



Chapter 7 Diagnostic Troubleshooting

1. Diagnostic Troubleshooting Function

Engine warning light (engine check light) will light up if one of the following cases occurs and the abnormality is associated with multi-point fuel injection system (MPI). During engine running, diagnostic code will be output if the light keeps lightened.

2. Engine Warning Light Check Items

Engine-ECU
Airflow sensor
Intake temperature sensor
Throttle position sensor
Coolant temperature sensor
Crank angle sensor
Cam position sensor
Barometric pressure sensor
Injector
Ignition coil, power transistor

Please refer to MUT-II Instruction Manual for the method of reading/clearing diagnostic code. You may use MUT-II data list and actuator experiment to check it.

1. Use data list and actuator function to check it. If abnormality exists, please check and repair electronic wiring and components in chassis.
2. After repair, check it again with MUT-II. Check if abnormal input/output have been return to normal status after check.
3. Remove memorizer diagnostic code.
4. Remove MUT-II.
5. Start on engine and make road test to make sure if the problem has been removed.



3、Diagnostic Prevention Function Reference List

If main sensor failure is detected by diagnostic function, the motor vehicle will be controlled by pre-setup control logic circuit to ensure its safe driving status.

Diagnostic Item	Control content when failure occurs
Airflow sensor	1、 Read basic injector drive timing and basic ignition timing from predefined drawing according to throttle position sensor signal and engine speed signal (crank angle sensor signal). 2、 Fix ISC servo on the proper position to disable idle speed control.
Intake temperature sensor	Intake temperature should be 25℃.
Throttle position sensor (TPS)	Do not increase fuel oil injection volume with throttle position sensor signal changing during accelerating.
Engine coolant temperature sensor	Coolant temperature should be 80℃.
Cam position sensor	Inject fuel oil to all cylinders at the same time. (However, do not check top dead center of 1st cylinder after ignition switch is set ON.)
Barometric pressure sensor	Barometric pressure is regarded as 101 kPa (sea level).
Ignition coil, power transistor	Shut off cylinder oil supply after abnormal ignition.
Communication with transmission controller	Do not delay ignition timing during transmission shifting. (Engine and transmission signal are controlled together.)
Alternator FR terminal	Do not perform alternator output control according to electronic load.

4. Diagnostic Code List

Codes	Diagnostic troubleshooting items
12	Airflow sensor system
13	Intake temperature system
14	Throttle position sensor system
21	Engine coolant temperature sensor system
22	Crank angle sensor system
23	Cam position sensor system
24	Vehicle speed sensor system
25	Barometric pressure sensor system
41	Injection system
44	Ignition coil system
61	Communication with A/T-ECU system
64	Alternator FR terminal

5、Diagnostic Symptom Check List

Diagnostic symptom		Check Sequence
Lost communication with MUT-II	MUT—II lost communication with all systems.	1
	MUT—II lost communication with engine-ECU	2
Engine warning light and related accessories	Engine warning light can't be lightened up at once when ignition switch is turned ON.	3
	Engine warning light can't be shut off.	4
Start on	Start motor run but engine can't start on.	5
	Engine can start on, but shut off at once.	6
	Start motor should try several times to succeed in starting on (Incorrect start on methods).	7
Idle speed stability (Idle speed defect)	Instable idle speed (change frequently)	8
	Too high idle speed (Engine speed isn't within the specified range)	9
	Too low idle speed (Engine speed isn't within the specified range)	10
Idle speed stability (Stall engine)	Engine may stall when cold at idle speed.	11
	Engine may stall when hot at idle speed.	12
	Engine may stall during starting on (accelerating)	13
	Engine may stall during decelerating	14
Running	Blowing, speed drop or instable	15
	Libration or impact during accelerating	16
	Libration or impact during decelerating	17
	Acceleration defect	18
	Surge	19
	Detonation	20
Afterburn (Diesel phenomenon)		21
The density of CO and HC is too high at idle speed.		22

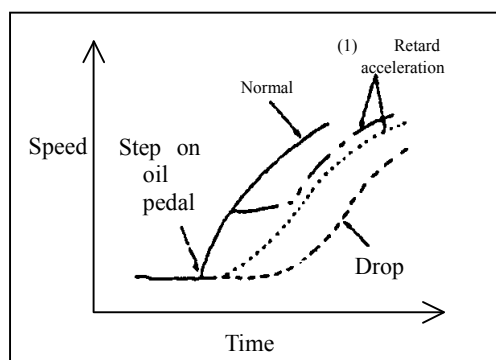


Fig.1

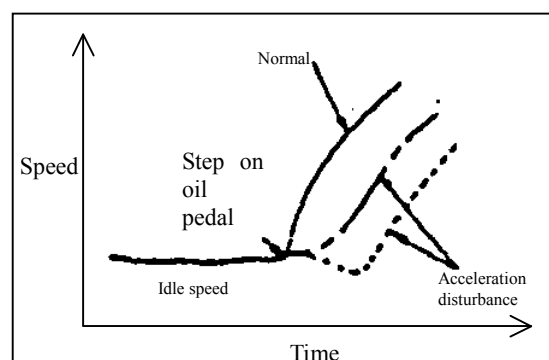


Fig.2



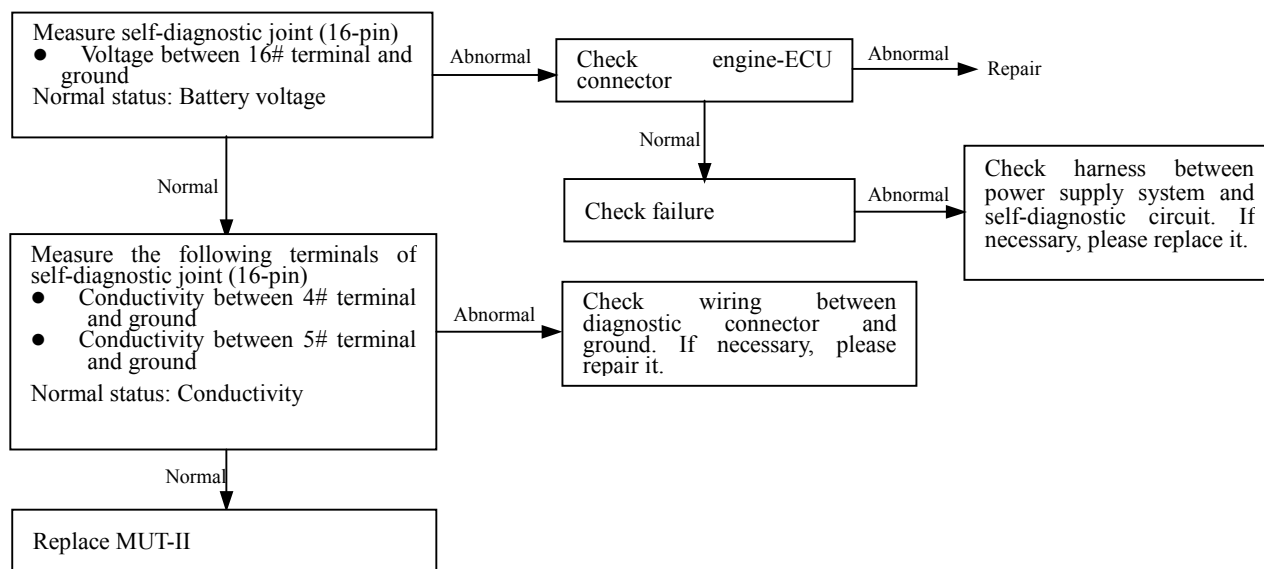
6、Diagnostic Symptom Description

Item		Diagnostic Description
Start on	Start on failure	Start motor drive engine running, but there is no burning in cylinder and engine fails to start on.
	Stall after oil burn	Engine can start on but may stall at once.
	Difficult to start on	It takes long time to start on after start motor run.
Idle stability	Instable idle speed	Engine idle speed is stable and varies within the idle speed range.
	Incorrect idle speed	Engine doesn't work at normal idle speed
	Stall during decelerating	As long as oil pedal is stepped down, engine may stall regardless of vehicle running.
	Stall during accelerating	Engine may stall when oil pedal is stepped down.
Running	Accelerating retard	Accelerating retard means when vehicle is to accelerate during running and oil pedal is stepped down, vehicle speed does not increase at once and accelerating response retards or engine speed drops temporarily. Serious accelerating retard is call "Drop". (Refer to Figure 1)
	Accelerating defect	Accelerating defect means accelerating performance is not as good as expected according to throttle position though the accelerating is smooth, or it fails to reach the fastest speed.
	Acceleration disturbance	Acceleration disturbance means engine speed fails to increase at once when oil pedal is stepped down. (Refer to Figure 2)
	Librating	You may feel strong impact or shake during engine accelerating or decelerating.
	Wobbling	When vehicle is running at light load, if speed varies, vehicle speed wobbles forward or backward.
	Detonation	During vehicle running, there is shrill detonation from engine.
Stall	Afterburn (Diesel phenomenon)	During engine running, turn ignition switch to OFF and engine will still keep running. It is called afterburn, also known as diesel phenomenon.

7、Failure Check Program

Check Program 1

MUT-II lost communication with all systems	Possible Reason
Power supply system badness of self-diagnostic circuit (including grounding)	- Joint contact badness - Harness failure

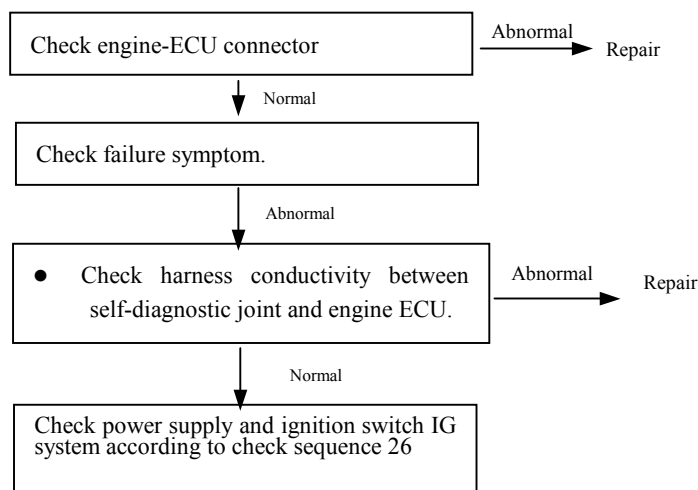


Harness side self-diagnostic joint



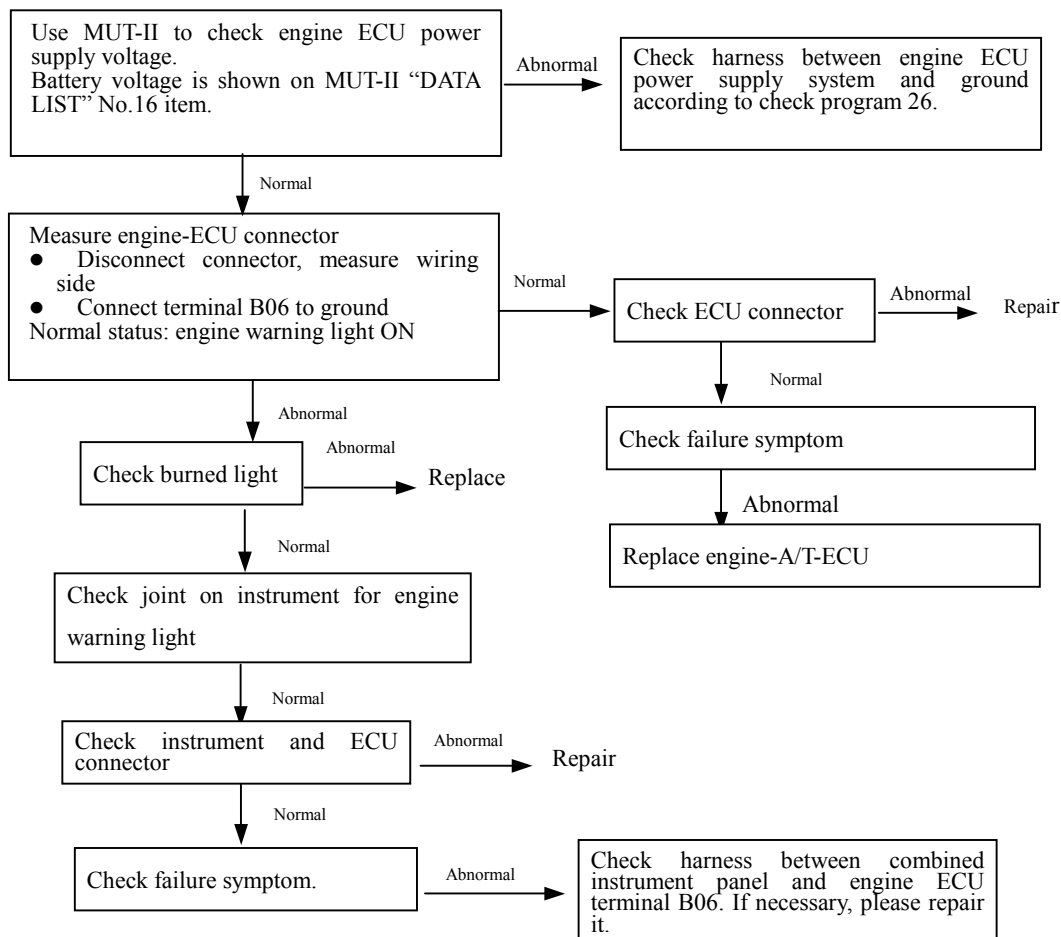
Check Program 2

MUT-II lost communication with engine ECU.	Possible Reason
Maybe one of the following reasons: - Engine ECU out of power - Engine ECU ground failure - Engine ECU failure - Communication circuit badness between engine ECU and MUT-II	- Power supply circuit failure of engine ECU - Engine ECU failure - Open circuit between engine ECU and MUT-II

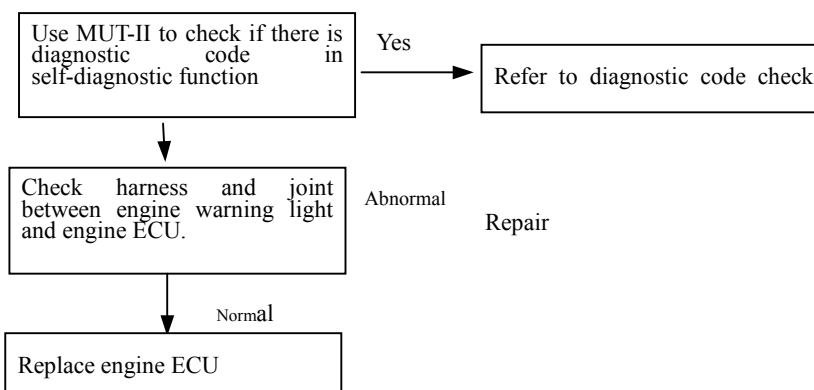


**Check Program 3**

When ignition switch is ON, engine warning light doesn't light up at once.	Possible Reason
When ignition switch is ON, engine warning light lights up at once and shuts off after 5 seconds. If engine warning light is off, it maybe caused by the failure listed at right side.	● Light burn ● Circuit failure of engine warning light ● Engine ECU failure

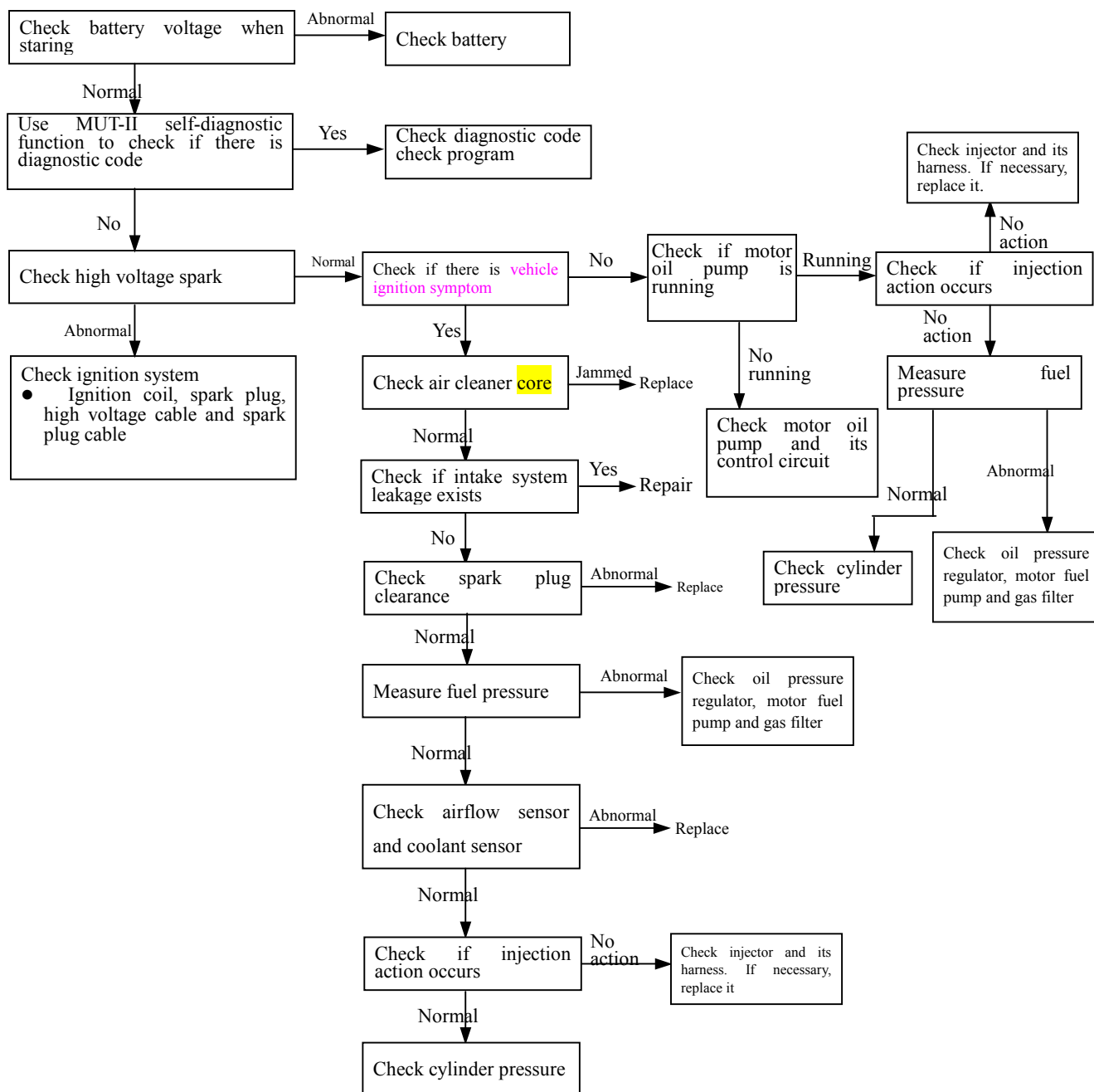
**Check Program 4**

Engine warning light can't be shut off.	Possible Reason
Maybe engine ECU detect some sensor or actuator failure, or as right side shown.	● Harness short circuit between engine warning light and engine ECU. ● Engine ECU failure



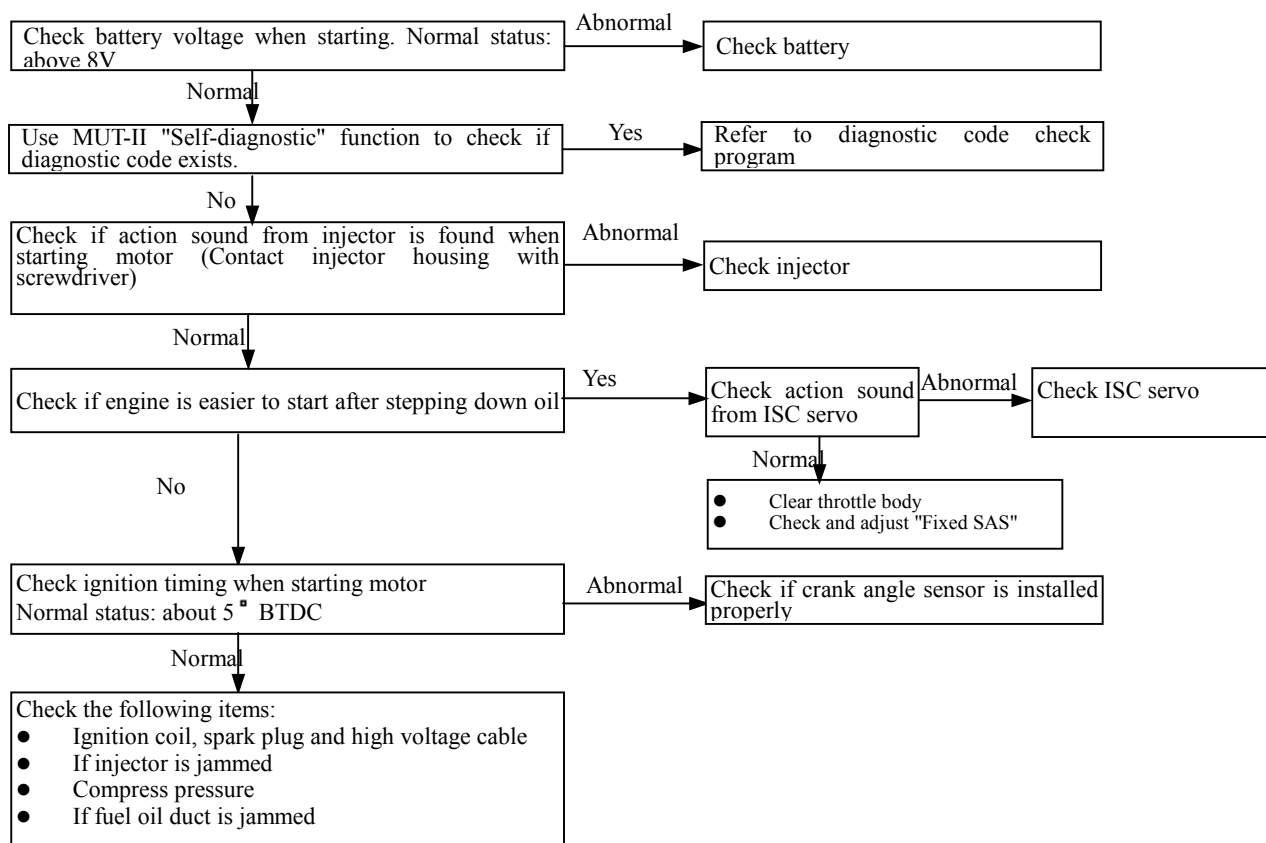
**Check Program 5**

Motor is running but engine can't start on	Possible Reason
Maybe spark plug defect or no fuel supplied to chamber. Additionally, impurity such as water, coal oil etc may be mixed with fuel.	• Ignition system failure • Oil supply failure • Injector failure • Engine EUC failure • Intake system leakage or failure • Impurity in fuel



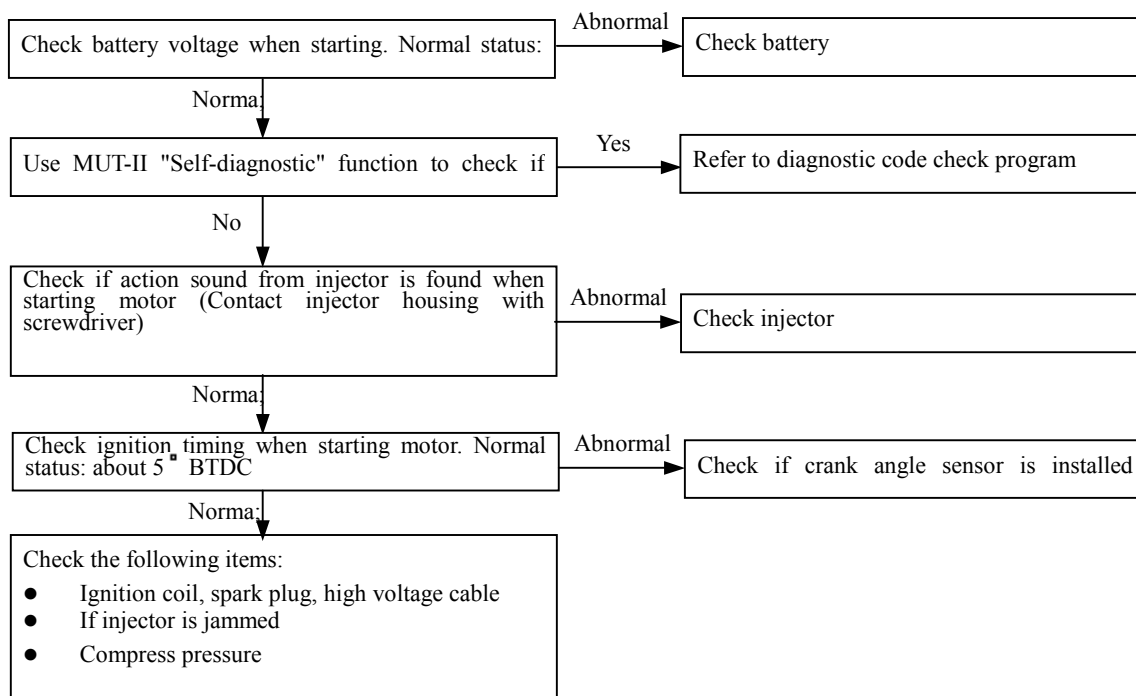
**Check Program 6**

Engine can start on, but shut off at once.	Possible Reason
The spark of spark plug may be too weak, or mixture ration when starting is incorrect.	• Ignition system failure • Injector failure • Lower compression pressure in cylinder • Engine ECU failure



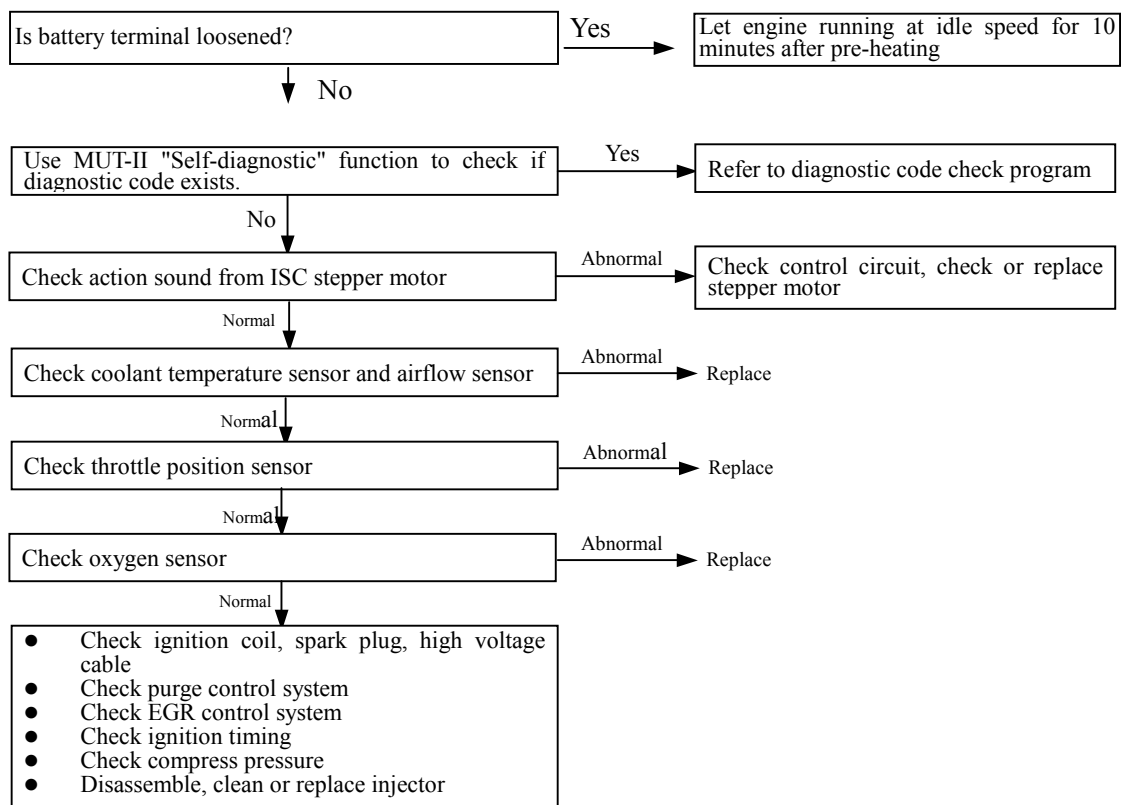
**Check Program 7**

Start motor should try several times to succeed in starting on (Incorrect start on methods).	Possible Reason
It is difficult to make ignition due to weak spark of ignition plug. It is caused by improper air fuel ratio in mixture or too low compress pressure when starting	● Ignition system failure ● Injector failure ● Too low compress pressure ● Improper fuel oil usage



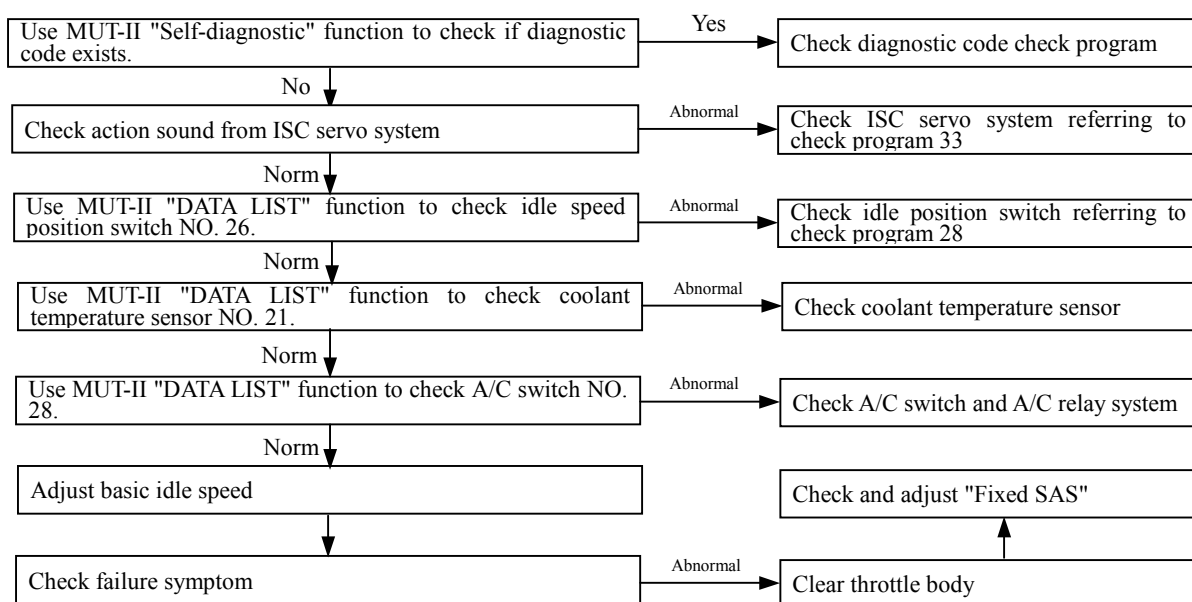
**Check Program 8**

Instable idle speed (change frequently)	Possible Reason
It may be caused by ignition system, air fuel ratio, ISC stepper motor badness or low compress pressure. For the number of possible reason is too many, so please check the simple items firstly.	● Ignition system failure ● ISC idle speed air fuel ration control system failure ● EGR emission control system failure ● Compress pressure is too low ● Air return to emission system



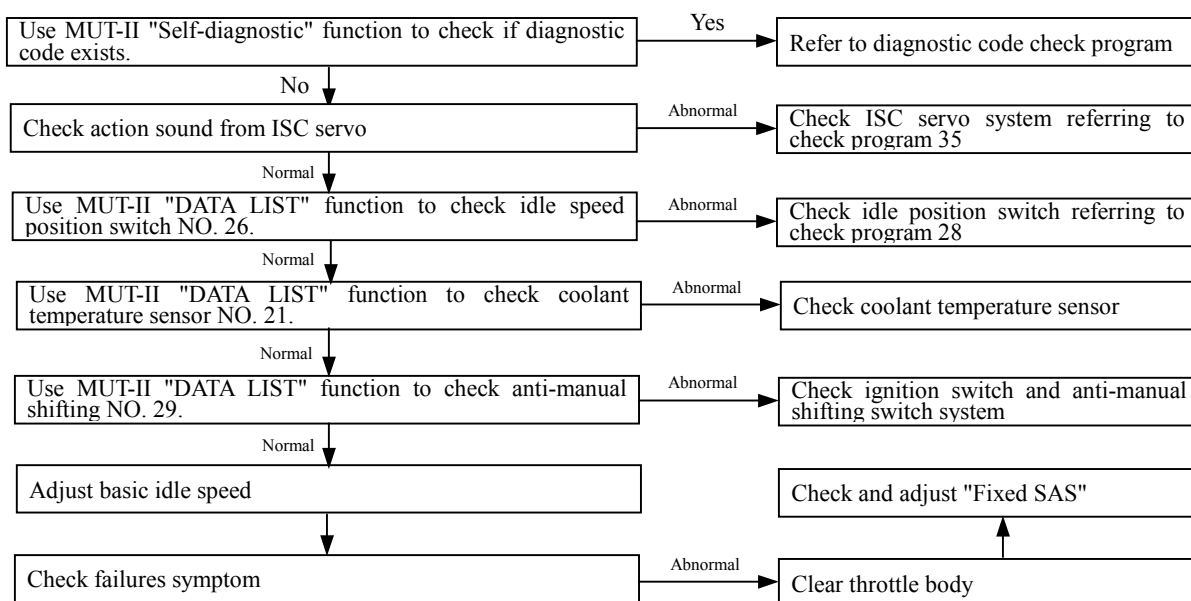
**Check Program 9**

Idle speed is too high (Idle speed is not within the specified range)	Possible Reason
It may be caused by too much intake airflow at idle speed running or airflow sensor failure.	• ISC stepper motor failure • Throttle body failure • Airflow sensor failure



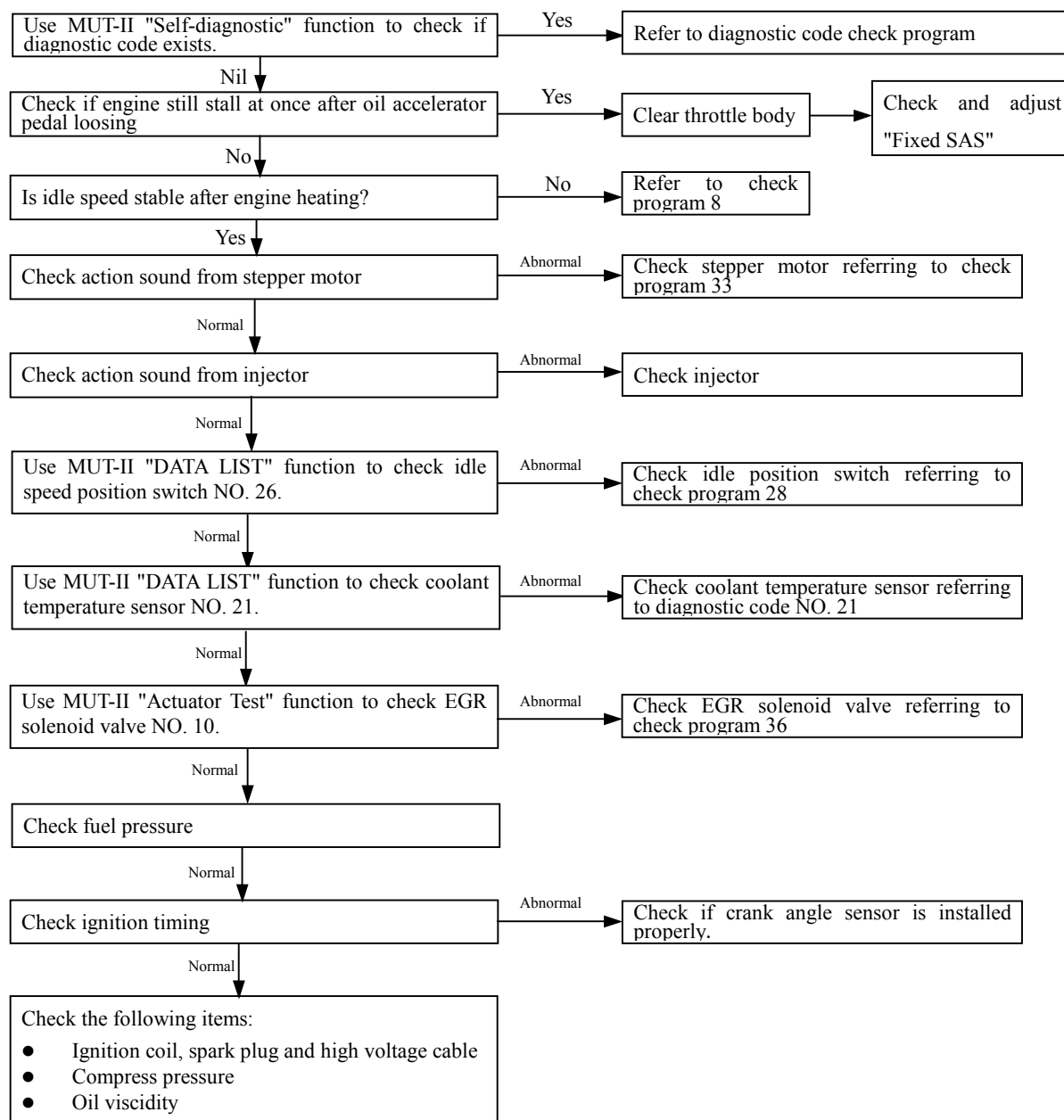
**Check Program 10**

Idle speed is too low (Idle speed is not within the specified range)	Possible Reason
It may be caused by intake air lack when idle running	• ISC stepper motor failure • Throttle body failure



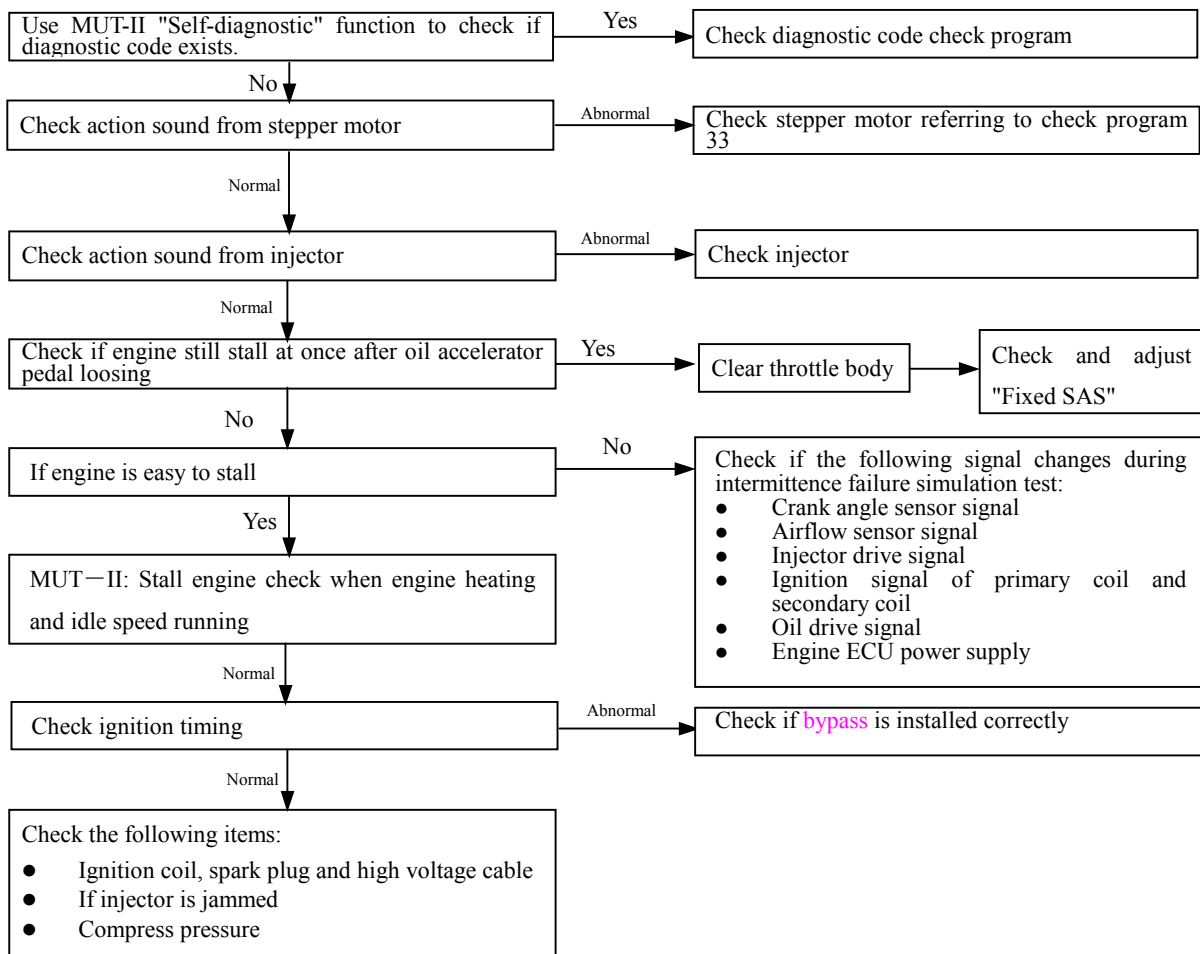
**Check Program 11**

Engine idle speed running may stall when engine is cold (Decelerating stall)	Possible Reason
It may be caused by improper air fuel ratio in mixture or intake air lack when engine is cold.	• ISC servo failure • Throttle body failure • Injector failure • Ignition system failure



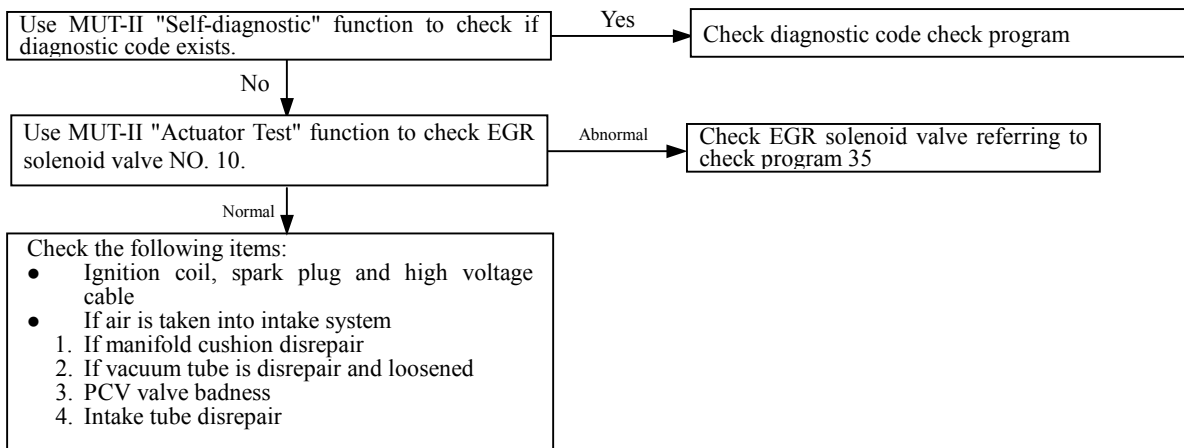
**Check Program 12**

Engine idle speed running may stall when heating	Possible Reason
It may be caused by ignition system, air fuel ration, ISC stepper motor or compress pressure badness. Additionally, it may be caused by harness joint contact badness if engine stalls suddenly.	• Ignition system failure • ISC system failure • Air fuel ratio system failure • Air is taken into intake system • Harness joint contact failure

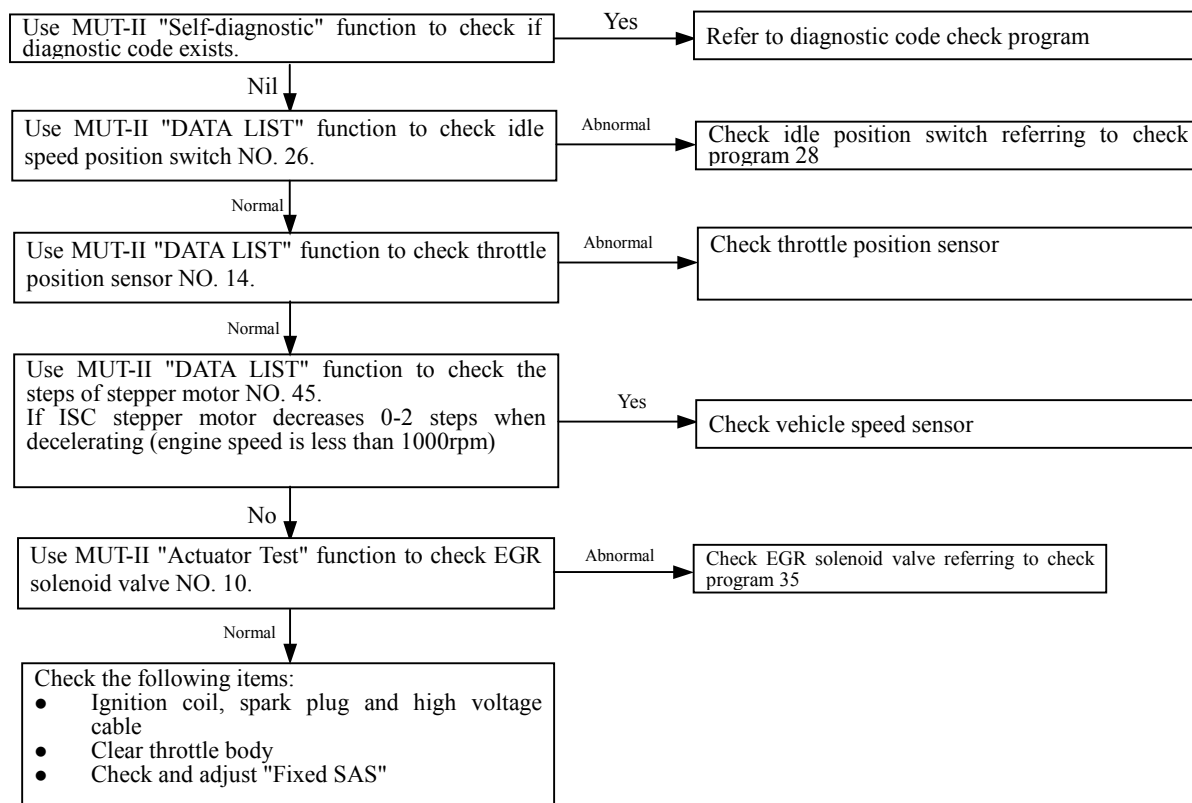


**Check Program 13**

Engine may stall during starting on (accelerating)	Possible Reason
Spark weakness maybe cause ignition failure or it is due to improper air fuel ration when stepping down accelerator pedal	• Air is taken into intake system • Ignition system

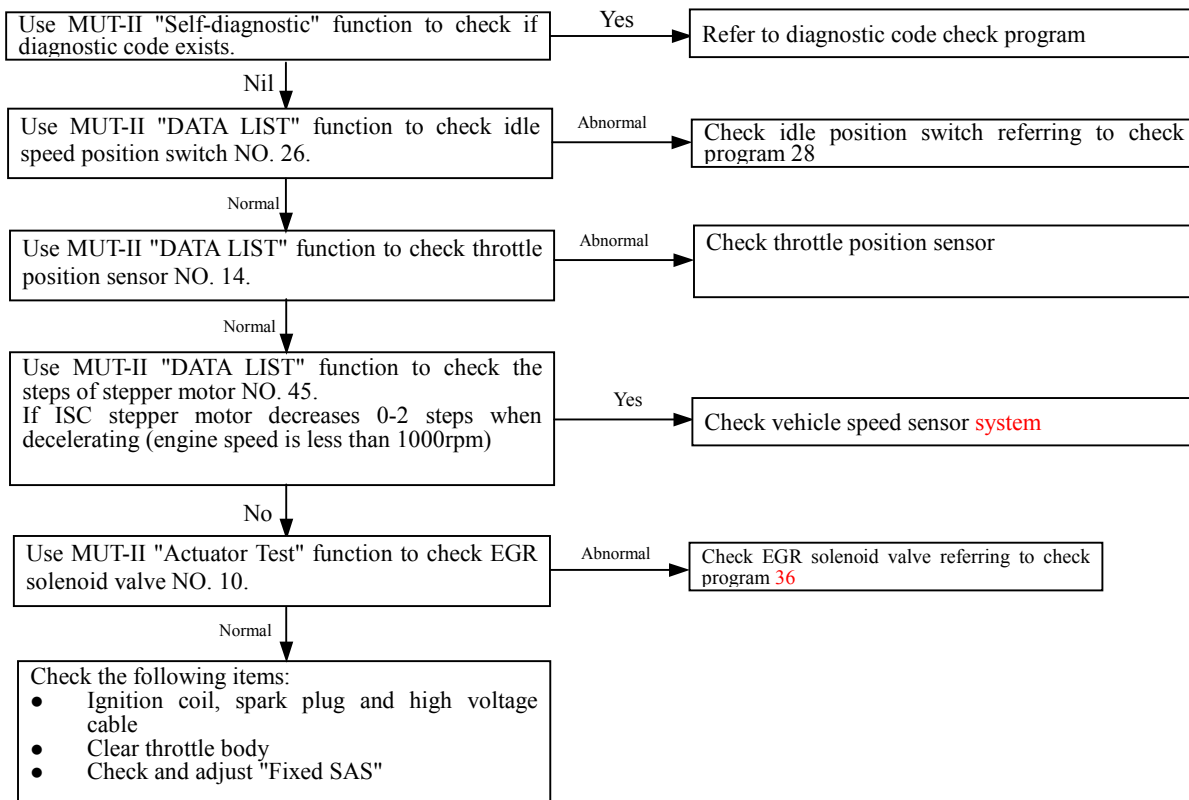
**Check Program 14**

Engine may stall during decelerating	Possible Reason
ISC servo system failure maybe cause engine intake air lack.	ISC servo system defect



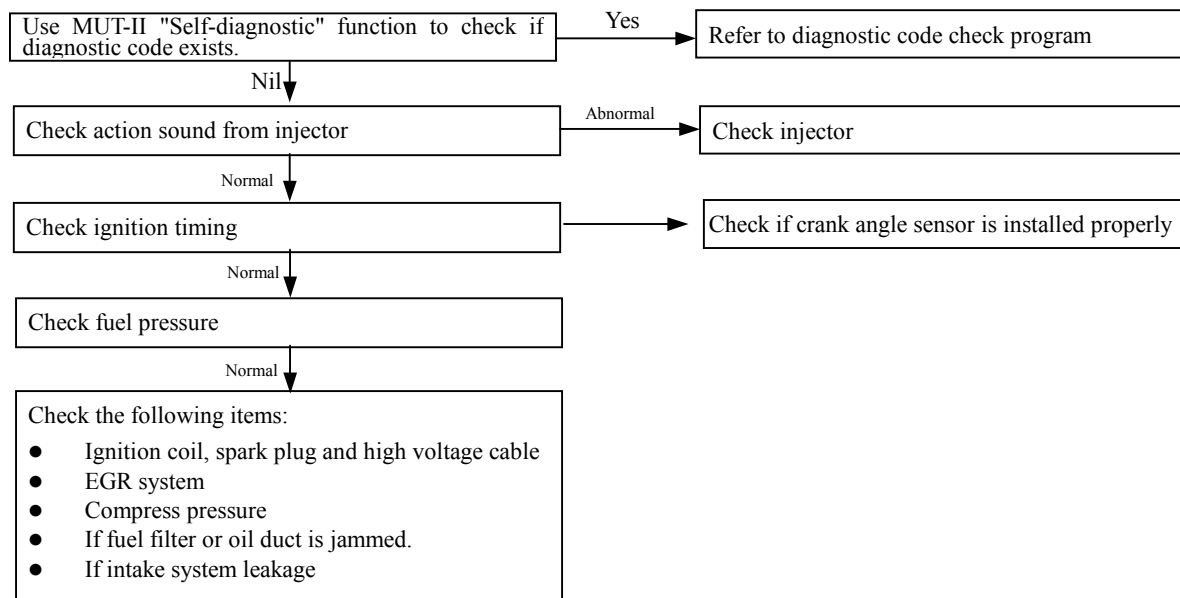
**Check Program 14**

Engine may stall during decelerating	Possible Reason
ISC servo system failure maybe cause engine intake air lack.	ISC servo system defect

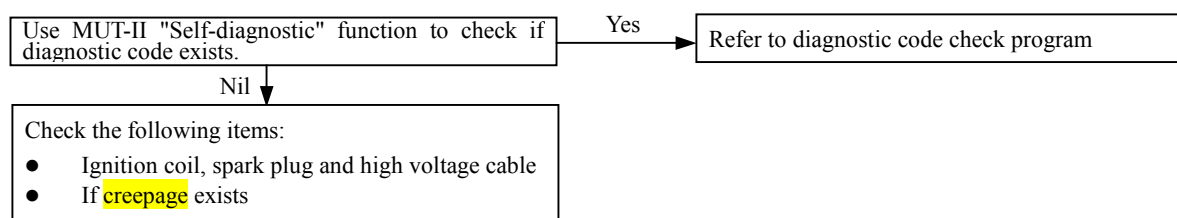


**Check Program 15**

Blowing speed drop or instable	Possible Reason
It may be caused by ignition, air fuel ration or compress pressure badness.	• Ignition system failure • Air fuel ration control system failure • Fuel oil supply system failure • EGR control solenoid valve failure • Compress pressure is too low.

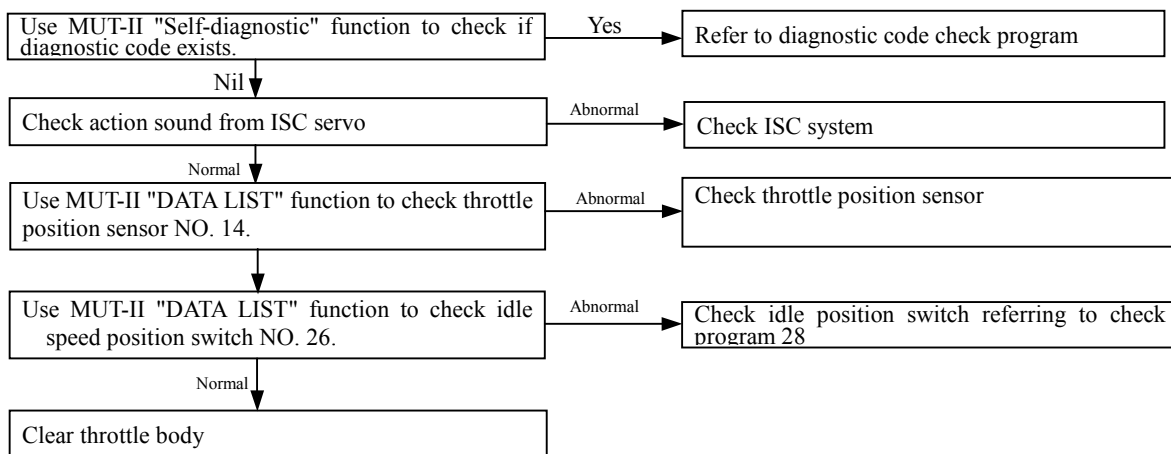
**Check Program 16**

Libration or impact during accelerating	Possible Reason
Creepage maybe occurred with required voltage increasing of spark plug when accelerating.	• Ignition system failure

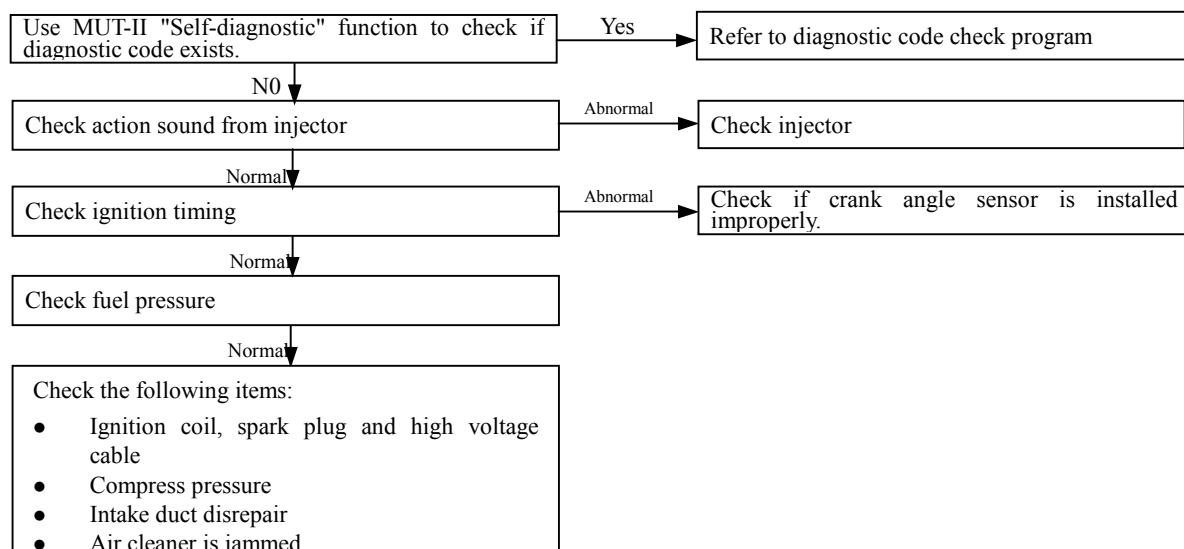


**Check Program 17**

Impact or vibration exists when decelerating	Possible Reason
Maybe ISC servo system failure	ISC system failure

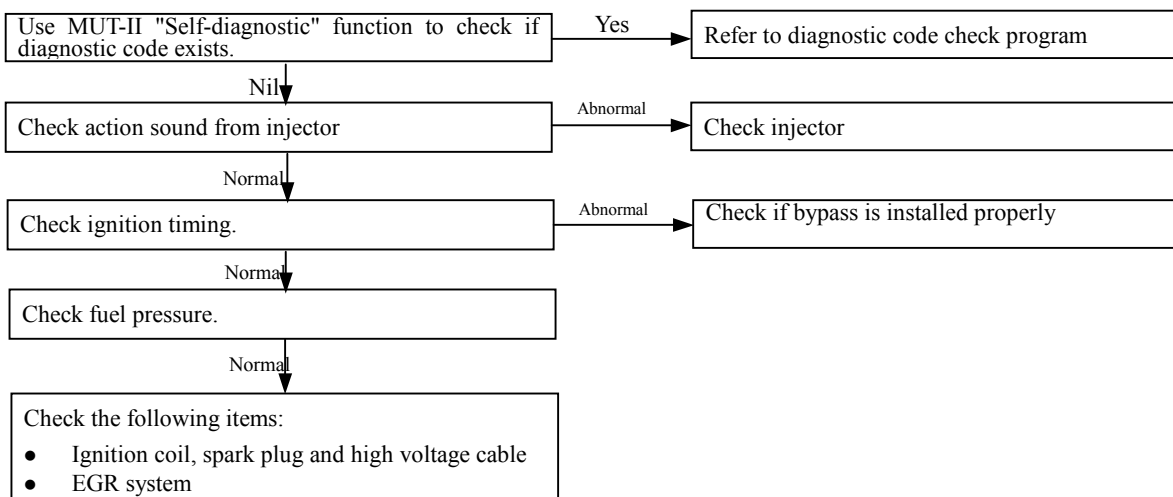
**Check Program 18**

Acceleration defect	Possible Reason
It may be caused by ignition system failure, air fuel ration abnormality and compress pressure lack.	- Ignition system failure - Air fuel ration control system failure - Oil supply system failure - Compress pressure is too low - Emission system jammed



**Check Program 19**

Surge	Possible Reason
It may be caused by ignition system failure or abnormal air fuel ratio.	• Ignition system failure • Air fuel ratio control system failure • EGR control solenoid valve failure

**Check Program 20**

Detonation	Possible Reason
The calorific value choice of spark plug may be improper.	• The calorific value level is improper.

Check the following items:
• Spark plug model • Oil model or quality issue

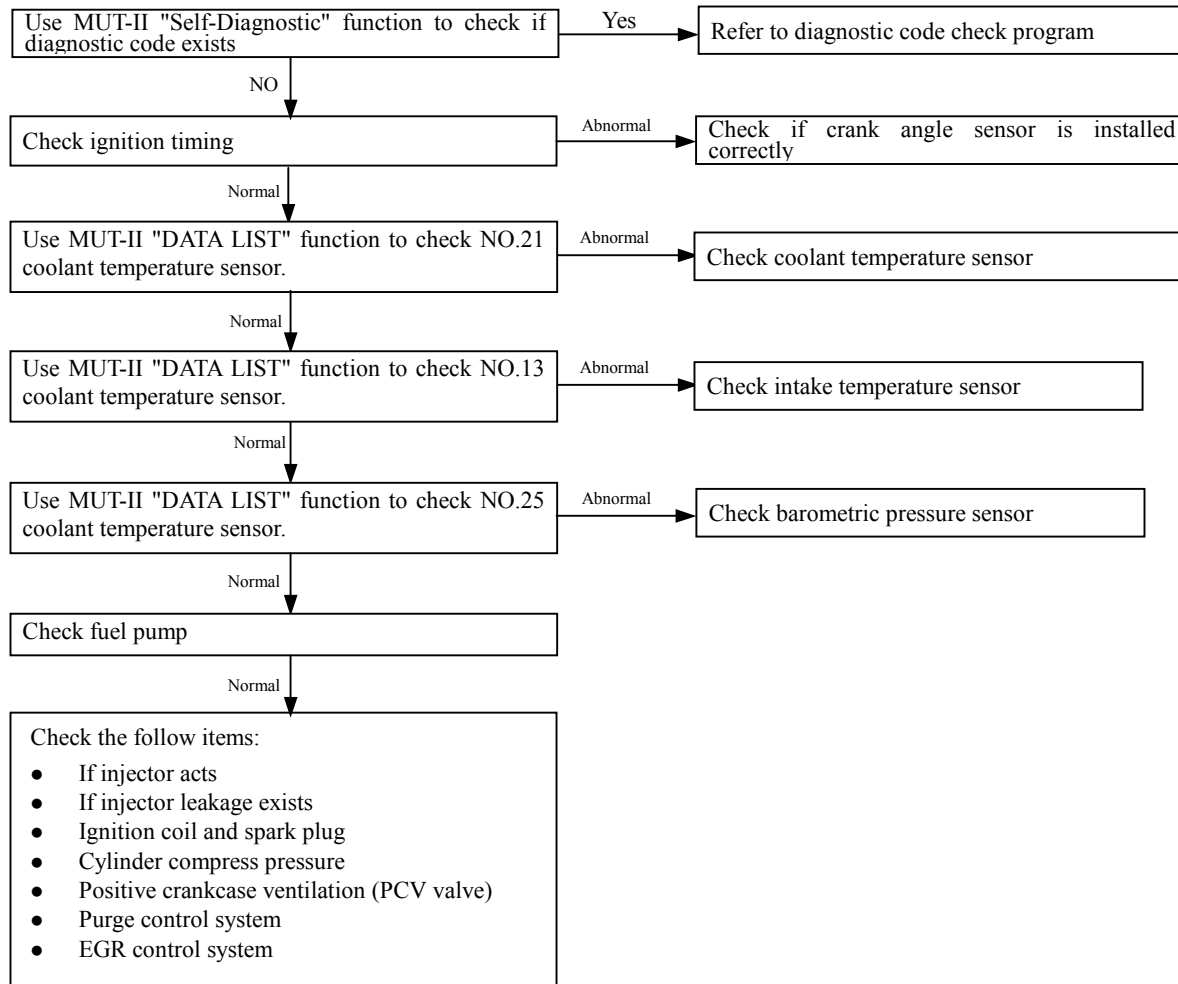
Check Program 21

Afterburn	Possible Reason
Maybe injector leakage	• Injector leakage

Check if injector leakage exists

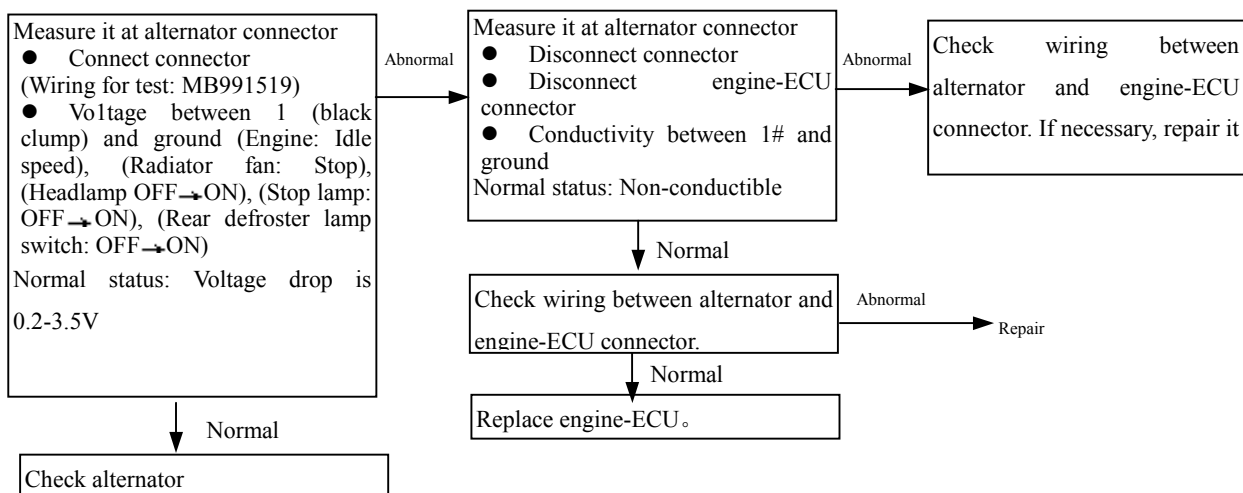
**Check Program 22**

The density of CO and HC is too high at idle speed	Possible Reason
Air fuel ratio may be abnormal	• Air fuel ration control system failure

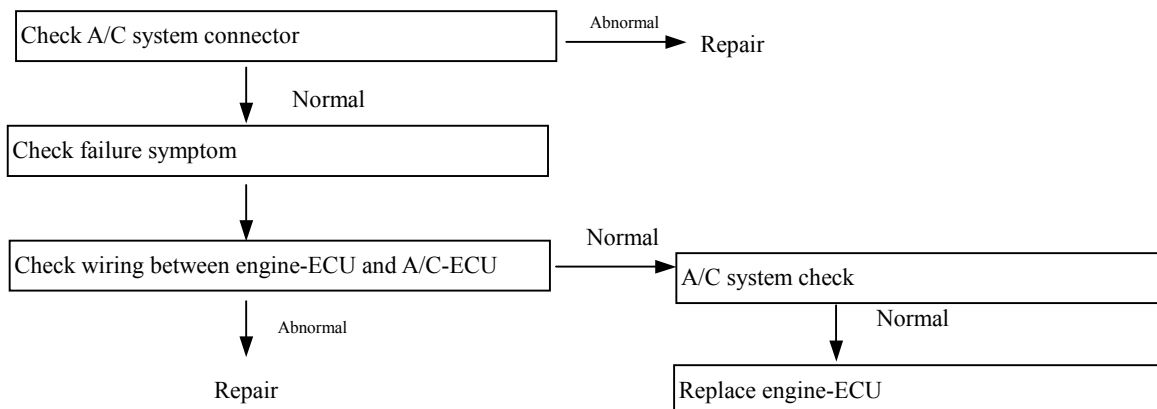


**Check Program 23**

Alternator output voltage is low (about 12.3V)	Possible Reason
Alternator may be destroyed or it maybe caused by the failure listed at right side.	• Charging system failure • Short wiring between alternator terminal G and engine-ECU. • Engine-ECU failure

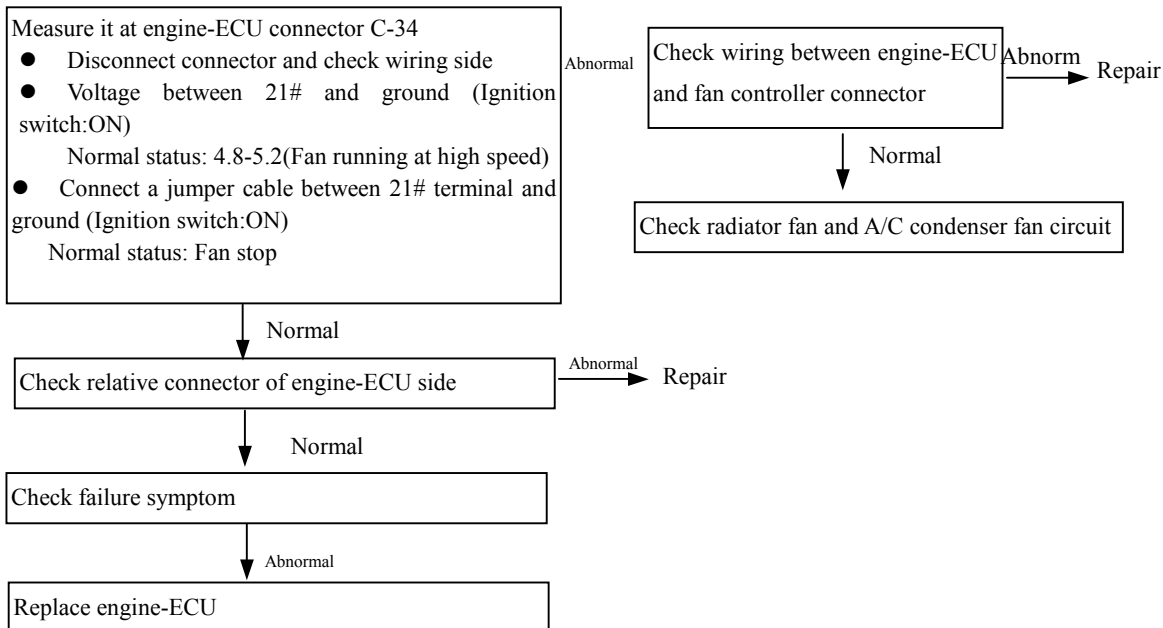
**Check Program 24**

Idle speed is abnormal when A/C running	Possible Reason
A/C-ECU check A/C load status, which will be the input signal of A/C switch 2 to engine-ECU. Engine-ECU will drive ISC servo with the signal to control idle speed.	• A/C control system failure • Circuit broken/short or connector contact defect • Engine-ECU failure

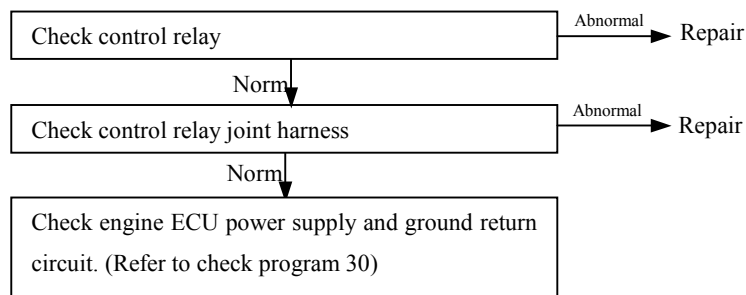


**Check Program 25**

Fan(Radiator, A/C condenser fan) is abnormal	Possible Reason
According to engine coolant temperature, vehicle speed and A/C switch position engine-ECU provide fan controller with a load signal, with which fan controller control radiator fan and A/C condenser fan. (The closer average voltage of the terminal reaches 5V, the higher fan speed is.)	• Fan motor relay failure • Fan motor failure • Fan controller failure • Connector contact defect, wiring open or short. • Engine-ECU failure

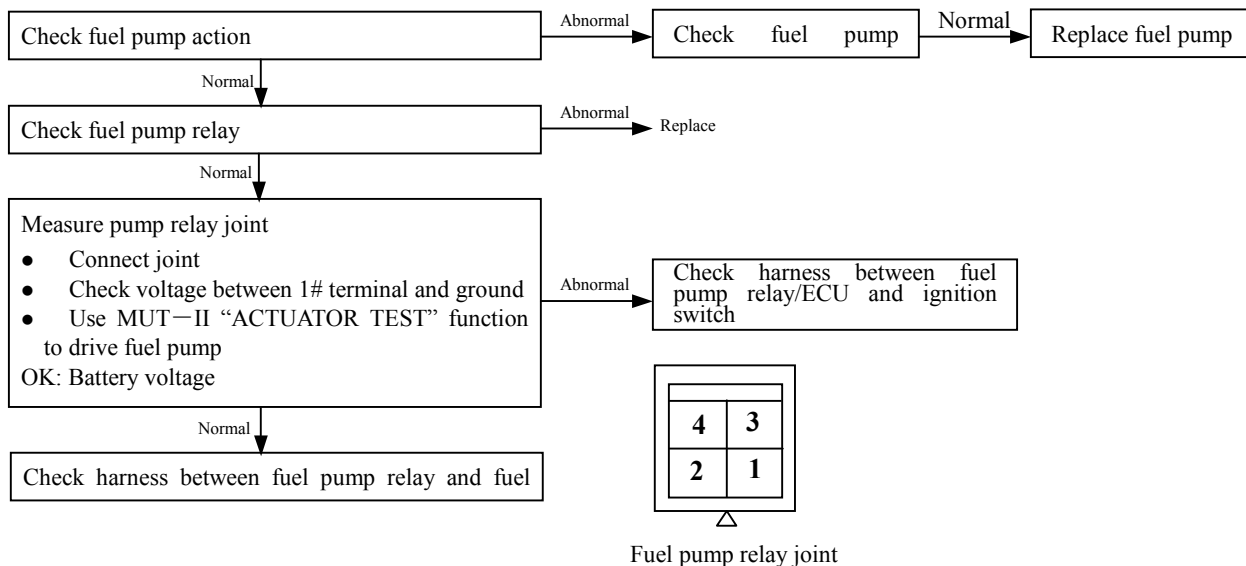
**Check Program 26**

Power supply system and ignition switch- IG	Possible Reason
When ignition switch ON signal is transferred to engine ECU, ECU will control relay ON, which supply battery power to engine ECU, injector and airflow sensor.	• Ignition system failure • Control relay failure • Harness joint contact defect, harness broken or short • Engine ECU ground wiring loosen • Engine-ECU failure



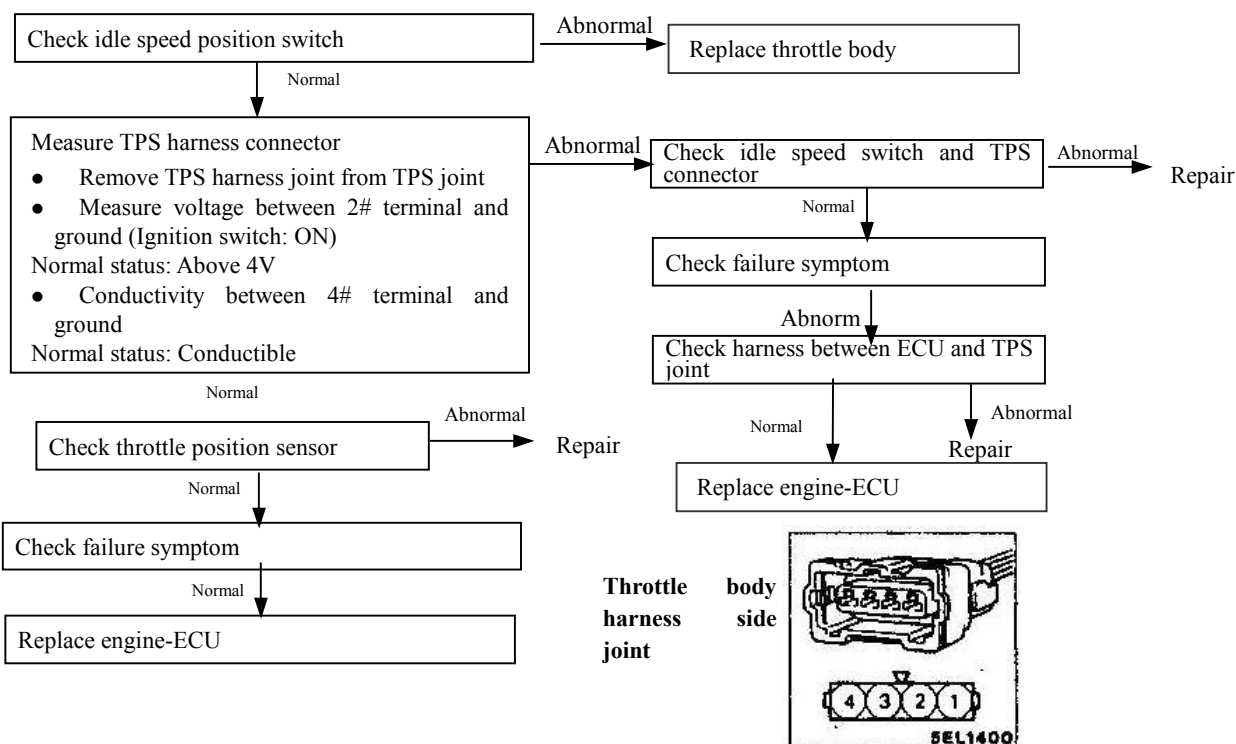
Check Program 27

Fuel pump system	Possible Reason
When engine starts motor and runs, engine ECU control relay ON to supply power to fuel pump.	- Fuel pump relay failure - Fuel pump failure - Harness joint contact defect, broken/short circuit - Engine ECU defect



Check Program 28

Idle speed position switch system	Possible Reason
Idle speed position switch input the signal of whether accelerator pedal act or not to engine ECU, which control idle speed control servo according to the input signal.	- Accelerator pedal adjustment improper - Fixed SAS adjustment improper - Idle speed position switch or TPS adjustment improper - Harness joint contact defect, harness short or broken - Engine ECU defect



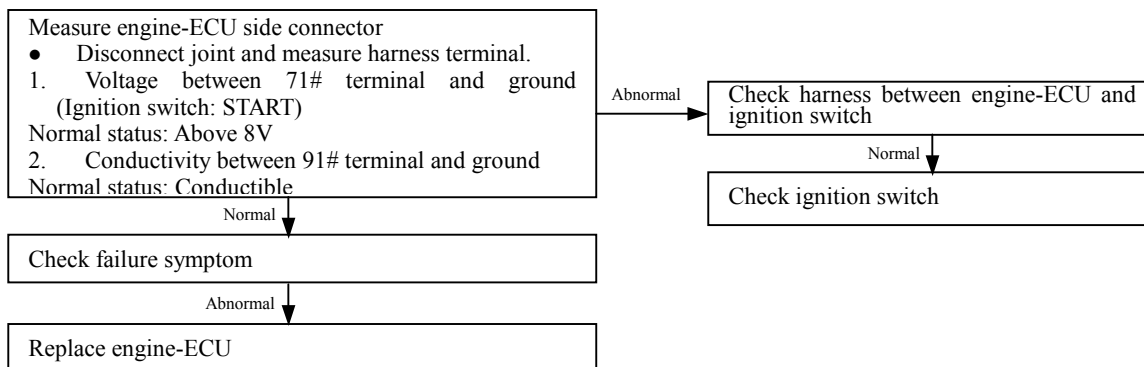
**Check Program 29**

Ignition switch-ST system<M/T>	Possible Reason
When engine starts, ignition switch-ST output high voltage signal to ECU, with which engine ECU control fuel injection when engine starting.	• Ignition switch failure • Harness joint contact defect, harness broken or short • Engine ECU failure

Check with MUT-II:

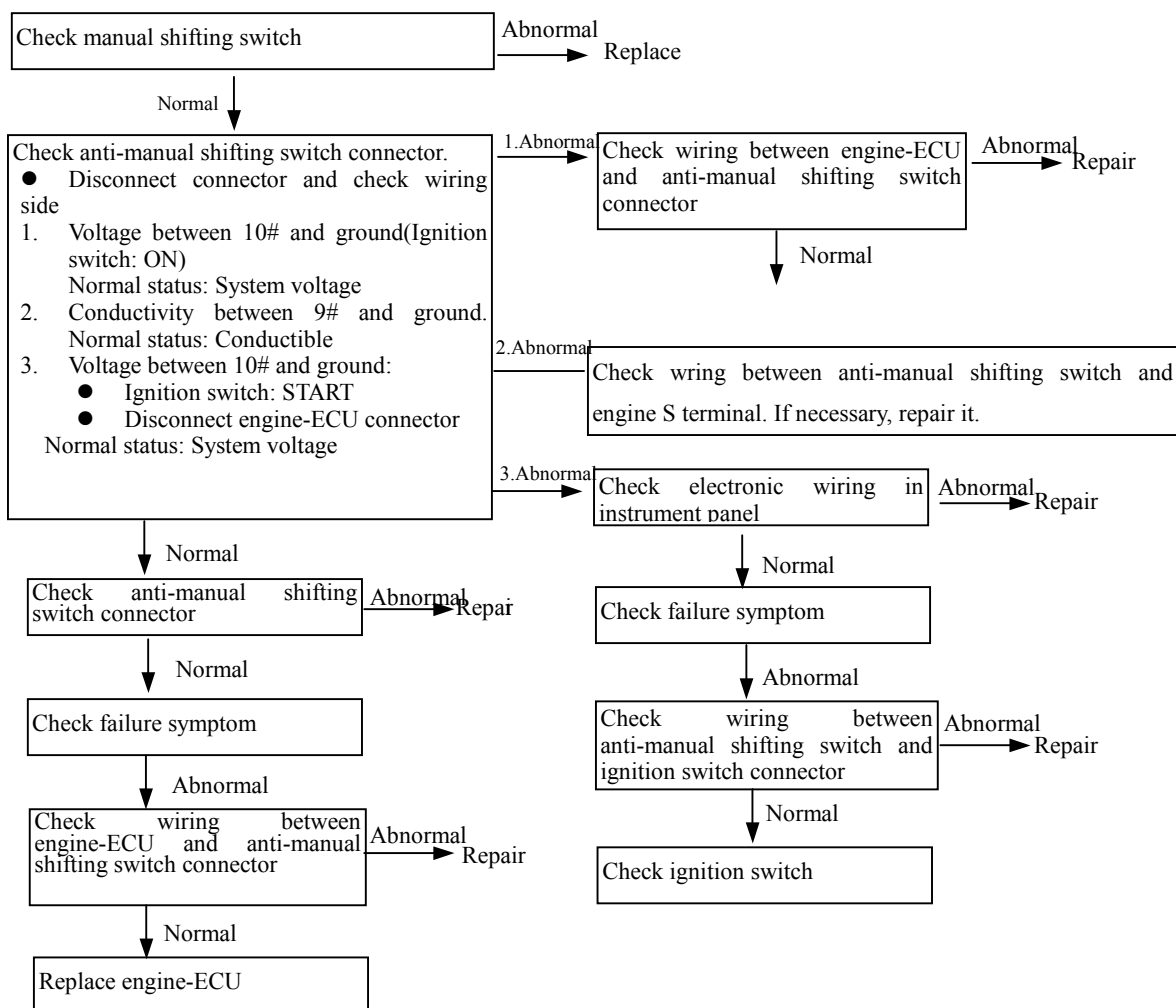
Function operation	Check code	Data display	Check condition	Engine status	Normal display
“Data reading”	18	ON/OFF status	Ignition switch: ON	Stop	OFF
				Start motor	ON
				Normal running	OFF

If the data shown on MUT-II is abnormal, please check harness as follows:



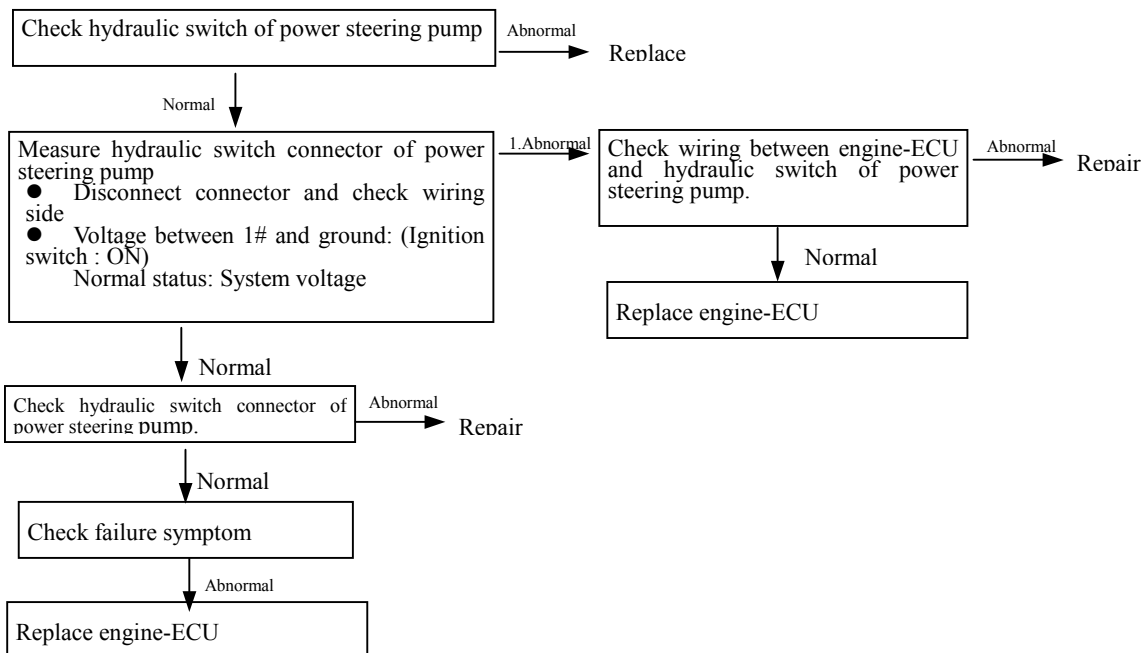
**Check Program 30**

Ignition switch-ST and anti-manual shifting switch system<A/T>	Possible Reason
● Ignition switch-ST output high voltage signal to ECU when engine is running. Engine-ECU control fuel injection when engine start. ● Anti-manual shifting switch will choose the rod status, that is, P/N shift or other shift, which will be input to engine-ECU. According to it engine-ECU control idle speed control (ISC) servo.	● Ignition switch failure ● Anti-manual shifting switch failure ● Connector contact failure, wiring open or short ● Engine-ECU failure

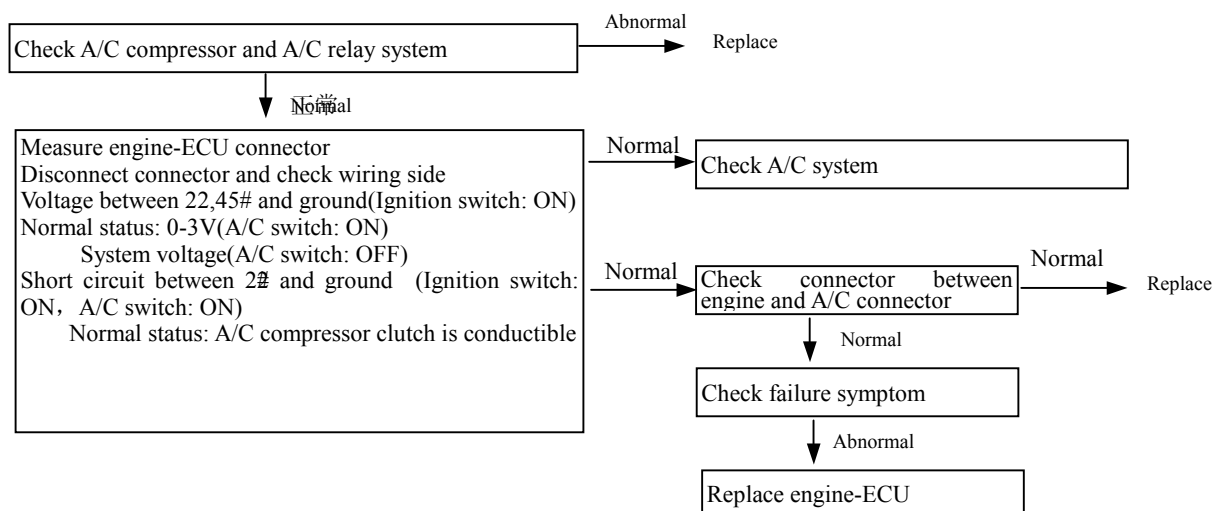


**Check Program 31**

Power steering pump hydraulic switch system	Possible Reason
Switch signal of power steering pump load in input to engine-ECU. Engine-ECU control idle speed control (ISC) servo according to the input signal.	• Power steering pump hydraulic switch failure • Connector contact failure, wiring open or short. • Engine-ECU failure

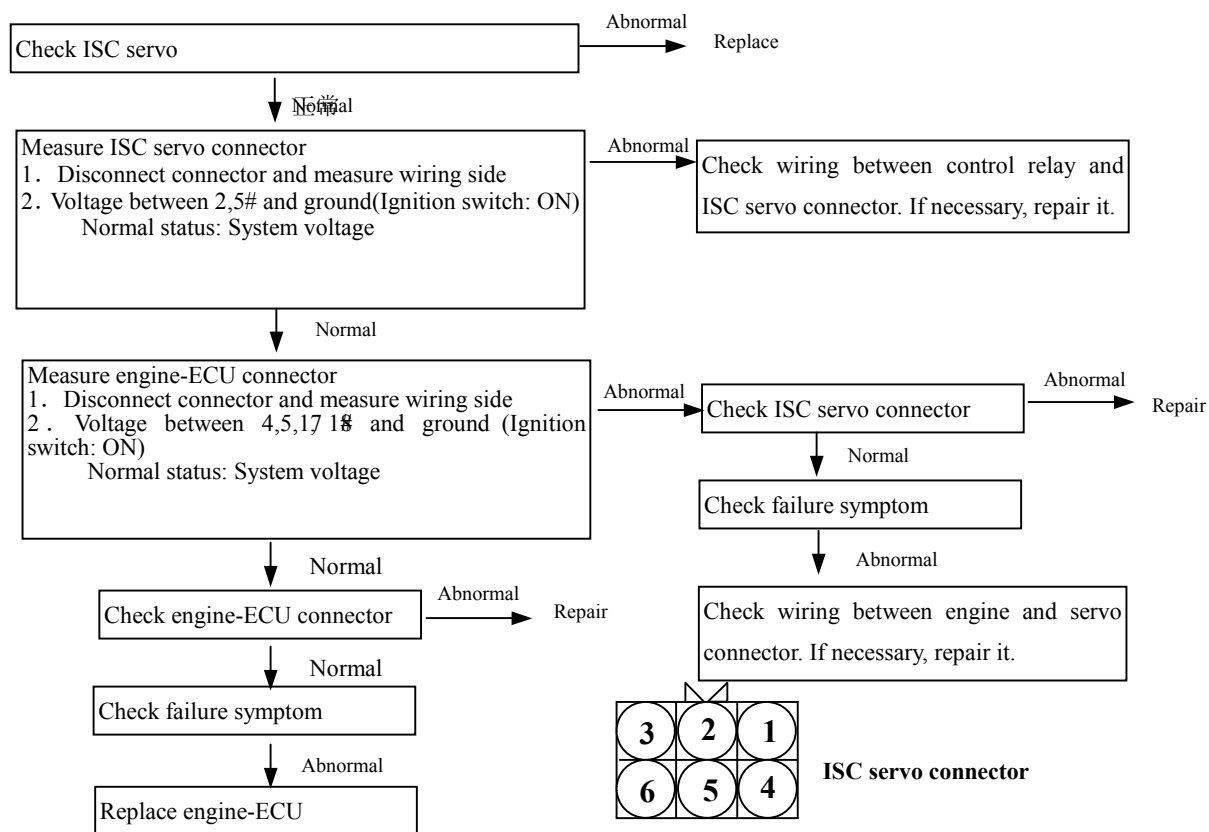
**Check Program 32**

A/C switch and A/C relay system	Possible Reason
When A/C ON signal is input to engine-ECU, engine-ECU controls idle speed control (ISC) servo according to it and manipulate A/C compressor solenoid clutch.	• A/C control system failure • A/C switch failure • Connector contact failure, open or short circuit wiring • Engine-ECU failure



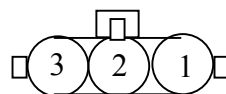
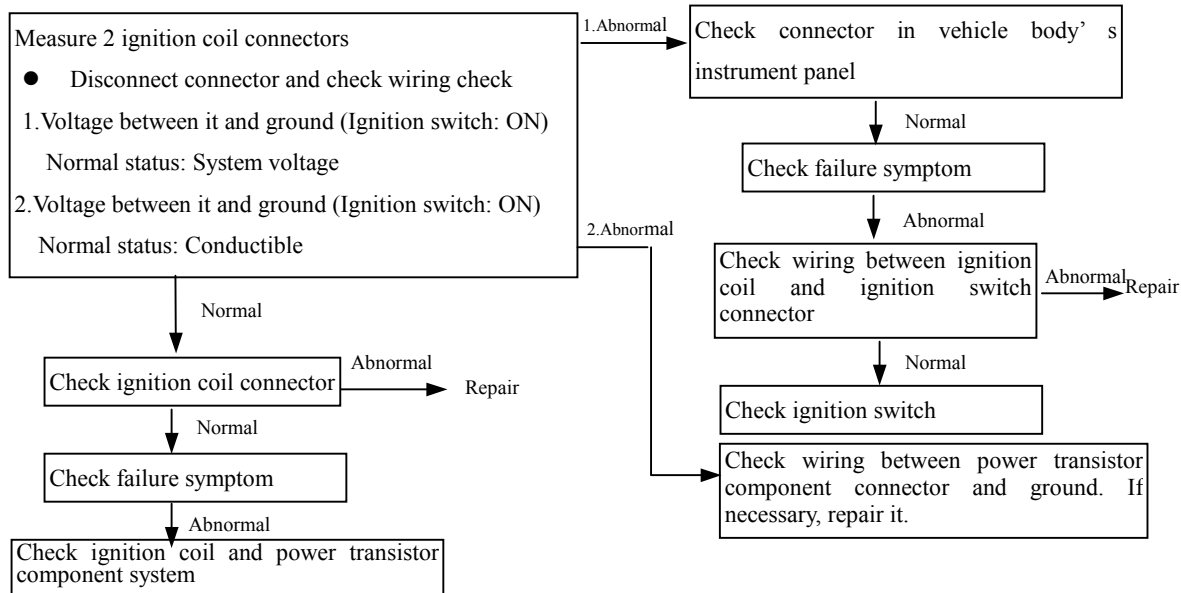
Check Program 33

Idle speed control (ISC) servo (stepper motor) system	Possible Reason
Engine-ECU control inlet airflow by changing servo valve position of bypass duct.	- ISC servo failure - Connector contact failure, wiring open or short - Engine-ECU failure



Check Program 34

Ignition circuit system	Possible Reason
Engine-ECU cuts off ignition coil primary circuit by controlling the conductivity of power transistor in ignition coil.	- Ignition switch failure - Connector contact failure, wiring open or short - Engine-ECU failure



Ignition coil connector

**Check Program 35**

EGR solenoid valve system	Possible Reason
EGR solenoid valve makes EGR valve act through the control over the vacuity of the upper of EGR valve.	• Solenoid valve failure • Harness contact defect, broken or short circuit harness • Engine ECU failure

Check ECU solenoid valve. Refer to emission control system check

Normal

Measure harness joint of EGR solenoid valve

- Disconnect connector and check wiring check
- Measure voltage between 1# terminal and ground (Ignition switch: ON)

OK: Battery voltage

Abnormal

Check harness between control relay and EGR solenoid valve.

Normal

Measure engine ECU connector

- Disconnect connector and check wiring check
- Voltage between 6# terminal and ground (Ignition switch: ON)

OK: Battery voltage

Abnormal

Check harness between engine ECU and EGR solenoid valve. If necessary, repair it.

Normal

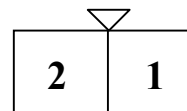
Check engine ECU connector

Normal

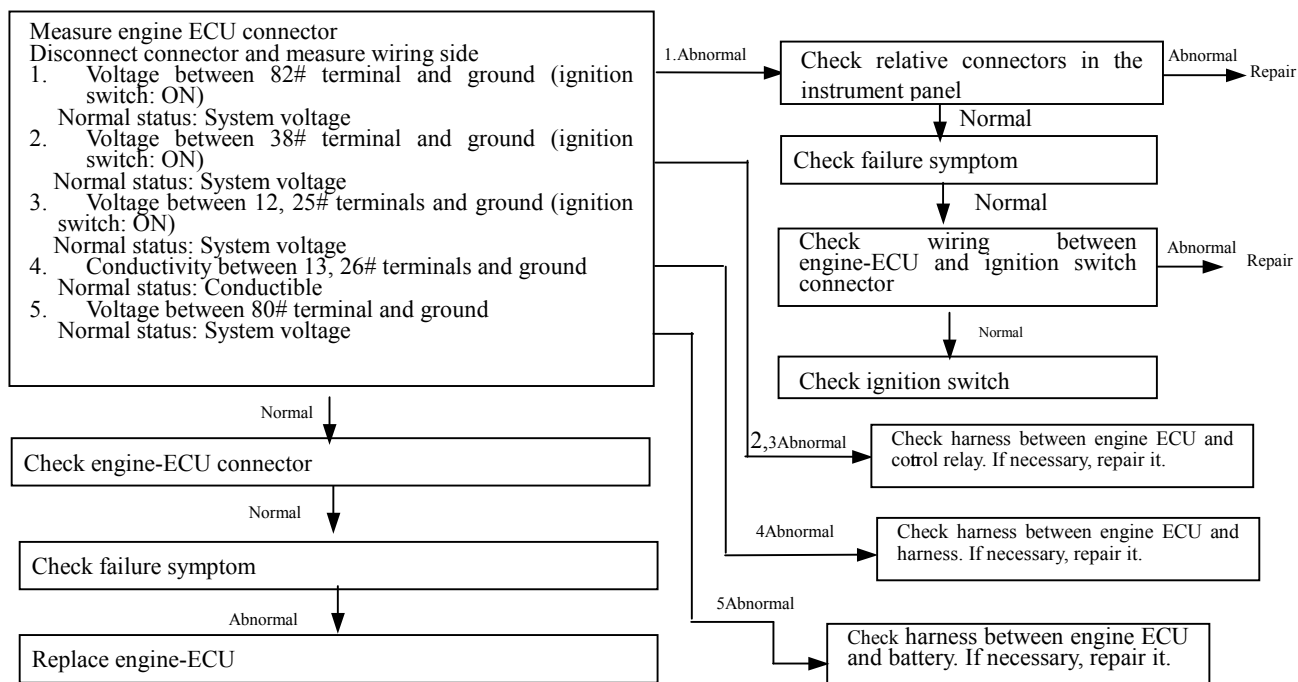
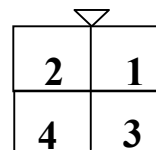
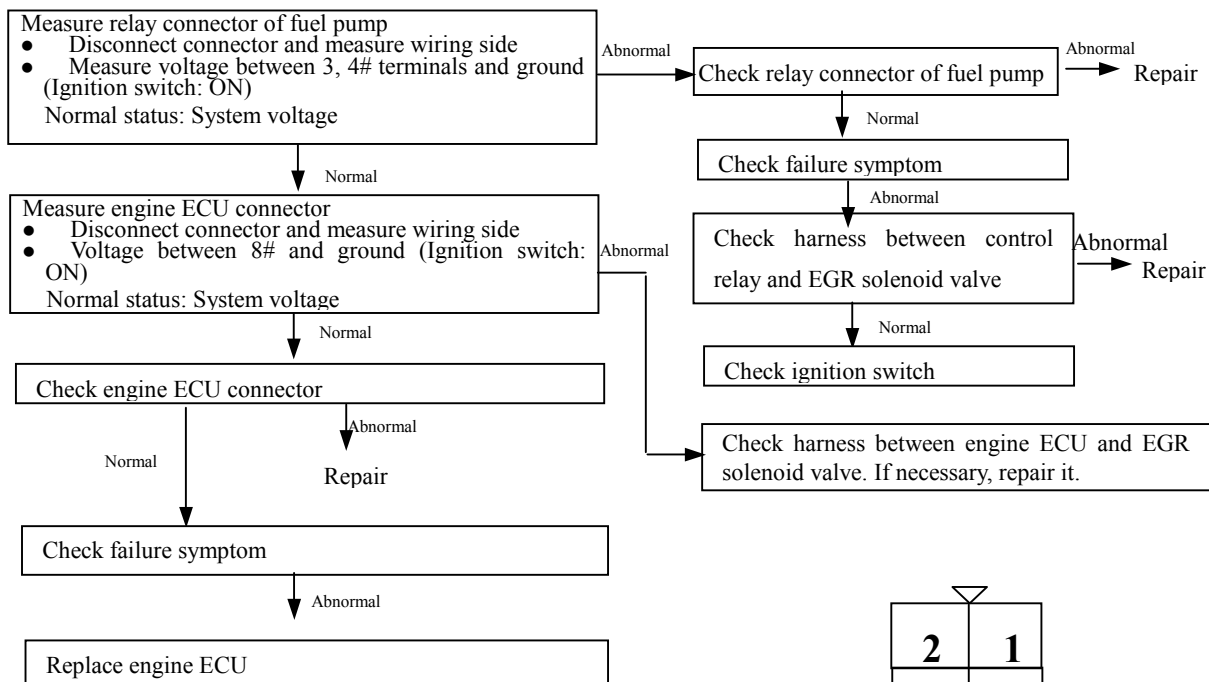
Check failure symptom

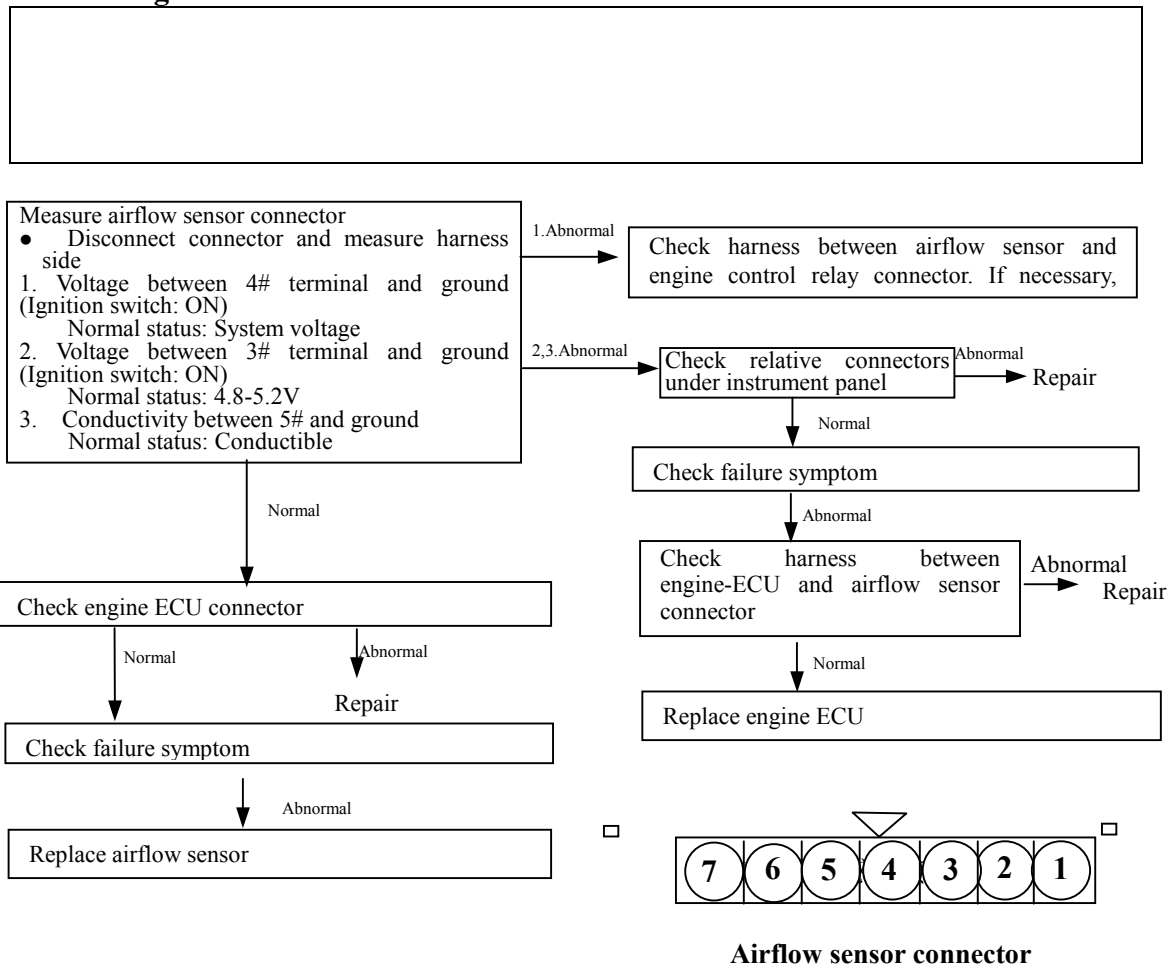
Abnormal

Replace engine ECU



EGR solenoid valve connector

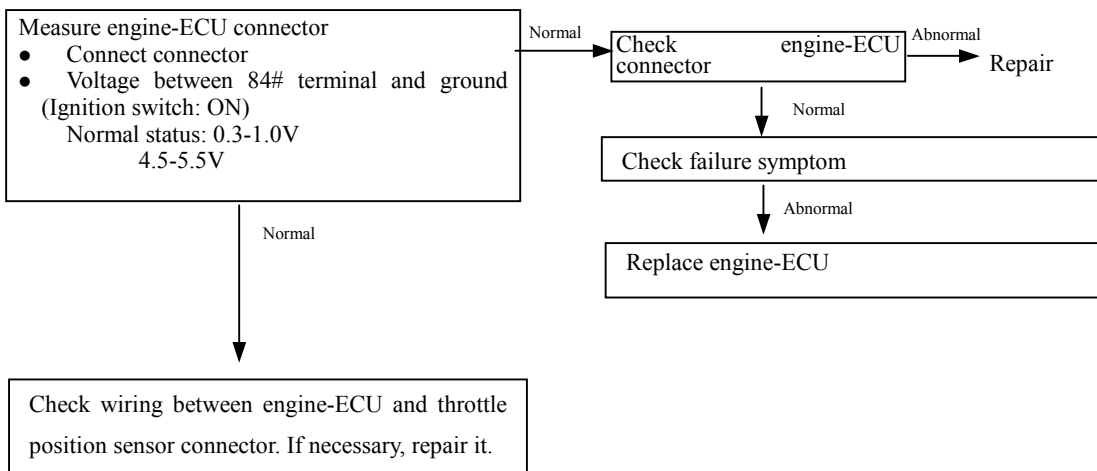
**Check Program 36****Check engine ECU power supply and ground circuit.****Check Program 37****Check drive control circuit of fuel pump****Fuel pump relay connector**

**Check Program 38**



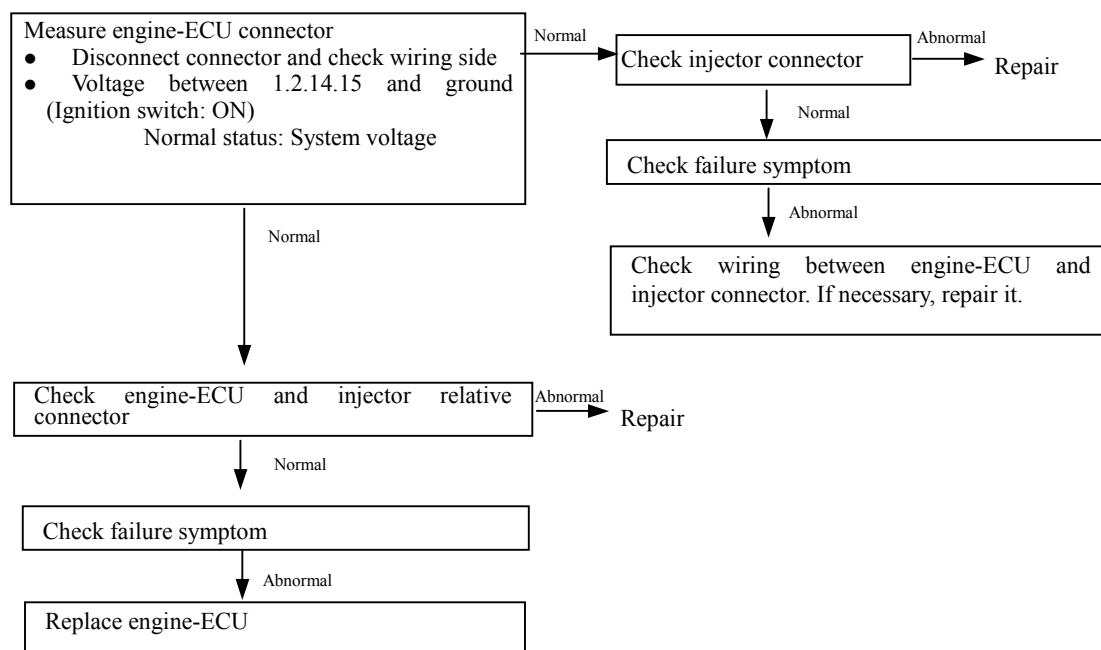
Check Program 39

Check output circuit of throttle position sensor (TPS)



Check Program 40

Check injector control circuit



**Data Reference List**

Note:

- 1*. As for new vehicle whose travel miles is no more than 500km, airflow sensor output frequency is basically 10% higher than standard frequency.
- 2*. When throttle position sensor voltage is 50-100mV higher than the voltage at idle speed position, idle position switch is usually closed. When throttle position sensor voltage increase 100mV and throttle valve is open, if you want to turn throttle position switch to ON, you need to adjust idle position switch and throttle position sensor previously.
- 3*. Injector drive time means how long crank speed is less than 250rpm at 11V power supply voltage.
- 4*. As for new vehicle whose travel miles is no more than 500km, sometimes injector drive time is 10% more than standard time.
- 5*. As for new vehicle which travel miles is no more than 500km, sometimes the step of stepper motor is 30 steps more than standard step.

Item No.	Check Item	Check content		Normal condition	Check Program
11	Oxygen sensor	Engine: warming up status	Engine decelerates suddenly from 4000rpm	≤ 200mV	Diagnostic code: 11
		A/F: The density decreases during decelerating and increases during accelerating	Engine accelerates suddenly	600-1000mV	
		Engine: warming up status	Engine is at idle speed.	≤ 400mV	
		Check A/F with oxygen sensor signal and check control condition with ECU	At 2500rpm	600-1000mV	
12	Airflow sensor*1	- Engine coolant temperature: 80~95℃ - Light and all accessories: OFF - Transmission: Neutral	Engine is at idle speed.	19-45Hz	
			At 2500rpm	72-112Hz	
			Engine is accelerating	Frequency increases with speed increase	
13	Intake temperature sensor	Ignition switch: ON Or engine is running.	Intake temperature is -20℃	-20 ℃	Diagnostic code: 13
			Intake temperature is 0℃	0 ℃	
			Intake temperature is 20℃	20 ℃	
			Intake temperature is 40℃	40 ℃	
			Intake temperature is 80℃	80 ℃	
14	Throttle position sensor	Ignition switch: ON	Idle speed position	300-1000mV	Diagnostic code: 14
			Gradually open throttle	Increase in direct proportion to throttle open angle	
			Wide open	4500-5500mV	



Item No.	Check Item	Check content		Normal condition	Check Program
16	Power supply voltage	Ignition switch: ON		System voltage	Check Program NO.23
18	Crank signal (Ignition switch-ST)	Ignition switch: ON	Engine: Shut off	OFF	Check Program NO.26
			Engine: Start on motor	ON	
21	Engine coolant temperature sensor	Ignition switch: ON Or engine is running	Engine coolant temperature is -20 ℃	-20 ℃	Diagnostic code: 21
			Engine coolant temperature is 0 ℃	0 ℃	
			Engine coolant temperature is 20 ℃	20 ℃	
			Engine coolant temperature is 40 ℃	40 ℃	
			Engine coolant temperature is 80 ℃	80 ℃	
22	Crank angle sensor	- Engine: Running - Tachometer: Connected	Compare engine speed-reading from tachometer and MUT-II separately.	Identical	Diagnostic code: 22
		- Engine: Idle speed - Idle speed switch: ON	Engine coolant temperature is -20 ℃	1275-1475rpm	
			Engine coolant temperature is 0 ℃	1220-1420rpm	
			Engine coolant temperature is 20 ℃	1100-1300rpm	
			Engine coolant temperature is 40 ℃	940-1140rpm	
25	Barometric pressure sensor	Ignition switch: ON	Altitude height: 0m	101kPa	Diagnostic code: 25
			Altitude height: 600m	95kPa	
			Altitude height: 1200m	88kPa	
			Altitude height: 1800m	81kPa	
26	Idle speed position switch	Ignition switch: ON Step down accelerator pedal repeatedly to check it.	Throttle: at idle speed position	ON	Check Program: 25
			Throttle valve: partial open	OFF*5	
27	Power steering hydraulic pressure switch	Engine: Idle speed	Steering wheel inaction	OFF	
			Steering wheel running	ON	
28		Engine: Idle speed	A/C switch: OFF	OFF	



Item No.	Check Item	Check content		Normal condition	Check Program
	Air conditioner (A/C) switch	(When A/C is ON, A/C compressor works.)	A/C switch: ON	ON	
41	Injector*2	Engine: Running	Engine coolant temperature is 0 ℃	13-20ms	
			Engine coolant temperature is 20 ℃	27-41ms	
			Engine coolant temperature is 80 ℃	6.8-10.2ms	
	Injector*3	- Engine coolant temperature: 80-95 ℃ - Light & all accessories: OFF Transmission: Neutral	Engine idle speed	1.9-3.1ms	
			2500rpm	1.7-2.9ms	
			Engine races at high speed suddenly.	Increase	
44	Ignition coil and power transistor	- Engine: warming up status - Timing light: Using (Using timing light to check actual ignition time)	Engine idle speed	2-18 ° BTDC	
			2500rpm	18-38 ° BTDC	
45	ISC stepper motor*4	Engine coolant temperature: 80-95 ℃ - Light & all accessories: OFF - Transmission: Neutral - Idle speed position switch: ON - Engine: Idle speed - When A/C switch is ON, A/C compressor should work	A/C switch: OFF	2-25 steps	
			A/C switch: OFF → ON	Increase 10-70 steps	
			- A/C switch: OFF → ON - Selection rod: N shift → D shift	Increase 5-50 steps	
49	A/C Relay	Engine: after warming up/idle speed	A/C switch: OFF	OFF (Compressor clutch doesn't work)	
			A/C switch: ON	ON (Compressor clutch works)	