

**DENSO**

**Diesel Injection Pump**

# **SERVICE MANUAL**

**New Common Rail System for HINO  
E13C Type Engine**

**OPERATION**

**February, 2004**

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## 1. Outline

### 1-1. Product Application

#### A. Application

Manufacturer	Engine Model	Destination
HINO	E13C	General countries

#### B. System Components Parts Number

Parts Name	DENSO Parts Number	Manufacturer Parts Number	Remarks
Supply pump	094000-0421	22730-1231A	HP0 type
Injector	095000-5223	23910-1242A	With QR code
Rail	095440-0460	22760-1150A	
Engine ECU	102758-3001	89560-6530A	With EDU inside
Accelerator position sensor	198300-8160	89441-6950A	
Crankshaft position sensor	029600-0570	89411-1280A	
Cylinder recognition sensor	949979-1300	—	Included in the supply pump
Fuel temperature sensor	179730-0090	22790-1010A	
Coolant temperature sensor	071560-0110	83420-1250A	
Intake air temperature sensor	072800-0350	89441-6230A	
Intake air pressure sensor	079800-5890	89390-1080A	

### 1-2. Outline

- This Service Manual describes the new common rail system installed on the E13C engine of large Hino trucks. The biggest difference compared with conventional common rail systems is that it uses an injector with a QR code. The basic construction and operation of the system is about the same as for systems installed on the P11C engine, so this Service Manual will only give a general outline of the E13C system and describe its unique features. For details on the common rail system, refer to Service Bulletin ECD 01-08 "New Common Rail System (ECD-U2) for HINO" published in December 2001, and Service Manual "Common Rail System for HINO J05D/J08E Type Engine" published in October 2003.

2. Outline of The Main New Features

2-1. Common Rail Specifications and Engine Features

		E13C	K13C (Current Model)	
Common Rail Specifications	Main Features	HP-0 + G2	HP-0 + X1	
	Pressure	160 MPa	120 MPa	
	Type	L6, TI, 4 valves	L6, TI, 4 valves	
Engine Features	Displacement	13 L	13 L	
	Variation	5 Output Settings	Low Output	High Output
	Output	265-382 kW/1800-2200 rpm	272 kW/2000 rpm	294 kW/2000 rpm
	Torque	1764-2156 N•m/900 rpm	1520 N•m/1100 rpm	1667 N•m/1100 rpm
Vehicle		Cargo and Dump Trucks, Tractors	Cargo and Dump Trucks, Tractors	



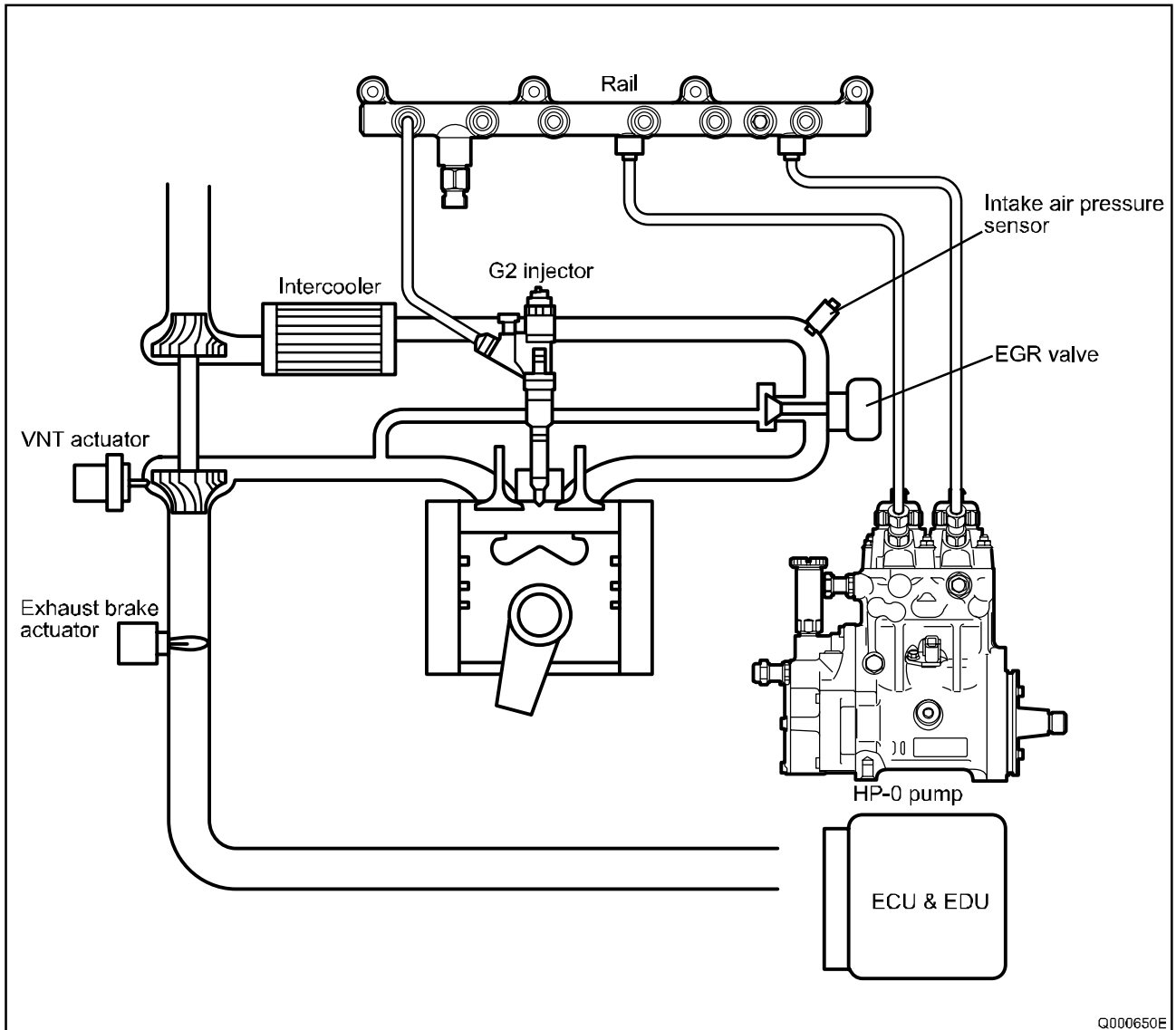
E13C Engine

Q000649E

## 2-2. System Construction

< NOTE >

- For details on sensors such as the NE sensor and G sensor (sub-NE sensor), refer to Page 3,4 in Service Bulletin 01-08.



### 3. Outline of Changes in Main Functional Parts

Only the functional parts with significant changes are described.

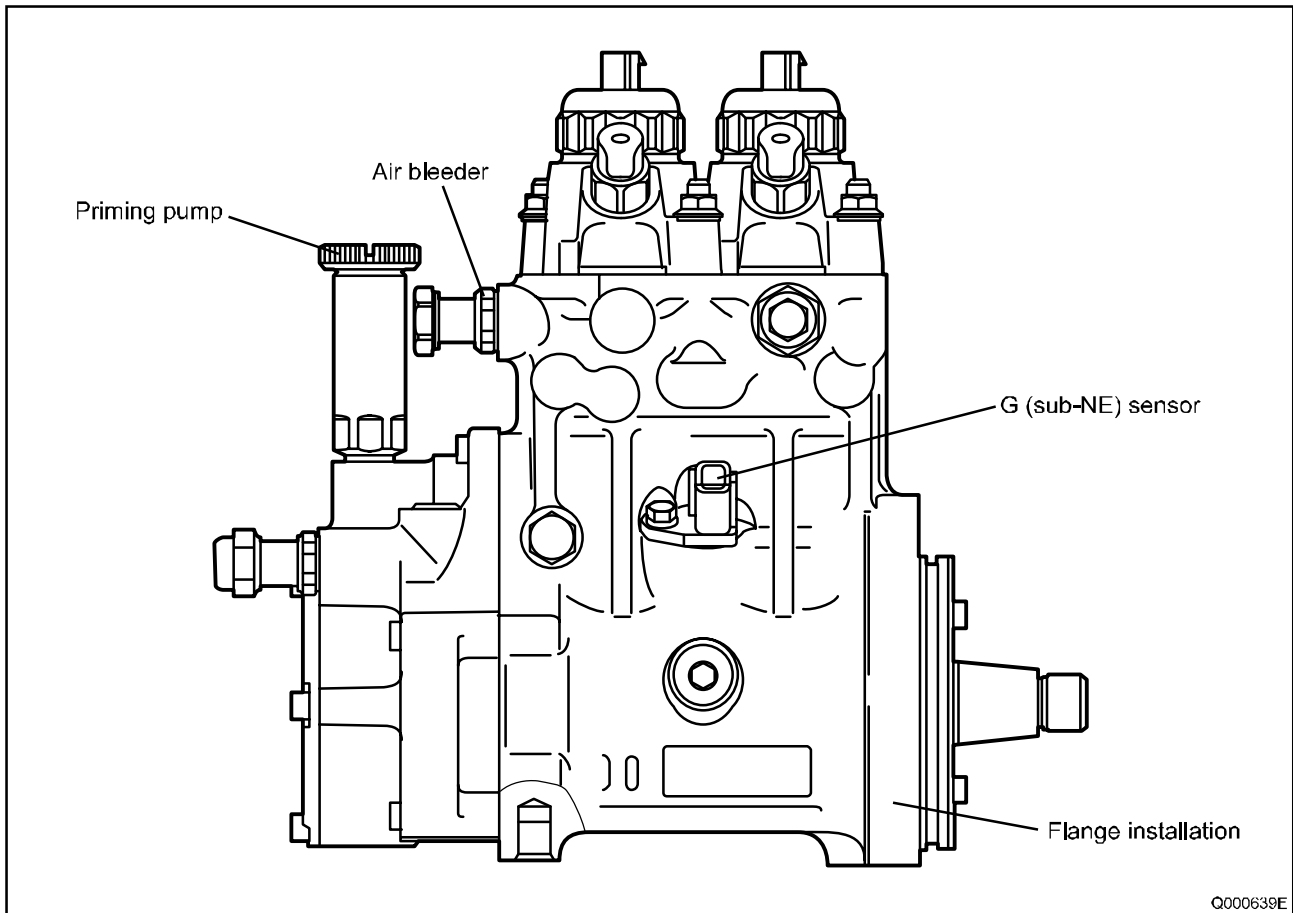
#### 3-1. Supply Pump

##### A. Changes

The items that have changed significantly are shown in the table below.

Item	Conventional System	New System	Reason for Change
Installation method	Saddle type	Flange type	Easier installation
Driving method	Coupling	Gear	Easier installation
G sensor	MPU	MRE	Reduced cost

##### B. Construction



##### C. Operation

For details on the operation, refer to page 12 - 15 in Service Manual "Common Rail System for HINO J05D/J08E Type Engine".

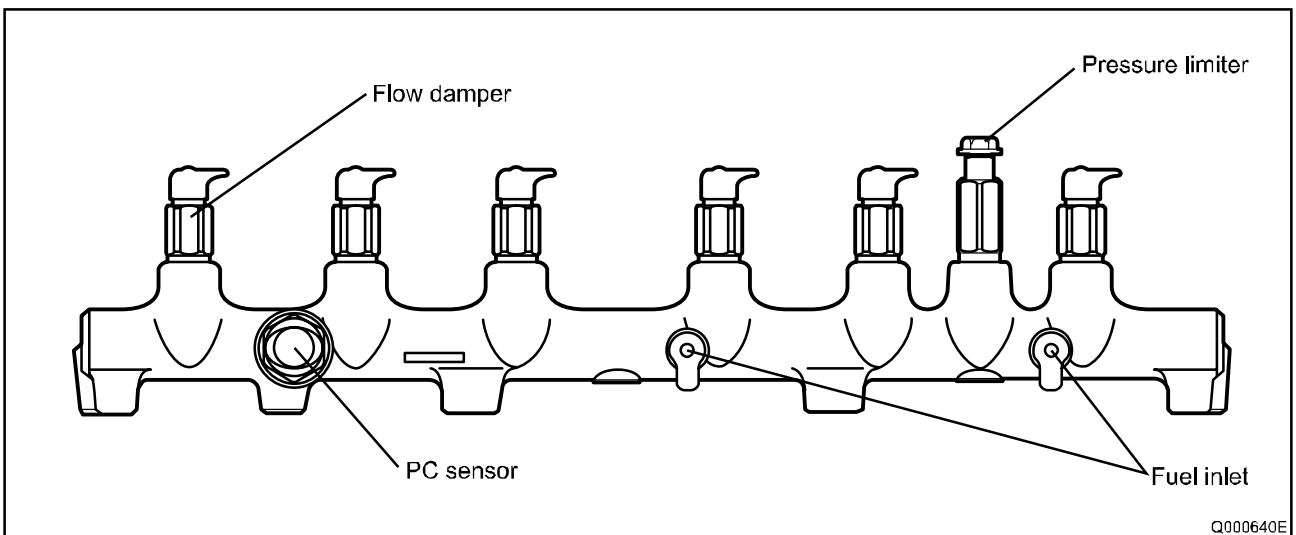
### 3-2. Rail

#### A. Changes

The items that have changed significantly are shown in the table below.

Item	Conventional System	New System	Reason for Change
System pressure	120 MPa	160 MPa	Improves performance
Highest pressure during normal use	130 MPa	176 MPa	Improves performance
Pressure limiter valve opening pressure	140 ± 5 MPa	200 ± 9 MPa	To deal with the system pressure
PC sensor specification	180 MPa	120 MPa	To deal with the system pressure
Installation position	Outside engine head	Inside engine head	Easier installation

#### B. Construction



#### C. Operation

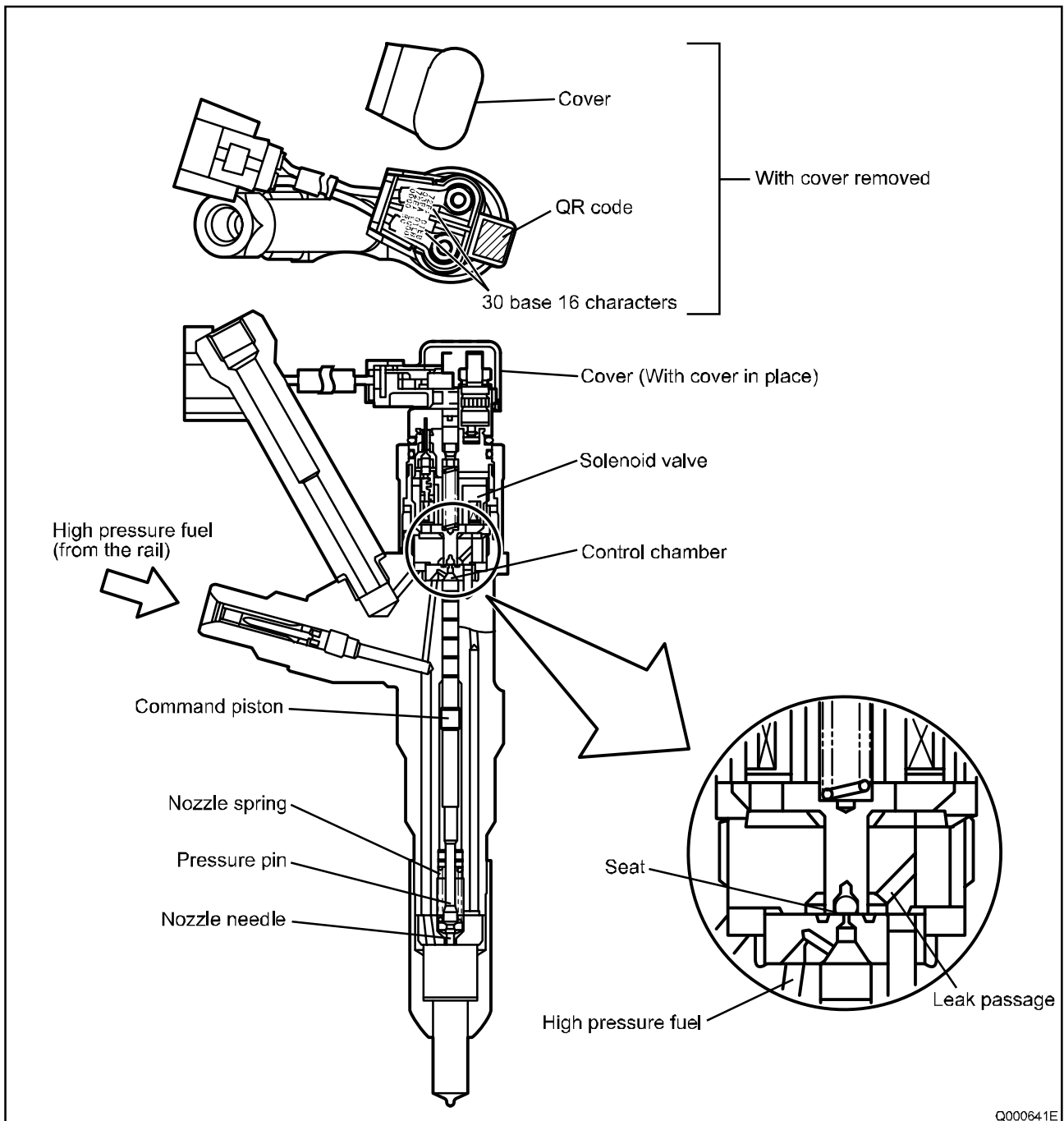
For details on construction and operation, refer to page 10 in Service Bulletin 01-08.

### 3-3. Injector

#### A. Changes

- Uses a compact and power-saving TWV (Two-Way Valve) for electromagnetic control of the injector.
- Conventional systems use adjusted resistance to correct the injection volume, but to improve the accuracy of correction, the new system uses a QR (Quick Response) code. The QR code greatly increases the correction points of the injection volume, improving correction accuracy. The properties of the engine cylinders are made more equal than before, which increases fuel efficiency and decreases exhaust gas emissions. The ID code (30 base 16 characters) for injection volume correction information is stamped on the injector head.

#### B. Construction





### C. Operation

The TWV (solenoid valve) controls the pressure in the chamber by opening and closing the outlet orifice passage, which in turn controls the start and end of injection.

#### a. When not injecting

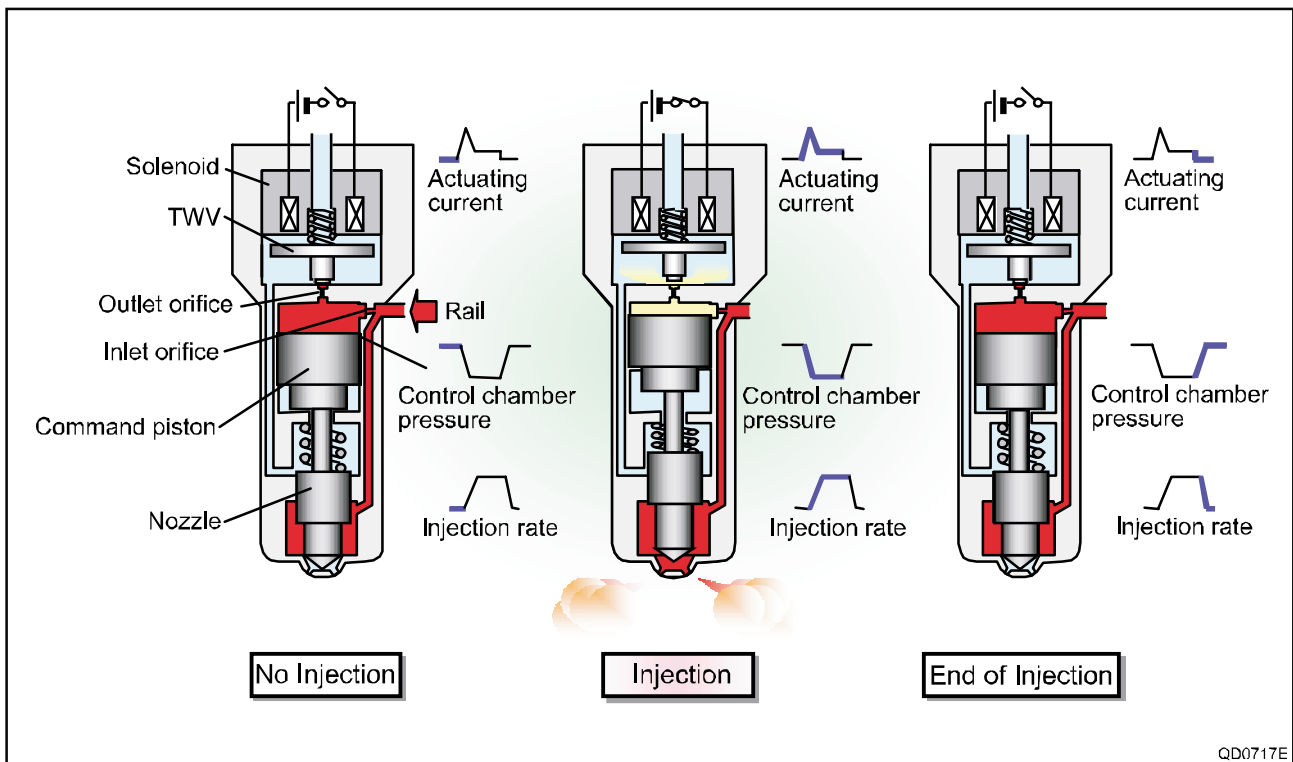
When the solenoid is not energized, the outlet orifice passage is closed by the downward force of the TWV (solenoid valve) spring. From this, the control chamber pressure trying to push down the command piston and the pressure trying to push up the nozzle needle is the same. The differences in the areas receiving pressure and the force of the nozzle spring closes the nozzle needle, so there is no injection.

#### b. During injection

When the solenoid is energized, the TMV (solenoid valve) is pulled up by the force of the solenoid, which opens the outlet orifice, discharging the fuel from the control chamber. When fuel is discharged, the pressure in the control chamber is reduced, which pulls up the command piston. This raises the nozzle needle, and injection is started.

#### c. End of injection

As the solenoid continues to be energized, the nozzle reaches its maximum lift point, creating the maximum injection rate. When the energization of the solenoid is turned OFF, the TWV (solenoid valve) lowers, closing the outlet orifice. Because of this, fuel enters the control chamber from the inlet orifice, which increases the pressure. This makes the nozzle needle close abruptly, stopping the injection.



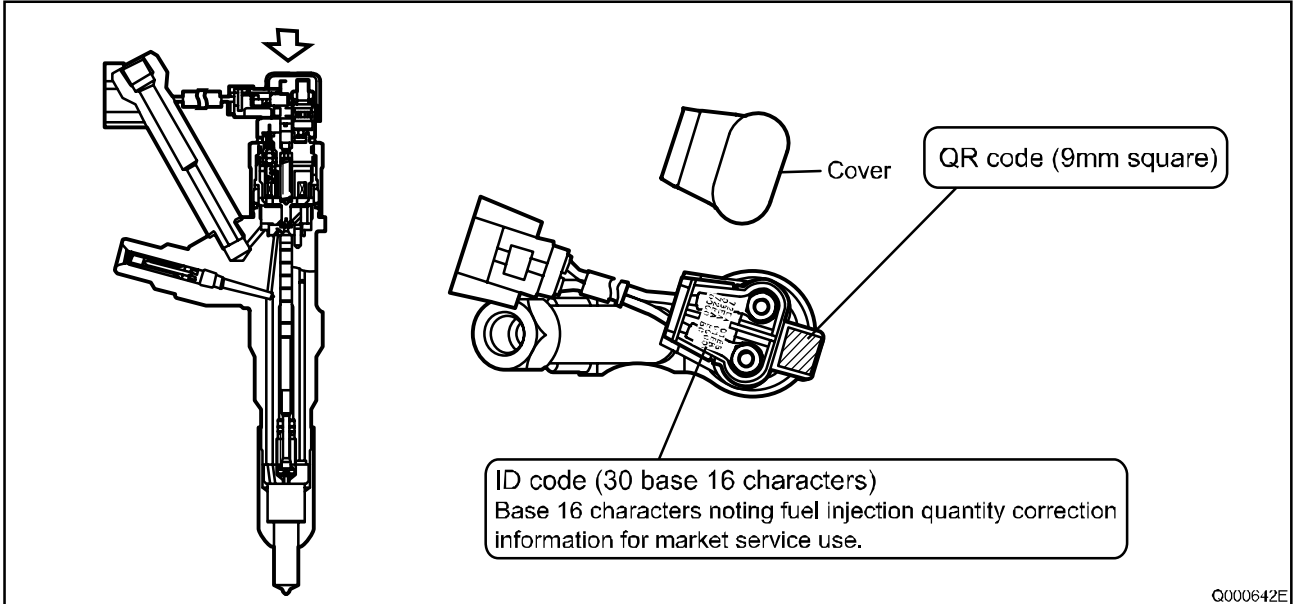
#### D. Servicing injectors with QR code (Reference)

When replacing the injector or engine ECU, a HINO diagnostic tool must be used to register ID code in the engine ECU.

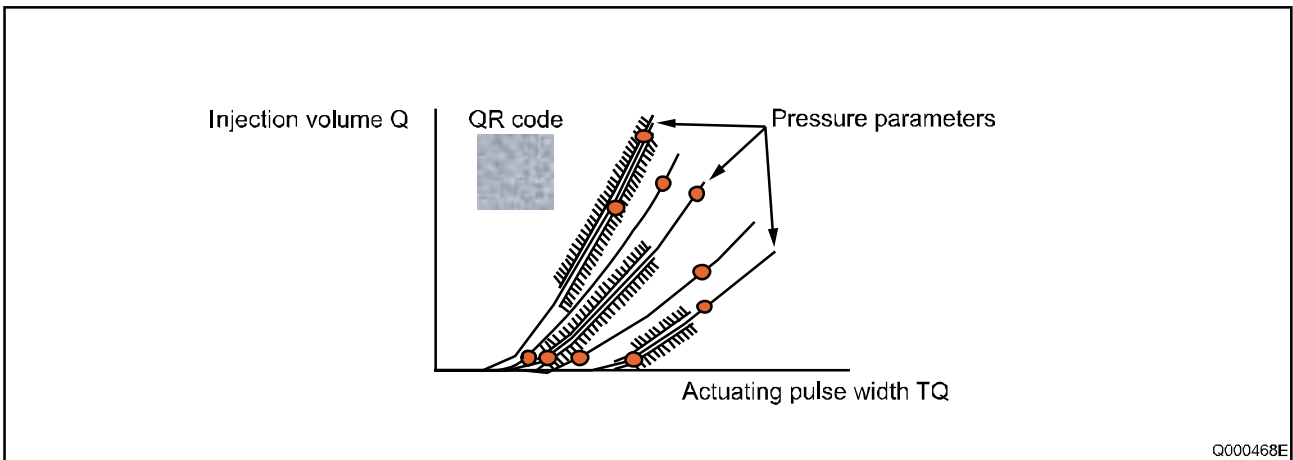
< NOTE >

- If the ID code of the installed injector is not correctly registered, it could cause engine malfunctions such as rough idling or noise.

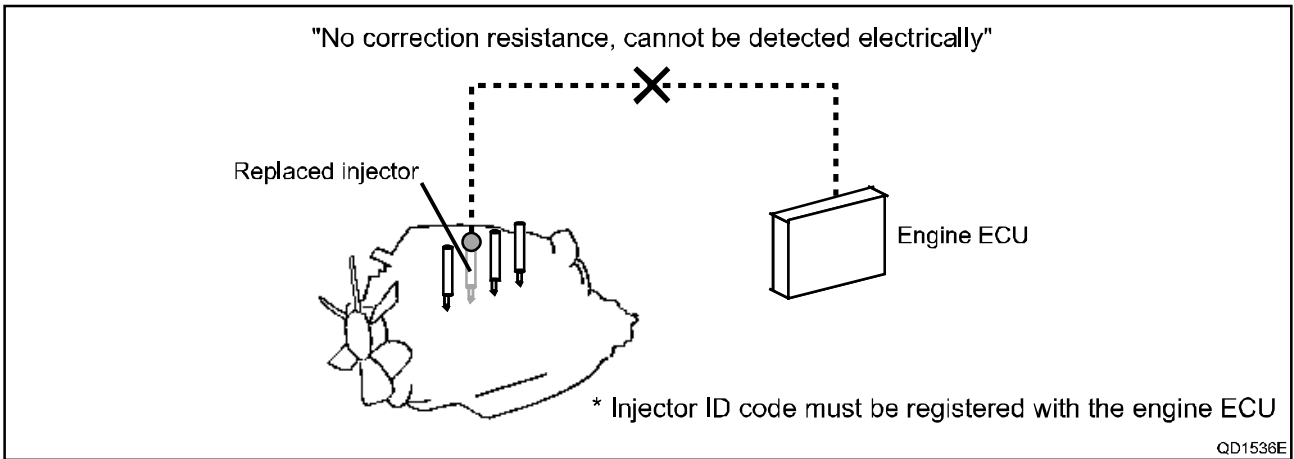
##### a. QR code location



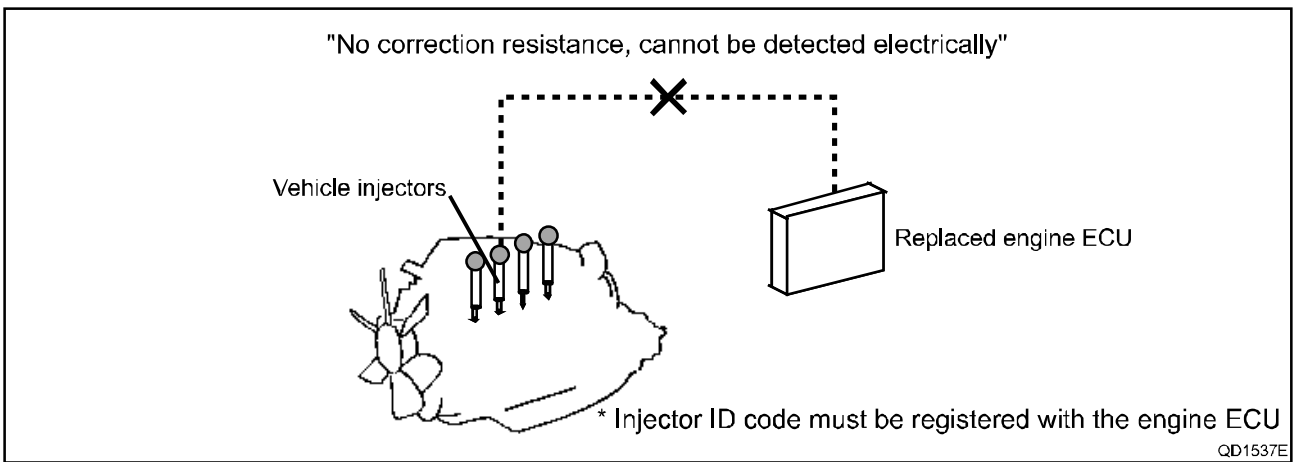
##### b. QR code correction points



c. When replacing the injector



d. When replacing the engine ECU



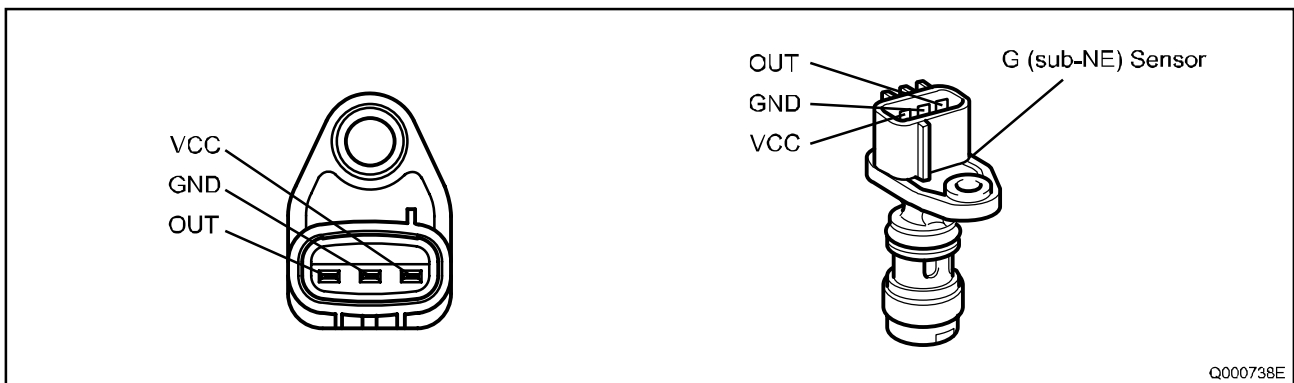
### 3-4. Sensors (Only sensors that were changed.)

#### A. G Sensor (Cylinder Recognition Sensor)

The G sensor is an MRE (electromagnetic resistance element) type. When the hole on the flywheel passes the sensor, the electromagnetic resistance flowing through the sensor changes. This variation in current is amplified by the internal IC circuit, and a signal is output to the engine ECU. A cylinder recognition pulsar is installed to the supply pump camshaft, and a cylinder recognition signal is output. 7 pulses are output for every revolution of the supply pump, or for every 2 revolutions of the engine. Cylinder recognition is inferred by combining the NE signal and the G signal. The irregular 7th pulse is used to recognize the first cylinder.

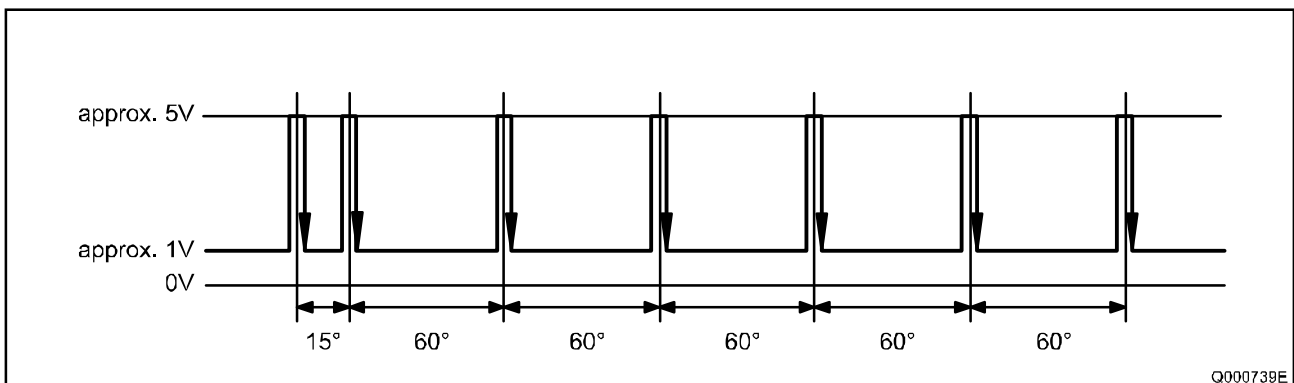
##### a. External View and Terminal Positions

The MRE type differs to the conventional type in that a pulse of constant amplification is generated so that the OUT terminal does not affect engine speed changes when constant amplitude (5V) is applied to the VCC.

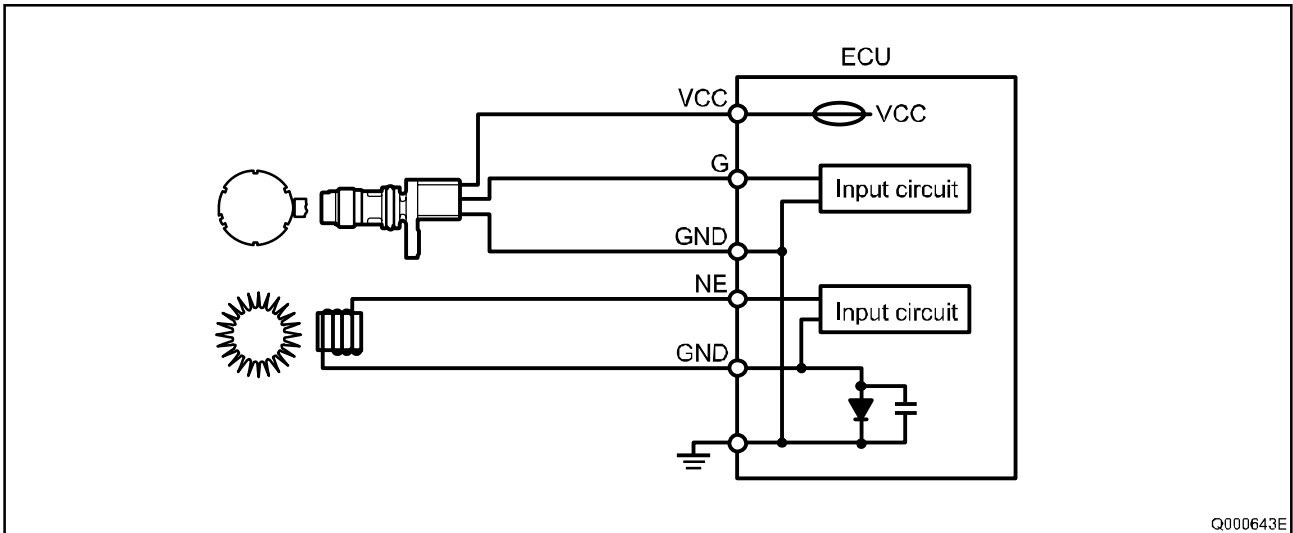


##### b. Output Signal

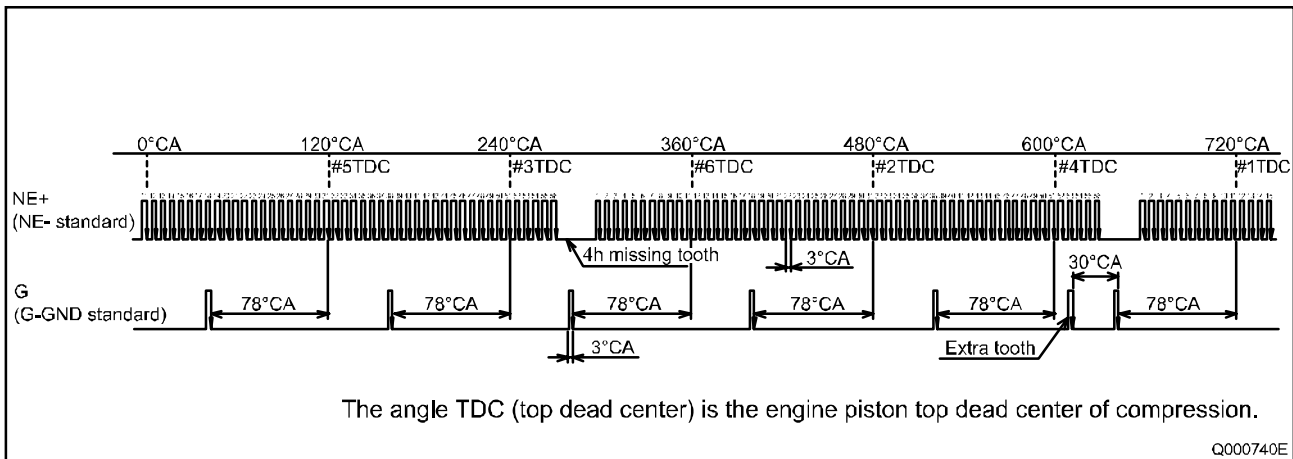
The OUT terminal outputs the following in synchronization with the pulsar missing teeth (pump camshaft). For each one rotation of the pump camshaft, there are 6 pulses at 60° intervals, and 1 extra pulse used for recognition of the number one cylinder.



c. NE/G Sensor wiring diagram

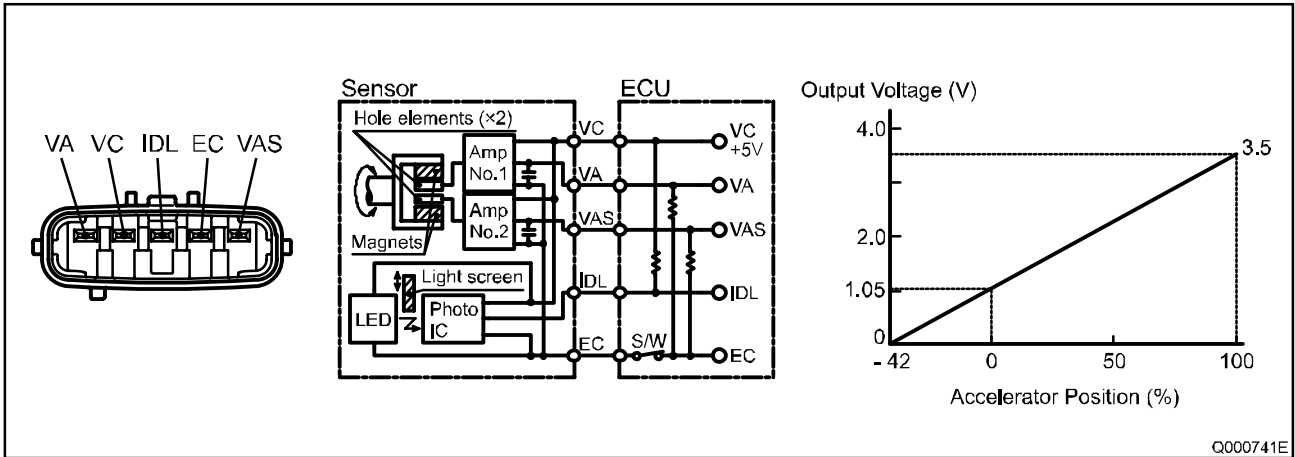


d. NE/G pulse chart



## B. Accelerator Sensor

The accelerator sensor is a non-contact type. It is linked to the movement of the accelerator pedal, which rotates the lever, and the voltage of the output terminal changes according to the rotational position of the lever. There are hole elements on the sensor. A magnet is installed on the shaft, which moves together with the accelerator pedal, so the magnetic field changes with the rotation of the shaft. A voltage is generated from these changes in the magnetic field.



## 3-5. ECU

- The ECU has 32 bits, compared to the 16 bits of conventional systems, so processing is faster. As in previous systems, it is integrated with the EDU.

### A. ECU External Wiring Diagram

### B. ECU Connector Diagram

< NOTE >

- For the above details, refer to page 44 - 47 in Service Manual "Common Rail System for HINO J05D/J08E Type Engine", published in October 2003.

## 3-6. Various Types of Control

< NOTE >

- Refer to page 20 - 24 in Service Bulletin ECD 01-08.

#### 4. Diagnosis

##### 4-1. DTC (Diagnostic Trouble Code) Table

- A HINO PC tester can be used at the HINO dealership to display DTCs and perform diagnostic troubleshooting on the significantly changed items. The DTCs (to be dealt with at the HINO dealership) are shown below for reference.

DTC	P_Code	DST-1 display	Code explanation	Reference
31	P0047	VNT solenoid valve 1 malfunction	VNT solenoid valve 1 is abnormal. There could be a solenoid valve malfunction, harness open circuit, or ground short.	
31	P0048	VNT solenoid valve 1 malfunction	VNT solenoid valve 1 is abnormal. There could be a harness +B short.	
39	P0049	Turbo speed overrun	An abnormally high turbo speed is detected.	Detected by turbine rotation sensor
76	P0088	Abnormally high rail pressure	An abnormally high fuel pressure is detected.	
78	P0093	Fuel leak	There could be a fuel leak. Perform a fuel leak check.	Conventional pump cannot pump (fuel discharge)
88	P0096	EGR valve seizure malfunction	The EGR system is abnormal	Valve is detected through EGR gas temperature to have seized in the fully closed position
18	P0097	EGR gas temperature sensor malfunction (LO)	Cannot detect the temperature normally. There could be a sensor malfunction or a harness ground short.	
18	P0098	EGR gas temperature sensor malfunction (HI)	Cannot detect the temperature normally. There could be a sensor malfunction, harness open circuit or +B short.	
17	P0102	Air flow sensor malfunction (LO)	The air flow sensor is abnormal. There could be a sensor malfunction, harness open circuit or GND short.	
17	P0103	Air flow sensor malfunction (HI)	The air flow sensor is abnormal. There could be a sensor malfunction or a harness +B short.	
37	P0108	Boost pressure sensor malfunction (HI)	Cannot detect the boost pressure normally. There could be a sensor malfunction or harness short.	
16	P0112	Intake air temperature sensor malfunction (LO)	Cannot detect the temperature normally. There could be a sensor malfunction or a harness ground short.	Air flow sensor internal sensor
16	P0113	Intake air temperature sensor malfunction (HI)	Cannot detect the temperature normally. There could be a sensor malfunction, harness open circuit or +B short.	Air flow sensor internal sensor
11	P0117	Coolant temperature sensor malfunction (LO)	Cannot detect the temperature normally. There could be a sensor malfunction or a harness ground short.	

DTC	P_Code	DST-1 display	Code explanation	Reference
11	P0118	Coolant temperature sensor malfunction (HI)	Cannot detect the temperature normally. There could be a sensor malfunction, harness open circuit or +B short.	
14	P0187	Fuel temperature sensor malfunction (LO)	Cannot detect the temperature normally. There could be a sensor malfunction or a harness ground short.	Leakage temperature
14	P0188	Fuel temperature sensor malfunction (HI)	Cannot detect the temperature normally. There could be a sensor malfunction, harness open circuit or +B short.	Leakage temperature
67	P0191	Rail pressure sensor malfunction	Cannot detect the rail pressure normally. There could be a sensor malfunction.	Characteristic abnormality
67	P0192	Rail pressure sensor malfunction (LO)	Cannot detect the rail pressure normally. There could be a sensor malfunction or harness ground short.	
67	P0193	Rail pressure sensor malfunction (HI)	Cannot detect the rail pressure normally. There could be a sensor malfunction, harness open circuit or +B short.	
59	P0200	ECU charge circuit fault (HI)	The voltage for actuating the injector is too high. Replace the ECU.	
51	P0201	Injector 1 open circuit	There could be an injector 1 malfunction or harness open circuit.	
52	P0202	Injector 2 open circuit	There could be an injector 2 malfunction or harness open circuit.	
53	P0203	Injector 3 open circuit	There could be an injector 3 malfunction or harness open circuit.	
54	P0204	Injector 4 open circuit	There could be an injector 4 malfunction or harness open circuit.	
55	P0205	Injector 5 open circuit	There could be an injector 5 malfunction or harness open circuit.	
56	P0206	Injector 6 open circuit	There could be an injector 6 malfunction or harness open circuit.	
6	P0217	Overheating	Overheating is detected. Inspect the cooling system.	
7	P0219	Engine overrun	The engine speed is above the rated value.	
34	P0234	Turbo over boost	The boost pressure is higher than the standard.	
37	P0237	Boost pressure sensor malfunction	Cannot detect the intake air pressure normally. There could be a sensor malfunction, harness open circuit or short.	



DTC	P_Code	DST-1 display	Code explanation	Reference
61	P0263	Cylinder correction error #1	The speed variations of the first cylinder are larger than those of the other cylinders. The flow damper could be operating.	Conventional product flow damper operation judgment and new speed variation judgment
62	P0266	Cylinder correction error #2	The speed variations of the second cylinder are larger than those of the other cylinders. The flow damper could be operating.	Conventional product flow damper operation judgment and new speed variation judgment
63	P0269	Cylinder correction error #3	The speed variations of the third cylinder are larger than those of the other cylinders. The flow damper could be operating.	Conventional product flow damper operation judgment and new speed variation judgment
64	P0272	Cylinder correction error #4	The speed variations of the fourth cylinder are larger than those of the other cylinders. The flow damper could be operating.	Conventional product flow damper operation judgment and new speed variation judgment
65	P0275	Cylinder correction error #5	The speed variations of the fifth cylinder are larger than those of the other cylinders. The flow damper could be operating.	Conventional product flow damper operation judgment and new speed variation judgment
66	P0278	Cylinder correction error #6	The speed variations of the sixth cylinder are larger than those of the other cylinders. The flow damper could be operating.	Conventional product flow damper operation judgment and new speed variation judgment
13	P0335	NE sensor malfunction	Cannot detect the pulses from the NE sensor. There could be a sensor malfunction or harness abnormality.	This code is also output if both the NE and G sensors are malfunctioning
12	P0340	G sensor malfunction	Cannot detect the pulses from the G sensor. There could be a sensor malfunction or harness abnormality.	
88	P0401	Insufficient EGR rate	The EGR system is abnormal. The EGR rate is lower than the standard value.	Valve is detected through Air flow sensor to have seized in the fully closed position

DTC	P_Code	DST-1 display	Code explanation	Reference
88	P0402	Excessive EGR rate	The EGR system is abnormal. The EGR rate is higher than the standard value.	Valve is detected through Air flow sensor to have seized in the fully open position
81	P0489	EGR solenoid valve 1 malfunction	EGR solenoid valve 1 is abnormal. There could be a solenoid valve malfunction, harness open circuit or ground short.	
81	P0490	EGR solenoid valve 1 malfunction	EGR solenoid valve 1 is abnormal. There could be a solenoid valve malfunction or +B harness short	
21	P0500	Vehicle speed sensor malfunction (LO)	Cannot detect the pulses from the vehicle speed sensor. There could be a sensor malfunction or harness abnormality.	Open circuit
21	P0501	Vehicle speed sensor malfunction (HI)	The pulses from the vehicle speed sensor are abnormal. There could be a sensor malfunction or harness abnormality.	Noise
42	P0510	Idling switch malfunction	The idling switch is not functioning normally. While monitoring the vehicle conditions, check the ON/OFF judgment.	
25	P0540	Pre-heat device malfunction	The intake heater relay is abnormal. There could be a relay malfunction or harness abnormality.	
97	P0545	Exhaust temperature sensor 1 malfunction (LO)	Cannot detect the temperature normally. There could be a sensor malfunction or a harness ground short.	
97	P0546	Exhaust temperature sensor 1 malfunction (HI)	Cannot detect the temperature normally. There could be a sensor malfunction, harness open circuit or +B short.	
3	P0605	Flash ROM abnormality	ECU internal malfunction. Please replace the ECU.	
3	P0606	CPU malfunction (hardware detection)	ECU internal malfunction. Please replace the ECU.	
3	P0907	CPU surveillance IC malfunction	ECU internal malfunction. Please replace the ECU.	
59	P0611	ECU charge circuit fault	The voltage for actuating the injector is too low. Replace the ECU.	
45	P0617	Starter switch malfunction	The starter switch has shorted. While monitoring the vehicle conditions, check the ON/OFF judgment.	
73	P0628	Supply pump solenoid valve 1 malfunction	The supply pump solenoid valve 1 has a voltage abnormality. There could be an open circuit or ground short.	PCV1, PCV1 & PCV2 (large)

DTC	P_Code	DST-1 display	Code explanation	Reference
73	P0629	Supply pump solenoid valve 1 malfunction	The supply pump solenoid valve 1 has a voltage abnormality. There could be a +B short.	PCV1, PCV1 & PCV2 (large)
5	P0686	Main relay malfunction	The main relay cannot be switched OFF. Inspect the relay.	
41	P0704	Clutch switch malfunction	Cannot detect the clutch switch normally. While monitoring the vehicle conditions, check the ON/OFF judgment.	
47	P0850	Neutral switch malfunction	Cannot detect the neutral switch normally. While monitoring the vehicle conditions, check the ON/OFF judgment.	
32	P1062	VNT solenoid valve 2 malfunction	VNT solenoid valve 2 is abnormal. There could be a solenoid valve malfunction, harness open circuit, or ground short.	
32	P1063	VNT solenoid valve 2 malfunction	VNT solenoid valve 2 is abnormal. There could be a solenoid valve malfunction or harness +B short.	
33	P1067	VNT solenoid valve 3 malfunction	VNT solenoid valve 3 is abnormal. There could be a solenoid valve malfunction, harness open circuit, or ground short.	
33	P1068	VNT solenoid valve 3 malfunction	VNT solenoid valve 3 is abnormal. There could be a solenoid valve malfunction or harness +B short.	
38	P1071	Turbo speed sensor malfunction (HI)	The pulses from the turbine speed sensor are abnormal. There could be a sensor malfunction or harness abnormality.	
38	P1072	Turbo speed sensor malfunction (LO)	Cannot detect the pulses from the turbo speed sensor. There could be a sensor malfunction or harness abnormality.	
23	P1132	Operation accelerator sensor (LO)	Cannot detect the operation accelerator sensor normally. Check the sensor voltage. There could be an open circuit or a ground short.	
23	P1133	Operation accelerator sensor (HI)	Cannot detect the operation accelerator sensor normally. Check the sensor voltage. There could be a +B short.	
44	P1142	Idling volume (LO)	Cannot detect the idling volume normally. Check the sensor voltage. There could be an open circuit or a ground short.	
44	P1143	Idling volume (HI)	Cannot detect the idling volume normally. Check the sensor voltage. There could be a +B short.	
57	P1211	Injector common 1 malfunction	There could be a ground short. Check the injector and the wiring.	

DTC	P_Code	DST-1 display	Code explanation	Reference
57	P1212	Injector common 1 malfunction	There could be an open circuit or +B short. Check the injector and the wiring.	
58	P1214	Injector common 2 malfunction	There could be a ground short. Check the injector and the wiring.	
58	P1215	Injector common 2 malfunction	There could be an open circuit or +B short. Check the injector and the wiring.	
76	P1229	Supply pump excessive pumping	An abnormally high fuel pressure is detected. Inspect the pump system.	
77	P1266	Supply pump pumping fault	An abnormally high fuel pressure is detected. Inspect the pump system.	Conventional pumps cannot pump or pressure limiter operation
82	P1402	EGR solenoid valve 2 malfunction	EGR solenoid valve 2 is abnormal. There could be a solenoid valve malfunction, harness open circuit or ground short.	
82	P1403	EGR solenoid valve 2 malfunction	EGR solenoid valve 2 is abnormal. There could be a solenoid valve malfunction or harness +B short.	
83	P1407	EGR solenoid valve 3 malfunction	EGR solenoid valve 3 is abnormal. There could be a solenoid valve malfunction, harness open circuit or ground short.	
83	P1408	EGR solenoid valve 3 malfunction	EGR solenoid valve 3 is abnormal. There could be a solenoid valve malfunction or harness +B short.	
84	P1412	Pulse EGR solenoid valve malfunction	The pulse EGR solenoid valve is abnormal. There could be a solenoid valve malfunction, harness open circuit or ground short.	
84	P1413	Pulse EGR solenoid valve malfunction	The pulse EGR solenoid valve is abnormal. There could be a solenoid valve malfunction or harness +B short.	
85	P1416	EGR cooler overheat	Overheating of the EGR cooler is detected. Inspect the EGR cooler.	
19	P1417	EGR cooler coolant temperature sensor malfunction (LO)	Cannot detect the temperature normally. There could be a sensor malfunction or a harness ground short.	
19	P1418	EGR cooler coolant temperature sensor malfunction (HI)	Cannot detect the temperature normally. There could be a sensor malfunction, harness open circuit or +B short.	
96	P1427	Exhaust pressure sensor malfunction (LO)	Cannot detect the exhaust pressure normally. There could be a sensor malfunction, harness open circuit or ground short.	

DTC	P_Code	DST-1 display	Code explanation	Reference
96	P1428	Exhaust pressure sensor malfunction (HI)	Cannot detect the exhaust pressure normally. There could be a sensor malfunction or harness +B short.	
26	P1462	Engine retarder 1 malfunction	Engine retarder solenoid valve 1 is abnormal. There could be a solenoid valve malfunction, harness open circuit or ground short.	#4 to #6 side retarder
26	P1463	Engine retarder 1 malfunction	Engine retarder solenoid valve 1 is abnormal. There could be a solenoid valve malfunction or harness +B short	#4 to #6 side retarder
27	P1467	Engine retarder 2 malfunction	Engine retarder solenoid valve 2 is abnormal. There could be a solenoid valve malfunction, harness open circuit or ground short.	#1 to #3 side retarder
27	P1468	Engine retarder 2 malfunction	Engine retarder solenoid valve 2 is abnormal. There could be a solenoid valve malfunction or harness +B short	#1 to #3 side retarder
27	P1472	T/M retarder relay malfunction	The T/M retarder relay is abnormal. There could be a relay malfunction, harness open circuit or ground short.	T/M retarder relay for interlocked cruise control in large and medium sized vehicles
29	P1473	T/M retarder relay malfunction	The T/M retarder relay is abnormal. There could be a relay malfunction or harness +B short.	T/M retarder relay for interlocked cruise control in large and medium sized vehicles
46	P1530	Engine stop switch closing malfunction	The engine stop switch is malfunctioning, or the wiring has shorted. While monitoring the vehicle conditions, check the ON/OFF judgment.	
43	P1565	Cruise switch malfunction	The cruise switch has an ON malfunction. While monitoring the vehicle conditions, check the ON/OFF judgment.	
2	P1601	QR code malfunction	The QR code is abnormal. Check the QR code.	
48	P1676	PCS switch malfunction	Cannot detect the PCS switch normally. While monitoring the vehicle conditions, check the ON/OFF judgment.	
28	P1681	Exhaust brake solenoid valve malfunction	The exhaust brake solenoid valve is abnormal. There could be a solenoid valve malfunction, harness open circuit or ground short.	
28	P1682	Exhaust brake solenoid valve malfunction	The exhaust brake solenoid valve is abnormal. There could be a solenoid valve malfunction or harness +B short.	

DTC	P_Code	DST-1 display	Code explanation	Reference
91	P2002	DPF system malfunction	The DPF system is abnormal. There could be welding damage or clogging. Perform a DPF system check.	
98	P2032	Exhaust temperature sensor 2 malfunction (LO)	Cannot detect the temperature normally. There could be a sensor malfunction or a harness ground short.	
98	P2033	Exhaust temperature sensor 2 malfunction (HI)	Cannot detect the temperature normally. There could be a sensor malfunction, harness open circuit or +B short.	
22	P2120	Malfunction of both accelerator sensors	Both accelerator sensor systems are malfunctioning. There could be a sensor abnormality or harness abnormality.	
22	P2121	Accelerator sensor 1 malfunction	Cannot detect accelerator sensor 1 normally. Check the sensor voltage.	
22	P2122	Accelerator sensor 1 malfunction (LO)	Cannot detect accelerator sensor 1 normally. Check the sensor voltage. There could be an open circuit or ground short.	
22	P2123	Accelerator sensor 1 malfunction (HI)	Cannot detect accelerator sensor 1 normally. Check the sensor voltage. There could be a +B short.	
22	P2126	Accelerator sensor 2 malfunction	Cannot detect accelerator sensor 2 normally. Check the sensor voltage.	
22	P2127	Accelerator sensor 2 malfunction (LO)	Cannot detect accelerator sensor 2 normally. Check the sensor voltage. There could be an open circuit or ground short.	
22	P2128	Accelerator sensor 2 malfunction (HI)	Cannot detect accelerator sensor 2 normally. Check the sensor voltage. There could be a +B short.	
15	P2228	Atmospheric pressure sensor malfunction (LO)	The atmospheric pressure sensor (inside the ECU) is abnormal. If it occurs frequently, the ECU must be repaired or replaced.	
15	P2229	Atmospheric pressure sensor malfunction (HI)	The atmospheric pressure sensor (inside the ECU) is abnormal. If it occurs frequently, the ECU must be repaired or replaced.	
72	P2633	Supply pump solenoid valve 2 malfunction	Supply pump solenoid valve 2 has abnormal voltage. There could be an open circuit or ground short.	PCV2 for large vehicles
72	P2634	Supply pump solenoid valve 2 malfunction	Supply pump solenoid valve 2 has abnormal voltage. There could be a +B short.	PCV2 for large vehicles
9	U0101	Communication obstruction (transmission)	Communication with the transmission ECU is obstructed.	Abnormal communication with AT-ECU

DTC	P_Code	DST-1 display	Code explanation	Reference
9	U0104	Communication obstruction (cruise)	Communication with the vehicle cruise ECU is obstructed.	
9	U0121	Communication obstruction (ABS)	Communication with the ABS ECU is obstructed.	
9	U0132	Communication obstruction (air suspension)	Communication with the air suspension ECU is obstructed.	
9	U0155	Communication obstruction (meter)	Communication with the meter ECU is obstructed.	
9	U1001	CAN communication obstruction (vehicle)	The communication with the other computers installed in the vehicle is abnormal.	CAN communication bus OFF judgment