## Modelos competidores (Diesel)

<table>
<thead>
<tr>
<th>Item/Modelo</th>
<th>Kia Sorento</th>
<th>Hyundai Teracan</th>
<th>Daewoo Rexton</th>
<th>Opel Frontera</th>
<th>Mitsubishi Pajero</th>
<th>LandRover Freelander</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacidad (cc)</td>
<td>2,497</td>
<td>2,476</td>
<td>2,874</td>
<td>2,171</td>
<td>3,200</td>
<td>1,950</td>
</tr>
<tr>
<td>M.Potencia (Ps)</td>
<td>145/4,000</td>
<td>103/3,800</td>
<td>120/4,000</td>
<td>115/3,800</td>
<td>160/3,800</td>
<td>112/4,000</td>
</tr>
<tr>
<td>M.Par (kg-m)</td>
<td>33/2,000</td>
<td>24/2,000</td>
<td>25.5/2,400</td>
<td>26.5/1,900</td>
<td>38/2,000</td>
<td>26.5/1,750</td>
</tr>
<tr>
<td>Longitud (mm)</td>
<td>4,567</td>
<td>4,710</td>
<td>4,720</td>
<td>4,658</td>
<td>4,280</td>
<td>4,368</td>
</tr>
<tr>
<td>Anchura (mm)</td>
<td>1,865</td>
<td>1,860</td>
<td>1,870</td>
<td>1,814</td>
<td>1,875</td>
<td>2,068</td>
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<tr>
<td>Altura (mm)</td>
<td>1,730</td>
<td>1,795</td>
<td>1,760</td>
<td>1,748</td>
<td>1,845</td>
<td>1,708</td>
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<tr>
<td>Entre ejes (mm)</td>
<td>2,710</td>
<td>2,750</td>
<td>2,820</td>
<td>2,702</td>
<td>2,545</td>
<td>2,557</td>
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<tr>
<td>Peso (Kg)</td>
<td>1,957</td>
<td>1,975</td>
<td>1,950</td>
<td>1,884</td>
<td>2,055</td>
<td>1,771</td>
</tr>
</tbody>
</table>
### Especificaciones del motor

<table>
<thead>
<tr>
<th>Items / Modelo</th>
<th>A 2.5 TCI CRDI</th>
<th>3.5 (V6)</th>
<th>SIRIUS-Ⅱ (2.4ℓ I4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tipo</td>
<td>IN-LINE 4 Cylinder</td>
<td>V6</td>
<td>IN-LINE 4 Cylinder</td>
</tr>
<tr>
<td>Sistema de válvulas</td>
<td>DOHC</td>
<td>DOHC</td>
<td>DOHC</td>
</tr>
<tr>
<td>Max. Potencia (Ps/rpm)</td>
<td>145/4000</td>
<td>195/5500</td>
<td>140/5500</td>
</tr>
<tr>
<td>Max. Par (kg-m/rpm)</td>
<td>33/2000</td>
<td>30/3000</td>
<td>20.2/3000</td>
</tr>
<tr>
<td>Tipo de inyección</td>
<td>Direct Injection</td>
<td>MPI</td>
<td>MPI</td>
</tr>
<tr>
<td>Capacidad (cc)</td>
<td>2,497</td>
<td>3,497</td>
<td>2,361</td>
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<tr>
<td>Diámetro X carrera (mm)</td>
<td>91x96</td>
<td>93x85.8</td>
<td>86.5x100</td>
</tr>
<tr>
<td>Relación de compresión</td>
<td>17.7:1</td>
<td>10:1</td>
<td>10:1</td>
</tr>
<tr>
<td>Cruce de válvulas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Admisión</td>
<td>Abre(APMS)</td>
<td>8'</td>
<td>11.5'</td>
</tr>
<tr>
<td></td>
<td>Cierra(DPMS)</td>
<td>38'</td>
<td>60.5'</td>
</tr>
<tr>
<td>Escape</td>
<td>Abre(BBDC)</td>
<td>52'</td>
<td>43.5</td>
</tr>
<tr>
<td></td>
<td>Cierra(ATDC)</td>
<td>8'</td>
<td>20.5'</td>
</tr>
<tr>
<td>Juego de válvulas</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ralentí (rpm)</td>
<td>800±50</td>
<td>700±100</td>
<td>800±50</td>
</tr>
<tr>
<td>Avance de encendido (BTDC)</td>
<td>-</td>
<td>10' ± 2'</td>
<td>5'±2'</td>
</tr>
<tr>
<td>Orden de encendido</td>
<td>1-3-4-2</td>
<td>1-2-3-4-5+6</td>
<td>1-3-4-2</td>
</tr>
</tbody>
</table>
Vista del motor – A 2.5 TCI (CRDI)

A – 2.5 TCI – CRDI
Vista del motor – Σ 3.5 (V6)

Sigma(Σ) 3.5ℓ
Vista del motor – Sirius-Ⅱ (2.4ℓ)

Sirius-Ⅱ 2.4ℓ (In-Line)
Cambio manual:  → M5UR1

Cambio automático:  → 30-40LEI
Sistema de inyección diesel

Motor diesel
A-2.5 TCI
A-2.5 TCI (CRDI)

- Incrementada la potencia específica y reducido el consumo
  - DOHC 4 válvulas por cilindro
  - Turbo con intercooler
  - Electronic Diesel Control (EDC) de Bosch con Common Rail
  - Inyectores de alta precisión controlados electrónicamente montados en el centro de la cámara de combustión
  - Alta presión de inyección, aprox. 1,350 bar

- Reducido las emisiones, ruidos y vibraciones
  - Inyección piloto antes de la principal
  - Arboles contrarrotantes
  - EGR con catalizador por oxidación
  - Soporte de árboles de levas y doble cárter
A-2.5 TCI (CDRI) – Curvas del motor

Prueba: JIS 82 NET
Motor: D4CB(A2.5 TCI)
Turbo - VGT

- VGT (Turbo de Geometría Variable)

Diagram showing:
- Vacuum Actuator
- Nozzle Vane
- Unison Ring
A-2.5 TCI (CDRI) – Presión del turbo

- Presión del turbo a la salida del intercooler
Enfriamiento del aire de admisión
Temperatura del aire a la salida del intercooler
A-2.5 TCI(CRDI)  Diagrama de sistema de raíl común

Diagrama del sistema – CP3
Componentes

- ①: Depósito
- ②: Prefiltro
- ③: Filtro de combustible
- ④: Bomba de baja presión
- ⑤: Bomba de alta presión
- ⑥: Válvula de control
- ⑦: Raíl común
- ⑧: Válvula limitadora
- ⑨: Línea de retorno
- ⑩: Línea de alta
- ⑪: Línea de baja
- ⑫: Inyector
- ⑬: Sensor del árbol de levas
- ⑭: Sensor de flujo de aire
- ⑮: Sensor de temperatura
- A: Relé de calentadores
- B: ECM
- C: Sensor del cigüeñal
- D: Sensor de alta presión
- E: Turbo
- F: Válvula de descarga
- G: Sensor del acelerador
- H: Interruptor de freno
- I: Interruptor del embrague
- J: Interruptor A/C
- K: Conector de diag.
- L: Can Bus
- M: Cuadro
- N: Modulador de vacío para la EGR
- O: Batería
- KIA MOTORS
Limpieza

La alta presión requerida en los sistemas de raíl común hacen necesario hacer los orificios de los inyectores mucho más pequeños que los de un sistema convencional.

Por ello, la limpieza a la hora de trabajar con estos sistemas es fundamental e imprescindible.
Sorento – Engine Room

- Sensor de flujo de aire
- Válvula EGR
- Intercooler
- Bomba de alta presión
- Vantilador del condensador
A 2.5 TCI – Vista frontal

- Alternador
- Tensor
- Cadena de distribución “C”
- Bomba de alta presión
- Embrague del ventilador
Embrague del ventilador
A 2.5 TCI – Vista lateral

- Calentador
- Sensor del cigüeñal
- Enfriador de aceite
- Filtro de aceite
- Doble cárter
- Correa múltiple
- Turbo
- Compresor del A/C
- Cárter
Características - Turbo

■ Turbo

- Turbo refrigerado por agua
- Válvula de descarga
- Intercooler frontal
Características – Correa múltiple

Componentes

- Correa múltiple
- Alternador
- Rodillos
- Bomba de agua
- Compresor del A/C
- Tensor
- Bomba de dirección
Características – Soporte de los árboles de levas

Componentes

El uso de soporte para los árboles de levas reduce el ruido y las vibraciones.
Características – Válvulas

■ Componentes

- 4 válvulas por cilindro con ajuste hidráulico

Ajuste hidráulico
Características – Pistón y biela

■ Componentes

- Pistones refrigerados por aceite

- Par de apriete de las tapas de biela:
  ① apretar a 6.0kg-m
  ② aflojar
  ③ Reapretar a 3.5kg-m
  ④ apretar de 60~64 grados
Características – NVH

- Componentes

8 contrapesos

Arboles contrarrotantes
Características - NVH

■ Componentes

- Doble cárter
Características – Oil Pump

Componentes

- Bomba de aceite montada dentro del cárter
- Aceite usado: CE grade 10W30
Cadenas de distribución

Componentes

- Libres de mantenimiento
- Compuesto por tres cadenas: A, B y C
Cadena “A”

Componentes
- Mueve el piñón del cigüeñal, la bomba de alta presión y el árbol contrarrotante derecho
Cadena “B”

- Componentes

  - Mueve el piñón del cigüeñal, la bomba de aceite y el árbol contrarrotante izquierdo
  - Marcas alineadas en la instalación inicial
  - Adecuado engrase de la cadena y la guía

![Imagen de componentes de la cadena B con elementos destacados como dientes de cadena y rodamientos]
Componentes

- Mueve la bomba de alta presión y los piñones de los árboles de levas.
■ Reference
- El reemplazamiento de las cadenas A y B no es posible con el motor montado, sin embargo, la cadena C sí.
- La alineación de las cadenas con los piñones es fundamental, sobre todo en la cadena C.
- Hay tres tipos de piñones para la bomba de alta presión. Cada vez que se cambie el piñón de la bomba, hay que medir la distancia entre el piñón y la bomba y colocar el que corresponda.

<table>
<thead>
<tr>
<th>Color</th>
<th>Grosor (mm)</th>
<th>Piñón</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue</td>
<td>34.2-35.0</td>
<td>A</td>
</tr>
<tr>
<td>White</td>
<td>33.4-34.2</td>
<td>B</td>
</tr>
<tr>
<td>Red</td>
<td>35.0-35.8</td>
<td>C</td>
</tr>
</tbody>
</table>
Sistema de combustible
Sistema de combustible – Línea de baja presión

Componentes:

- Válvula limitadora
- Common rail
- Sensor de presión del rail
- Inyector
- Bomba de alta presión
- Filtro de combustible
  - Decantador agua
  - Calentador gasoil
- Sensor de presión del rail
- Depósito

Presión:

- Presión de succión (0.5-1 bar)
- Presión de succión (4-6 bar)
- Presión (4-6 bar)
- Prefiltro (600 µl)
Línea de baja presión - Componentes

- El depósito está situado debajo de la segunda fila de asientos
- La capacidad es de 72 ℓ
- La válvula de corte (situada bajo el filtro del aire) previene fugas de gasoil del depósito al cánister en caso de emergencia
- **Aforador** : Detecta la cantidad de gasoil por medio de un potenciómetro que manda la señal al cuadro.

- **Luz de reserva** : Cuando el potenciómetro marca un cierto valor durante $60 \pm 20$ segundos, la luz de reserva se enciende.

### Relé de la luz de reserva

<table>
<thead>
<tr>
<th>Posición</th>
<th>Lleno</th>
<th>3/4</th>
<th>1/2</th>
<th>Luz de reserva on</th>
<th>Vacío</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistencia Valor($\Omega$)</td>
<td>$3\pm1$</td>
<td>$18.5\pm1$</td>
<td>$32.5\pm1.5$</td>
<td>$83\pm2$</td>
<td>$110\pm2$</td>
</tr>
<tr>
<td>Capacidad del depósito($\ell$)</td>
<td>72</td>
<td>54</td>
<td>36</td>
<td>12</td>
<td>8</td>
</tr>
</tbody>
</table>
Línea de baja presión – Filtro de combustible

■ Componentes

- El sistema de rail común necesita un gasoil mucho más limpio que un sistema convencional por varias razones.
- El agua y los contaminantes sólidos, sobre todo en invierno, dan lugar a desgaste, erosión, filtro obstruido, picaduras, pérdida de presión y eventualmente falta de lubricación de la bomba.
- Para reducir estos problemas, el Sorento monta un filtro Bosch con decantador de agua y calentador de gasoil incluidos.

- **Componentes**: 
  ① Filtro  
  ② Interruptor de temperatura del gasoil  
  ③ Sensor de agua  
  ④ Calentador del gasoil  
  ⑤ Purgador
Descripción

- Previene que el gasoil se solidifique a bajas temperaturas.

- Funcionamiento:
  on: por debajo de -5 °C
  off: por encima de 3 °C

Diagrama
Línea de baja presión – Bomba de aspiración
Sistema de combustible – Línea de alta presión

- Depósito
- Filtro de combustible
- Prefiltro (600 µl)
- Bomba de succión
- Inyector
- Presión (0.5-1 bar)
- Válvula limitadora
- Common rail
- Sensor de presión del rail
- Válvula de control de la presión
- Bomba de alta presión (4-6 bar)
- Linea de alta presión
Componentes

Bomba de aspiración

Válvula de control

Bomba de alta
Línea de alta presión – Válvula de control de presión
Componentes

- **Ralentí (800rpm):**
  - Ciclo ≈ 45%
  - Presión del rail ≈ 270bar

- **Carga (4500rpm):**
  - Ciclo ≈ 35%
  - Presión del rail ≈ 1350bar
Componentes

- Bomba de alta presión
- Válvula de control de presión
- Bomba de aspiración

Entrada de baja
Retorno de baja
Salida de alta
Línea de alta presión – Bomba de alta presión

■ Componentes

- Componentes principales:
  1. Eje principal
  2. Eje excéntrico.
  3. Pistones
  4. Válvula de entrada
  5. Válvula de salida
Línea de alta presión – Rail común

Componentes

① Rail
② Entrada desde la bomba
③ Sensor de presión del rail
④ Válvula limitadora de presión
⑤ Tuberías de los inyectores
Componentes

Válvula mecánica.
Abre cuando la presión en el rail sube a 1.750 bares

① Conexión al rail
② Paso de combustible
③ Pistón
④ Muelle
⑤ Retorno de combustible
Línea de alta presión – Inyector

■ Componentes
- Situado en el centro de la cámara de combustión, inyecta el combustible en la cantidad y tiempo exacto determinado por la unidad de control.

※ Corriente inicial de apertura : 80V/20A
Componentes

1. Retorno de combustible
2. Conector
3. Solenoide
4. Entrada de combustible
5. Bola
6. Canal de descarga
7. Canal de alimentación
8. Cámara de control
9. Embolo
10. Paso de combustible
11. Aguja
Línea de alta presión – Inyector

■ Componentes :
- Secuencia de la inyección:

A = Intensidad
B = Carrera en mm
C = Presión en alta
D = Tiempo de inyección

a = Corriente al solenoide
b = Carrera de la válvula
c1 = Presión en la cámara de control
c2 = Presión de alimentación
d = Inyección
Línea de alta presión – Inyector

Control de la inyección:

1. Descarga del condensador
2. Apertura del inyector
3. Carga del condensador
4. Mantenimiento de la corriente
5. Carga del condensador
6. Corriente de mantenimiento
7. Corriente de mantenimiento
Línea de alta presión – Inyector

- **Descripción:**

  - **Inyección piloto:**

  1 = Inyección piloto

  1a = Presión de la inyección con inyección piloto

  2 = Inyección principal

  2a = Presión de la inyección sin inyección piloto
Descripción:
- Montaje del inyector:
  - Entrada de combustible
    - Par de apriete: 2.5~2.9kg-m
  - Arandela de sujeción
    - Par de apriete: 3.1±0.3kg-m
Electronic Diesel Control (EDC)
### EDC – Entradas / Salidas

**Entradas**

1. Sensor de masa de aire
2. ECT Sensor
3. IAT Sensor
4. CKP Sensor
5. CMP Sensor
6. Rail Pressure Sensor
7. Acel. Pedal Sensor
8. Interruptores
   - Freno
   - Embrague
   - A/C
9. Sensor vel. vehículo

**Salidas**

1. Inyector
2. Válvula control presión
3. Relés
   - Principal
   - Calentadores
   - Ventilador
   - Ventilador condensador
4. VAC modulador de EGR
5. Calentadores refrigerante
6. CAN

**ECM**
EDC – ECM

Descripción:

- Borrado de códigos de avería:
  Los códigos de avería almacenados en la ECM sólo pueden ser borrados usando el Hi-Scan Pro.

- Función de identificación:
  Ya que el Sorento usa la misma ECM, ya sea con cambio manual o cambio automático, es necesario programar el tipo de cambio usado utilizando el Hi-Scan Pro.
- Parada de emergencia

Por razones de seguridad, la ECM efectúa una parada del motor cuando hay una avería en los siguientes casos:

① Inyectores
② Sensor del cigüeñal
③ válvula de control de presión
④ Fugas de combustible

- Atención: No se debe trabajar en el sistema de combustible hasta pasados 30 segundos después de que el motor esté parado.
EDC – Sensor de masa de aire con película caliente

■ Componentes:

- El principio de funcionamiento está basado en el enfriamiento de la película caliente, esto produce una variación de la resistencia que la unidad traduce en la cantidad de aire que entra. Este valor es usado por la ECM exclusivamente para el funcionamiento de la EGR. El sensor de temperatura del aire de admisión está integrado.

- Functions:

① Control de la EGR

② Corrección del combustible en aceleración y desaceleración.

![Diagrama del sensor de aire]
**EDC – Sensor de masa de aire**

- En caso de avería, las revoluciones del motor se limitan a **2250rpm**

<table>
<thead>
<tr>
<th>Code</th>
<th>CC</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTC</td>
<td></td>
<td></td>
<td>Fuel = 0</td>
<td>EGR off</td>
</tr>
<tr>
<td>0100</td>
<td>C001</td>
<td>Signal below lower limit(Air mass &lt; 20kg/h)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C002</td>
<td>Signal above upper limit(Air mass &gt; 800kg/h)</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C003</td>
<td>General Error(Reference Volt &gt; 4.7~5.1)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Graph**

- **Characteristic U = f (m)**

- **FR CH A 5.0 V 0.2 ms CH B 1.0 V**
- **MIN: 4.4 V AVE: 4.6 V MAX: 5.0 V**
- **FREQ: 8.33 kHz DUTY: 49 %**

**Image**

- **HOLD ZOOM CURS RECD MENU**
Descripción:

- El IAT está integrado en el sensor de masa de aire. Usando una resistencia NTC, el sensor mide la temperatura del aire de admisión.

Cuando hay una avería en el sensor, el valor de temperatura alternativo es de 50 °C.

<table>
<thead>
<tr>
<th>Code</th>
<th>Detail Description</th>
<th>Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTC</td>
<td>CC</td>
<td>Fuel = 0</td>
</tr>
<tr>
<td>0110</td>
<td>C001 Signal below lower limit(Signal &lt;224mV)</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>C002 Signal above upper limit(Signal&gt;4.97V)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(Malfunction set value : 50 °C)</td>
<td></td>
</tr>
</tbody>
</table>
EDC – Sensor del pedal del acelerador

■ Descripción:

- El sensor del pedal de acelerador está situado en el pedal del acelerador y mide la posición del pedal para controlar la cantidad de inyección a través de la señal que llega a la ECM. El sensor está compuesto de dos potenciómetros APS1 y APS2. El APS 1 es el sensor principal y el APS 2 se usa para controlar el funcionamiento correcto del APS1. El valor del sensor APS 2 es justo la mitad que el valor del APS 1.
- Cuando hay un fallo del sensor las revoluciones del motor se limitan a **1250rpm**

<table>
<thead>
<tr>
<th>Code</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>DTC 0120</strong></td>
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<td></td>
</tr>
<tr>
<td>C001</td>
<td>Signal below lower limit(Signal &lt;68.4mV)</td>
<td>Y</td>
<td>IG On</td>
</tr>
<tr>
<td>C002</td>
<td>Signal above upper limit(Air mass&gt;4.9V)</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>C003</td>
<td>General error(Reference Volt&gt;1.7~5.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C004</td>
<td>Plausibility error with brake signal</td>
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<td></td>
</tr>
<tr>
<td><strong>DTC 0220</strong></td>
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</tr>
<tr>
<td>C001</td>
<td>Signal below lower limit(Signal &lt;68.4mV)</td>
<td></td>
<td>IG On</td>
</tr>
<tr>
<td>C002</td>
<td>Signal above upper limit(Air mass&gt;2.45V)</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>C003</td>
<td>General error(Reference Volt&gt;1.7~5.1)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C004</td>
<td>Plausibility error (APS 1 and APS 2)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EDC – Sensor del pedal del acelerador

- Ralenti:
  - MIN: 325.7mV AVE: 434.3mV MAX: 597.2mV
  - MIN: 705.8mV AVE: 814.4mV MAX: 1.1 V

- Carga total:
  - MIN: 1.1 V AVE: 1.8 V MAX: 2.0 V
  - MIN: 3.8 V AVE: 3.9 V MAX: 4.0 V
EDC – Sensor del cigüeñal (CKP)

■ Descripción:
- El sensor del cigüeñal (CKP) es del tipo inductivo. Al paso de los dientes de la corona dentada (60 – 2) genera una corriente alterna que envía a la ECM, que traduce la señal y calcula las revoluciones del motor y el PMS.
EDC – Sensor del cigüeñal

- Si hay código de avería, el motor se para y no vuelve a arrancar.

Sensor motion direction

Crankshaft
Mechanical
Target Wheel

Reference point of the target used by EMS to synchronize the engine

Air gap=1±0.5mm

Output sensor
Electrical signal

ON = 0V

Above 4.7V

OFF ≥ 4.2V

OFF ≥ 4.2V

Tolerance = +/- 0.45 ° crankshaft

ON ≤ 1.8

Below 0.8V

≤ 1.8

≥ 4.7V

KIA MOTORS
EDC – Sensor del árbol de levas (CMP)

■ Descripción:
- El sensor del árbol de levas (CMP) es del tipo Hall:

El sensor del árbol de levas controla la posición del árbol de levas enviando una señal a la ECM, de esta manera, la ECM cual es el pistón que está en la carrera de compresión, algo que sólo con el sensor del cigüeñal es imposible determinar.
- Si hay un fallo del sensor, el motor sigue funcionando, pero no vuelve a arrancar.

### Check Condition

<table>
<thead>
<tr>
<th>Code</th>
<th>CC</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0340</td>
<td>CMP signal below lower limit (No signal)</td>
<td>Fuel = 0</td>
<td>No START</td>
</tr>
<tr>
<td>C001</td>
<td></td>
<td>CMP Signal above upper limit</td>
<td>EGR off</td>
<td></td>
</tr>
<tr>
<td>C002</td>
<td></td>
<td>CKP&amp;CMP General error (Rationality check)</td>
<td>Fuel Limit</td>
<td></td>
</tr>
<tr>
<td>C003</td>
<td></td>
<td>CKP Plausibility error</td>
<td>MIL On</td>
<td></td>
</tr>
<tr>
<td>C004</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EDC – Sensor de presión del rail (RPS)

■ Descripción:
- El sensor de presión del rail (RPS) está ubicado en el rail:
  El objetivo del sensor es medir la presión del rail en cada momento mandando una señal en forma de voltaje a la ECM.
- Si falla el sensor, el motor se para y no vuelve a arrancar.

Arranque : 0.5→1.3V(≒250bar)
Ralenti : 1.3V(≒250~260bar)
WOT : 4.1V(≒1350bar)

- sensor monitoring

<table>
<thead>
<tr>
<th>Code</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTC</td>
<td>Code</td>
<td>Fuel = 0</td>
<td>EGR off</td>
</tr>
<tr>
<td>0190</td>
<td>C001</td>
<td>Signal below lower limit(Signal &lt;180mV)</td>
<td>Y</td>
</tr>
<tr>
<td></td>
<td>C002</td>
<td>Signal above upper limit(Signal&gt;4.8V)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>C003</td>
<td>General Error(Reference Volt&gt; 4.7~5.1)</td>
<td></td>
</tr>
</tbody>
</table>
## EDC – Rail Pressure Sensor (RPS)

- **Pressure monitoring**: only conduct more than 700 rpm condition

<table>
<thead>
<tr>
<th>Code</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTC</td>
<td></td>
<td>Fuel = 0</td>
<td>EGR off</td>
</tr>
<tr>
<td>CC</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>1181</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C005</td>
<td>Maximum pressure exceed (pressure &gt; 1480 bar)</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>C006</td>
<td>* Pressure lower limit by rpm</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C008</td>
<td>* Pressure target value check (Negative deviation)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>C010</td>
<td>* Pressure target value check (Positive deviation)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Pressure lower limit by rpm**:
- 120 bar / 800 rpm, 180 bar / 2000 rpm, 230 bar / 3000 rpm, 270 bar / 4000 rpm

**Pressure target value check**: (RPS stuck, wiring problem)
- 350 bar / 800 rpm, 300 bar / 2000 rpm, 250 bar / 3000 rpm

**Pressure target value check**: (fuel leakage, failure from feed pump or high pump)
- 300 bar / 800 rpm, 250 bar / 2000 rpm
EDC – Sensor de temperatura del refrigerante (WTS)

■ Components Descriptions:
- El sensor está situado en la culata:
el sensor del tipo NTC mide la temperatura del refrigerante y manda una señal a la ECM. La resistencia del sensor disminuye cuando la temperatura del refrigerante aumenta.

La ECM utiliza la señal para calcular el avance de la inyección y adecuar las revoluciones del motor. También disminuye la cantidad de inyección cuando el motor está a la temperatura de servicio.
EDC – Sensor de temperatura del refrigerante (WTS)

- Si falla el sensor :
  ① No funciona el A/C ni el precalentamiento del refrigerante, el ventilador funciona constantemente.
  ② Valor alternativo : después del arranque : 80 ℃
                     antes de arrancar : -20 ℃

<table>
<thead>
<tr>
<th>Code</th>
<th>DTC</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>CC</td>
<td></td>
<td>Fuel = 0</td>
<td>EGR off</td>
</tr>
<tr>
<td></td>
<td>C001</td>
<td>Signal below lower limit(Signal &lt;225mV)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>C002</td>
<td>Signal above upper limit(Signal&gt;4.9V)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
EDC – Interruptor del freno

■ Descripción:
Hay dos interruptores por razones de seguridad. Cuando el pedal de freno se pisa el interruptor 1 se cierra, mientras que el 2 se abre.
A través de estas señales contrarias, la ECM es capaz de controlar en todo momento el estado del interruptor del freno.
### EDC – Interruptor del freno

<table>
<thead>
<tr>
<th>Code</th>
<th>CC</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>0703</td>
<td>C004</td>
<td>Plausibility error (comparing switch 1&amp; 2)</td>
<td>Fuel = 0</td>
<td>EGR off</td>
</tr>
</tbody>
</table>

**Check Condition:**
- Fuel = 0
- EGR off
- Fuel Limit
- MIL On

**Symptoms:**
- IG On
EDC – Interruptor del embrague

■ Descripción :

- Sólo se usa para cambio manual:
  ① Reduce la emisión de humos al cambiar de marcha
  ② Control de crucero

<table>
<thead>
<tr>
<th>Code</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTC</td>
<td>CC</td>
<td>Fuel = 0</td>
<td>EGR off</td>
</tr>
<tr>
<td>0704</td>
<td>C004 Plausibility error (No signal within 80km/h)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Los inyectores montados en el Sorento tienen un sistema servo hidráulico y una bobina. **Corriente de apertura : 20A±1A, corriente de mantenimiento : 12A±1A**
- Si fallan dos o más inyectores el motor se para automáticamente.
<table>
<thead>
<tr>
<th>Code</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>Fuel = 0</td>
<td>EGR off</td>
</tr>
<tr>
<td>0201</td>
<td>Low side Line short circuit (current &gt; 29.5–34A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0202</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>0203</td>
<td>High side line short circuit (current &gt; 28–36A)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>0204</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Line open circuit</td>
<td>Y</td>
<td>Y</td>
</tr>
</tbody>
</table>

※ 0201 : Injector No. 1  0202 : Injector No. 2  
0203 : Injector No. 3  0204 : Injector No. 4
EDC – Sistema de calentadores

■ Descripción:

El sistema de calentadores es responsable de un aranque perfecto cuando el motor está frío y también acorta el periodo de calentamiento, lo que reduce la emisión de gases.
EDC – Sistema de calentadores

- El tiempo de calentamiento depende de la temperatura y de las revoluciones.
- Hay tres modos en el sistema de calentadores:

① **Precalentamiento:**

<table>
<thead>
<tr>
<th>Temp. refrigerante(℃)</th>
<th>-20℃</th>
<th>-10℃</th>
<th>20℃</th>
<th>50℃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Calentamiento (Sec.)</td>
<td>12</td>
<td>8</td>
<td>3</td>
<td>0.7</td>
</tr>
</tbody>
</table>

② Durante el aranque: En caso de que el motor no arranque después de tiempo de precalentamiento, si en motor está por debajo de 60º los calentadores se ponen en funcionamiento como max. durante 30 seg. Si antes de pasar los 30 seg. el motor sube más de 60º, se paran los calentadores.

③ **Post calentamiento:** Si el motor no sube de 2500 rpm y la cantidad de inyección es inferior a 75cc/min.

<table>
<thead>
<tr>
<th>Coolant Temp.(℃)</th>
<th>-20℃</th>
<th>-10℃</th>
<th>20℃</th>
<th>40℃</th>
</tr>
</thead>
<tbody>
<tr>
<td>Glow time (Sec.)</td>
<td>40</td>
<td>25</td>
<td>10</td>
<td>0</td>
</tr>
</tbody>
</table>
Diagrama:

EDC – Relé principal
<table>
<thead>
<tr>
<th>Code</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>1616</td>
<td>Plausibility Error (IG signal comparison)</td>
<td>Fuel = 0, EGR off, Fuel Limit, MIL On</td>
<td>IG. On</td>
</tr>
</tbody>
</table>
EDC – Calentadores del refrigerante

Tres calentadores
EDC – EGR

Componentes:

- Solenoide
- Válvula EGR
EDC – EGR

- Diagrama :

- Turbine
- Entrada de aire
- AFS signal
  (EGR feedback control)
- MOTOR
- Col. escape
- Col. admisión
- Inter-Cooler
- Bomba de vacío
- Controlled Vac. Pressure
- ECM
  - Feed back EGR
  - Target EGR
- APS
  - rpm
- EGR Valve
- Admisión
- Vacío
- Señal
- Escape
- EGR Gas

KIA KIA MOTORS
### EDC – EGR

<table>
<thead>
<tr>
<th>Code</th>
<th>Detail Description</th>
<th>Symptoms</th>
<th>Check Condition</th>
</tr>
</thead>
<tbody>
<tr>
<td>DTC</td>
<td></td>
<td>Fuel = 0</td>
<td>EGR off</td>
</tr>
<tr>
<td>0403</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C018</td>
<td>Short circuit to Bat(+)</td>
<td>Y</td>
<td></td>
</tr>
<tr>
<td>C019</td>
<td>Short circuit to GND</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Note:**
- **C018** indicates a short circuit to the battery (positive side).
- **C019** indicates a short circuit to ground.
Engine
Contents

- Sigma(Σ) Engine Hardware
- Sigma(Σ) Engine Management System
Sigma(Σ) 3.5ℓ Eng. – Engine Concept

- Sigma(Σ)3.5ℓ Development concept

- Lay-out
  - Σ 3.5 Dohc FF (already installed in Carnival) → FR Design
- Performance
  - Low-middle range torque up --- VIS
- Emission
  - Korean Domestic 2000, LEV, Euro - III
- NVH
  - HLA, Beam Bearing Cap, Engine Cover
- Long Durability
## Sigma(Σ) 3.5ℓ Eng. – Engine Concept

<table>
<thead>
<tr>
<th>Sys.</th>
<th>BL Σ-3.5 FR</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lubrication</td>
<td>∙ Oil Level Stability of Up/Downhill at 35 Degree and Fast Turning</td>
<td></td>
</tr>
<tr>
<td>Cooling</td>
<td>∙ Cooling &amp; Air-Vent Sys. Design for Engine Install(5° incline in front side)</td>
<td></td>
</tr>
<tr>
<td>Intake &amp; Exhaust</td>
<td>∙ Added Vacuum Type VIS and Aerodynamic Port Design for Low-Middle Performance &lt;br&gt; ∙ Added MCC and Minimized Exhaust Gas Resistance for LEV</td>
<td></td>
</tr>
<tr>
<td>Accessory</td>
<td>∙ Optimization of Aux. Drive Belt Lay-out Design</td>
<td></td>
</tr>
<tr>
<td>Moving</td>
<td>∙ Improved HC EM &amp; Blow-by Gas</td>
<td></td>
</tr>
</tbody>
</table>
## Comparison

<table>
<thead>
<tr>
<th>Part Name</th>
<th>Σ3.5 ENG</th>
<th>MAKER</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>GQ3.5</td>
<td>BL3.5</td>
<td></td>
</tr>
<tr>
<td>Water Temp Sensor &amp; Heat Gage Unit</td>
<td>Part No.</td>
<td>Part No.</td>
<td></td>
</tr>
<tr>
<td></td>
<td>39220–38020</td>
<td>←</td>
<td>ELEC. KOREA INSI</td>
</tr>
<tr>
<td></td>
<td>39220–38030</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td>Ignition Coil</td>
<td>27300–39050</td>
<td>27300–39800</td>
<td>DENSO PUNGSON</td>
</tr>
<tr>
<td>Ignition Failure Sensor</td>
<td>27370–38000</td>
<td>←</td>
<td>Hyundai Autonet</td>
</tr>
<tr>
<td>Spark Plug</td>
<td>18817–11051(PFR5N–11) 27410-37100(RC10PPYPB4)</td>
<td>←</td>
<td>WOOJIN SERM</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Small different shape</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Same performance</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Integrated Power_Tr</td>
</tr>
<tr>
<td>Air flow sensor</td>
<td>28100–39400</td>
<td>←</td>
<td>BOSCH KOREA</td>
</tr>
<tr>
<td></td>
<td>28100–39450</td>
<td>←</td>
<td>– Hot Film Type</td>
</tr>
<tr>
<td>Air Temp. Sensor</td>
<td>Integrated in AFS</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td>Crank Angle Sensor (CAS)</td>
<td>39310–39010</td>
<td>39310–39800</td>
<td>VDO HALRA</td>
</tr>
<tr>
<td>Cam position Sensor(CPS)</td>
<td>39310–39110</td>
<td>39318–39800</td>
<td>VDO HALRA</td>
</tr>
<tr>
<td>ECU</td>
<td>39110–39600</td>
<td>39110–39420</td>
<td>KEFICO</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– GQ : PCU(ECU+TCU)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– BL : ECU (separated TCU)</td>
</tr>
<tr>
<td>Throttle Body Assy</td>
<td>35100–39610</td>
<td>35100–39600</td>
<td>DEASONG</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Small different shape</td>
</tr>
<tr>
<td>Throttle Position Sensor*</td>
<td>incorporated in THV</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– Same Sp</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>– with idle switch</td>
</tr>
</tbody>
</table>
### Sigma(Σ) 3.5ℓ Eng. – Main component comparison

<table>
<thead>
<tr>
<th>Part Name</th>
<th>GQ3.5</th>
<th>BL3.5</th>
<th>MAKER</th>
<th>REMARK</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle Speed Actuator*</td>
<td></td>
<td></td>
<td></td>
<td>- Same Sp&lt;br&gt;- Stepping Motor</td>
</tr>
<tr>
<td>Part No.</td>
<td></td>
<td></td>
<td></td>
<td>←</td>
</tr>
<tr>
<td>Fuel injector ass'y</td>
<td>35310-38010</td>
<td>←</td>
<td>KEFICO</td>
<td></td>
</tr>
<tr>
<td>Fuel pressure regulator</td>
<td>35301-39600</td>
<td>35301-39410</td>
<td>INZI</td>
<td>- Same press. control (3.35±0.05Kgf/㎠)&lt;br&gt;- Different shape</td>
</tr>
<tr>
<td>Knock sensor</td>
<td>39320-35561</td>
<td>39510-39810</td>
<td>INZI</td>
<td>- Same Spec&lt;br&gt;(resonance-type : 11.0KHz)&lt;br&gt;- Different L/Wire</td>
</tr>
<tr>
<td>MAP sensor</td>
<td>39300-38100 39300-38200</td>
<td>←</td>
<td>KEFICO</td>
<td>- 20~106.7KPa abs&lt;br&gt;- FLO Type (+ Heated type)&lt;br&gt;- Different L/Wire</td>
</tr>
<tr>
<td>O2 sensor (Bank1-Up)</td>
<td>39210-39800</td>
<td>39210-39820</td>
<td>WOOJIN</td>
<td>- Heated type&lt;br&gt;- Different L/Wire&lt;br&gt;- FLO Type (+ Heated type)&lt;br&gt;- Different L/Wire</td>
</tr>
<tr>
<td>O2 sensor (Bank1-Down)</td>
<td>39210-39650</td>
<td>39210-39550</td>
<td>WOOJIN</td>
<td></td>
</tr>
<tr>
<td>O2 sensor (Bank2-Up)</td>
<td>39210-39600</td>
<td>39210-39820</td>
<td>WOOJIN</td>
<td>- Heated type&lt;br&gt;- Different L/Wire&lt;br&gt;- FLO Type (+ Heated type)&lt;br&gt;- Different L/Wire</td>
</tr>
<tr>
<td>O2 sensor (Bank2-Down)</td>
<td>39210-39025</td>
<td>39210-39500</td>
<td>WOOJIN</td>
<td></td>
</tr>
<tr>
<td>Purge solenoid valve</td>
<td>39460-38650</td>
<td>←</td>
<td>KEFICO</td>
<td>- 60L</td>
</tr>
<tr>
<td>Case assy catalyst(MCC)</td>
<td>28530-39675(LH)&lt;br&gt;28530-39685(RH)</td>
<td>28530-39410</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Converter assy catalyst(UCC)</td>
<td>28950-39671</td>
<td>28950-38610</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
Sigma(Σ) 3.5ℓ Eng. – Main component

■ Throttle Body

1) TPS (Throttle Position Sensor)
   - With Idle Switch

2) Idle Speed Control Motor
   - Stepping Motor
   - Control Range (0 ~ 120 Step)
   - Initial Position: 80 Step
   - After IG-Key Off,
     Stop-position is initialized by
     ECU during power latch time.

3) Thermo. WAX
   - Operating according to water temp.
   - Closed about 60 ℃ (water temp)
Ignition coil

- Integrated Power_TR (IGNITOR)
- 2- Cyl. Simultaneous Ignition
Ignition failure sensor

- ECM
- VB
- IGf
- G
- IG+
- Coil #1
- Coil #2,3
- Pulse Generator
- Comparator
- Tachometer
- IG Coil Primary Circuit Wave form
  - Ignition Failure Sensor Output
### Sigma(∑) Engine

- **General**

The Delta engine is a compact V6 DOHC engine, light in weight due to the use of aluminum engine parts with high torque output in low and medium speeds. This engine incorporates only one timing belt. This has resulted in a reduction of noise and increase in serviceability.

The Sigma engine is designed and manufactured by Hyundai Motor Company.

<table>
<thead>
<tr>
<th>Items</th>
<th>Sigma 3.5L</th>
<th>Items</th>
<th>Sigma 3.5L</th>
</tr>
</thead>
<tbody>
<tr>
<td>Displacement(cc)</td>
<td>3,497</td>
<td>Injector Type</td>
<td>4Hole 2 Spray</td>
</tr>
<tr>
<td>Bore X Stroke(mm)</td>
<td>93 X 85.8</td>
<td>Injection Timing</td>
<td>BTDC17.5°</td>
</tr>
<tr>
<td>Compression Ratio</td>
<td>10:1</td>
<td>Spark Plug</td>
<td>PFR6.1-11</td>
</tr>
<tr>
<td>Firing Order</td>
<td>1-2-3-4-5-6</td>
<td>Spark Plug Gap(mm)</td>
<td>1.0mm</td>
</tr>
<tr>
<td>Basic IG. Timing(°)</td>
<td>BTDC10° ± 2°</td>
<td>Oxygen Sensor</td>
<td>ZrO2</td>
</tr>
<tr>
<td>Idle RPM</td>
<td>700 ± 100</td>
<td>Coolant Control</td>
<td>Inlet Control</td>
</tr>
<tr>
<td>HLA</td>
<td>End Pivot Type</td>
<td>Air Flow Sensor</td>
<td>Hot Film</td>
</tr>
<tr>
<td>Fuel Pres.(Kgf/㎠)</td>
<td>3.33 ~ 3.35</td>
<td>EMS</td>
<td>Melco</td>
</tr>
</tbody>
</table>
### Sigma(Σ) 3.5ℓ Eng. – Comparison with GQ

<table>
<thead>
<tr>
<th>Item</th>
<th>GQ Σ-3.5 FF</th>
<th>BL Σ-3.5 FR</th>
<th>Remark</th>
</tr>
</thead>
<tbody>
<tr>
<td>Engine Instl.</td>
<td>FF</td>
<td>FR</td>
<td></td>
</tr>
<tr>
<td>Engine Code</td>
<td>G6CU</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td>Dis. (CC)</td>
<td>3,497</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td>B×S (mm)</td>
<td>93.0 x 85.8</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td>Compression Ratio</td>
<td>10.0</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td>Valve System Type</td>
<td>DOHC 4 Valve</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td>Firing Order</td>
<td>1-2-3-4-5-6</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td>Aspiration</td>
<td>NA</td>
<td>←</td>
<td></td>
</tr>
<tr>
<td>Vis Type</td>
<td>Electronic</td>
<td>Vacuum</td>
<td></td>
</tr>
<tr>
<td>EGR</td>
<td>Yes</td>
<td>No</td>
<td></td>
</tr>
<tr>
<td>Eng. Weight (DRY, Kg)</td>
<td>193.6</td>
<td>209.8</td>
<td></td>
</tr>
<tr>
<td>Eng. Size (LxWxH, mm)</td>
<td>746×758×733</td>
<td>608×658×780</td>
<td></td>
</tr>
</tbody>
</table>
Sigma(∑) 3.5ℓ Eng.

- The sorento is equipped with the Sigma 3.5 Liter Engine with 195 hp @ 5500rpm and torque @ 3500rpm. The intake manifold features a variable intake system which extends the torque curve by selecting designated intake runners to improve performance.

The block is made of cast iron. The cylinder heads and upper oil pan are aluminum. Hydraulic Lash Adjusters (HLA) eliminate the need for valve lash adjustments. There are three drive belts on the Sigma 3.5ℓ engine with mechanical tensioners. The timing belt turns all four cam sprockets with an hydraulic timing belt tensioner.
Sigma(∑) 3.5ℓ Eng.- Performance Curve (WOT)

Performance Curve

<table>
<thead>
<tr>
<th>SYSTEM</th>
<th>MAX. POWER (Ps/rpm)</th>
<th>MAX. TORQUE (Kg.m/rpm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>BL</td>
<td>195</td>
<td>30.0</td>
</tr>
<tr>
<td>XG</td>
<td>197</td>
<td>29.8</td>
</tr>
</tbody>
</table>

![Engine Performance Curve](image)
Sigma(Σ) 3.5ℓ Eng. – Engine Feature

- End Pivot Type HLA
- Dry type liner
- Steel Cylinder block
- AL material Upper oil pan
### Intake System

<table>
<thead>
<tr>
<th>GQ Σ-3.5 FF</th>
<th>BL Σ-3.5 FR</th>
</tr>
</thead>
<tbody>
<tr>
<td>![Diagram GQ Σ-3.5 FF]</td>
<td>![Diagram BL Σ-3.5 FR]</td>
</tr>
</tbody>
</table>

**Sigma(Σ) 3.5ℓ Eng. – Intake System**
### Drive Belt

<table>
<thead>
<tr>
<th>GQ</th>
<th>BL/HP</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Σ-3.5 FF</strong></td>
<td><strong>Σ-3.5 FR</strong></td>
</tr>
</tbody>
</table>

- Three mechanical drive belt tension adjuster
Timing Belt

- Hydraulic auto timing belt tensioner:

One cogged-tooth timing belt, that turns all four camshafts and the water pump.
Sigma(Σ) 3.5ℓ Eng. – Engine Feature

■ Cylinder Block

- Torque - Angle Method
  Connecting Rod Cap(33~37Nm+90~94˚)
- Torque tightening
  Main bearing Cab bolts(70~80Nm)
Cylinder Head

- Torque Tightening
  Cylinder head bolts (105~115Nm)
- Hydraulic Lash Adjuster
  End Pivot type HLA
  Air bleeding method
 Sigma(Σ) 3.5ℓ Eng. – Ignition Timing Check

### Checking condition

- Normal Operating Engine Temperature(80~95℃).
- No electrical load
- Neutral of Transaxle
- No operation of Steering wheel

1. Ground the No.3 pin(Ignition timing checking terminal) of DLT.
2. Check the timing on crankshaft pulley with timing light.
Sigma(Σ) 3.5ℓ Eng. – Idle Speed Adjustment

Checking condition

- Normal Operating Engine Temperature(80~95℃).
- No electrical load
- Neutral of Transaxle
- No operation of Steering wheel

① Connect Hi-scan Pro to DLC( L-line Grounded)
② Ground the Ignition timing check terminal.
   (To make engine stable, Ignition timing is controlled. ECM goes into Idle speed adjusting mode)
③ Check idle RPM(700±100rpm). If beyond the specification, adjust it through Idle speed adjust screw.
Location

Fuel Pump Module |

Fuel Filter

※ Recommended replacement intervals : 100,000 mile / 10Years
Sigma(∑)-engine

Engine Management System
Contents

- System Configuration
- System Description
- ECM Input/Output
- OBD2 Functions
- Diagnostic Trouble Code
- ECM Wiring circuit
General descriptions:

- The Sorento utilizes a Mitsubishi Electronics Company Engine Management System (MELCO). The MELCO system features a single 32 bit Powertrain Control Module (PCM) to control engine management as well as all automatic transaxle functions. Serial communication is used to transmit data between the engine and transaxle sections of the PCM. A sequential Multiport Fuel Injection system (SFI) is incorporated, along with a distributorless ignition system.

- The ignition system of Sorento Sigma 3.5ℓ engine is very similar to previous ignition systems used on Kia vehicles since 1998 with the exception of having an additional coil for the 2 extra cylinders and an ignition failure sensor.

- Engine management system monitoring functions are conducted in compliance with OBD-II regulations. An EGR system is not employed in the Sorento.
### System Description

<table>
<thead>
<tr>
<th>Engine</th>
<th>V6 3.5L DOHC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Emission Standard</td>
<td>LEV (0.130 NMOG)</td>
</tr>
<tr>
<td>Evaporative System</td>
<td>New EVAP/ORVR</td>
</tr>
<tr>
<td>PCM</td>
<td>MELCO</td>
</tr>
<tr>
<td>Microprocessor</td>
<td>MH8305F(32bit)</td>
</tr>
<tr>
<td>Frequency</td>
<td>32 MHz</td>
</tr>
<tr>
<td>Memory Size</td>
<td>512Kbyte</td>
</tr>
<tr>
<td>Monitoring Functions</td>
<td>MCC Monitoring</td>
</tr>
<tr>
<td>Catalyst</td>
<td>Yes</td>
</tr>
<tr>
<td>O2 sensor</td>
<td>Yes</td>
</tr>
<tr>
<td>Misfire</td>
<td>Yes</td>
</tr>
<tr>
<td>Fuel System</td>
<td>Yes</td>
</tr>
<tr>
<td>Evap System</td>
<td>0.02in Leakage Monitoring</td>
</tr>
<tr>
<td>Thermostat</td>
<td>Yes</td>
</tr>
<tr>
<td>Comprehensive Component</td>
<td>Yes</td>
</tr>
</tbody>
</table>

▶ MCC = Manifold Catalytic Converter
<table>
<thead>
<tr>
<th>VEHICLE</th>
<th>IGNITION TIMMING</th>
<th>VEHCILE</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>BL3.5 NAS</td>
</tr>
<tr>
<td>P,N RANGE</td>
<td>A/CON OFF</td>
<td>800 ± 100</td>
</tr>
<tr>
<td>RPM</td>
<td>A/CON ON</td>
<td>900 ± 100</td>
</tr>
<tr>
<td>D RANGE</td>
<td>A/CON OFF</td>
<td>750 ± 100</td>
</tr>
<tr>
<td>RPM</td>
<td>A/CON ON</td>
<td>750 ± 100</td>
</tr>
<tr>
<td>OVERRUN</td>
<td>P/N</td>
<td>4000</td>
</tr>
<tr>
<td>F/CUT RPM</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>D</td>
<td>6198</td>
</tr>
</tbody>
</table>

BTDC 10° ± 2°
Sigma(∑) 3.5ℓ Eng. – ECM Input/Output

ECM Input/Output

Input

Oxygen Sensor (Bank1, Sensor1)
Oxygen Sensor (Bank1, Sensor2)
Oxygen Sensor (Bank2, Sensor1)
Oxygen Sensor (Bank2, Sensor2)
Air Flow Sensor
Air Temp. Sensor
T.P.S.
C.M.P
C.K.P.
W.T.S

ECM

Manifold Differential Press. Sensor
Knock Sensor
Fuel Level Sensor
Fuel Tank Press. Sensor
Fuel Temp. Sensor
Ignition Detect Signal
Vehicle Speed Sensor
Power Steering Sensor
Ignition Switch
Battery Voltage

Output

Ignition
Injector
Idle Speed Cont. Motor
Main Relay Control
Fuel Pump Control
Cooling Fan Control
Diagnosis (OBD)
Mass Air Flow Sensor (MAF)

The air flow sensor installed between the air cleaner assembly and the throttle body assembly integrates Intake Air Temperature Sensor. Air flow sensing part consists of the heater device for keeping the constant relative temperature difference and the sensor device for measuring the air flow rate, and detect the balance of heat loss on hot film as circuit current increment. The ECM can calculate the mass air flow rate to engine, and this is the most basic and important value for engine control in injection duration and ignition timing calculation.

---

**Electric Circuit**

1: Air Temp. Signal
2: Vb
3: GND
4: Vref
5: Air Flow Signal
-HFM5

---

**Location**

---

**Sensor Signal**
Throttle Position Sensor (TPS)

This is a rotary potentiometer having idle switch mounted on throttle body assembly. This sensor provides throttle angle information to the ECM to be used for the detection of engine status such as idle, part load, full throttle condition and anti-jerk condition and acceleration fuel enrichment correction.

<table>
<thead>
<tr>
<th>Electric Circuit</th>
<th>Location</th>
<th>Sensor Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td><img src="image" alt="Electric Circuit Diagram" /></td>
<td><img src="image" alt="Location Image" /></td>
<td><img src="image" alt="Sensor Signal Diagram" /></td>
</tr>
</tbody>
</table>

1: GND
2: Idle Sig.
3: TPS Sig.
4: Vref
Sigma(Σ) 3.5ℓ Eng. – ECM Input/Output

Throttle Position Sensor (TPS)

- Sensor Signal

[ At idle → fuel cut ]

[ At idle → running ]
Engine Coolant Temperature Sensor (ECT)

The engine coolant temperature sensor integrated heat gauge is installed in the thermostat housing. This sensor having gold coated terminals provides information of coolant temperature to the ECM for controlling:

- *Injection time and ignition timing during cranking & warm-up & hot condition*
- *ISC Motor to keep nominal idle engine speed*
- *Cooling & condenser fan etc.*
Heated Oxygen Sensors (HO2S)

There are four O2 sensors in a vehicle, two of them are installed in the upstream and the others are installed downstream of each bank of manifold catalyst.

The O2 sensors is consists of Zirconia type sensing element and heater. The sensing element produces voltage according to the richness of exhaust gas, and this voltage to reference in ECM reflect lean or rich status.

For each bank(1/2), ECM can control the fuel injection rate separately with the feedback of each front O2 sensor signals, and the desired air/fuel ratio which provide the best conversion efficiency is achieved.

The rear O2 sensors also inform ECM of lean or rich status of exhaust gas existing the closed-coupled catalyst.

The rear O2 sensor signals are used not only for the richness correction to control NOx emission effectively but for the determination of catalyst deterioration factor to monitor the catalyst converter.

And, the O2 sensor tip temperature is controlled to 750deg.C to get reliable sensor signal output by already programed O2 heater control function.
Heated Oxygen Sensors (HO2S)

**Electric Circuit**
- 1: Sensor Sig.
- 2: Sensor GND
- 3: Heater Sig.
- 4: Vb

**Location**
- HO2S Rear
- HO2S Front

**Sensor Signal**

---

### HO2S Rear

- **FR. Sensor, RE. Sensor**
  - FR CH A: 0.5 V, 500 mS
  - CH B: 0.5 V
  - MIN: 174.9 mV, AVE: 628.2 mV, MAX: 1.1 V
  - MIN: -219.8 mV, AVE: 76.8 mV, MAX: 457.0 mV

---

### HO2S Front

- **FR. Sensor Heater**
  - FR CH A: 1.0 V, 100 mS
  - CH B: 5.0 V
  - MIN: 388.2 mV, AVE: 9.8 V, MAX: 13.8 V
  - FREQ: 18.18 Hz, DUTY: 72 %
Crankshaft Position Sensor (CKP)

The crankshaft position sensor detects and counts the tooth on teeth target wheel(3) and provides ECM with the information on the current position of crank angle and cylinder, and also the duration of each tooth and segment. So injection and ignition could be activated exactly in desired crank angle and current engine speed could be calculated also. The Sigma 3.5ℓ engine will not run if CKP sensor circuit failure conditions exist. The CKP is located adjacent to the crankshaft pulley (similar to 2.4 Optima).

**Electric Circuit**

<table>
<thead>
<tr>
<th>B</th>
<th>GND.</th>
</tr>
</thead>
<tbody>
<tr>
<td>SGT</td>
<td>2: Sensor Sig.</td>
</tr>
<tr>
<td>E</td>
<td>3: Vb</td>
</tr>
</tbody>
</table>

- Hall effect type sensor

**Location**
Crankshaft Position Sensor (CKP)

Sensor Signal

Synchronization with CMP

No.1 Cylinder TDC when both signals are at high.
Camshaft Position Sensor (CMP)

The Hall effect camshaft position sensor detects the teeth target wheel (Irregular four teeth) and provides ECM with the information on the current position of piston and cylinder, and also the duration of each tooth and segment. So **injection and ignition could be activated exactly in desired TDC of each cylinder.** The CMP is installed near the exhaust camshaft sprocket on the left cylinder bank. The target wheel is on the exhaust camshaft, behind the sprocket.

**Electric Circuit**

- B
- SGC
- E

1: GND.
2: Sensor Sig.
3: Vb

-Hall effect type sensor

**Location**

![CMP Location Image]

**Sensor Signal**

<table>
<thead>
<tr>
<th>CH 1</th>
<th>2.0 V</th>
<th>18 µS</th>
<th>CH 2</th>
<th>0.5 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN:</td>
<td>-128.5 mV</td>
<td>AVE: 2.4 V</td>
<td>MAX: 5.2 V</td>
<td></td>
</tr>
<tr>
<td>FREQ:</td>
<td>29.85 Hz</td>
<td>DUTY: 42%</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

![Sensor Signal Graph]
Knock Sensor

The knock sensor is installed to detect knock occurrence of each individual cylinders. The knock sensor signal is processed with filtering, signal noise level calculation and final decision of knock by comparing the noise level with calculated noise level threshold.

When knock is detected, ignition timings of corresponding cylinder are retarded by defined value, different engine operating conditions, and advanced again with delay and increment slop.

Electric Circuit

1: Sensor Sig.
2: Shield GND.
-Piezo type sensor

Location

Sensor Signal

At idle
Idle Speed Control Motor (ISC)

Step Motor is installed to control the proper intake air amount to keep nominal idle engine speed and to avoid uncompleted combustion in closed throttle condition. *The ISC Motor opening value is concluded by Engine load (A/C, Fans, Drive, ...), Altitude etc.*

ECM sends a signal to each coils of step motor in series to open or close the by-pass passage of throttle body. The idle speed actuator has four coils.

**Electric Circuit**

<table>
<thead>
<tr>
<th>Location</th>
<th>Electric Circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Idle Speed Adjust Screw (SAS)</td>
<td>1: Control Sig. A</td>
</tr>
<tr>
<td>FIAV (Fast Idle Air Valve) for cold condition</td>
<td>2: Vb.</td>
</tr>
<tr>
<td>ISC STM</td>
<td>3: Control Sig. B</td>
</tr>
<tr>
<td>SAS</td>
<td>4: Control Sig. C</td>
</tr>
<tr>
<td></td>
<td>5: Vb</td>
</tr>
<tr>
<td></td>
<td>6: Control Sig. D</td>
</tr>
<tr>
<td></td>
<td>-Coil type</td>
</tr>
</tbody>
</table>
Idle Speed Control Motor (ISC)

Output Characteristic

A & B at the moment A/C Off → On
C & D

Details →

Operation
Order

a : Valve Closing
b : Valve Opening
Fuel Injectors

The six fuel injectors are sequentially activated by the PCM using ground controlled circuits. Each injector has four individual spray ports. The pulse signal from ECM actuates injector coil to open, thus inject a defined amount of fuel. The start and end of injection is controlled by ECM according to engine operating conditions.

<table>
<thead>
<tr>
<th>Electric Circuit</th>
<th>Location</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Control Sig.</td>
<td></td>
</tr>
<tr>
<td>2: Vb.</td>
<td></td>
</tr>
<tr>
<td>-Coil type</td>
<td></td>
</tr>
</tbody>
</table>
Fuel Injectors

Output Characteristic

#1, #2 Cylinder Injection at starting

#1, #2 Cylinder Injection at idle

CKP CMP

#1 Injection #2 Injection

CKP CMP

#3 Injection #4 Injection
**Purge Control Solenoid Valve**

20Hz pulse duty signal is sent from ECM to purge accumulated fuel in the canister charcoal. The Purge control valve is open or closed when OBD-II leakage monitoring is performed. The pulse duty to purge the canister is calculated according to engine operating condition (Engine speed, Mass air flow).

**Electric Circuit**

1: Control Sig.
2: Vb.
- Coil type

**Location**

Flow rate

Pressure difference
Fuel Tank Pressure Sensor (FTPS)

This sensor, installed on the fuel tank, measures the pressure of fuel tank to detect leakage or malfunction of related component during the leakage monitoring of evaporative emission control system.

Sensor Characteristic & Signal

<table>
<thead>
<tr>
<th>Location</th>
<th>Electric Circuit</th>
</tr>
</thead>
<tbody>
<tr>
<td>At the moment IG. Off → On</td>
<td></td>
</tr>
</tbody>
</table>

- Resistance type with Diaphram

<table>
<thead>
<tr>
<th>1: Sensor Sig.</th>
<th>3: Vref.</th>
<th>4: Sensor GND.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1: Sensor Sig.</td>
<td>3: Vref.</td>
<td>4: Sensor GND.</td>
</tr>
</tbody>
</table>

- Resistance type with Diaphram

At the moment IG. Off → On
Fuel Level Sensor (FLS), Fuel Temperature Sensor (FTS)

For engine management purposes, the Fuel Level Sensor (FLS) is also used as a supplementary device to assist with evaporative monitoring. The Fuel Temperature Sensor (FTS) is also incorporated for this purpose.

**Location**

- **Fuel Temp. Sensor**
- **Fuel Level Sensor**

**Sensor Signal**

<table>
<thead>
<tr>
<th>Location</th>
<th>Sensor Signal</th>
</tr>
</thead>
<tbody>
<tr>
<td>FLS at IG.</td>
<td>Off → On</td>
</tr>
<tr>
<td>FTS at IG.</td>
<td>Off → On</td>
</tr>
</tbody>
</table>

![Sensor Signal Chart]
Canister Close Solenoid Valve (CCV) – NA only

The Canister Close Solenoid Valve (CCV) is normally open; the ECM closes the valve to seal the evaporative emissions system for OBD-II leakage monitoring purposes. The CCV is located on the evap canister.

Electric Circuit

1: Control Sig.
2: Vb.
-Coil type

Location
Manifold Absolute Pressure Sensor (MAP)

This sensor is installed at intake surge tank to adapt fuel system for the altitude of vehicle (by detecting atmosphere pressure).

**Electric Circuit**

1: Sig.
2: Vref.
4: GND

-Piezo type sensor

**Location**

**Sensor Signal**

At idle → Acceleration
Ignition Failure Sensor

The ignition failure sensor is employed for the purposes of detecting ignition system Malfunctions. The three ignition coil primary circuits are connected through the ignition failure sensor. The ECM monitors the sensor output signal to determine if a failure condition exists. (The tachometer is also supplied with the ignition detect signal.)

**Electric Circuit**

1: Body GND.
2: Vref.
3: Vb Output
4: Vb Input
- IC type sensor

**Location**

![IFS Diagram]
Ignition Failure Sensor

The signal from IG. Failure Sensor is a kind of monitoring signal for the activation of each primary IG. Coil.

When each primary coil signal falls, the signal of IG. Failure Sensor rises.

ECM can monitor the primary IG. Coil signal at ECM outside with this signal and compares this signal with the each primary IG. Coil signal of ECM inside.

The frequency of both signal should be same. If there are any difference, ECM regards it as a misfire for the cylinder.
**Ignition Coil**

There are three ignition coils—#1/#4, #2/#5, and #3/#6. Each ignition coil is integrated with its own power transistor.

### Electric Circuit

1: Vb.
2: Body GND
3: Signal
4: IG. Coil integrated TR

### Location

IG. #1 & #4 & CMP

### Signal

<table>
<thead>
<tr>
<th>CH A</th>
<th>2.0 V</th>
<th>10 μS</th>
<th>CH B</th>
<th>2.0 V</th>
</tr>
</thead>
<tbody>
<tr>
<td>MIN:</td>
<td>-546.5 mV</td>
<td>AVE:</td>
<td>2.0 V</td>
<td>MAX:</td>
</tr>
<tr>
<td>MIN:</td>
<td>103.2 mV</td>
<td>AVE:</td>
<td>423.3 mV</td>
<td>MAX:</td>
</tr>
</tbody>
</table>
Variable Intake Manifold

Low to medium speed torque is boosted through the use of a Variable Intake Manifold. Intake manifold path is variable through the operation of VI vacuum according to the engine RPM. (≈3500rpm, on and off type)
Main Relay

The voltage after main relay is used to supply power to the sensors and actuators. *ECM controls the Main Relay and its remains ON at Key off in order to store the adaptation values and fault status to the memory.*

**Electric Circuit**

- A: Control Sig.
- B, C: Output Vb
- E, D: Input Vb
- Coil type

**Location**

**Output Characteristic**

- IG. KEY ON
- IG. KEY OFF
- Around 10 sec
- M/RELAY ON
- M/RELAY OFF
Catalyst Efficiency Monitoring

The signal from the O₂ sensor upstream from the monitored catalyst and the associated monitoring oxygen sensor downstream from the catalyst are used to estimate the Oxygen storage capability:

- If a catalyst has good conversion properties, the oxygen fluctuations upstream from the catalyst, generated by the lambda controller, are smoothed by the Oxygen storage capacity of the catalyst.
- If the conversion provided by the catalyst is low due to ageing, poisoning or misfiring, then the fluctuations upstream from the catalyst exist also downstream from the catalyst.
- Calculate a frequency ratio of output signals from the front and rear oxygen sensors according to the following equation.

\[ R_f = \frac{\text{Frequency of Rear Oxygen}}{\text{Frequency of Front Oxygen}} \]

if \( R_f > R_0 \) (Threshold value), determine the catalyst malfunction.
Misfire Monitoring

Misfire induces a decrease of the engine speed, therefore a variation in the segment period. The misfiring detection is based on the observation of this variation of segment period. As a result, ECM monitor the fluctuation of crank angular acceleration. If the crank angular acceleration is out of specification, ECM determines misfire on engine.

Main causes of misfiring:
- injector shut-off
- fuel pressure problems
- fuel combustion problems
- ignition cut-off…

Misfire fade-out conditions:
- Min. engine rpm
- Max. engine rpm (6500)
- Min. engine load (0)
- Max. air mass gradient
- Max throttle gradient
- Max. ignition angle gradient
- Aircon compressor activation
- Cylinder shut-off
- Rough road detection
- Crankshaft oscillation.
- Shift change
- Sudden deceleration

Carb. A error:
- Check recurrence: 200CKP revolution
- Target: to avoid cataylist damage

Carb. B error:
- Check recurrence: 1000CKP revolution
- Emission decrease
O2 Sensor Monitoring

The fluctuation of O2 signal characteristics is significant to perform properly lambda feedback control. And, too slow sensing response of O2 signal can cause the increment of exhaust emission.

- Response time monitoring
Detect the response time (TLR, TRL) of oxygen sensor output signals when air-fuel ratio is changed intentionally from lean to rich (TLR) or rich to lean (TRL) under the hot steady state condition.
If T_{LR} > T1 or T_{RL} > T2 (T1, T2 : threshold value), determine the oxygen sensor malfunction.
Fuel System Monitoring

A/F feedback compensation value (A/F learning value and Integral value of A/F feedback) is monitored. Injection time (T) is conceptually defined as follows:

$$T = TB \times (KLRN + KI + 1.0)$$

TB : Base injection time

KI is determined to achieve A/F ratio stoichiometric for short-term trim and KLRN for long-term trim. If KLRN > K0 and KI > K1 or KLRN < K2 and KI < K3 (K0, K1, K2, K3 : threshold value), determine the fuel system malfunction.
Evaporative System Monitoring

At driving condition, the fuel tank pressure gradient and the duration to reach to certain tank pressure are monitored after vacuuming the evaporative system to use the throttle body vacuum through the purge solenoid valve and canister close valve. If the evaporative system has a small leakage such as Φ1mm leakage hole, the pressure gradient will be above a certain threshold map value which consists of ΔP, ΔT.

At idle condition, if the evaporative system has a small leakage such as Φ0.5mm leakage hole, the pressure gradient will be above a certain threshold map value which consists of fuel temperature (FTMP), fuel level(FLVL).

\[ -\Delta P \geq \text{Threshold map value} \ (\Delta P, \Delta T) \text{ or, Threshold map value} \ (\text{FTMP}, \text{FLVL}) \]

where, \( \Delta P = (P_{\text{REAL}} - P_3) - (P_2 - P_1) \), \( \Delta T = T(P_2') - T(P_2) \)

\[-P_{2\text{REAL}} > \text{Threshold value}\]
Thermostat Monitoring

Engine coolant temperature from the sensor voltage is monitored. For thermostat monitoring, three Malfunction criteria (TWTFL_H, TWTFL_M, TWTFL_L) according to intake air flow are reduced per 500msec. Malfunction decision is performed when the counter of malfunction criteria is zero in the case of the engine coolant temperature is over thermostat regulating temperature.

Malfunction Condition
Coolant temperature at start : 5 ~ 60℃
Coolant temperature at start - Intake air temperature at start < 10℃
Intake air temperature at start - Intake air temperature < 5℃
The integrated time of low air flow(TWOAFS) ≤ 200sec
The integrated time of high air flow(TWOAFS_H) ≤ 100sec

Malfunction Criteria
The counter of malfunction criteria(TWTFL_H, TWTFL_M, TWTFL_L) is changed.
intake average air flow(Qave).

\[
\begin{align*}
Q_{ave} > 19.2 \text{ g/sec} & \Rightarrow TWTFL_H \\
19.2 \text{ g/sec} > Q_{ave} > 11.52 \text{ g/sec} & \Rightarrow TWTFL_M \\
Q_{ave} \leq 11.52 \text{ g/sec} & \Rightarrow TWTFL_L
\end{align*}
\]
# Sigma(Σ) 3.5ℓ Eng. – Diagnostic Trouble Code

<table>
<thead>
<tr>
<th>COMPONENT SYSTEM</th>
<th>FAULT CODE</th>
<th>MONITOR STRATEGY DESCRIPTION</th>
<th>MALFUNCTION CRITERIA</th>
<th>THRESHOLD VALUE</th>
<th>SECONDARY PARAMETERS</th>
<th>ENABLE CONDITIONS</th>
<th>TIME REQUIRED</th>
<th>MIL ILLUM.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalyst (Bank 1)</td>
<td>P0421</td>
<td>Frequency ratio (Rf) of front and rear oxygen sensor used. Bank 1</td>
<td>FTP emission &gt; 1.75 * emission standard</td>
<td>&gt; 0.801</td>
<td>Closed loop</td>
<td>Load value 25% ~ 70%</td>
<td>150 sec once per driving cycle</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Engine speed &lt; 2500rpm</td>
<td>Idle switch off</td>
<td></td>
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<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Vehicle speed &gt; 15KPH</td>
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</tr>
<tr>
<td>Catalyst (Bank 2)</td>
<td>P0431</td>
<td>Frequency ratio (Rf) of front and rear oxygen sensor used. Bank 2</td>
<td>FTP emission &gt; 1.75 * emission standard</td>
<td>&gt; 0.801</td>
<td>Closed loop</td>
<td>Load value 25% ~ 70%</td>
<td>150 sec once per driving cycle</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td></td>
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<td></td>
<td></td>
<td></td>
<td>Engine speed &lt; 2500rpm</td>
<td>Idle switch off</td>
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<td></td>
<td></td>
<td></td>
<td>Vehicle speed &gt; 15KPH</td>
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</tr>
<tr>
<td>Misfire</td>
<td>P0300(Multi)</td>
<td>Fluctuation of crank angular acceleration is monitored</td>
<td>FTP emission &gt; 1.5 * emission standard</td>
<td>&gt; 2.2%</td>
<td>Engine speed 500-6250rpm</td>
<td>Load value 11% ~ 100%</td>
<td>1000revs. Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td></td>
<td>P0301(#1 Cyl)</td>
<td></td>
<td></td>
<td></td>
<td>Catalyst temp. &gt; 950?</td>
<td>No running on rough road</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P0302(#2 Cyl)</td>
<td></td>
<td></td>
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<td></td>
<td>No shift change</td>
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<tr>
<td></td>
<td>P0303(#3 Cyl)</td>
<td></td>
<td></td>
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<td>No sudden deceleration</td>
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<tr>
<td></td>
<td>P0304(#4 Cyl)</td>
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<tr>
<td></td>
<td>P0305(#5 Cyl)</td>
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</tr>
<tr>
<td></td>
<td>P0306(#6 Cyl)</td>
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<td></td>
</tr>
<tr>
<td>Canister close valve</td>
<td>P0446</td>
<td>Surge voltage is monitored</td>
<td>Surge voltage, Vps &lt; Vb + 2V Battery voltage ≥ 10V</td>
<td>&lt; -200mmAq</td>
<td>FTPS voltage 1.0 V ~ 3.5V Purge Duty ≥ 20%</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>Clogging is monitored</td>
<td>Preal</td>
<td>&lt; -200mmAq</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Sigma(∑) 3.5ℓ Eng. – Diagnostic Trouble Code

<table>
<thead>
<tr>
<th>System</th>
<th>Description</th>
<th>Code</th>
<th>Condition</th>
<th>Action</th>
<th>Diagnostic Procedure</th>
</tr>
</thead>
<tbody>
<tr>
<td>Evap. Purge system</td>
<td>0.02inch leakage of evap. System is monitored</td>
<td>P0456</td>
<td>( \Delta P = (P_{real} - P_{3}) - (P_{2} - P_{1}) ) ( \geq ) Threshold value(( \Delta P, \ FTMP, FLVL ))</td>
<td>Idle switch on</td>
<td>90sec once per driving cycle</td>
</tr>
<tr>
<td></td>
<td>0.04inch leakage of evap. System is monitored</td>
<td>P0442</td>
<td>( \Delta P = (P_{real} - P_{3}) - (P_{2} - P_{1}) ) ( \geq ) Threshold value(( \Delta P, \ DT ))</td>
<td>Fuel temp. &lt; 45?</td>
<td>50sec once per driving cycle</td>
</tr>
<tr>
<td></td>
<td>Big leakage (fuel cap missing)</td>
<td>P0455</td>
<td>P2 real between detecting P2 and detecting P3</td>
<td>P0456 Big leakage (fuel cap missing)</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>Purge sol. Valve</td>
<td>Evap. Pressure is monitored</td>
<td>P0441</td>
<td>Preal &lt; -157mmAq</td>
<td>Vehicle speed ≥ 30KPH</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td></td>
<td>Surge voltage is monitored</td>
<td>P0443</td>
<td>Surge voltage, Vps &lt; Vb + 2V</td>
<td>Battery voltage ≥ 10V</td>
<td>Continuous</td>
</tr>
<tr>
<td>Fuel tank pressure sensor</td>
<td>Output voltage of tank pressure sensor is monitored</td>
<td>P0453</td>
<td>Purge Duty ≥ 100% and</td>
<td>Intake air temp. &gt; 5%</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td>Output voltage of tank pressure sensor is monitored</td>
<td>P0452</td>
<td>Intake air temperature &lt; 45? and Load value 25% ~ 70%</td>
<td>Engine speed &gt; 1440rpm</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td></td>
<td>(P1=pressure with full tank)</td>
<td>P0451</td>
<td>Sensor output voltage &lt; 1.0V</td>
<td>Vehicle speed ≥ 29.75KPH</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>Fuel Level Sensor</td>
<td>Change in output voltage(( \Delta VFLS )) and output voltage(VFLS) are monitored</td>
<td>P0463</td>
<td>( \Delta VFLS &lt; 0.039V ) and VFLS &gt; 4.9V</td>
<td>Time during vehicle speed &gt; 0</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P0462</td>
<td>( \Delta VFLS &lt; 1.0V ) and VFLS &lt; 4.9V</td>
<td></td>
<td>No MIL ON</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P0460</td>
<td>1.0 &lt; VFLS &lt; 4.9V</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fuel temperature sensor</td>
<td>Output voltage is monitored.</td>
<td>P0181</td>
<td>Output voltage, VFTMP &lt; 0.1V or &gt; 4.6V</td>
<td>Time after start &gt; 2sec</td>
<td>Continuous</td>
</tr>
<tr>
<td></td>
<td></td>
<td>P0183</td>
<td></td>
<td>Water temp at start - air temp. at start</td>
<td>2 Driving cycles</td>
</tr>
</tbody>
</table>

**Legend:**
- \( \Delta P \): Pressure difference
- \( FTMP \): Fuel temperature
- \( FLVL \): Fuel level
- \( P_{real} \): Real pressure
- \( P_{2} \): Pressure between detecting P2 and detecting P3
- \( P_{3} \): Pressure downstream of the system
- \( Vb \): Battery voltage
- \( Vp \): P/S pressure s/w
- \( V_{ps} \): Surge voltage
- \( V_{FTMP} \): Fuel temperature
- \( V_{FLVL} \): Fuel level
- \( V_{FVFLS} \): Fuel level
- \( P_{mean} \): Mean value
- \( P_{1} \): Pressure with full tank
- \( V_{FL} \): Fuel level
- \( V_{VFLS} \): Fuel level
- \( V_{VFTMP} \): Fuel temperature
- \( V_{VPS} \): Surge voltage
- \( V_{VPS} \): P/S pressure s/w
- MIL: Malfunction Indicator Light

**KIA KIA MOTORS**
<table>
<thead>
<tr>
<th><strong>Sigma(∑) 3.5ℓ Eng. – Diagnostic Trouble Code</strong></th>
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</thead>
<tbody>
<tr>
<td><strong>Fuel system (Bank 1)</strong></td>
</tr>
<tr>
<td><strong>P0171 (Too lean)</strong></td>
</tr>
<tr>
<td>A/F learning value (KLRN) &amp; integral value of A/F feedback compensation (KI) are monitored</td>
</tr>
<tr>
<td>Idle</td>
</tr>
<tr>
<td>Part</td>
</tr>
<tr>
<td>load</td>
</tr>
<tr>
<td><strong>P0172 (Too rich)</strong></td>
</tr>
<tr>
<td>A/F learning value (KLRN) &amp; integral value of A/F feedback compensation (KI) are monitored</td>
</tr>
<tr>
<td>Idle</td>
</tr>
<tr>
<td>Part</td>
</tr>
<tr>
<td>load</td>
</tr>
<tr>
<td><strong>P0174 (Too lean)</strong></td>
</tr>
<tr>
<td>A/F learning value (KLRN) &amp; integral value of A/F feedback compensation (KI) are monitored</td>
</tr>
<tr>
<td>Idle</td>
</tr>
<tr>
<td>Part</td>
</tr>
<tr>
<td>load</td>
</tr>
<tr>
<td><strong>P0175 (Too rich)</strong></td>
</tr>
<tr>
<td>A/F learning value (KLRN) &amp; integral value of A/F feedback compensation (KI) are monitored</td>
</tr>
<tr>
<td>Idle</td>
</tr>
<tr>
<td>Part</td>
</tr>
<tr>
<td>load</td>
</tr>
</tbody>
</table>

| **Oxygen Sensor (Bank 1, front)** |
| **P0133** |
| Response time from lean to rich (TLR) & from rich to lean (TRL) are monitored when A/F is intentionally changed. |
| From lean to rich (TLR) | > 1.1sec |
| From rich to lean (TRL) | > 0.95sec |
| **P0132** |
| Circuit voltage (Vf) is monitored. |
| Circuit voltage after applying 5V to sensor | ≥ 4.5V |
| **P0136** |
| Circuit voltage (Vf) is monitored. |
| Circuit voltage after applying 5V to sensor | ≥ 4.5V |
| **P0140** |
| Circuit voltage is monitored when A/F is made to be rich 15% during 10sec |
| Circuit voltage Vf | ≥ 0.5V |
| Circuit voltage Vr | < 0.1V |
| **P0139** |
| Rationality Check |
| Response Rate, TRL | ≥ 1sec |

| **Closed loop** |
| Continuous 2 Driving cycles |
| Engine coolant | > 35? |
| Load value | 25-60% |
| Engine speed | 1375-3000rpm |
| Fuel Cut on | 3sec |
| Continuous 2 Driving cycles |
| Engine coolant | > 82? |
| Sensor voltage | < 0.2V for 180s |
| Continuous 2 Driving cycles |
| Engine coolant | > 77? |
| Engine speed | > 1200rpm |
| Load value | > 25% |

<p>| <strong>KIA MOTORS</strong> |</p>
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<tr>
<th>Sensor Type</th>
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<th>Control</th>
<th>Duration</th>
<th>Cycles</th>
<th>Notes</th>
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<td>Oxygen Sensor (Bank 2, front)</td>
<td>P0150</td>
<td>Response time from lean to rich (TLR) &amp; from rich to lean (TRL)</td>
<td>&gt; 1.1sec</td>
<td>Closed loop</td>
<td>8sec</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>From lean to rich (TLR)</td>
<td>&gt; 0.95sec</td>
<td>Engine coolant</td>
<td>&gt; 35?</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>From rich to lean (TRL)</td>
<td>&gt; 0.95sec</td>
<td>Engine speed</td>
<td>1375~3000rpm</td>
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</tr>
<tr>
<td></td>
<td>P0152</td>
<td>Circuit voltage(Vf) is monitored.</td>
<td>≥ 4.5V</td>
<td>Engine coolant</td>
<td>&gt; 35?</td>
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<tr>
<td></td>
<td>P0156</td>
<td>Circuit voltage(Vf) is monitored.</td>
<td>≥ 4.5V</td>
<td>Engine coolant</td>
<td>&gt; 77?</td>
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<td></td>
</tr>
<tr>
<td>Oxygen Sensor (Bank 2, rear)</td>
<td>P0160</td>
<td>Circuit voltage is monitored when A/F is made to be rich 15% during 10sec</td>
<td>≥ 0.5V</td>
<td>Engine speed</td>
<td>&gt; 1375rpm</td>
<td>Load value</td>
<td>≥ 25%</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Circuit voltage Vf</td>
<td>≥ 0.5V</td>
<td>Engine coolant</td>
<td>&gt; 70?</td>
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<tr>
<td></td>
<td></td>
<td>Circuit voltage Vr</td>
<td>&lt; 0.1V</td>
<td>Engine coolant</td>
<td>&gt; 82?</td>
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</tr>
<tr>
<td></td>
<td>P0159</td>
<td>Rationality Check</td>
<td>≥ 1sec</td>
<td>Fuel Cut</td>
<td>on</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Oxygen Sensor Heater (Bank 1)</td>
<td>P0135(front)</td>
<td>Heater circuit current(AH) is monitored.</td>
<td>&lt; 200mA or ≥ 3.5A</td>
<td>Heater</td>
<td>on</td>
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<tr>
<td></td>
<td>P0141(rear)</td>
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<tr>
<td>Oxygen Sensor Heater (Bank 2)</td>
<td>P0155(front)</td>
<td>Heater circuit current(AH) is monitored.</td>
<td>&lt; 200mA or ≥ 3.5A</td>
<td>Heater</td>
<td>on</td>
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<tr>
<td></td>
<td>P0161(rear)</td>
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<tr>
<td>Throttle position sensor</td>
<td>P0122</td>
<td>Output voltage is monitored.</td>
<td>&lt; 0.2V or ≥ 2V</td>
<td>Idle switch</td>
<td>on</td>
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<tr>
<td></td>
<td>P0123</td>
<td>Output voltage is monitored.</td>
<td>&gt; 4.6V</td>
<td>Load value</td>
<td>&lt; 30%</td>
<td>Engine speed</td>
<td>&lt; 3000rpm</td>
</tr>
<tr>
<td>Cam position sensor</td>
<td>P0340</td>
<td>Change in output voltage (ΔVcam) is monitored.</td>
<td>ΔVcam</td>
<td>Engine coolant</td>
<td>&gt; 35?</td>
<td></td>
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<tr>
<td>Crank angle sensor</td>
<td>P0335</td>
<td>Change in output voltage (ΔVcrank) is monitored.</td>
<td>ΔVcrank</td>
<td>Cranking switch</td>
<td>on</td>
<td></td>
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</tr>
</tbody>
</table>

*Pattern of the signal combinations of the crank angle sensor signal & cam position sensor signal are monitored every 2sec continuously.
<table>
<thead>
<tr>
<th>PID</th>
<th>Description</th>
<th>Conditions</th>
<th>Minimum Time</th>
<th>Testing Cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>P0102</td>
<td>Output voltage is monitored</td>
<td>Output voltage, VAFS &lt; 1.055V, Engine speed &gt; 3000rpm</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>P0103</td>
<td>Output voltage is monitored</td>
<td>Output voltage, VAFS ≥ 4.5V, Engine speed ≤ 2000rpm, TPS ≤ 2V</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>P0101</td>
<td>Rationality Check</td>
<td>Output voltage, VAFS 0.957V ~ 1.055V, ∆VAFS ≤ 0.039V, Load value</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>&gt; Th1(rpm, tps) Engine coolant &gt; 81?, &gt; 2000rpm</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>P0101</td>
<td></td>
<td>≤ Th2(rpm, tps) Intake air temp. 5 &lt; AT &lt; 45?</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>P0115</td>
<td>Resistance of sensor(Rcts) is monitored</td>
<td>Resistance, Rcts &lt; 50Ω or ≥ 72kΩ, Time after start &gt; 60sec</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>P0125</td>
<td>Time(Tfbi) from engine starting to the reaching engine coolant temp. of F/B on</td>
<td>Tfbi &gt;300sec@-8?, &gt;110sec@20?, &gt;60sec@82?, AFS voltage, Engine coolant ≥ -10?, Air temperature ≥ -10?</td>
<td>300sec after engine start</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>P0116</td>
<td>Temperature shifting is monitored</td>
<td>Time(Tdf) is monitored (elapsed time under 40? after over 40? once)</td>
<td>300sec</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Tdf &gt; 300sec</td>
<td>Continuous</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Wtmax - Wtmin</td>
<td>&lt; 1? Engine speed &gt; 1500rpm, Load value &gt; 25%, cool at start &gt; 7? Air temperature &lt; 60?</td>
</tr>
<tr>
<td>P0112</td>
<td>Resistance of sensor(Rats) is monitored</td>
<td>Resistance, Rats &lt; 0.09kΩ, Time after start &gt; 2sec</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>P0113</td>
<td>Resistance, Rats</td>
<td>Resistance, Rats ≥ 50kΩ, Time after start</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>P0506</td>
<td>Real engine speed &amp; target engine speed are monitored.</td>
<td>Real engine speed &lt; Target-100rpm or &gt; Target+200rpm, ISC Feedback on</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>P0507</td>
<td>Real engine speed</td>
<td>Real engine speed</td>
<td>Continuous</td>
<td>2 Driving cycles</td>
</tr>
<tr>
<td>Condition</td>
<td>Code</td>
<td></td>
<td>Engine speed</td>
<td></td>
</tr>
<tr>
<td>------------------------------------------------</td>
<td>--------</td>
<td>---</td>
<td>--------------</td>
<td>---</td>
</tr>
<tr>
<td>Idle switch is not made &quot;on&quot; for at least once during 1 driving cycle</td>
<td>P0510</td>
<td></td>
<td>&lt; 812rpm</td>
<td>Continuous 2 Driving cycles</td>
</tr>
<tr>
<td>Surge voltage(Vinj) at injector drive is monitored.</td>
<td>P0201</td>
<td></td>
<td>&lt; Vb + 2V</td>
<td>&lt; 1000rpm</td>
</tr>
<tr>
<td></td>
<td>P0202</td>
<td></td>
<td>Vb : Battery V</td>
<td>TPS voltage</td>
</tr>
<tr>
<td></td>
<td>P0203</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P0204</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P0205</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>P0206</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>O2 sensor staying time(TFB2) below or under the reference voltage to decide rich/lean is monitored.</td>
<td>P0134</td>
<td></td>
<td>15sec</td>
<td>15sec</td>
</tr>
<tr>
<td>O2 sensor staying time(TFB2) below or under the reference voltage to decide rich/lean is monitored.</td>
<td>P0154</td>
<td></td>
<td>15sec</td>
<td>15sec</td>
</tr>
<tr>
<td>Signal of power steering pressure switch is monitored.</td>
<td>P1521</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Output voltage(Vmap) is monitored.</td>
<td>P0106</td>
<td></td>
<td>&lt; 0.1V or &gt; 4.6V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P0108</td>
<td></td>
<td>&gt; 4.2V</td>
<td></td>
</tr>
<tr>
<td></td>
<td>P0107</td>
<td></td>
<td>&lt; 1.8V</td>
<td></td>
</tr>
<tr>
<td>Signal at current segment is compared to previous one.</td>
<td>P0325</td>
<td></td>
<td>&lt; 0.06V</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Time after start</td>
<td>&gt; 2sec</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Engine speed</td>
<td>≥ 2500rpm</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Load value</td>
<td>≥ 30%</td>
</tr>
</tbody>
</table>
### Sigma(Σ) 3.5ℓ Eng. – Diagnostic Trouble Code

<table>
<thead>
<tr>
<th>Thermostat</th>
<th>P0128</th>
<th>After given time (function or mass air flow, vehicle speed, engine speed) has elapsed, engine coolant temperature is monitored.</th>
<th>Engine coolant temperature after given time has elapsed.</th>
<th>&lt; 77?</th>
<th>Engine coolant at start</th>
<th>5? ~ 60?</th>
<th>Intake air temp. decrease after start</th>
<th>&lt; 5?</th>
<th>10~30min. depending on mass air flow, vehicle speed, engine speed</th>
<th>2 Driving cycles</th>
</tr>
</thead>
<tbody>
<tr>
<td>Battery backup line P0560</td>
<td>VB backup voltage is monitored.</td>
<td>VB backup voltage</td>
<td>&lt; 2V</td>
<td>Battery voltage</td>
<td>≥ 10V</td>
<td>Duration</td>
<td>10sec</td>
<td>Continuous</td>
<td>1 Driving cycle</td>
<td></td>
</tr>
<tr>
<td>Ignition coil P0350</td>
<td>Current through ignition coil is monitored.</td>
<td>No current of 1 or 2 IG coil group at the 3 IG coil group</td>
<td>During 48 ignitions</td>
<td>Engine speed</td>
<td>&lt; 4000rpm</td>
<td>Continuous</td>
<td>2 Driving cycle</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ignition failure sensor P0320</td>
<td>Current through ignition coil is monitored.</td>
<td>No current at the 3 IG coil group</td>
<td>During 32 ignitions</td>
<td>Engine speed</td>
<td>&lt; 4000rpm</td>
<td>Continuous</td>
<td>No MIL ON</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**KIA KIA MOTORS**
Sirius Ⅱ 2.4ℓ Eng.

Sirius2-Engine
Contents

- General Description
- Engine Feature
- Timing Belt
- Engine Tightening Torque
- ECM Overview
- ECM Input/Output
Sirius II 2.4ℓ Eng. – General Description

■ Sirius2 Engine

The Sirius2 engine is In-line 4 Cylinder DOHC engine adopted aluminium oil pan, inlet type cooling system, DLI type ignition coil integrated Power Transistor, and a ignition failure sensor added to detect ignition problems to increase serviceability.

Also, hall type CKP and CMP sensors are installed. This engine incorporates only one timing belt.

The Sirius2 engine is designed by Mitsubishi Motor company and manufactured by Hyundai Motor Company.

<table>
<thead>
<tr>
<th>Item</th>
<th>Sirius II 2.4 DOHC</th>
</tr>
</thead>
<tbody>
<tr>
<td>Capacity(cc)</td>
<td>2351</td>
</tr>
<tr>
<td>Engine type</td>
<td>In line 4 cylinder MPI DOHC</td>
</tr>
<tr>
<td>Bore×Stroke</td>
<td>86.5 × 100</td>
</tr>
<tr>
<td>Compression ratio</td>
<td>10:01</td>
</tr>
<tr>
<td>Max. Power(PS/RPM)</td>
<td>140/5500</td>
</tr>
<tr>
<td>Max. Torque(Kgm/RPM)</td>
<td>20.2/3000</td>
</tr>
<tr>
<td>Ignition Timing</td>
<td>BTDC 5° ± 2°</td>
</tr>
<tr>
<td>Idle RPM</td>
<td>800± 50RPM</td>
</tr>
<tr>
<td>Valve Clearance</td>
<td>0(HLA)</td>
</tr>
<tr>
<td>Fuel Pressure(Kg/㎠)</td>
<td>3.06</td>
</tr>
<tr>
<td>Ignition Order</td>
<td>1→3→4→2</td>
</tr>
</tbody>
</table>
Sirius Ⅱ 2.4ℓ Eng. – Engine Feature

- Top View

- PCSV
- ISA
- Connector for CKP
- Connector for IG Coil
2. INSTALL TIMING BELT

1. ALIGN TIMING MARKS

3. REMOVE SET’G PIN

4. TURN THE CRANKSHAFT SPROCKET 2 REVOLUTION

5. CHECK THE CLEARANCE OF AUTO TENSIONER

**Timing Belt**

- CAMSHAFT SPROCKET
- AUTO TENSIONER
- CRANKSHAFT SPROCKET
- OIL PUMP SPROCKET
Tightening Torque

**CAMSHAFT BEARING CAP:** 19~21Nm

**CONNECTING ROD BEARING CAP BOLT:** 18~22Nm + 90~94°

**MAIN BEARING CAP BOLT:** 25Nm + 90~94°

**CYLINDER HEAD BOLT:**
- **OVERHAUL WITHOUT REPLACE:**
  20N.m + 90~94° + 90~94°
- **REPLACE GASKET:**
  80N.m, LOOSE, 20N.m + 90~94° + 90~94°
- **REPLACE HEAD BOLT:**
  20N.m + 180~184°, LOOSE, 20N.m + 90~94° + 90~94°
ECM Overview

- CKP
- Knock sensor
- ECT
- O2 sensor
- ISA
- MAP
- Fuel Pressure Regulator
- PCSV
- IG Coil
- F/Pump
- CKP
ECM Input/Output

- MAP
- Oxygen sensor
- CKP
- CMP
- ECT
- IAT
- Knock sensor
- VSS
- Various switches

ECM

MELCO

Fuel control
Ignition control
Knocking control
Idle speed control
Purge control
Cooling fan control
A/C COMP. control
C/Relay control
Alt. current control