M272 Engine
Objectives

Students will be able to:

• identify differences between M112 and M272

• explain the camshaft adjusters operation

• identify major components of the M272

• explain function of the swirl flaps

• explain function of the temperature management system
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## M272 – M112 Comparison

<table>
<thead>
<tr>
<th>M272</th>
<th>M112</th>
</tr>
</thead>
<tbody>
<tr>
<td>3.5 litre</td>
<td>3.2 litre</td>
</tr>
<tr>
<td>268 hp @ 6000 rpm</td>
<td>214 hp @ 5700 rpm</td>
</tr>
<tr>
<td>258 lb-ft @ 2500 to 5000 rpm</td>
<td>228 lb-ft @ 5700 rpm</td>
</tr>
<tr>
<td>Compression Ratio 10.7 : 1</td>
<td>Compression Ratio 10.0 : 1</td>
</tr>
<tr>
<td>Sparkplugs per cylinder 1</td>
<td>Sparkplugs per cylinder 2</td>
</tr>
<tr>
<td>ME 9.7</td>
<td>ME 2.8</td>
</tr>
<tr>
<td>Coil On Plug</td>
<td>Double ignition coils</td>
</tr>
</tbody>
</table>
Comparison

Red line (Dash) = M112 3 valve

Blue line (solid) = M272 4 valve
New M272 introduced in the new SLK 171

Let's look at some highlights
M272 HighLights

• M112 replacement

• 3.5 litre displacement

• Counter rotating balance shaft

• Stiffer engine with lateral main bearing attachments

• 4 valve continuously variable camshafts intake and exhaust (DOHC)
M272 Highlights

- 90 degree V-6
- Two stage Intake manifold
- Turbulence flaps in the intake ports
- ME 9.7 control unit mounted on top of engine
- Electrically assisted thermostat
- No EGR valve
  - Both cams adjust
Let's take a look at what changed mechanically
Motor Mechanicals

• Based off of M112 engine
• Bore and Stroke increase compared to M112
• Die cast aluminum crankcase
• Silitec coated cylinder liners
• Starter openings both sides of block
• 8 lateral main bearing bolts
Crankshaft

• Crankshaft lighter as compared to M112

• Wider main bearings as compared to M112 used to reduce vibration

• Iron coated cast aluminum pistons
Balance shaft, familiar function

Oil sensor, now a switch
Balance Shaft

• Balance shaft similar to the M112

• Balance shaft rotates opposite crankshaft
Oil Level Switch

- Reed contact oil level switch S43 replaces B40
- Only one pin of the two pin connector used
- S43 mounted in oil pan
- Chain driven oil pump
- Vehicle equipped with an oil level dipstick
Partial and full load crankcase ventilation system
Crankcase Ventilation

Crankcase ventilation diagram

- Part load system over volume cut off on left cyl. head cover
- Full load system centrifuge on exhaust camshaft
Cylinder head

4 valves

DOHC

Cam adjusters
Cylinder Head

• New design cast aluminum cylinder heads

• 4 overhead camshafts (DOHC)

• 4 valves per cylinder, improve torque and horsepower compared to 3 valve engines

• Camshaft upper bearing surfaces integrated into cam housing cover

• Nickel coated high strength steel exhaust valves
Cylinder Head

- 4 Cam adjusters
- 4 Cam Sensors
- ME can detect Cam position with ignition on
- Intake cam is chain driven and drives exhaust cam via gear
Chain Tensioner

- Step type chain tensioner with internal spring
- Located at the lower right front engine
- Must be manually reset if removed
- Failure to preset tensioner before assembly will result in engine damage
Camshaft Timing Adjusters

- Vane type, oil pressure controlled adjusters
- Continuously variable
- $40^\circ$ advanced for intake (from $4^\circ$ BTDC to up to $36^\circ$ ATDC)
- $40^\circ$ retard for exhaust (from $30^\circ$ BTDC to up to $10^\circ$ ATDC)
Exhaust Cam Gear

Note: Retaining nut at front timing adjuster is reverse thread
Camshaft Position Sensors

- 4 Hall effect sensors, one for each camshaft

- True Power On (TPO) sensor technology capable of detecting cam position with stationary engine

- Right and left camshaft signals staggered by 240° camshaft angle

- Signal is low in absence of a window
Impulse Wheels

• Four impulse wheels used on the M272 mounted on the front of each camshaft timing adjuster
  – Each impulse wheel has a different part number

• The openings of the impulse wheels help ME determine the camshafts exact position

• Can only be used one time!

• If new impulse wheels are not used the pins could shear off causing massive damage to adjusters

Both locating pins sheared off when reinstalled

Gouging of mounting surface
Exhaust Cam Gear

- Exhaust Cam 2 piece gear
- Smaller outer gear spring loaded for noise reduction
- Gear must be held in place prior to disassembly
- Segment Ring must be replaced once removed
- Adjuster bolt reverse threaded
Camshaft Timing Network

B6/4 – Camshaft position sensor (intake left)
B6/6 – Camshaft position sensor (exhaust left)
B6/7 – Camshaft position sensor (exhaust right)
B6/5 – Camshaft position sensor (intake right)
B11/4 – Engine coolant temperature sensor
B70 – Crankshaft hall sensor
B2/5 – MAF
N3/10 – ME 9.7
Y49/5 – Camshaft timing control solenoid (exhaust right)
Y49/7 – Camshaft timing control Solenoid (Intake right)
Y49/4 – Camshaft timing control solenoid (intake left)
Y49/6 – Camshaft timing control Solenoid (exhaust left)
Camshaft Position

- Remove camshaft sensors
- Align balancer (305°) to front cover pointer
- Check impulse wheels stamped numbers
- If above line up properly cam positions are correct
Camshaft Timing Basic Position

1. Align balancer to 40° ATDC to front cover pointer
2. Front cover pointer
3. Upper camshaft marks
4. Camshaft marks aligned to head
Intake

Variable runners

Swirl flaps
Intake Manifold

- Magnesium cast sectional intake manifold with integrated vacuum reservoir
- Variable intake runner
- Short runner for higher RPM
- Long runner for lower RPM
- Swirl-Flaps also added providing better fuel mixture
Intake Components

12 Intake manifold with integral vacuum reservoir
12/1 Swirl flap shaft, left cylinder bank
12/2 Swirl flap shaft, right cylinder bank
12/3 Longitudinal switch flap shaft, right cylinder bank
12/4 Longitudinal switch flap shaft, left cylinder bank
22/6 Intake manifold switchover diaphragm
22/9 Swirl valve switchover diaphragm
Y22/6 Variable intake manifold switchover valve
Y22/9 Intake manifold swirl flap switchover valve
Variable Length Intake Manifold

- Engine load over 50% from approx. 1750 RPM intake flaps closed (long runner)
  - Better cylinder filling and increased torque
- Above 3900 RPM switchover solenoid deactivated via ME intake flaps open (short runner)
  - Incoming air follows short runner
- Unlike M112, M272 has two diaphragm actuators
Intake Functional Diagram

A – Long runner
B – Short runner
1 - Switchover flaps
12 – Intake manifold with integral vacuum reservoir
B2/5 – Hot film mass airflow sensor

22/6 – Intake manifold switchover diaphragm
Y22/6 – Variable intake manifold switchover valve
M16/6 – Throttle valve actuator
B70 – Crankshaft hall sensor
N3/10 – ME 9.7
Swirl Flaps

- Under certain operating conditions intake air is swirled via swirl flap for improved mixture process

- Vacuum diaphragm driven by ME controls flap position

- Swirl flap position sensors (hall sensors) monitor 2 magnets attached to swirl flap actuating shafts to determine flap position (activated/not activated)

- Sensors located at rear of intake manifold
Swirl Flaps

A = Non swirl not active
B = Swirl active
Swirl Flaps
Swirl Flap Operating Parameters
Swirl Flap Functional Diagram

12 – Intake manifold
1 – Swirl flap
22/9 – Aneroid capsule swirl flap Switchover
B11/4 – Coolant temperature sensor
B70- Crankshaft hall sensor
B28/9 – Left intake manifold swirl flap position sensor
B28/10 – Right intake manifold swirl flap position sensor
B2/5 – Hot film mass airflow sensor
M16/6 – Throttle valve actuator
N3/10 – ME 9.7
Y22/9 – Intake manifold swirl flap switchover valve
A – Swirl flap recessed (no swirl)
B – Swirl flap outward (swirl)
ME 9.7

Inputs

Outputs
Control Module function:

• Cylinder sequential injection
• Single spark plug coil (control and diagnostics)
• Electronic throttle plate positioning
• LIN communication with alternator
• Turbulence flap regulation
• Variable length intake runner control
• After run process

Note: When erasing DTC’s you must wait for the after run function to finish otherwise faults may remain.
ME After Run Process

• ME performs an after run process when circuit 15 is switched off

• After run is determined by ME and required to store inputs

• After run time is typically 5 seconds but can take several minutes longer depending on various functions (temperature management, OBD, DAS3 etc.)
  – at 176°F approx. 4 seconds, at 68°F approx. 60 seconds and at -22°F approx. 150 seconds
  – After cycling key off, must wait ~ 150 seconds

• This is the period in which the fault memory is over-written
ME 9.7 Inputs/Outputs
ME 9.7 Inputs/Outputs Legend

- A16/1 – Right knock sensor
- A16/2 – Left knock sensor
- B2/5 – Hot film mass air flow sensor
- B4/3 – Fuel tank pressure sensor
- B6/4 – Left intake camshaft hall sensor
- B6/5 – Right intake camshaft hall sensor
- B6/6 – Left exhaust camshaft hall sensor
- B6/7 – Right exhaust camshaft hall sensor
- B11/4 – Coolant temperature sensor
- B28 – Intake manifold pressure sensor
- B28/9 – Left intake manifold swirl flap position sensor
- B28/10 – Right intake manifold swirl flap position sensor
- B37 – Accelerator pedal sensor
- B70 – Crankshaft hall sensor
- G2 – Alternator
- G3/3 – Left O2 sensor upstream of TWC
- G3/4 – Right O2 sensor upstream of TWC
- G3/5 – Left O2 sensor in TWC
- G3/6 – Right O2 sensor in TWC
- M16/6 – Throttle valve actuator
- N10/1 – Driver SAM
- N10/1kR – Circuit 87 relay
- N10/1kS – Starter relay
- N10/1kO – Air pump relay
- N10/2 – Rear SAM
- N10/2kA – Fuel pump relay
- S40/3 – Clutch pedal switch
- S40/5 – Start enable clutch pedal switch
- S43 – Oil level check switch
- M4/7 – Suction fan
- T1/1-6 – Ignition coils 1 to 6
- Y10/1 – Power steering pump pressure regulator valve
- Y22/6 – Variable intake manifold switchover valve
- Y22/9 – Intake manifold swirl flap switchover valve
- Y32 – Air pump switchover valve
- Y49/4 – Left camshaft intake solenoid
- Y49/5 – Right camshaft intake solenoid
- Y49/6 – Left camshaft exhaust solenoid
- Y49/7 – Right camshaft exhaust solenoid
ME 9.7 Network Signals

N73 – EIS
N15/5 – Electronic selector lever module control unit
A1 – Instrument Cluster
N47-5 – ESP and BAS control unit
N80 – Steering column module
Y3/8n4 – Fully integrated transmission control unit
X11/4 – Diagnostic connector
N93 – Central gateway control unit
N22 – AAC control and operating unit
N2/7 - Restraint systems control unit
ME 9.7 Network Signals
Crank sensor (Hall)

O2 sensors

Three way catalytic converters

Ignition coil

Mass airflow
Crank Sensor

- Hall effect sensor (not inductive)
- Output signal switches between ground and 5 volts
- Incremental ring gear 58 teeth (60–2) is carry over
Sensor Signals

1 - Crank angle (CKA)
2 - Ignition TDC cylinder (in firing order)
3 - Signal of crankshaft Hall sensor (B70)
4 - Rpm signal TNA
5 - Camshaft Hall sensor intake signal, left and right
6 - Camshaft hall sensor exhaust signal, left and right

A = Recognition of ignition TDC of cylinder 1
   - second negative signal edge of crankshaft hall sensor after the gap
   - Signals 5 and 6 are "LOW"
   - Rpm signal (4) changes from "HIGH" to "LOW"
O2 Sensors

• Upstream wide-band O2 sensors as known from the M271 and OM648

• Downstream planar type O2 sensors mounted in catalytic converter housing

• Three Way Catalytic Converters (TWC)

G3/3 – Left upstream O2 sensor
G3/5 – Left downstream O2 sensor
158 – Catalytic converter
G3/4 – Right upstream O2 sensor
G3/6 – Right downstream O2 sensor
Three Way Catalytic Converters

• Two ceramic monoliths with 600 cells each
• Reduces Hydrocarbons (HC)
• Reduces Carbon Monoxide (CO)
• Reduces Nitrogen Oxides (NOX)
• Downstream O2 sensor mounted between the monoliths
O2 Sensor Networking

17 – Fuel rail
158 – Catalytic converter
B2/5 – Hot film mass airflow sensor
B11/4 – Coolant temperature sensor
B70 – Crankshaft hall sensor
B37 – Accelerator pedal sensor
G3/3 – Left upstream O2 sensor
G3/5 – Left downstream O2 sensor
G3/4 – Right upstream O2 sensor
G3/6 – Right downstream O2 sensor
N3/10 – ME 9.7
Y62 – Fuel injectors
Ignition Coil

- Individual coil on plug
- Driver located inside coil not in ME 9.7
- Each coil controlled separately
- Diagnostic information sent back to ME
- Bi-directional communication with ME

Pin 1 – batt
Pin 2 – ground
Pin 3 – ground
Pin 4 – control/diagnosis
Ignition Networking

- A16/1 – Right knock sensor
- A16/2 – Left knock sensor
- B6/4 – Left intake camshaft hall sensor
- B6/5 – Right intake camshaft hall sensor
- B6/6 – Left exhaust camshaft hall sensor
- B6/7 – Right exhaust camshaft hall sensor
- B2/5 – Hot film mass airflow sensor
- B11/4 – Coolant temperature sensor
- B70 – Crankshaft hall sensor
- B37 – Accelerator pedal sensor
- M16/6 – Throttle valve actuator
- N3/10 – ME 9.7
- N47-5 – ESP and BAS control unit
- T1/1 through T1/6 – ignition coil for cylinders 1 to 6
- Y3/8n4 - Fully integrated transmission control (VGS) control unit
- X11/4 – Data link connector
Hot Film Mass Airflow Sensor

- Frequency signal from Mass Airflow to ME
- Integrated Intake air temperature sensor used
Temperature management

Thermostat

Control
Temperature Management

• Coolant Temperature is regulated via Me 9.7

• 3 plate thermostat

• Regulates temperature from 185°F to 221°F (85°C to 105°C)

• Heating element in thermostat energized to heat thermostat

• 4 operating modes dependent on engine temperature and load
Temperature Management

1 – To radiator
2 – From engine
3 – To engine

A – Stationary coolant (cold start)
B – Circuit for engine and heat exchanger
C – Active after 208°F (98°C), after start or ambient temp. above 82°F (28°C)
D – Position for max radiator operation
Temperature Management

Cooling system diagram

- Radiator
- Water pump
- 3 plate thermostat
- Oil cooler
- Aux. water pump
- Duo valves
- Heater core
Fuel tank

Fuel pump control
Fuel Tank

- Magnesium cover helps protect tank
- Two layer steel tank with 18.4 gallon capacity
- In tank fuel supply system operates with 3.8 bar pressure
- Fuel filter with pressure regulator
- Returnless fuel system
Fuel Networking

12 Intake manifold
17 Fuel rail
17/1 Fuel pressure reservoir
45 Fuel filler neck, with ORVR
51 Pressure gauge connection
55/2 Fuel filter
55/2a Fuel pressure regulator 3.8 bar
75 Fuel tank
76 Vent valve, except USA
77 Activated charcoal canister
B4/3 Fuel tank pressure sensor
M3 Fuel pump assembly (with integral fuel pump (FP))
N10/2kA Fuel pump relay
N3/10 ME-SFI control unit
Y58/1 Purge control valve
Y58/4 Activated charcoal filter shutoff valve
Y62 Fuel injection valves
Fuel Pump Control

- Fuel pump controlled via fuel pump relay (N10/2kA)
- Fuel pump Relay located in rear SAM (N10/2)
- Fuel pump relay energized via ME
- Fuel pump runs ~ 1 second after ignition on

N10/2 – Rear SAM
N10/2kA – Fuel pump relay
Fuel Supply Circuit In Tank

Fuel Pump

Pressure Regulator (3.8 bar)

Fuel Filter

Splash bowl

Supply

Return

Fuel supply to engine
Access Point To Fuel Filter and Pump

Tank Pressure Sensor

Connector For pump And level sensor
Fuel Pressure Regulator

A-from pump
B-return to splash bowl
C-filtered fuel to engine
Fuel Level Sensor
Splash Bowl

- pump
- Swivel
- 2 retainers to remove pump
Fuel Pump
N3/10 – ME 9.7
A1 – Instrument cluster
N10/2 – Rear SAM

B4 – Fuel level sensor
75 – Fuel tank
Speed Sensitive Power Steering
Speed Sensitive Power Steering

• Gives the customer firmer feel in steering at higher speeds and more assist for parking maneuvers at slower speeds

• ME 9.7 now controls functions of the Speed Sensitive Power Steering system

• The valve port is adjusted for steering support required for the current driving condition and is dependent on the following input signals:
  – Engine speed
  – Vehicle speed (Via CAN)
  – Steering angle (Via CAN)
  – Steering angle speed (Via CAN)
Speed Sensitive Power Steering

- The pressure regulator valve controls the valve port and is rigidly connected to the power steering pump.

- It is actuated according to a performance map with a duty cycle of 10 to 90% and regulates the amount delivered to the power steering pump at between 2 and 9 liters/minute.

- The pressure regulator valve is opened wide for ignition ON and during engine start.

- In the case of faults on the input signals or on the pressure regulator valve, actuation is interrupted immediately and the maximum support is available from the power steering pump.
Speed Sensitive Power Steering Networking

- B70 Crankshaft Hall sensor
- N3/10 ME-SFI control unit
- N47-5 ESP and BAS control unit
- N80 Steering column module
- Y10/1 Power steering pump pressure regulator valve
<table>
<thead>
<tr>
<th>Pin</th>
<th>Signal/Signal info</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Camshaft timing adjuster intake, right bank</td>
</tr>
<tr>
<td>2</td>
<td>Not used</td>
</tr>
<tr>
<td>3</td>
<td>Injection valve end stage, cyl.6</td>
</tr>
<tr>
<td>4</td>
<td>Not used</td>
</tr>
<tr>
<td>5</td>
<td>Pressure control valve steering assist pump</td>
</tr>
<tr>
<td>6</td>
<td>Ignition signal 1 Ignition coil cyl.1</td>
</tr>
<tr>
<td>7</td>
<td>Ignition signal 2 Ignition coil cyl.2</td>
</tr>
<tr>
<td>8</td>
<td>Ignition signal 3 Ignition coil cyl.3</td>
</tr>
<tr>
<td>9</td>
<td>Ignition signal 4 Ignition coil cyl.4</td>
</tr>
<tr>
<td>10</td>
<td>Camshaft sensor exhaust right bank</td>
</tr>
<tr>
<td>11</td>
<td>Lambda sensor before CAT left bank (Nernst voltage)</td>
</tr>
<tr>
<td>12</td>
<td>Lambda sensor before CAT left bank (trim resistor)</td>
</tr>
<tr>
<td>13</td>
<td>Signal lambda sensor in CAT left bank</td>
</tr>
<tr>
<td>14</td>
<td>Lambda sensor before CAT right bank (virtual ground)</td>
</tr>
<tr>
<td>15</td>
<td>Sensor ground 1</td>
</tr>
<tr>
<td>16</td>
<td>Sensor ground 2</td>
</tr>
<tr>
<td>17</td>
<td>Sensor ground</td>
</tr>
<tr>
<td>18</td>
<td>Not used</td>
</tr>
<tr>
<td>19</td>
<td>Switch over solenoid valve (EUV) turbulence flap</td>
</tr>
<tr>
<td>20</td>
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<tr>
<td>21</td>
<td>Variable intake manifold valve</td>
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<tr>
<td>22</td>
<td>Injection valve end stage, cyl.4</td>
</tr>
<tr>
<td>23</td>
<td>Injection valve end stage, cyl.1</td>
</tr>
<tr>
<td>24</td>
<td>Camshaft sensor exhaust right bank</td>
</tr>
<tr>
<td>25</td>
<td>Heater lambda sensor in CAT left bank</td>
</tr>
<tr>
<td>26</td>
<td>Injection valve end stage, cyl.5</td>
</tr>
<tr>
<td>27</td>
<td>Heater lambda sensor in CAT right bank</td>
</tr>
<tr>
<td>28</td>
<td>Not used</td>
</tr>
<tr>
<td>29</td>
<td>Not used</td>
</tr>
<tr>
<td>30</td>
<td>Ignition signal 2 Ignition coil cyl.4</td>
</tr>
<tr>
<td>31</td>
<td>Ignition signal 4 Ignition coil cyl.6</td>
</tr>
<tr>
<td>32</td>
<td>Ignition signal 6 Ignition coil cyl.5</td>
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<tr>
<td>33</td>
<td>Not used</td>
</tr>
<tr>
<td>34</td>
<td>Camshaft sensor exhaust left bank</td>
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<tr>
<td>35</td>
<td>Lambda sensor before CAT left bank (Nernst voltage)</td>
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<tr>
<td>36</td>
<td>Lambda sensor before CAT left bank (pump voltage)</td>
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<td>37</td>
<td>HFM - Signal secondary air pump (SULEV - not USA)</td>
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<td>38</td>
<td>Lambda sensor before CAT left bank (virtual Ground)</td>
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<tr>
<td>39</td>
<td>Sensor ground throttle plate potentiometer</td>
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<td>Sensor ground lambda sensor in CAT left bank</td>
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<tr>
<td>41</td>
<td>Signal lambda sensor in CAT right bank</td>
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<tr>
<td>42</td>
<td>5V Sensor power supply 1</td>
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<td>43</td>
<td>5V Sensor power supply throttle plate potentiometer</td>
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<tr>
<td>44</td>
<td>5V Sensor power supply 2</td>
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<tr>
<td>45</td>
<td>LIN - interface</td>
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<tr>
<td>46</td>
<td>Not used</td>
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<tr>
<td>47</td>
<td>Injection valve end stage, Cyl.3</td>
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<tr>
<td>48</td>
<td>Camshaft timing adjuster intake left bank</td>
</tr>
<tr>
<td>49</td>
<td>Heater lambda sensor before CAT right bank</td>
</tr>
<tr>
<td>50</td>
<td>Not used</td>
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<tr>
<td>51</td>
<td>Injection valve end stage, Cyl.2</td>
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<tr>
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<td>Not used</td>
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<td>53</td>
<td>Secondary air valve</td>
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<tr>
<td>54</td>
<td>3 plate thermostat</td>
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<tr>
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<td>Not used</td>
</tr>
<tr>
<td>56</td>
<td>Camshaft sensor intake left bank</td>
</tr>
<tr>
<td>57</td>
<td>Camshaft sensor intake right bank</td>
</tr>
<tr>
<td>58</td>
<td>Not used</td>
</tr>
<tr>
<td>59</td>
<td>Signal A knock sensor left bank</td>
</tr>
<tr>
<td>60</td>
<td>Signal A knock sensor right bank</td>
</tr>
<tr>
<td>61</td>
<td>Lambda sensor before CAT right bank (trim resistor)</td>
</tr>
<tr>
<td>62</td>
<td>Not used</td>
</tr>
<tr>
<td></td>
<td>Description</td>
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<td>---</td>
<td>----------------------------------------------------------</td>
</tr>
<tr>
<td>63</td>
<td>Position sensor turbulence flap left bank</td>
</tr>
<tr>
<td>64</td>
<td>Not used</td>
</tr>
<tr>
<td>65</td>
<td>Not used</td>
</tr>
<tr>
<td>66</td>
<td>Signal coolant temperature sensor</td>
</tr>
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<td>67</td>
<td>Not used</td>
</tr>
<tr>
<td>68</td>
<td>Not used</td>
</tr>
<tr>
<td>69</td>
<td>Signal hot film MAF</td>
</tr>
<tr>
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<td>Not used</td>
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<tr>
<td>71</td>
<td>Heater shut off valve</td>
</tr>
<tr>
<td>72</td>
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<tr>
<td>73</td>
<td>Heater lambda sensor before CAT left bank</td>
</tr>
<tr>
<td>74</td>
<td>Motor (plus) throttle plate motor</td>
</tr>
<tr>
<td>75</td>
<td>Motor (minus) throttle plate motor</td>
</tr>
<tr>
<td>76</td>
<td>Not used</td>
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<td>77</td>
<td>Not used</td>
</tr>
<tr>
<td>78</td>
<td>Not used</td>
</tr>
<tr>
<td>79</td>
<td>Not used</td>
</tr>
<tr>
<td>80</td>
<td>Ground crankshaft sensor</td>
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<tr>
<td>81</td>
<td>Signal crankshaft sensor</td>
</tr>
<tr>
<td>82</td>
<td>Not used</td>
</tr>
<tr>
<td>83</td>
<td>Signal B'knock sensor left bank</td>
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<tr>
<td>84</td>
<td>Signal B'knock sensor right bank</td>
</tr>
<tr>
<td>85</td>
<td>Lambda sensor before CAT right bank (pump current)</td>
</tr>
<tr>
<td>86</td>
<td>Signal manifold absolute pressure sensor</td>
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<tr>
<td>87</td>
<td>Oil pressure switch</td>
</tr>
<tr>
<td>88</td>
<td>Signal throttle plate potentiometer 1</td>
</tr>
<tr>
<td>89</td>
<td>Position sensor turbulence flap left bank</td>
</tr>
<tr>
<td>90</td>
<td>Not used</td>
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<td>91</td>
<td>Not used</td>
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<tr>
<td>92</td>
<td>Not used</td>
</tr>
<tr>
<td>93</td>
<td>Reference signal (temperature) hot film MAF</td>
</tr>
<tr>
<td>94</td>
<td>Oil level switch</td>
</tr>
<tr>
<td>95</td>
<td>Camshaft timing adjuster exhaust left bank</td>
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<tr>
<td>96</td>
<td>Not used</td>
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Questions?