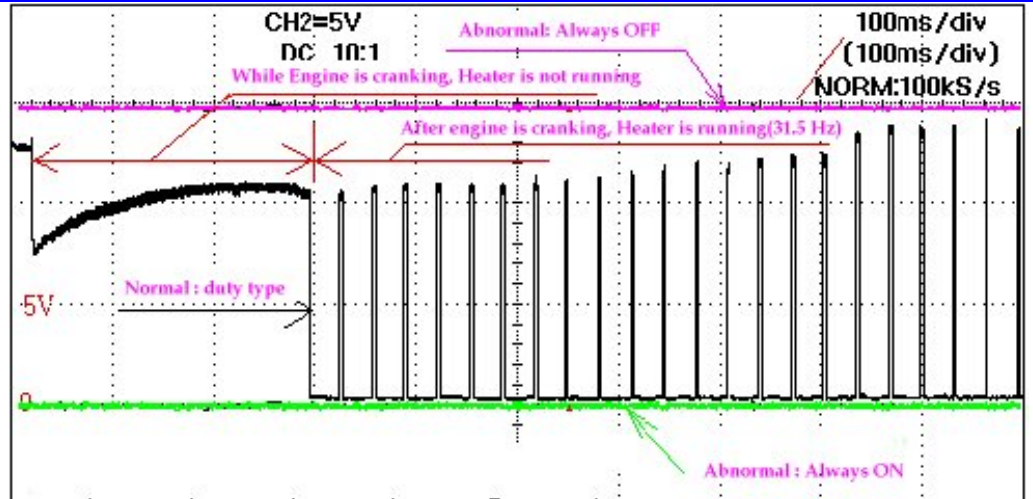
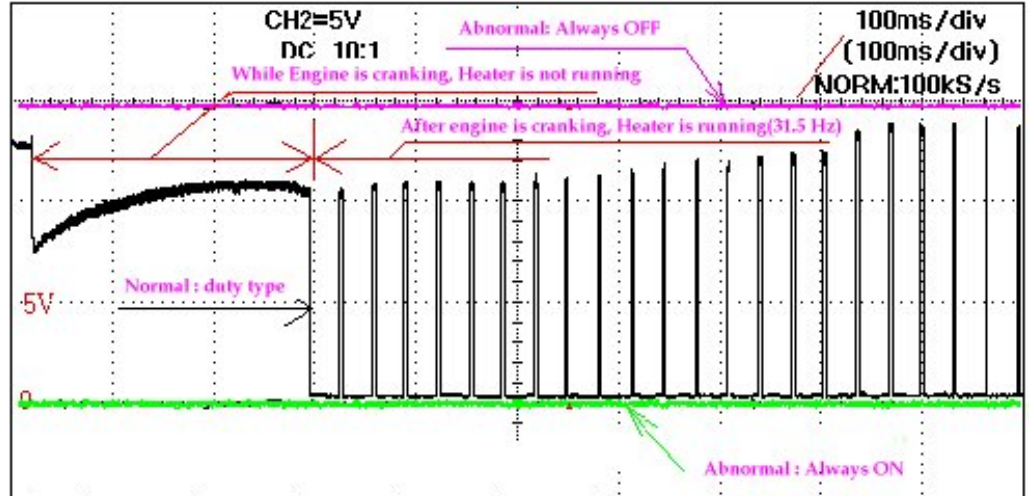


16. The signal of O2 Sensor Heater

1. Troubles

1. Power supply line break of O2 sensor heater	
Cause of trouble	1.1 Power supply line break 1.2 Duty control line break in ECU 1.3 Abnormal O2 sensor heater
Counter action	1.1 Repair power supply line 1.2 Repair duty control line in ECU 1.3 Replace O2 sensor
Engine state	There is no problem with engine operation but rich fuel control may be occurred with feedback start due to slow light-off of O2 sensor.
Signal measurement	

2. Oxygen sensor heater duty is always 100%	
Cause of trouble	2.1 Duty control line in ECU is shorted to ground 2.2 Abnormal canister solenoid
Counter action	2.1 Improvement of duty control line in ECU 2.2 Replace canister solenoid
Engine state	There is no problem with engine operation. With cold cranking, O2 sensor may be cracked due to rapidly heating and damaged by heat with high RPM and MAF condition.
Signal measurement	

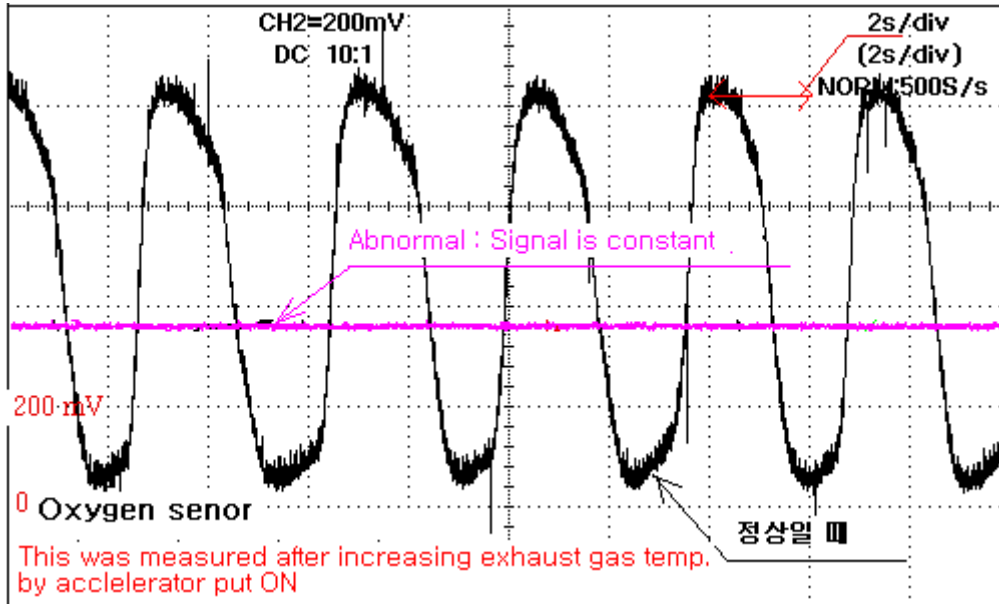
2. Field example

< Example 1 > The O2 sensor crack by dew point

Vehicle : B maker O2 sensor equipped vehicle

Problem description : O2 sensor crack is often occurred in fall and spring.

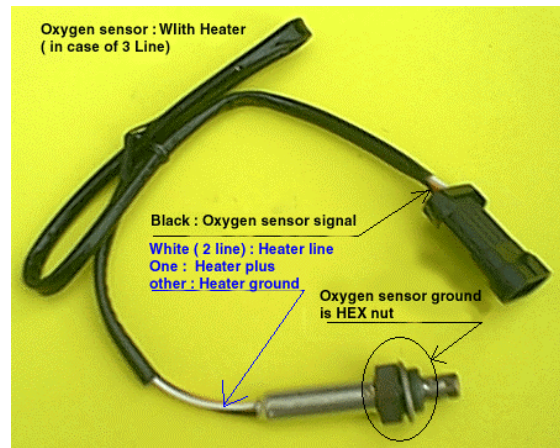
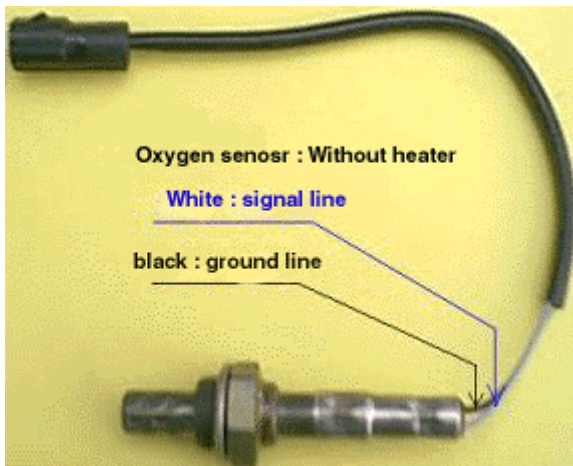
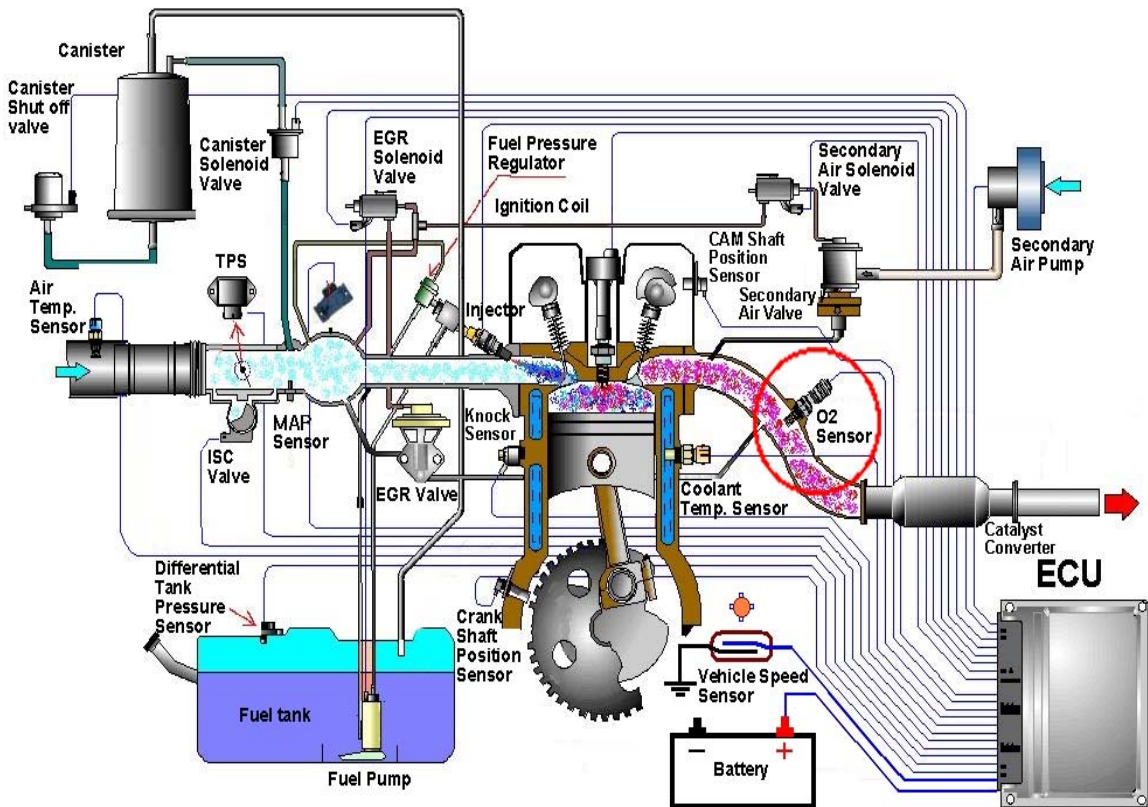
Signal measurement : O2 sensor signal is not measured.



Explanation : The vapor inside exhaust pipe is produced lots with ambient temperature 10°C. This vapor wrap around O2 sensor and it result in crack of tip. It is due to too fast heating for O2 sensor.

Enlargement of application : The O2 sensor should be heated after avoiding dew point temperature. And stop O2 heater control with temperature higher than 700°C so that O2 sensor tip should not be heated too much. Therefore when exchanging non-heated type with heated type O2 sensor, notice to customer that dew point problem may be occurred.

3. Location of O2 sensor heater



< Fig. : Oxygen sensor heater is not integrated(left)/integrated(right) >

4. Check method

Explain the checking Method and Diagnosis of trouble.

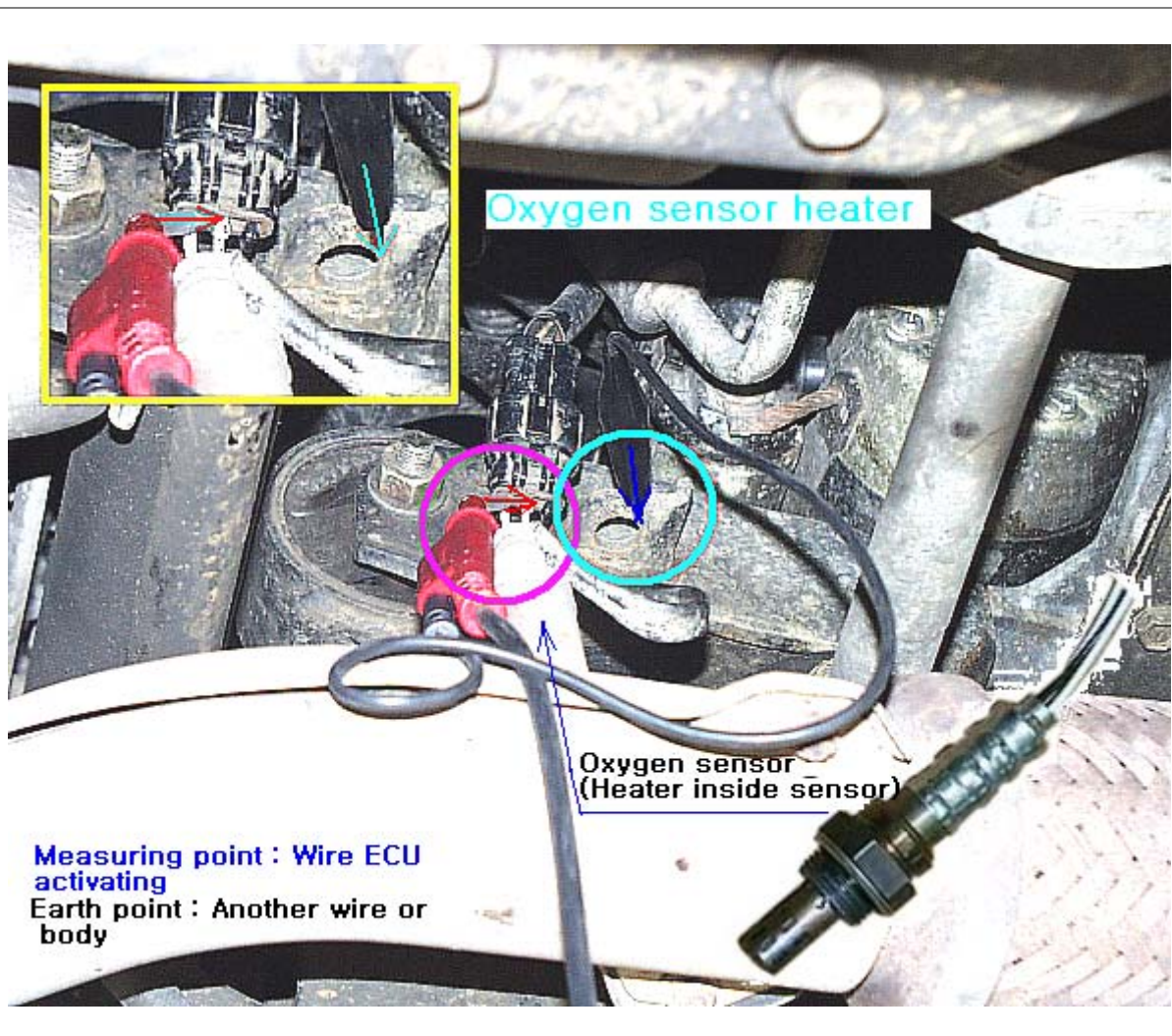
Preparation

1. Oscilloscope (It prefers not to use Multimeter available)
2. Wiring Diagram for Canister.
3. Scanner

1. Find and connect the sensor power line (Battery line), Ground line (grounded by ECU) in referencing the wiring diagram.
2. Look at how the voltage is in connecting the Oscilloscope.
3. There is the other case of outside ground not grounded by ECU. : Reference the wiring diagram.

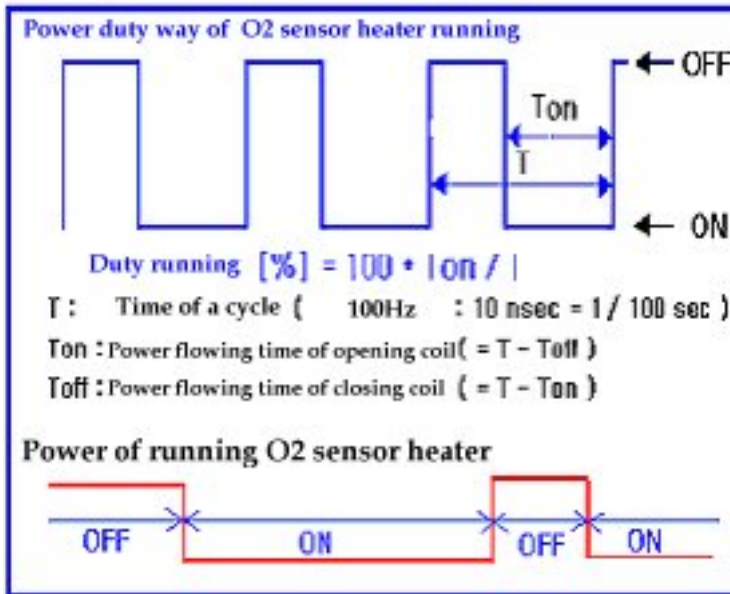
< Reference >

It prefers not to use Multimeter because it is difficult to measure the Heater operating state with Multimeter in case of Duty control (continuous ON/OFF type).

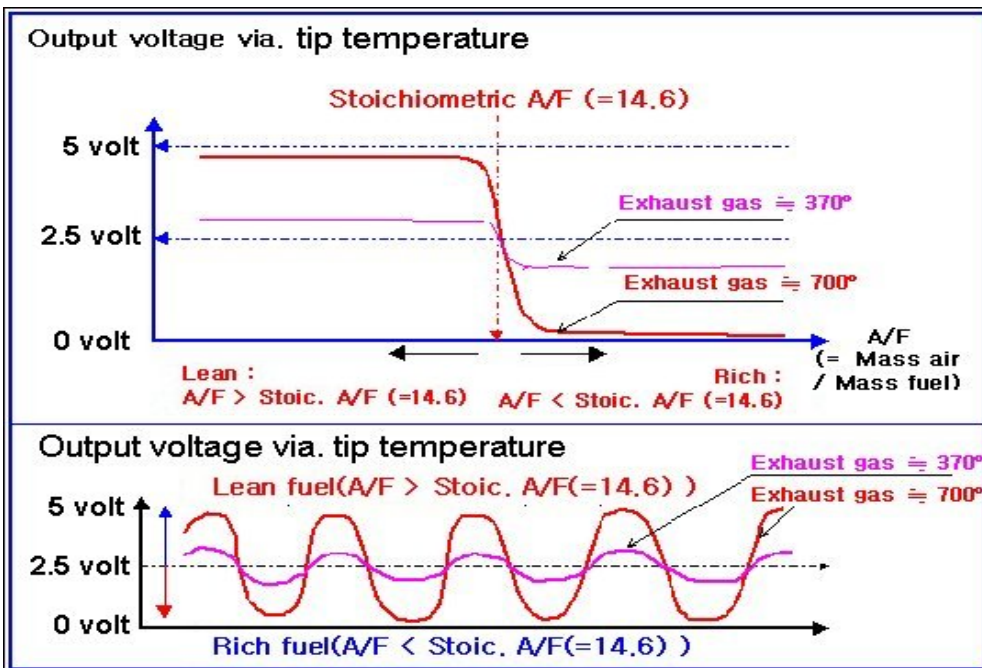


5. Wave analysis

Oxygen sensor heater power

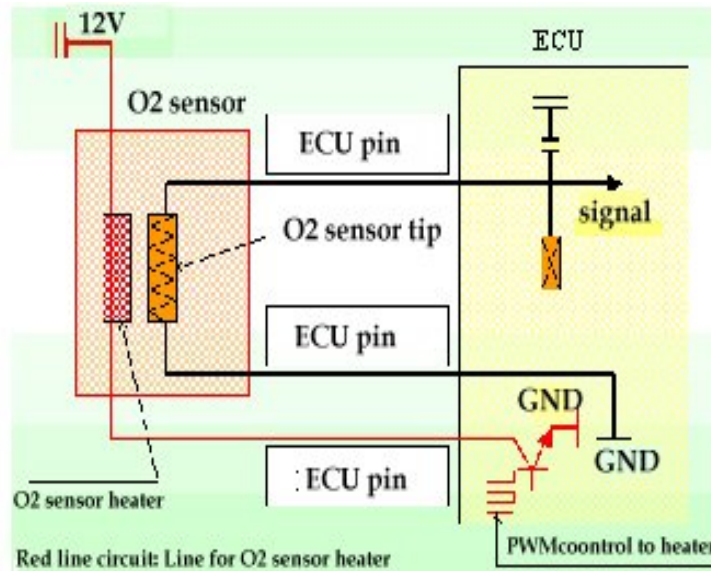


Oxygen sensor tip temperature effect (Zirconium)

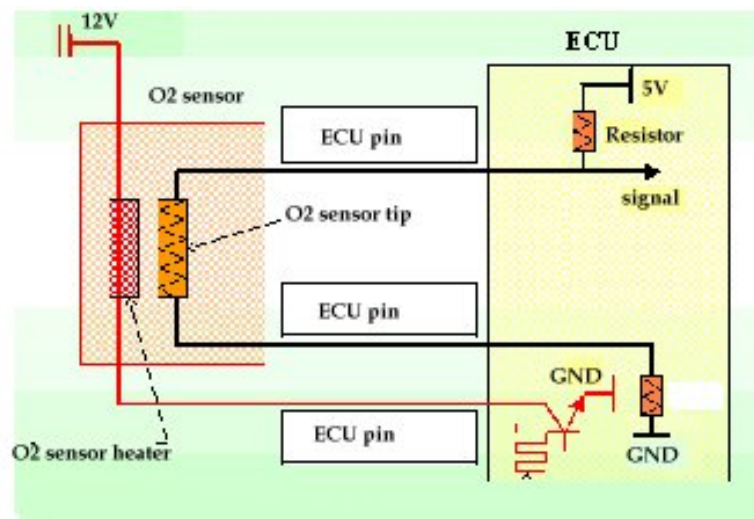


6. General

Oxygen sensor makes the voltage after tip temperature is over 370°C (Light off temperature). So it's required the heater if exhaust gas temperature is below this temperature (270~320°C during idle status).



< Heater circuit : ZrO₂>



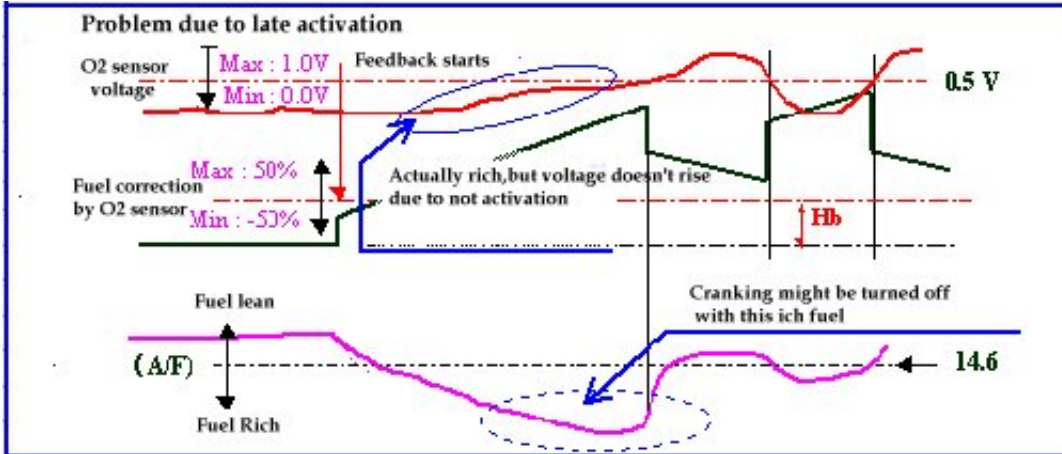
< Heater circuit : TiO₂>

Oxygen sensor is located in exhaust pipe, so vapor can be smeared to sensor tip area during cold condition. If heater is operated during cold (normally -5~25°C) condition, the oxygen sensor can be cracked. So heater control should be started after this temperature.

Also heater control is not operated during full acceleration phase because high exhaust gas temperature (over 750°C) makes the sensor damage if heater control is activated.

7. Principle (Algorithm) introduction

In case of oxygen sensor heater error, it does not give any direct influence to the vehicle. But, activation time of oxygen sensor will be late and since oxygen sensor feedback activate, oxygen sensor signal is still low and ECU detect is as lean mixture and will supply more fuel.



OUTPUT FAILURE STRATEGY	REMARKS
<p>PP & PM FUNCTION</p> <p>CO or CC</p> <p>NPxxx</p> <p>PPxxx <input type="checkbox"/> OFF <input type="checkbox"/> ON</p> <p>PMxxx <input type="checkbox"/> OFF <input type="checkbox"/> ON</p> <p>CEL (MIL) <input type="checkbox"/> OFF <input type="checkbox"/> ON</p> <p>Actuator activation <input type="checkbox"/> Actuator deactivated <input type="checkbox"/> Actuator activated</p>	<p>xxxTC : Actuator deactivation time when PP detected.</p> <p>xxxTL : Actuator deactivation time when PM detected.</p> <p>cf) xxxTC & xxxTL : Calibration value</p> <p>a : Actuator activation time to confirm failure</p>
<p>OUTPUT FAILURE DETECTION AT IGNITION KEY "ON"</p> <p>Ignition key</p> <p>Fuel pump relay</p> <p>TMDGOUT</p> <p>Output failure detection sequence</p> <p>Output activation and failure test</p>	<p>The total time of the sequence + TMDGOUT should be shorter than the fuel pump activation time (= TBPMP sec)</p> <p>NCYxxx : The number of output activation (= calibration value)</p>

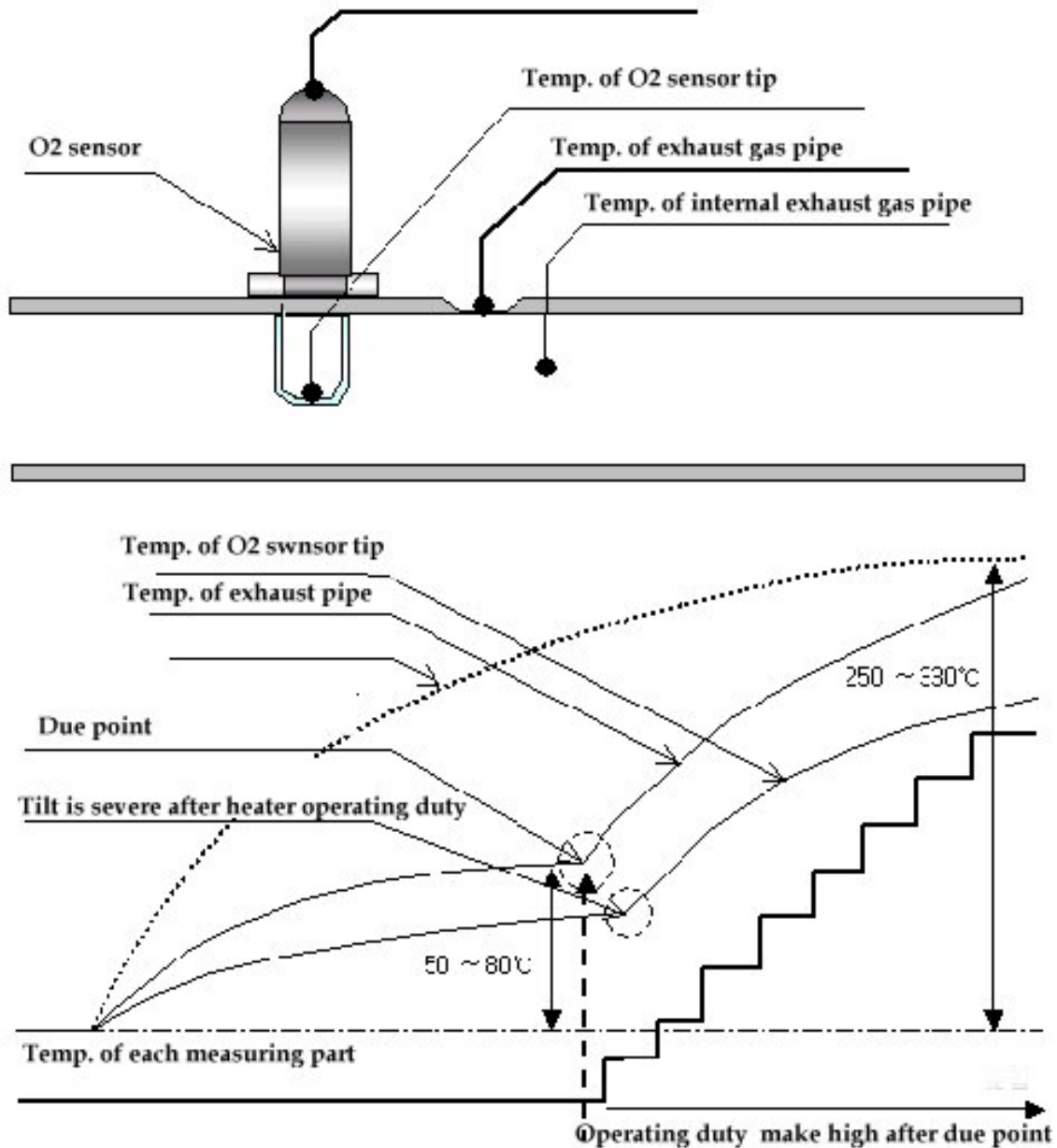
Actually, feedback control condition of the car which has oxygen sensor with heater is simple and fast and therefore it is easily expected that additional fuel supply with low sensor signal by heater error.

For the oxygen sensor heater error, it is same as other output diagnosis. If the current (or resistance) of inside of ECU is less or bigger than threshold during operation of output component, error is detected. Diagnosis for output is finished for the first 1sec after ignition

key ON. And after engine start, diagnosis is performed under each error check conditions.

Most of important point at the oxygen sensor heater is dew point. This is to heat the sensor after removing of water on the oxygen sensor tip. Some test too see how much time is need to pass dew

point after start is performed. And then delay time for heating is applied with consideration of “intake air temperature, coolant temperature and difference between intake and coolant



temperature.” Generally, in case of that oxygen sensor is installed on the horizontal exhaust pipe, dew point can be seen clearly. But sometimes it is not shown with the oxygen sensor installed on the vertical exhaust pipe.

The main purpose of oxygen sensor heater control is to heat up the sensor more fast with 100%. So, if we know the dew point exactly, 100% of heating can be applied right after dew point. But, in order to prevent oxygen sensor damage by overheating, heater control is stop in the area of high exhaust gas temperature.

This kind of functions are exist to protect some problems can be happened in the vehicle. If a certain vehicle has ON/OFF type oxygen sensor heater, the heater will be ON as soon as engine start and there will be a possibility of oxygen sensor damage by dew point or overheating.