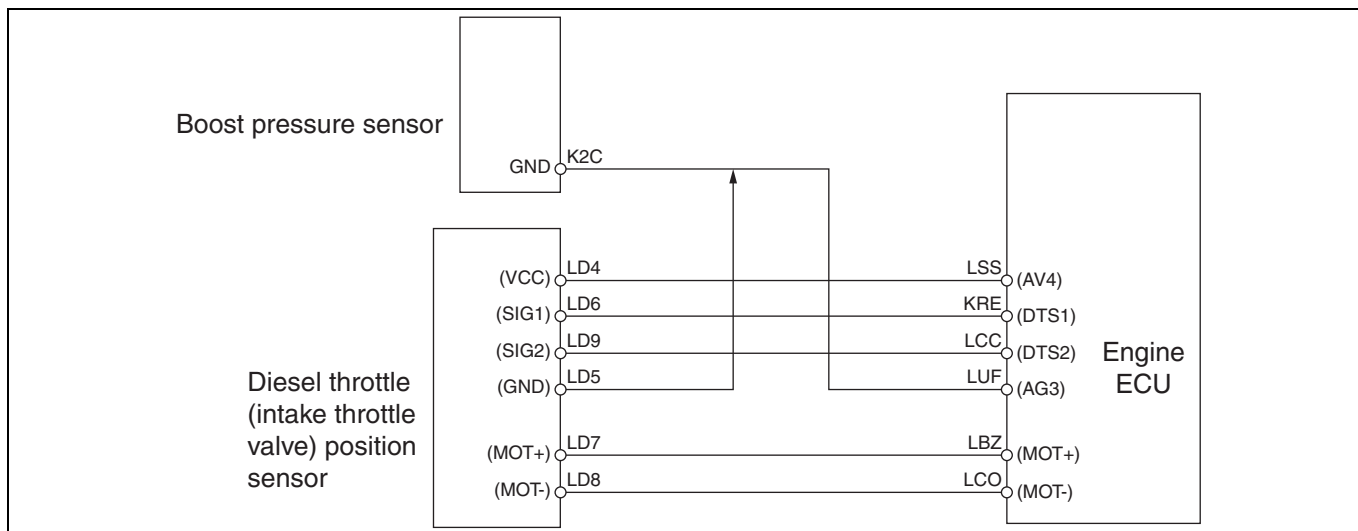
- After normal operation is restored and the starter switch is turned OFF.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON
- SVS light: OFF
- Engine output is restricted.
- Cruise control function is not available.

P0123: Intake throttle valve position sensor - out of range (Out of range high)

INFORMATION



SAPH16F090300247

1. Technical description

- The diesel throttle controls valves steplessly to control boost pressure and intake air volume.
- Inside the diesel throttle, a sensor designed to detect a travel of the valve consistently monitors a measurement reading and an actual opening.

<Description of malfunction>

- High voltage failure of diesel throttle (intake throttle valve) position sensor is detected.

2. DTC set condition

(1) Check conditions

- Starter switch ON.
 - Battery voltage is in the range of 10 V to 16 V.
- The conditions described above remain for 5 seconds or longer.

(2) Judgment criteria

- Output of the sensor remains at 4.8 V (120 degrees) or more for 3 seconds or longer.

3. Reset condition

- After normal operation is restored.
- Restarting after engine stall.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON
- SVS light: OFF

5. Symptoms on the vehicle when the DTC is set

<Symptoms on the vehicle due to backup control (fail safe function)>

- –

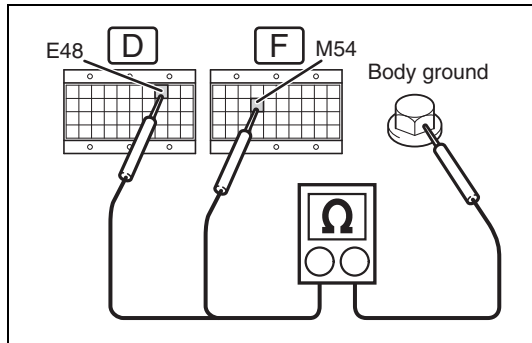
<Symptoms on the vehicle due to malfunction>

- –

6. Pre-inspection work

- Check that the battery voltage is in the normal range.

5 Inspect for short-circuits in wire harness of fuel temperature sensor



SAPH16F090300289

1. Set the starter switch to the "LOCK" position.
2. Connect the signal check harness to the engine ECU vehicle side harness. (Do not connect the harness to the ECU.)
3. Use the electrical tester to measure the resistance between the terminal of the engine ECU (signal check harness) and body ground.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Engine ECU (signal check harness) E48 (THF+) – Body ground M54 (AG6) – Body ground	$\infty \Omega$

Do the measurements meet the standard value?

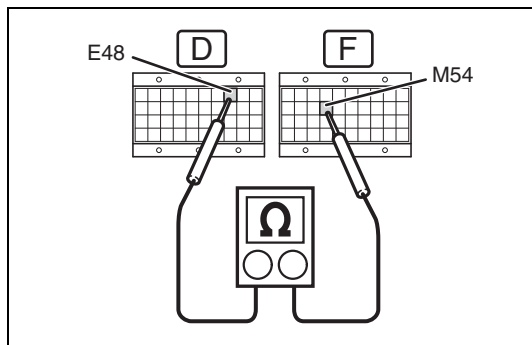
YES

Go to step 6.

NO

Repair or replace the harness.
Perform "After-inspection work" of INFORMATION section.

6 Inspect disconnection of the fuel temperature sensor harness



SAPH16F090300290

1. Connect the connector of the fuel temperature sensor.
2. Use the electrical tester to measure the resistance between the terminals of the engine ECU (signal check harness).

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Engine ECU (signal check harness) E48 (THF+) – M54 (AG6)	20 °C {68 °F}: 2.45 kΩ 40 °C {104 °F}: 1.15 kΩ 60 °C {140 °F}: 584 Ω 80 °C {176 °F}: 318 Ω

Do the measurements meet the standard value?

3 Check the engine speed main sensor

1. Check the installation of the engine speed main sensor.
2. Make sure there is no dirt or damage to the engine speed main sensor.

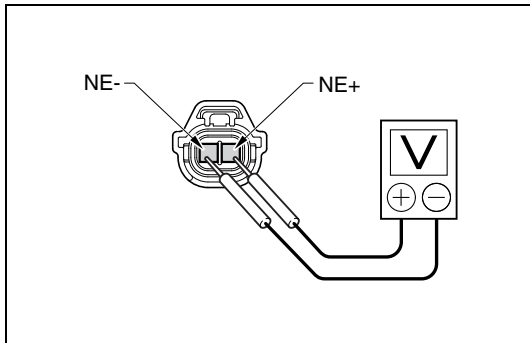
Was any failure found?

YES

Clean the engine speed main sensor and install it properly.
If damaged, replace the engine speed main sensor.
Perform "After-inspection work" of INFORMATION section.

NO

Go to step 4.

4 Inspect the engine speed main sensor power supply

SAPH16F090300331

1. Set the starter switch to the "LOCK" position.
2. Disconnect the engine speed main sensor connector.
3. Set the starter switch to the "ON" position.
4. Use the electrical tester to measure the voltage between the terminals of the engine speed main sensor vehicle-side connector.

Measurement conditions	Tester connections	Standard values
Starter switch: ON	Engine speed main sensor vehicle-side connector NE+ – NE-	4.5 – 5.5 V

Do the measurements meet the standard value?

YES

Go to step 7.

NO

Go to step 5.

- Barometric pressure ≥ 75 kPa {10.8 psi}
- The exhaust brake and PTO are inactive.
- Other diagnostic judgments have not been made (system normal).

Engine speed (r/min)

	TRANS
D range	725-775
N range	N/A
P range	N/A

3. If the rotational speed abnormality measured on each cylinder by the engine speed main sensor (crankshaft position sensor) continued for more than 20 seconds, judge it has malfunction.

(2) Judgment criteria

- If the injection amount exceeds the nominal value for more than 20 seconds. (The nominal value changes according to the engine load and T/M.)

3. Reset condition

- After restoration to normal condition.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON
- SVS light: OFF

5. Symptoms on the vehicle when the DTC is set**<Symptoms on the vehicle due to backup control (fail safe function)>**

- –

<Symptoms on the vehicle due to malfunction>

- Excessive vibration while engine is idling.

6. Pre-inspection work

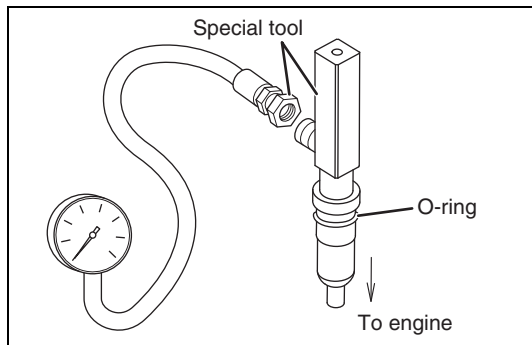
- Check that the battery voltage is in the normal range.

7. After-inspection work

- Clear all past DTCs.
- Check that no DTC is stored after test drive.

8. Estimated failure factors

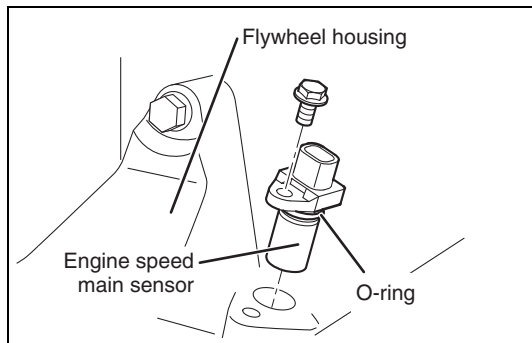
- Fuel injection line: break, crack, fuel leak
- Cylinder: compression leak
- Injector: clogged or stays open
- Fuel filter: Dirt, clogging, damage

12 Inspecting the compression pressure

SAPH16F090300442

1. Warm up the engine. (Coolant temperature: 80 °C {176 °F} or more)
2. Stop the engine.
3. Remove injectors from all cylinders.
4. Install the special tool (SST) and measure the compression pressure of each cylinder.

Measurement conditions	Tester connections	Standard values
Engine speed: 200 r/min	Each cylinder	Limit value: 3.0 MPa {31 kg/cm ² , 435 lbf/in ² }

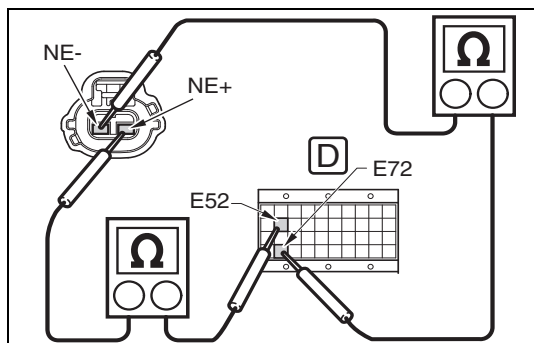
Is the measured value within the standard range?**YES****Go to step 13.****NO****Overhaul the engine.****13 Inspecting the engine speed main sensor (crank shaft position sensor)**

SAPH16F090300443

1. Inspect the connection of the engine speed main sensor connector (fitting and contact).
2. Inspect the installation state of the engine speed main sensor (rattling, looseness, and floating).

Is any defect found?**YES****Repair or replace the defective part.****NO****Go to step 14.**

3 Inspect disconnection of the crankshaft position sensor (engine speed main sensor) harness



SAPH16F090300493

1. Set the starter switch to the "LOCK" position.
2. Connect the signal check harness to the engine ECU vehicle-side harness. (Do not connect the harness to the ECU.)
3. Use the electrical tester to measure the resistance between the terminals of the engine ECU (signal check harness) and crankshaft position sensor (engine speed main sensor) vehicle-side connector.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Engine ECU (signal check harness) – Crankshaft position sensor (engine speed main sensor) vehicle-side connector NE1+(E52) – NE+ NE1-(E72) – NE-	Less than 2 Ω

Do the measurements meet the standard value?

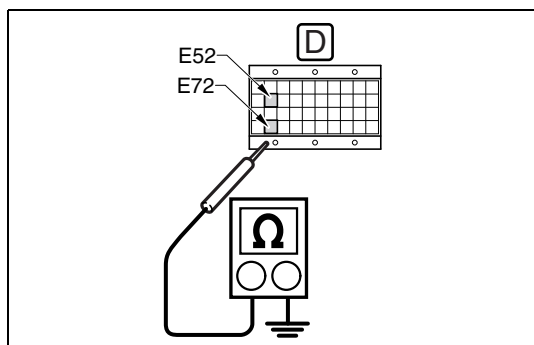
YES

Go to step 4.

NO

Repair or replace the harness.
Perform "After-inspection work" of INFORMATION section.

4 Inspect for short-circuit of the crankshaft position sensor (engine speed main sensor) harness



SAPH16F090300494

1. Use the electrical tester to measure the resistance between the terminals of the engine ECU (signal check harness) and ground.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Engine ECU (signal check harness) NE1+(E52) – Ground NE1-(E72) – Ground	$\infty \Omega$

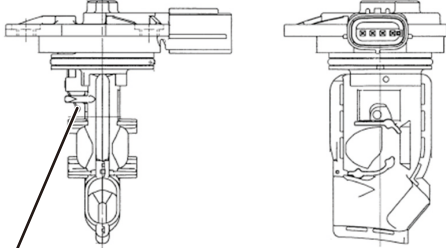
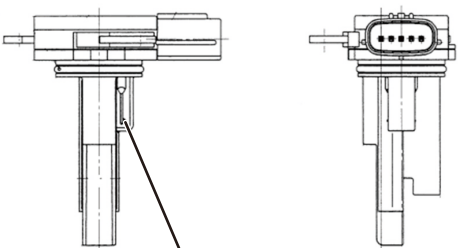
Do the measurements meet the standard value?

Cleaning procedure using air blow

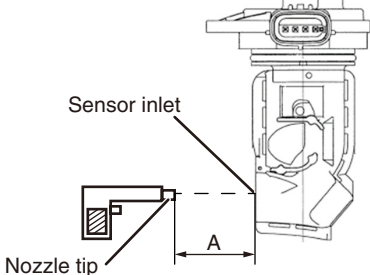
- This vehicle has an air flow sensor with a thin film chip type flow rate detector. Therefore, the air flow sensor can be cleaned using air blow. (An air flow sensor with a wire type flow rate detector cannot be cleaned, so pay attention to the detector type if you want to use air blow to clean other vehicles.)
- If a deterioration in performance is observed in the air flow sensor with the thin film chip type flow rate detector, it is recommended to clean the sensor by air blow before replacing it with a new one because performance may be restored by air blow cleaning.

⚠ CAUTION

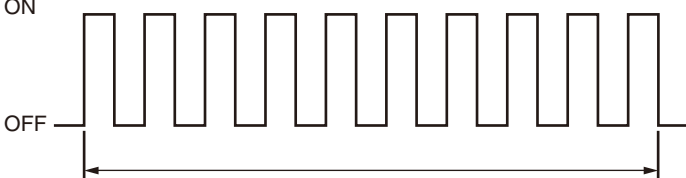
- The air to be used for air blow cleaning should not contain any oil, water or foreign matter (impurities, dust and dirt).

Air blow cleaning	Available	Not available
Flow rate detector	Thin film chip type	Wire type
Shape		

Cleaning procedure

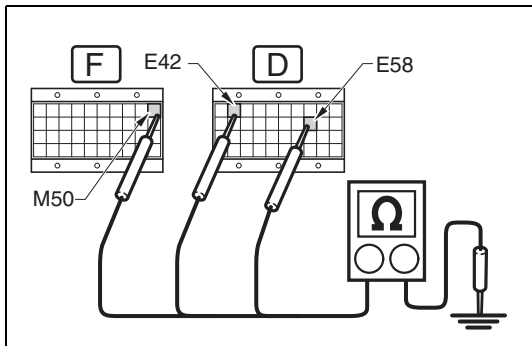


- Distance from the nozzle (A): 0 - 30 mm {0 - 1.18 in.}
- Do not insert the nozzle tip into the sensor inlet.
- Air must be blown from the sensor inlet side.
- Air pressure: 392 - 980 kPa (4 - 10 kgf/cm², 5.68 - 142.1 lbf/in²)
- Cleaning method: Intermittently blow air for 30 seconds or more. (Repeat by turning the blower ON and OFF 10 times or more.)
- For details, see the below figure.



For more than 30 seconds (Repeat by turning the blower ON and OFF 10 times or more.)

9 Inspect for short-circuit of the exhaust gas temperature sensor 1 (ATC inlet) and the exhaust gas temperature sensor 2 (ATC outlet) harness



SAPH16F090300578

1. Set the starter switch to the "LOCK" position.
2. Connect the signal check harness to the engine ECU. (Do not connect harness to the ECU.)
3. Use the electrical tester to measure the resistance between the terminals of the engine ECU and ground.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Engine ECU (signal check harness) EXT+ (E42) – Ground AG5 (E58) – Ground ET+ (M50) – Ground	$\infty \Omega$

Do the measurements meet the standard value?

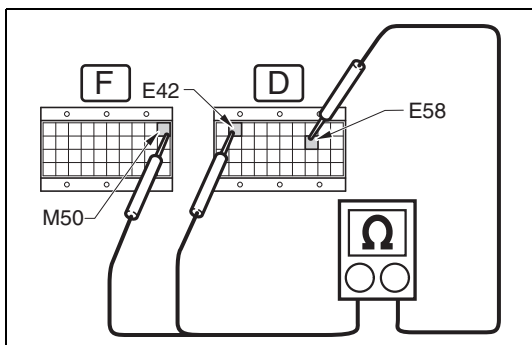
YES

Go to step 10.

NO

Repair or replace the harness.
Go to step 10.

10 Inspect disconnection of the exhaust gas temperature sensor 1 (ATC inlet) and the exhaust gas temperature sensor 2 (ATC outlet) harness



SAPH16F090300579

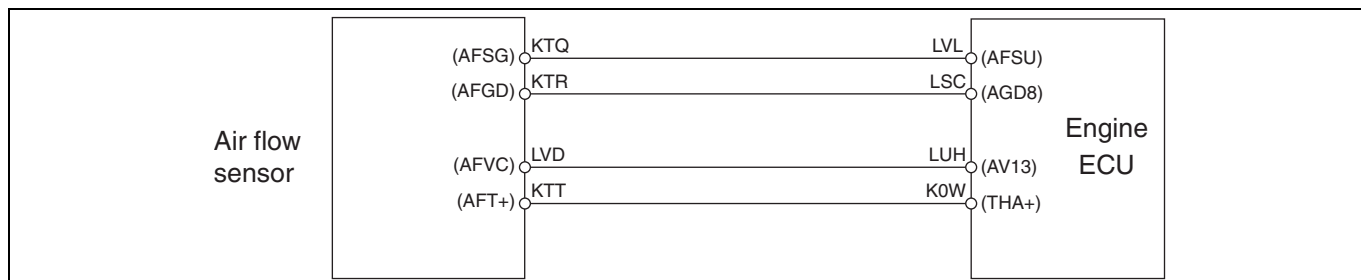
1. Connect the exhaust gas temperature sensor 1 (ATC inlet) and the exhaust gas temperature sensor 2 (ATC outlet) connector.
2. Use the electrical tester to measure the resistance between the terminals of the engine ECU (signal check harness).

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Engine ECU (signal check harness) EXT+ (E42) – AG5 (E58) ET+ (M50) – AG5 (E58)	20 °C {68 °F}: 13.7 – 29.8 k Ω 50 °C {122 °F}: 7.13 – 13.7 k Ω 80 °C {176 °F}: 4.1 – 7.13 k Ω

Do the measurements meet the standard value?

DTC: P04DB

EN01H16F09030F03001089

P04DB: Crankcase ventilation system - disconnection between the CV valve and the intake manifold**INFORMATION**

SAPH16F090300620

1. Technical description

- The closed breather circuit is malfunctioning and the air flow sensor detects trouble when air enters through the malfunctioning part.

<Description of malfunction>

- Closed breather malfunction is detected.

2. DTC set condition**(1) DTC detection condition**

- Engine speed is between 600 r/min and 1,000 r/min.
- Fuel injection quantity is between 0 mm³/st. cyl and 80 mm³/st. cyl.
- Engine coolant temperature is 60 °C {140 °F} or less.
- EGR valve opening is 0 % or less (EGR-cut status)
- No other DTC is detected.

(2) Judgment criteria

- Theoretical air quantity calculated from boost pressure and atmospheric pressure and actual air quantity are compared for at least 10 seconds, and the ratio of theoretical air quantity to actual air quantity is at least 1.10. and:
- Difference between the DCY (Driving Cycle) value prior to the result above and the current DCY value is greater than 0.10; and
- The condition "(boost pressure - atmospheric pressure) was ≤18 kPa {2.6 psi}" when the starter switch turned off and engine was stopped after previous driving cycle is not continued for more than 3 seconds.

3. Reset condition

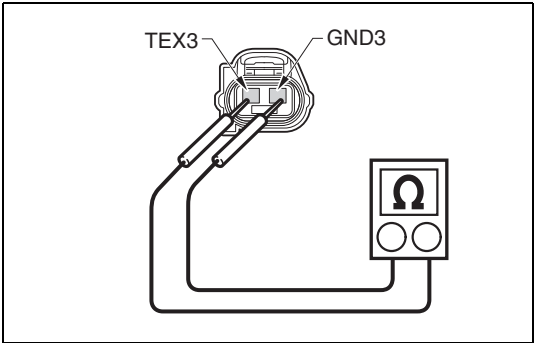
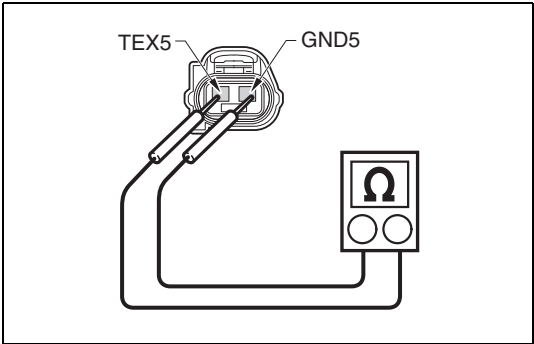
- After normal operation is restored and the starter switch is turned OFF.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON
- SVS light: OFF
- Engine output is restricted.

3

Inspect the exhaust gas temperature sensor 1 (ATC inlet) and the exhaust gas temperature sensor 2 (ATC outlet) unit



1. Set the starter switch to the "LOCK" position.
2. Disconnect the exhaust gas temperature sensor 1 (ATC inlet) and the exhaust gas temperature sensor 2 (ATC outlet) connector.
3. Use the electrical tester to measure the resistance between the terminals of the exhaust gas temperature sensor 1 (ATC inlet) and the exhaust gas temperature sensor 2 (ATC outlet).

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Exhaust gas temperature sensor 1 (ATC inlet)	20 °C {68 °F}: 13.7 – 29.8 kΩ
	TEX5 – GND5	50 °C {122 °F}: 7.13 – 13.7 kΩ
	Exhaust gas temperature sensor 2 (ATC outlet)	80 °C {176 °F}: 4.1 – 7.13 kΩ
	TEX3 – GND3	

Do the measurements meet the standard value?

YES

Go to step 4.

NO

Replace faulty part.
Perform "After-inspection work" of INFORMATION section.

INSPECTION PROCEDURE: P062F**1 Check injector replaced record**

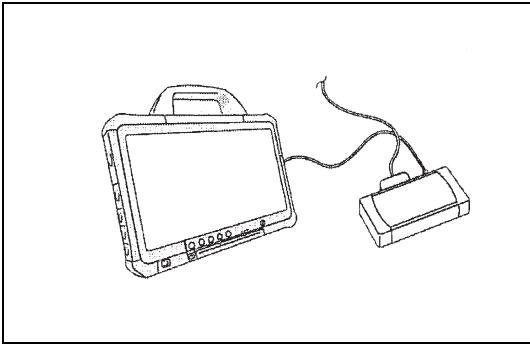
1. Check injector replaced record.

Does the injector have a replacement record?**YES**

(When it has a record or unclear)
Go to step 3.

NO

(When it has not a record)
Go to step 2.

2 Inspection of QR code [HINO DX II]

SAPH16F090300695

1. Re-input the registration QR code data of the service server.
2. Erase the DTC memory, and recheck DTC code.
Confirm that DTC code P062F is not detected.

Has DTC P062F been detected?**YES**

Go to step 3.

NO

Procedure completed.
Perform "After-inspection work" of INFORMATION section.

DTC: P06A5

EN01H16F09030F03001119

P06A5: ECU sensor power supply 4 failure (High) INFORMATION

1. Technical description

- Power is supplied to the sensor power supply 3 circuit (Diesel throttle position sensor 1 and 2, engine speed sub sensor, electric fan clutch revolution sensor, air mass flow sensor).

<Description of malfunction>

- High power supply failure of the sensor power supply circuit is detected.

2. DTC set condition

(1) DTC detection condition

- Starter switch ON.
- Battery voltage is in the range of 11 V to 16 V
Above condition continues for 5 seconds or more.

(2) Judgment criteria

- AC/DC converter input sensor power supply voltage is detected 3.5 V or more for at least 3 seconds.

3. Reset condition

- Immediately after normal operation is restored.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: OFF
- SVS light: OFF

5. Symptoms on the vehicle when the DTC is set

<Symptoms on the vehicle due to backup control (fail safe function)>

-

<Symptoms on the vehicle due to malfunction>

-

6. Pre-inspection work

- Check that the battery voltage is in the normal voltage

7. After-inspection work

- Clear all past DTCs
- Check that no DTC is detected after test drive

8. Estimated failure factors

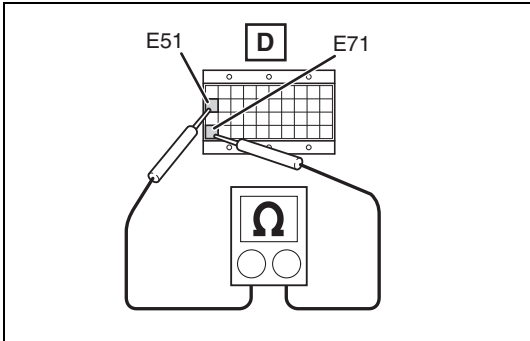
- Harness failure (Battery power supply short-circuit)
- Engine ECU sensor power supply failure, internal circuit failure

YES

Go to step 6.

NO

Repair or replace the wire harness.

6 Inspecting the turbocharger revolution sensor wire harness for disconnection

SAPH16F090300786

1. Connect the connector of the turbocharger revolution sensor.
2. Using the electrical tester, measure the resistance between terminals of the engine ECU (signal check harness).

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Engine ECU (signal check harness) TUN+ (E51) terminal – TUN- (E71) terminal	Approximately 850 Ω

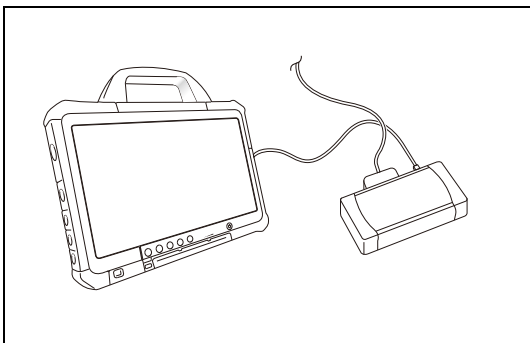
Is the measured value within the standard range?

YES

Go to step 7.

NO

Repair or replace the wire harness.

7 Reading the DTC [HINO DX II]

SAPH16F090300787

1. Connect the diagnostic tester (HINO DX II) to the vehicle.
2. Set the starter switch to the "ON" position.
3. Erase the malfunction history.
4. Set the starter switch to the "LOCK" position.
5. Start the engine.
6. On the diagnostic tester screen, check that DTC P1072 is not detected.

Is DTC P1072 detected?

YES

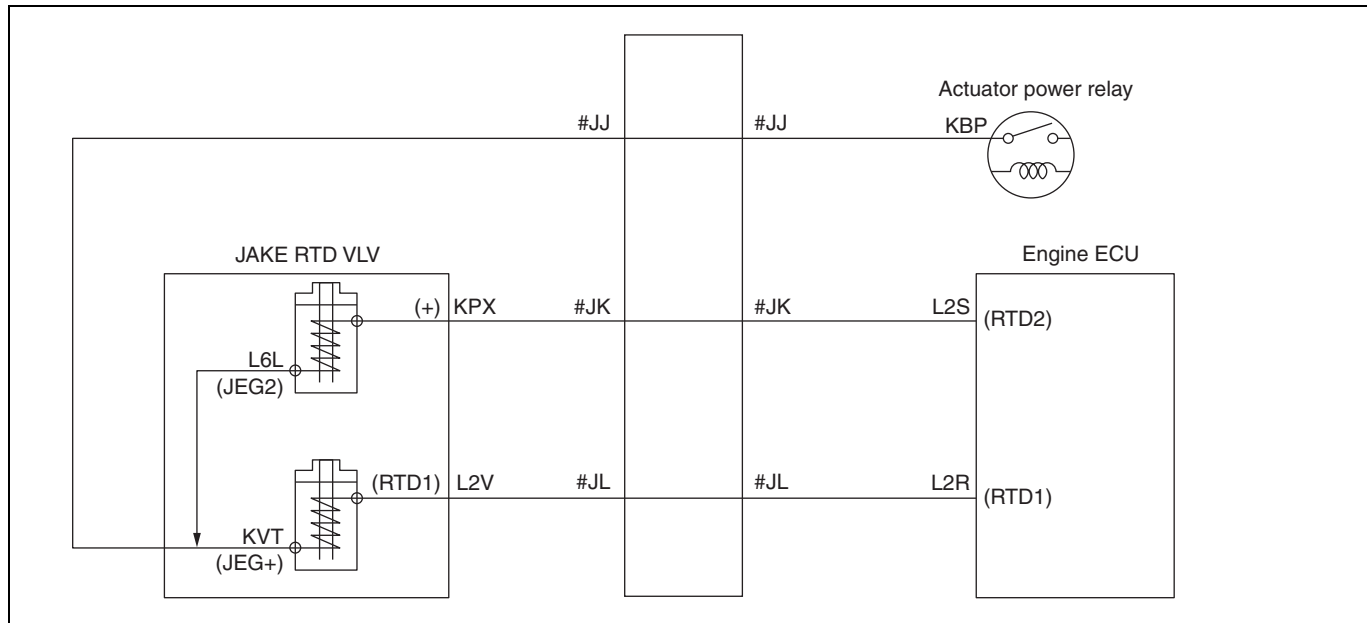
Replace the engine ECU.

NO

The inspection is finished.

DTC: P1462

EN01H16F09030F03001140

P1462: Malfunction of engine retarder 1 [open/ GND short-circuit]**INFORMATION**

SAPH16F090300827

1. Technical description

- –

<Description of malfunction>

- The engine retarder solenoid valve is not in operation.
- Malfunction of solenoid valve, harness disconnection or GND short circuit is likely to have occurred.

2. DTC set condition**(1) DTC detection condition**

- Non-actuation of the engine retarder is being requested.
 - The starter switch is set to the "ON" position.
 - The battery voltage is between 10 V or more and 16 V or less.
- The conditions described above remain for 5 seconds or more.

(2) Judgment criteria

- Voltage of the engine retarder solenoid valve circuit is 6.4 V or less.
- Malfunction diagnosis time is 3 seconds or more.

3. Reset condition

- Immediately after return to normal

4. Indication, warning or system control regulation when the DTC is set.

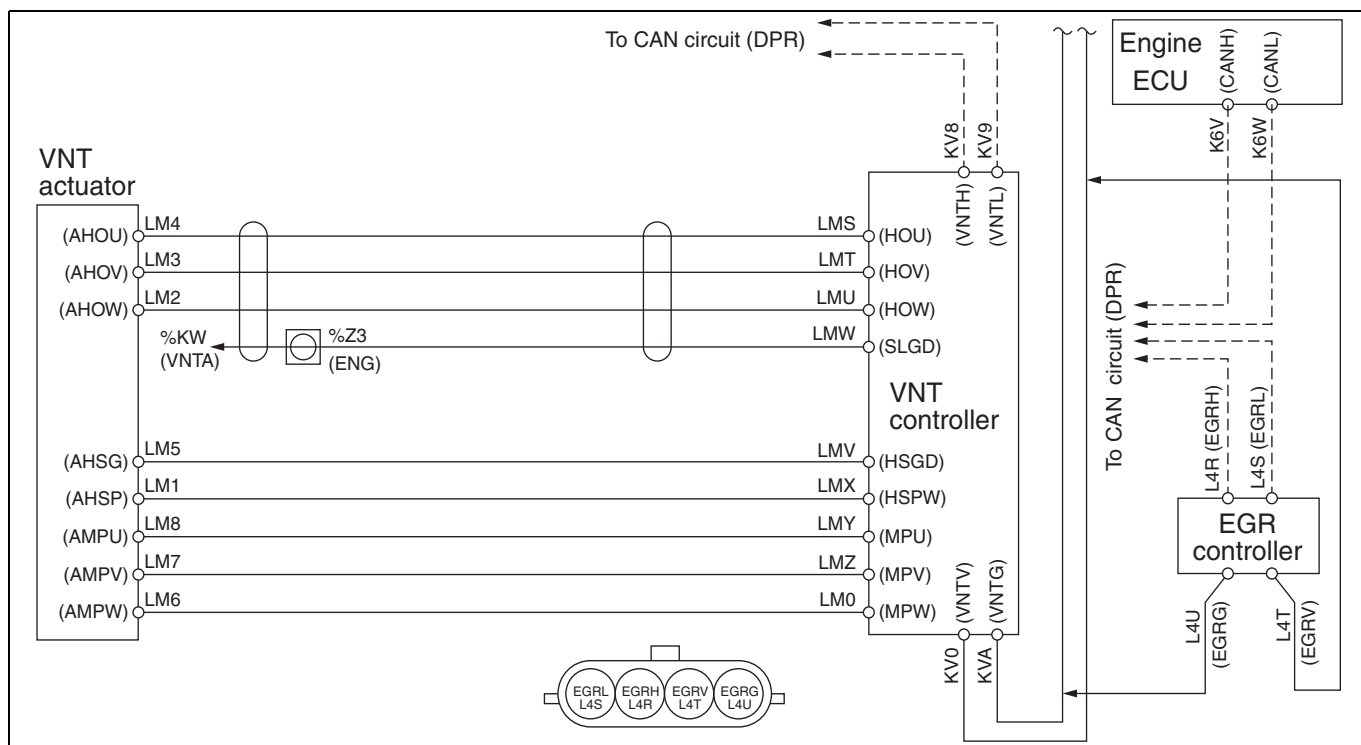
- MIL: OFF
- SVS light: ON

DTC: P14BC and P14BD

EN01H16F09030F03001148

P14BC: EGR valve controller temperature sensor 2 (Signal too low) (EGR actuator temp. sensor 2 signal too low)

INFORMATION



SAPH16F090300869

1. Technical description

- EGR valve is a butterfly type.
- EGR valve opening is controlled by engine speed and amount of intake air.
- EGR valve opening is adjusted by engine ECU and CAN communication.
- EGR valve will not operate when engine coolant temperature is low ($\leq 40\text{ }^{\circ}\text{C}$ {104 } $^{\circ}\text{F}$).
- DTC is issued when failure message is received from EGR actuator unit.

<Description of malfunction>

- EGR actuator system is malfunctioning.

2. DTC set condition

(1) DTC detection condition

- Battery voltage is in the range of 10 V to 16 V.
- There is no disconnection in harness connected to EGR valve.
- Starter switch ON. (Not related to engine speed.)

(2) Judgment criteria

- When temperature of temperature sensor 2 (CPU side) inside actuator is $-50\text{ }^{\circ}\text{C}$ { $-58\text{ }^{\circ}\text{F}$ } or less, and this condition continues for 1 second.

3. Reset condition

- Normal operation is restored and accelerator is not being operated.

5 Perform engine basic inspection

1. Based on the Engine basic inspection sheet, inspect each engine part and system.

HINT

Inspect each engine system and check for anything that may deteriorate the exhaust gas properties.

Was any failure found?

YES

**Repair or replace the faulty part.
Perform "After-inspection work" of INFORMATION section.**

NO

**Procedure completed.
Perform "After-inspection work" of INFORMATION section.**

6 Inspect the exhaust gas temperature sensor 5 (DPR outlet) connector

1. Check the connection of the exhaust gas temperature sensor 5 (DPR outlet) connector (Looseness and poor contact).

Was any failure found?

YES

**Connect securely, repair if needed.
Perform "After-inspection work" of INFORMATION section.**

NO

Go to step 7.

7 Inspect the exhaust gas temperature sensor 4 (DPR inlet)

1. Check the installation of the exhaust gas temperature sensor 4 (DPR inlet).
2. Make sure there is no dirt, damage or clogging in the sensing unit of exhaust gas temperature sensor 4 (DPR inlet).

Was any failure found?

YES

**Clean the sensing unit and install it properly.
If damaged, replace the exhaust gas temperature sensor 4 (DPR inlet).
Perform "After-inspection work" of INFORMATION section.**

NO

Go to step 8.

8. Estimated failure factors

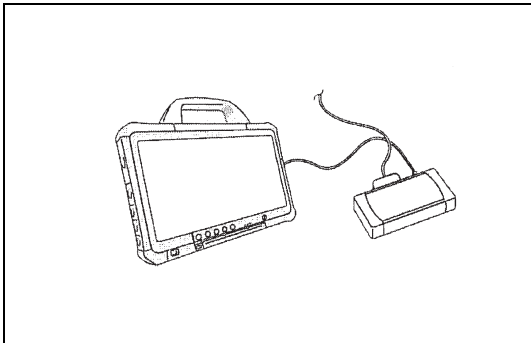
- Faulty DEF solution reduction
- Harness disconnection or short-circuit
- NOx sensor failure
- Air flow sensor failure
- Exhaust gas temperature sensor (SCR inlet) failure
- DEF quality sensor failure
- SCR catalyst: miscalculation of adsorption amount or HC poisoning

NOTICE

If no trouble causes are found, it can be suspected that the respective DTC was issued because of a temporary fault condition caused by the freezing of the DEF.

YES**Go to step 6.****NO**

**Repair or replace the wire harness (fuel dosing valve – engine ECU).
Perform "After-inspection work" of INFORMATION section.**

6 Check the DTC detected [HINO DX II]

SAPH16F090301049

1. Connect the vehicle to HINO DX II .
2. Perform DPR manual regeneration.
3. After completion of regeneration, reload the DTC and check if the DTC P20CD has been detected.

Has DTC P20CD been detected?**YES**

**Replace the engine ECU.
Perform "After-inspection work" of INFORMATION section.**

NO

**Procedure completed.
Perform "After-inspection work" of INFORMATION section.**

- (6) Make sure that the amount of DEF injected is as specified as patterns 1 to 3.

HINT

- The urea crystal is soluble in the DEF. Clogging may be eliminated by repeating injection several times. For this reason, even if there are the urea deposits on the tip of the DEF injector. It is not an abnormality as long as the above injection is possible.

Is operation normal?

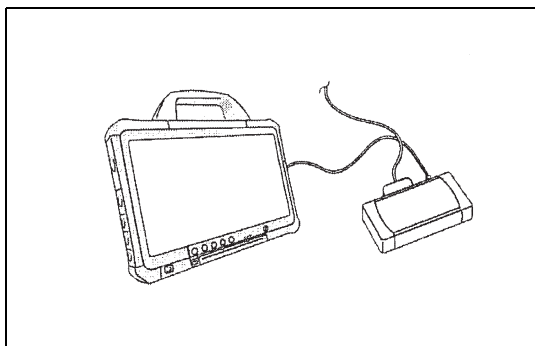
YES

Re-install the DEF injector on the muffler.
Go to step 16.

NO

Go to step 15.

15 Inspect the DEF injector 2 [HINO DX II]



SAPH16F090301112

1. Set the starter switch to the "LOCK" position.
 2. Replace the DEF injector with a new part. (Do not install it on the muffler.)
 3. Set the starter switch to the "ON" position.
 4. Select [DCU].
 5. Select [Inspection Menu] on HINO DX II menu and check the operation of the DEF injector.
<Inspection procedure>
 - (1) Select [Active test setting].
 - (2) Select [DEF injector opening].
 - (3) Enter the indicated value and execute it.
- Check that DEF is injected from the DEF injector.

Is operation normal?

YES

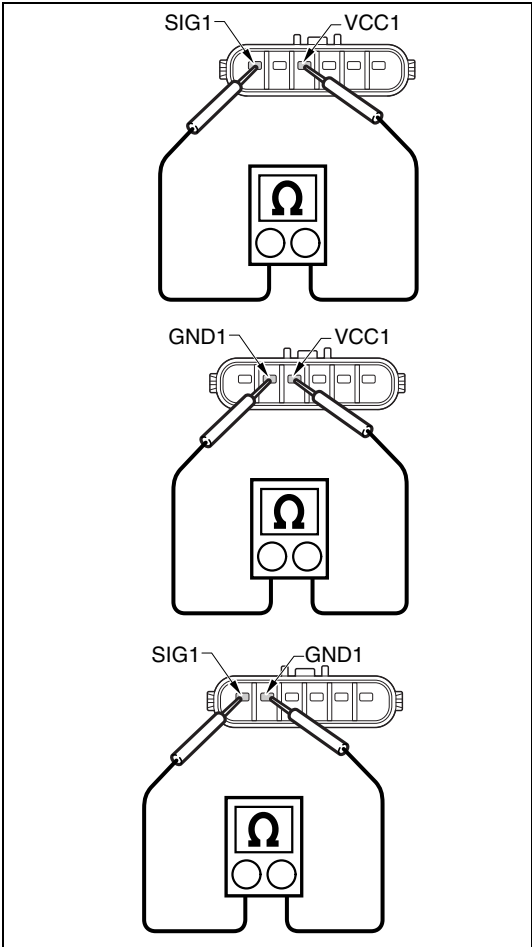
Install the new injector on the muffler and complete the check.
After installing the injector, idle the engine (for about 10 min.) and on HINO DX II (Data Monitor) verify that the DEF solution is stable between 800 kPa {116 psi} and 1,051 kPa {152 psi}.
Perform "After-inspection work" of INFORMATION section.

NO

Re-install the DEF injector and replace the DEF pipe (pressure line).
After replacing the pipe, idle the engine (for about 10 min.) and on HINO DX II (Data Monitor) verify that the DEF solution is stable between 800 kPa {116 psi} and 1,051 kPa {152 psi}.
Perform "After-inspection work" of INFORMATION section.

3

Inspect the accelerator sensor 1 unit



SAPH16F090301148

1. Set the starter switch to the "LOCK" position.
2. Disconnect the accelerator sensor 1 connector.
3. Use the electrical tester to measure the resistance between the terminals of the accelerator sensor 1.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Accelerator sensor 1	2 Ω
	VCC1 – SIG1	
	VCC1 – GND1	
	SIG1 – GND1	

Do the measurements meet the standard value?

YES

Go to step 4.

NO

Replace the accelerator sensor 1.
Perform "After-inspection work" of INFORMATION section.

3. Reset condition

- After normal operation is restored and engine is restarted after having stalled.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON
- SVS light: OFF
- Engine output is restricted.
- Cruise control function is not available.
- Idling stop system is not available.
- Vehicle start control is not available.

5. Symptoms on the vehicle when the DTC is set**<Symptoms on the vehicle due to backup control (fail safe function)>**

- Engine output is insufficient.
- Cruise control does not work.
- Idling stop system does not work.
- Vehicle start control does not work.

<Symptoms on the vehicle due to malfunction>

- –

6. Pre-inspection work

- Check that the battery voltage is in the normal range.

7. After-inspection work

- Clear all past DTCs.
- Check that no DTC is detected after test drive.

8. Estimated failure factors

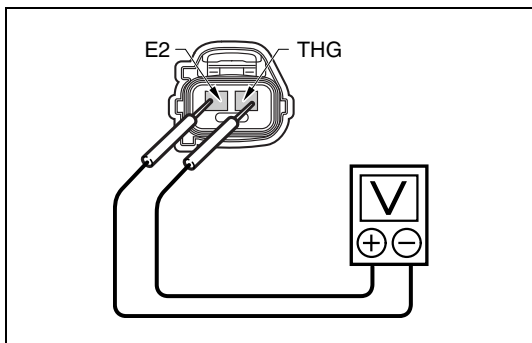
- Harness disconnection or short-circuit
- Irregular contact (disconnection or poor fit of connector)
- Injector internal coil disconnection
- Engine ECU failure

YES

Go to step 36.

NO

Replace the intake air temperature sensor (intake manifold).
Go to step 36.

36 Inspect the sensor power supply

SAPH16F090301254

1. Set the starter switch to the "ON" position.
2. Use the electrical tester to measure the voltage between the terminals of the intake air temperature sensor (intake manifold) vehicle-side connector.

Measurement conditions	Tester connections	Standard values
Starter switch: ON	Intake air temperature sensor (intake manifold) vehicle-side connector THG – E2	4.5 – 5.5 V

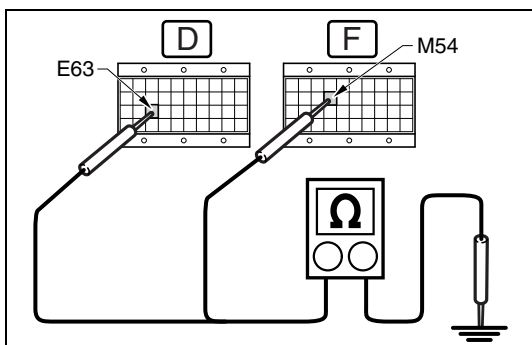
Do the measurements meet the standard value?

YES

Go to step 39.
If any failure was found at the step 33 - 35, perform "After-inspection work" of INFORMATION section.

NO

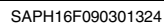
Go to step 37.

37 Inspect for short-circuit of the intake air temperature sensor (intake manifold) harness

SAPH16F090301255

1. Set the starter switch to the "LOCK" position.
2. Connect the signal check harness to the engine ECU. (Do not connect the harness to the ECU.)
3. Use the electrical tester to measure the resistance between the terminals of the engine ECU (signal check harness) and ground.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Engine ECU (signal check harness) AT1+(E63) – Ground AG6(M54) – Ground	$\infty \Omega$



- | Was any failure found? |
|------------------------|
| |

NO

Go to step 6.

1. Check the connection of the exhaust gas temperature sensor 4 (DPR inlet) connector (Looseness and poor contact).

Was any failure found?

NO

**Connect securely, repair if needed.
Go to step 7.**

Go to step 7.

1. Check the installation of the exhaust gas temperature sensor 4 (DPR inlet).
2. Make sure there is no dirt or damage to the exhaust gas temperature sensor 4 (DPR inlet).

Was any failure found?

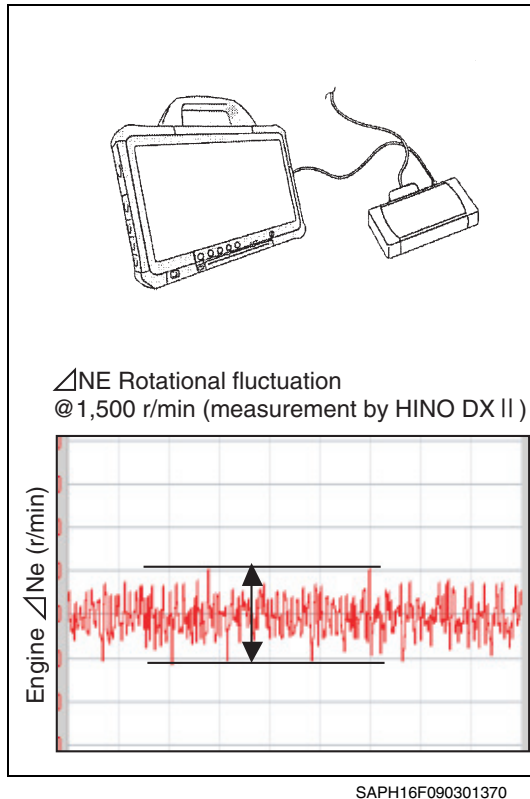
NO

Go to step 8.

2**Inspect the injector [HINO DX II]**

Check the injection quantity and the rotational fluctuation.

1. Start the engine.
2. Select [Injection quantity] from the [Data monitor Setting] menu and measure the injection quantity.
3. Select [Engine speed] from the [Data monitor Setting] menu and measure the rotational fluctuation.

**Measurement conditions**

**Engine speed: 1,500 r/min No-load,
T/M shift lever: Neutral position, A/C off and
Air compressor un-operating.
Engine coolant temperature: more than 80 °C {176 °F}**

Standard values

Type of	Q (mm ³ /st)	△ Ne (r/min)
MT	5.0q ≤	≤ 26
Allison®3000 RDS	6.0q ≤	
Allison®3000 HS		
Allison®3500 RDS		

Do the measurements meet the standard value?

(Both the injection quantity and the rotational fluctuation are within the standard values)

YES

Go to step 3.

NO

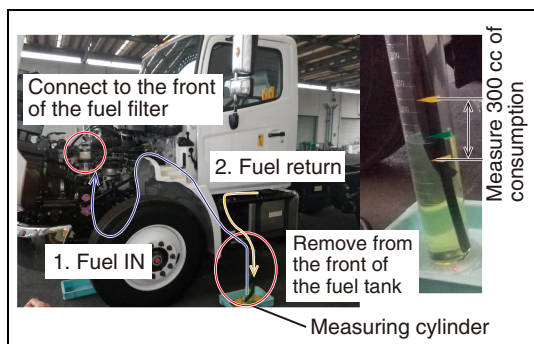
**Replace the injector.
Perform "After-inspection work" of INFOR-
MATION section.**

⚠ WARNING

To prevent fires, keep burning cigarettes away from the injector during work.

NOTICE

- For content of work, see the left illustration.
- Prepare waste cloths because fuel will spill during work.
- If you get fuel on your hands, immediately wash it off with soap and water.
- Before starting work, don protective glasses in order to prevent fuel from getting in your eyes.
- If fuel gets in your eyes, flush your eyes with clean water for 15 minutes or longer. After that, consult a physician.
- When discarding fuel, comply with regulations and rules set in your local area.



SAPH16F090301425

- Use the tools illustrated below to inspect the injector.



SAPH16F090301426

DTC: P2463

EN01H16F09030F03001198

P2463: DPF clogged INFORMATION

1. Technical description

- ECU constantly calculate and accumulate the amount of soot deposit from the engine. Moreover, based on the accumulated amount, the regeneration mode is determined.

<Description of malfunction>

- Operation is not completed according to DPR manual regeneration request.

2. DTC set condition

(1) DTC detection condition

- Starter switch ON.

(2) Judgment criteria

- Judge when soot deposit accumulated by ECU reaches the warning level judgment value (5.0 g/L). (Automatic regeneration was not completed for some reason. Then, the DPR light blinked, but manual regeneration was not performed. Or manual regeneration was attempted, but the regeneration did not start and the vehicle continued to be driven.)

3. Reset condition

- Immediately after normal operation is restored and DPR-related memory is reset.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON
- SVS light: OFF
- Engine output is restricted.

5. Symptoms on the vehicle when the DTC is set

<Symptoms on the vehicle due to backup control (fail safe function)>

- DPR reproduction prohibited.

<Symptoms on the vehicle due to malfunction>

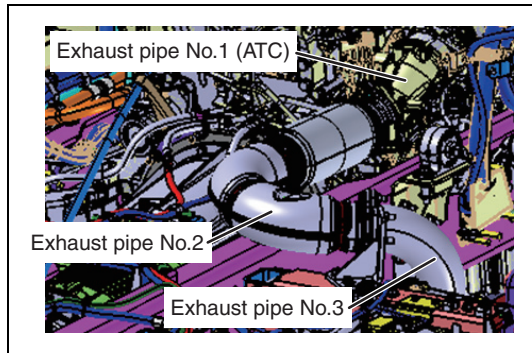
- –

6. Pre-inspection work

- Check that the battery voltage is in the normal range.

7. After-inspection work

- Clear all past DTCs.
- Check that no DTC is stored after test drive.

3 Inspect the exhaust pipe

SAPH16F090301526

1. Check for exhaust pipe crack, exhaust gas leak (soot contamination) and improper coupling flange tightening.

Was any failure found?**YES**

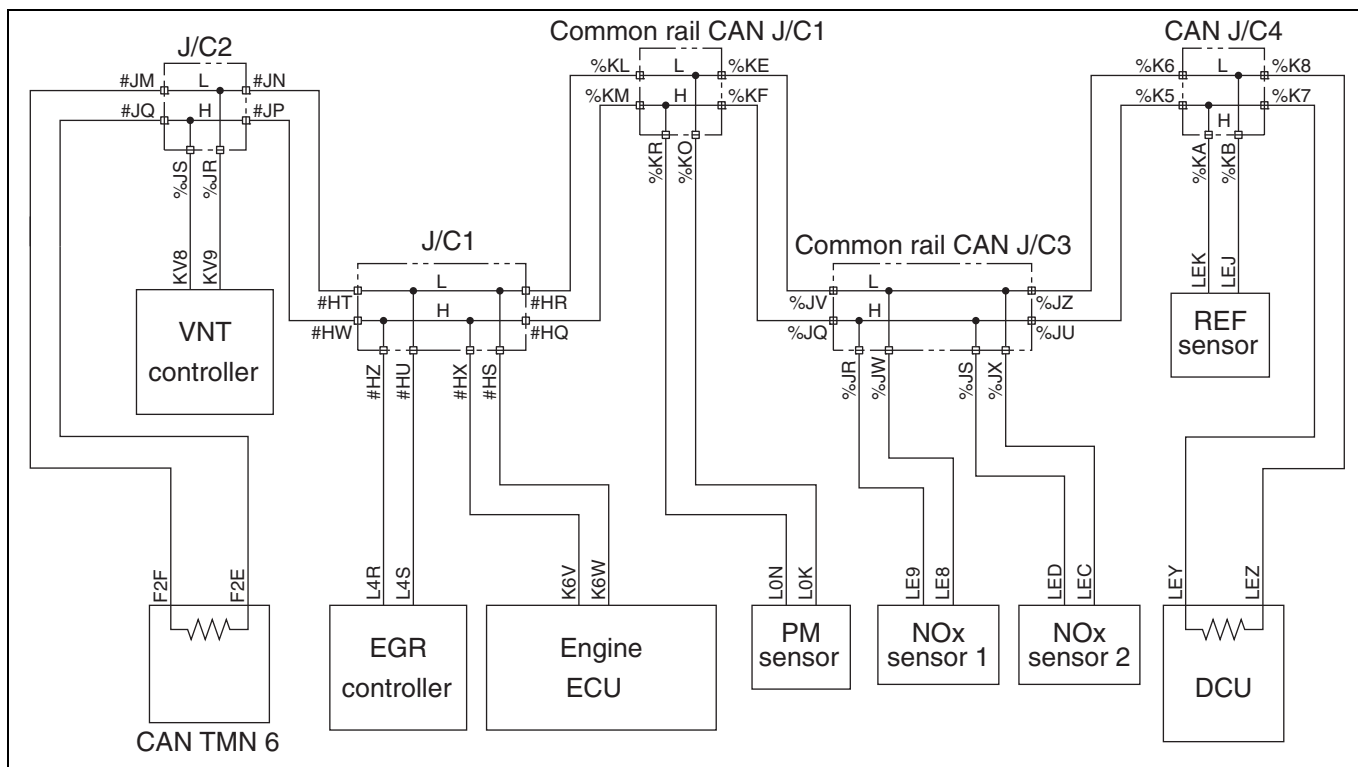
**Repair or replace the exhaust pipe.
Perform "After-inspection work" of INFORMATION section.**

NO

Go to step 4.

DTC: P24B7

EN01H16F09030F03001212

P24B7: Performance - PM sensor heater resistance (2 digit diagnosis code 08)**INFORMATION**

SAPH16F090301574

1. Technical description

- The PM sensor is installed downstream of DPR filter to monitor the PM volume from the DPR filter.

<Description of malfunction>

- The resistance behavior of the PM sensor heater is not proper.
- This diagnosis is deduced if the PM sensor head is modified intentionally (such as an external resistor being installed on the heater circuit).

2. DTC set condition

- (1) DTC detection condition
 - PM sensor is active.
 - Battery power supply voltage is in the range of 10 V to 16 V.
 - Starter switch remains ON (does not active for starter) for more than 5 seconds.
- (2) Judgment criteria
 - Abnormal is detected by the error diagnosis from PM sensor.

3. Reset condition

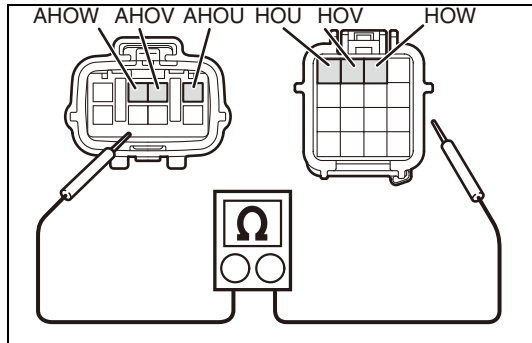
- After normal operation is restored and the starter switch is turned LOCK.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON

5. Symptoms on the vehicle when the DTC is set**<Symptoms on the vehicle due to backup control (fail safe function)>**

- Overlooking of the DPF damage

4**Check harness in hall effect device line between VNT actuator and VNT controller**

1. Set the starter switch to the "LOCK" position.
2. Disconnect the connectors from the VNT actuator and the VNT controller.
3. Using the electrical tester, measure the resistance between vehicle side connector terminals (shown in the table below) at the VNT actuator and the VNT controller.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	VNT actuator vehicle side connector – VNT controller vehicle side connector AHOW – HOW AHOW – HOV AHOU – HOU	Less than 1 Ω

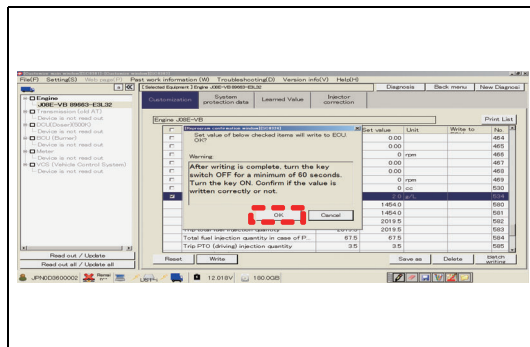
Do the measurements meet the standard value?**YES**

Connect the VNT actuator connector, and go to step 5.

NO

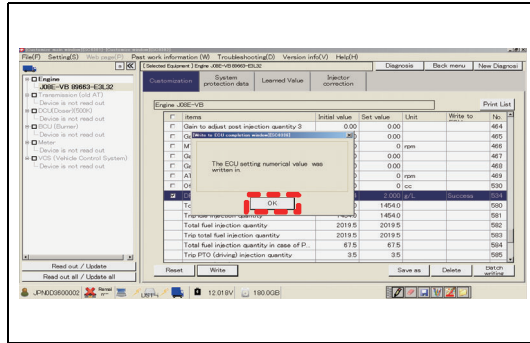
Disconnection or faulty continuity in hall effect device lines between VNT actuator and VNT controller.
Repair or replace the harness.
Perform "After-inspection work" of INFORMATION section.

6. Set the starter switch "OFF" and then "ON" according to the instruction.
Then, click [OK].



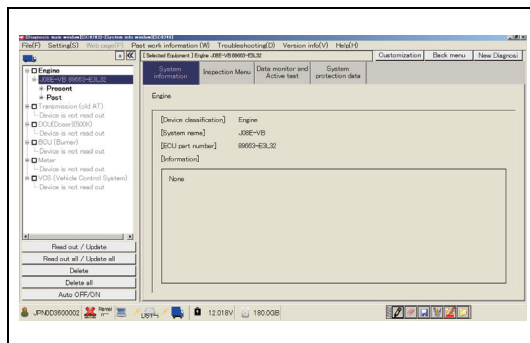
SAPH16F090301683

7. Check that ECU writing has been completed. Click [OK].
Refer to the window on the left.



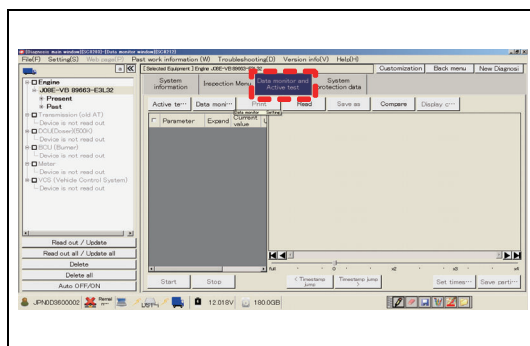
SAPH16F090301684

8. Start monitoring using the data monitoring function of DX II .
Check the output waveform of the NOx sensor on the monitor.



SAPH16F090301685

9. Select [Data monitor and Active test].



SAPH16F090301686

2. DTC set condition

- (1) DTC detection condition
 - Starter switch ON.
- (2) Judgment criteria
 - Transmitted data set No. ≠ received data set No.

3. Reset condition

- –

4. Indication, warning or system control regulation when the DTC is set.

- –

5. Symptoms on the vehicle when the DTC is set

<Symptoms on the vehicle due to backup control (fail safe function)>

- –

<Symptoms on the vehicle due to malfunction>

- –

6. Pre-inspection work

- Check that the battery voltage is in the normal range.

7. After-inspection work

- Clear all past DTCs.
- Check that no DTC is stored after test drive.

8. Estimated failure factors

- DCU malfunction

- Check if no DTC is stored after test drive.

8. Estimated failure factors

- Disconnection or short-circuit in the sensor harness
- Disconnection or poor fit of connector
- Malfunction of the ambient air temperature sensor
- Failure of the external resistor

5. Symptoms on the vehicle when the DTC is set**<Symptoms on the vehicle due to backup control (fail safe function)>**

- –

<Symptoms on the vehicle due to malfunction>

- DEF level indicator is OFF.

6. Pre-inspection work

- Check if the battery voltage is in the normal range.

7. After-inspection work

- Clear all past DTCs.
- Check if no DTC is stored after test drive.

8. Estimated failure factors

- DEF tank level sensor failure.

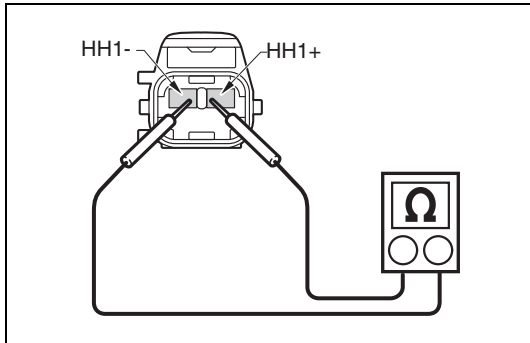
YES

Clean the ambient air temperature sensor and install it properly. If damaged, replace the ambient air temperature sensor. Perform "After-inspection work" of INFORMATION section.

NO

Go to step 4.

4 Inspect the ambient air temperature sensor unit



SAPH16F020400141

1. Set the starter switch to the "LOCK" position.
2. Disconnect the ambient air temperature sensor connector.
3. Use the electrical tester to measure the resistance between the terminals of the ambient air temperature sensor.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	Ambient air temperature sensor HH1+ – HH1-	0 °C {32 °F}: 4.92 – 6.12 kΩ 10 °C {50 °F}: 3.08 – 3.65 kΩ 25 °C {77 °F}: 1.65 – 1.78 kΩ

Do the measurements meet the standard value?

YES

Go to step 5.

NO

Replace the ambient air temperature sensor. Perform "After-inspection work" of INFORMATION section.

5 Inspect the DCU 86P connector

1. Check the connection of the DCU 86P connector (Looseness and poor contact).

Was any failure found?

YES

Connect securely, repair if needed. Perform "After-inspection work" of INFORMATION section.

NO

Go to step 6.

8. Estimated failure factors

- Disconnection or short-circuit in sensor harness
- Irregular contact (disconnection or poor fit of connector)
- Malfunction of DEF reverting valve

7. After-inspection work

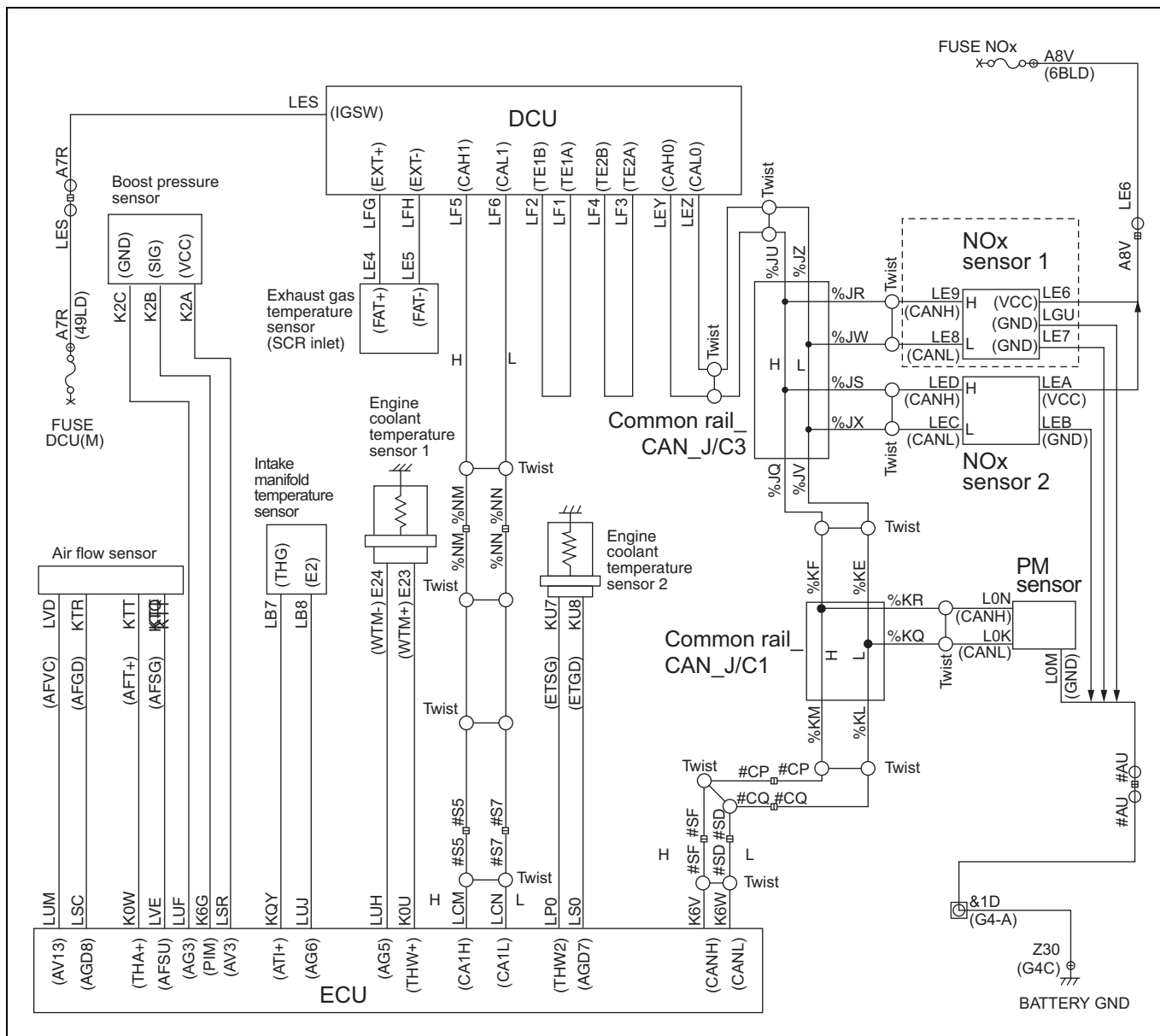
- Clear all past DTCs.
(Also clear DTC P204F (DEF SCR system failure) of the engine ECU side.)
- Using HINO DX II , set DEF heater ON for 10 seconds.
- Check if no DTC is stored after test drive.

8. Estimated failure factors

- Harness disconnection or short-circuit of +B
- DEF heater (1 or 2) malfunction
- DEF heater relay malfunction

DTC: P2204

EN01H16F02040F03001066

**DTC: P2204 SCR inlet NOx sensor abnormal
INFORMATION**

SAPH16F020400256

1. Technical description

- NOx sensor 1 (SCR upstream) is controlled by the NOx sensor controller.
- The NOx sensor controller is connected via the DCU and a harness, and it sends and receives data.

<Description of malfunction>

- Failure of NOx sensor 1 (SCR upstream) is detected.

<Description of malfunction>

- Failure of DEF injection control is detected.
- Feedback is reset when the target purification quantity during feedback implementation is stuck at the maximum value. If reset is repeated, this DTC is detected.

2. DTC set condition

- (1) DTC detection condition
The engine is ON.
- (2) Judgement criteria
Dosing feedback is reset 3 times at an interval of 180 sec. or shorter.

3. Reset condition

- After having restored to the normal conditions.

4. Indication, warning or system control regulation when the DTC is set.

- MIL: ON
- DEF injection is stopped.
- NOx reduction quantity monitoring is aborted.

5. Symptoms on the vehicle when the DTC is set**<Symptoms on the vehicle due to backup control (fail safe function)>**

- Exhaust gas purification function is declined.

<Symptoms on the vehicle due to malfunction>

- –

6. Pre-inspection work

- Check if the battery voltage is in the normal range.

7. After-inspection work

- Clear all past DTCs.
- Check if no DTC is stored after test drive.

8. Estimated failure factors

- It is likely that a NOx purification quantity has dropped or NH₃ slip has occurred.
(When the amount of NOx to be purified is small compared with the amount of DEF solution, NH₃-slip will occur. In the NOx sensor, NH₃ is functionally counted as NOx; when NH₃-slip occurs, therefore, the NOx sensor reading will be higher than the actual value.)
- NOx sensor 1 (SCR upstream)
 - If the NOx sensor 1 (SCR upstream) reads low or high NOx due to malfunction, the NOx sensor 2 (SCR downstream) reading may be high due to NH₃ slip.
- NOx sensor 2 (SCR downstream)
 - It is likely that the NOx sensor 2 (SCR downstream) reads high NOx.
- DEF: Low concentration
- DEF dose: Excessively low level of DEF dose
- SCR catalyst: When purification performance is degraded by deterioration of the catalyst, feedback control will be activated.

NOTICE

If no trouble causes are found, it can be suspected that the respective DTC was issued because of a temporary fault condition caused by the freezing of the DEF.

VEHICLE CONTROL SYSTEM (VCS)

11-001

VEHICLE CONTROL SYSTEM	11-2
PRECAUTIONS FOR DIAGNOSIS.....	11-2
SYSTEM BLOCK DIAGRAM.....	11-4
SIGNAL CHECK HARNESS.....	11-5
DIAGNOSIS USING THE PC DIAGNOSIS	
TOOL.....	11-13
VEHICLE CONTROL ECU INSPECTION.....	11-14
DIAGNOSIS MONITOR CODE AND DIAGNOSIS	
TROUBLE CODE TABLE.....	11-20
DTC: P0500	11-21
DTC: P0501	11-25
DTC: P0617	11-29
DTC: P0704	11-32
DTC: P0850	11-35
DTC: P1565	11-41
DTC: U0101	11-44
DTC: U0105	11-47
DTC: U0121	11-50
DTC: U0155	11-53
NO ACTIVATION OF AUXILIARY BRAKE	11-55
NO ACTIVATION/RELEASE OF CRUISE	
FUNCTION.....	11-61
NO ACTIVATION/RELEASE OF ECO MODE.....	11-67

3. Reset condition

- After restoration to normal condition.

4. Indication, warning or system control regulation when the DTC is set.

- SVS light: OFF

5. Symptoms on the vehicle when the DTC is set

<Symptoms on the vehicle due to backup control (fail safe) - Action arising from backup control>

- Cruise control does not function.

<Symptoms on the vehicle due to malfunction>

- Retarder control does not function.

6. Pre-inspection work

- Check that the battery voltage is in the normal range.

7. After-inspection work

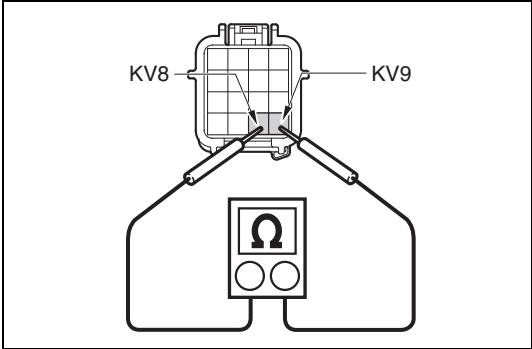
- Clear all past DTCs.
- Check that no DTC is detected after test drive.

8. Estimated failure factors

- CAN circuit failure
- TRANS-ECU failure
- Harness disconnection or short-circuit

7

Check for disconnection in CAN bus line between J/C2 and VNT controller (malfunction part 7)



1. Use the electrical tester to measure the resistance between KV8 terminal and KV9 terminal in the VNT controller connector. (vehicle side)

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	VNT controller connector (Vehicle side) KV8 terminal (H-line) – KV9 terminal (L-line)	110 Ω – 130 Ω

Do the measurements meet the standard value?

YES

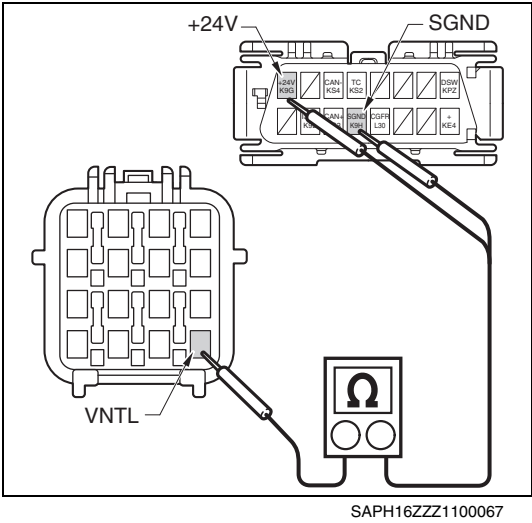
Go to step 8.

NO

CAN bus line disconnection or poor continuity between KV8 (H-line) and KV9 (L-line) in the VNT controller.
Repair or replace the harness.
Perform After-inspection work. (Clear all past DTC. Check no DTC is stored after test drive.)

6

Check for short-circuit in CAN L-line between J/C2 and VNT controller (malfunction part 2)



1. Use the electrical tester to check the continuity between the following terminals.
- (1) Between the VNTL terminal in the VNT controller vehicle-side connector and the +24V(K9G) terminal in the DLC(16P) connector.
 - (2) Between the VNTL terminal in the VNT controller vehicle-side connector and the SGND(K9H) terminal in the DLC(16P) connector.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	VNT controller vehicle-side connector – DLC(16P) connector VNTL – +24V(K9G) VNTL – SGND(K9H)	No Continuity

Do the measurements meet the standard value?

YES

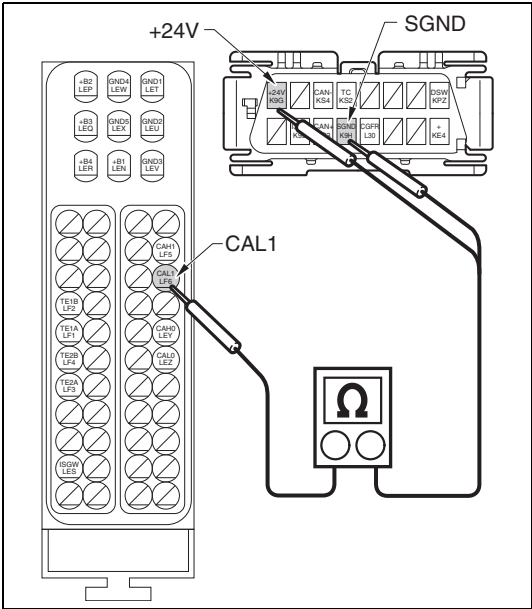
Go to step 7.

NO

Short-circuit in CAN L-line +B/GND between J/C2 and VNT controller.
Repair or replace the wire harness.
Perform After-inspection work. (Clear all past DTC. Check no DTC is stored after test drive.)

2

Check for short-circuit in CAN L-line between No.30 J/C and the DCU(53P) (malfunction parts 1)



SAPH16ZZZ1100123

1. Use the electrical tester to check the continuity between the following terminals.
- (1) Between the CAN L-line CAL1(LF6) terminal in the DCU vehicle-side connector(53P) and the +24V(K9G) terminal in the DLC(16P) connector.
 - (2) Between the CAN L-line CAL1(LF6) terminal in the DCU vehicle-side connector(53P) and the SGND(K9H) terminal in the DLC(16P) connector.

Measurement conditions	Tester connections	Standard values
Starter switch: LOCK	DCU vehicle-side connector(53P) – DLC(16P) connector CAL1(LF6) – +24V(K9G) CAL1(LF6) – SGND(K9H)	No continuity

Do the measurements meet the standard value?

YES

Go to step 3.

NO

Short +B/GND in CAN L-line between No. 30 J/C and the DCU.
Repair or replace the harness.
Perform After-inspection work. (Clear all past DTC. Check no DTC is stored after test drive.)

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