TECHlink

GM

May 2003
Volume 5, No. 5

A Monthly Publication for GM Dealership Service Professionals

GM Oil Life System Revisited

How often should engine oil be changed?

- 3,000 miles (5000 km)
- 5,000 miles (8000 km)
- 7,500 miles (12000 km)
- 10,000 miles (16000 km)

Actually, all of these are correct, depending on operating conditions. Oil life is affected by many factors other than just miles driven. The type of driving, temperature, and engine load all play a part.

That's why GM has developed the GM Oil Life System, an electronic watchdog that keeps track of all these variables and notifies the driver when it's time to change oil. We first told you about the GM Oil Life System in the March 2000 TechLink. Since then, the system has become standard equipment on nearly all GM products.

Briefly, the Oil Life System is programmed with a certain number of engine revolutions. As the engine runs, this number is reduced until it reaches zero, and the Oil Life light or message comes on. But there's more. Operating the engine under low or high temperatures, and under high load conditions subtracts (penalizes) extra revolutions, so the light comes on sooner.

Changing engine oil according to actual need rather than an inflexible schedule provides several benefits.

First is simpified determination about when to change oil. No more decisions about "normal" conditions vs. "severe" conditions. Second is reduced operating costs for GM's customers, who now have to change oil only when it's needed. Third is minimizing the amount of used oil that must be disposed of. And fourth, engines will always be running with suf-

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Techline News

How to Search on the TechLink Website

You can search the TechLink archives, in a roundabout sort of way. Go to www.google.com and select the advanced search option.

In the blue box, type in the key word(s) you want to search. You can limit the search four different ways, depending on which box(es) you type in.

Then in the next section of the form, on the file format line, select ONLY and select Adobe Acrobat PDF.

On the domain line, select ONLY, and then type http://service.gm.com in the box provided.

Click on the grey Google Search button. This will display a list of every issue of TechLink containing the specified key words. From this, choose the one that describes what you're looking for.

SHORTCUT TIP: If you want to avoid the form page, you can just type the search request in the input box on the main Google page. You must type your keyword(s) followed by this string exactly as shown. Spaces and punctuation are critical.

keyword **site:http://service.gm.com filetype:pdf**

This will find exactly the same items as the first method.

- Thanks to Mike Janke, Grand Prize Chevrolet Oldsmobile

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GM

ficiently fresh oil, for long life.

These benefits will be realized only if engine oil is actually changed as indicated by the GM Oil Life System.

Some customers "get it" when it's explained to them. Others may be reluctant to deviate from traditional oil change interval charts. So, part of the responsibility falls on retail service people to help get the message out.

TIP: To help you do this, an IDL broadcast is being prepared. Consult the GM Training Program Guide and Schedule for "Understanding the GM Oil Life System" (PPS03.P1D).

There's More

Traditionally, the vehicle maintenance schedule has been based on miles or time, while the oil change interval is now based on the GM Oil Life System. This could result in customers having to bring their vehicles in for an oil change when the light comes on, only to find that the vehicle is due in a month for scheduled maintenance.

That's all changing. In the accompanying article "Simplified Maintenance Schedules", you'll learn how maintenance intervals are now being tied into the oil change intervals indicated by the Oil Life System.

- Thanks to Jerry Garfield and Chuck Burns

Starter Cranks After Key is Released

Refer to bulletin 03-06-03-001. These are the highlights.

Owners of some 2003 Silverado and Sierra pickups or full-size utilities with the 5.3L Engine (VIN Z -- RPO L59) may comment that the engine starter continues to run after the key is released.

This is a normal condition and no repairs should be attempted for this condition.

On these vehicles, the starter relay is controlled by the PCM, with input from the key switch. After 0.4 seconds of cranking, a timer is activated in the PCM. Once this happens, even though the key is released, the PCM will continue to crank the starter until the engine starts or a no-start time limit is reached.

The fuel pump module may take several seconds to build fuel pressure, particularly after sitting overnight. The automatic crank feature ensures sufficient crank time even if the customer releases the ignition switch prematurely.

Power Door Lock and Window Switch

Owners of some 2001 - 03 Chevrolet Trackers may comment that the door locks and/or power windows are inoperative.

The wires may become pinched or chafed by the door check link assembly.

Service Bulletin 03-08-64-002, issued January, 2003 provides wire repair procedures. In addition, refer to SI document ID 162420 and reroute the wires for sufficient clearance.

- Thanks to Bill Denton

Reorganization Changes Coming to SI

The following subsections of the service manual will move from Body and Accessories to General Information starting with 2004 SI, as well as the paper service manual.

- Squeaks and Rattles
- Air / Wind Noise
- Waterleaks

More information will follow in a later issue of TechLink.

- Thanks to Jerry Bednarchik

- Thanks to Tracy Timmerman

Know-How Broadcasts for June

Emerging Issues	June 12, 2003	9:00 AM, 12:30 PM, 3:30 PM Eastern Time
10270.18D -- 2004 Cadillac New Model Features	June 26, 2003	9:00 AM, 12:30 PM, 3:30 PM Eastern Time

GM *TechLink* is a monthly magazine for all GM retail technicians and service consultants providing timely information to help increase knowledge about GM products and improve the performance of the service department.

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Oil Life System Reset Procedures – Cars

Many GM cars and trucks are equipped with an oil life system which determines when an oil change is required. After the oil has been changed, it's necessary to reset the system.

Procedures for resetting 2001 through 2004 passenger cars are published here. *Trucks will be published next month.*

The information for this article is the same as you will find in the applicable owner or service manual.

To find this information in SI 2000:

Select the vehicle

Select category General Information

Select category Maintenance and Lubrication

Select category Maintenance and then GM Oil Life System-Resetting.

TIP: You may be able to use the Search function using the words Oil Life System Resetting.

TIP: You can find copies of charts for earlier models on the TechLink website on the Internet at http://service.gm.com. Look for the January and February 2002 issues.

2001 - 04 Seville

2001 - 04 DeVille

1. Turn the ignition to ON but with the engine off.

2. Display the Oil Life message by pressing the Info button.

3. Press and hold the Reset button until the display shows 100% Engine Oil Life. This resets the oil life index.

2001 - 02 Eldorado

1. Turn the ignition to Run but with the engine off.

2. Display the OIL LIFE LEFT message by repeatedly pressing the SKIP INFO button.

3. Press the NO INFO RESET button until the display show 100% Engine Oil Life. This resets the oil life index.

2003 - 04 CTS

Base Audio System

1. Press the up or down arrow on the INFO button located to the right of the DIC display to access the DIC menu.

2. Once XXX% ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button.

3. The percentage will return to 100, and the oil life indicator will be reset.

4. Repeat the steps if the percentage does not return to 100.

Navigation System

1. Turn the system on by pressing the PWR/VOL knob once. The PWR/VOL knob is located to the lower left of the DIC display.

2. Press the INFO button located to the left of the display to access the Vehicle Info menu.

3. Turn the TUNE/SEL knob located to the lower right of the display until Engine Oil Life is highlighted. Press the knob once to select it.

4. Once XXX% Engine Oil Life is displayed, press the multifunction button next to the Reset prompt in the upper right corner of the display.

5. The percentage will return to 100, and the oil life indicator will be reset.

6. Repeat the steps if the percentage does not return to 100.

2004 SRX

Base Audio System

Press the CLR button on the right of the DIC display to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it. To reset the oil life indicator, use the following steps.

1. Press the up or down arrow on the INFO button located to the right of the DIC display to access the DIC menu.

2. Once XXX% ENGINE OIL LIFE menu item is highlighted, press and hold the CLR button. The percentage will return to 100, and the oil life indicator will be reset.

3. Turn the key to OFF.

If the Change Engine Oil message comes back when you start the vehicle, or the percentage does not return to 100, the engine oil life system has not reset. Repeat the procedure.

Navigation System

Press the display button to acknowledge the Change Engine Oil message. This will clear the message from the display and reset it. To reset the oil life indicator, use the following steps.

1. Turn the ignition to ON with the engine running.

2. Turn the system on by pressing the PWR/VOL knob located to the lower left of the DIC display

3. Press and hold the vehicle information display button located in the upper right of the screen for 3 seconds to enter the vehicle information menu.

4. Use the scroll up or down display keys to select Engine Oil Life.

5. Press and hold the RESET button on the display. The percentage will return to 100, and the oil life indicator will be reset. Repeat the steps if the percentage does not return to 100.

6. Press the RETURN button on the display to return to the main page.

7. Turn the key OFF.

If the Change Engine Oil message comes back when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

2004 XLR

1. Press the up or down arrow to scroll the DIC to show OIL LIFE.

2. Once the XXX% ENGINE OIL LIFE menu item is highlighted, press and hold the RESET button until the percentage shows 100%. Repeat the steps if the percentage does not return to 100.

3. Turn the key to OFF.

If the Change Oil Now message comes back when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

2001 - 04 Impala

2002 - 04 Monte Carlo

Using the Radio

1. Turn the ignition to ACC or ON, with the radio off.

2. Press and hold the TUNE DISP button on the radio for at least five seconds until SETTINGS is displayed.

3. Press the SEEK PTYPE up or down arrow to scroll through the main menu.

4. Scroll until OIL LIFE appears on the display.

5. Press the 1 PREV or 2 NEXT button to enter the submenu. RESET will be displayed.

6. Press the TUNE DISP button to reset. A chime will be heard to verify the new setting and DONE will be displayed for one second.

7. Once the message has been reset, scroll until EXIT appears on the display.

8. Press the TUNE DISP button to exit programming. A chime will be heard to verify the exit.

Using the Accelerator Pedal

1. Turn the ignition to ON, with the engine off.

2. Fully press and release the accelerator pedal three times within five seconds.

3. If the CHANGE ENGINE OIL message flashes, the system is reset. However, if it stays on, it did not reset. You'll need to repeat the procedure.

2001 - 02 Intrigue

1. Turn the ignition to ON, with the engine off.

2. Fully press and release the accelerator pedal three times within five seconds.

3. If the CHANGE OIL light flashes, the system is resetting.

4. Turn the key to OFF after the light has finished flashing, then start the vehicle.

5. If the CHANGE OIL light comes back on, the engine oil life system did not reset. Repeat the procedure.

2001 - 03 Grand Prix w/o Trip Computer

2001 - 04 Regal w/o DIC

2004 GTO

1. Turn the ignition to RUN, with the engine off.

2. Fully press and release the accelerator pedal three times within five seconds.

3. If the CHANGE OIL SOON light flashes, the system is resetting.

4. Turn the key to OFF after the light has finished flashing, then start the vehicle.

5. If the CHANGE OIL SOON light comes back on, the engine oil life system did not reset. Repeat the procedure.

2001 - 03 Grand Prix with Trip Computer

1. Press the MODE button until the light appears lit next to OIL LIFE.

2. Press and hold the RESET button for three seconds. The oil life percentage should change to 100%.

2001 - 03 Aurora

1. With the ignition on, press the SELECT right arrow button on the DIC to OIL so the OIL LIFE percentage is displayed.

continued on page 5

Simplified Maintenance Schedules Coming

New and simplified maintenance schedules are coming for 2004.

Historically, maintenance schedules have been regarded as complicated, extensive, and in some cases confusing to customers.

In fact, there have been two separate schedules from which a choice must be made. The short trip/city schedule was defined by a list of conditions, including trips below 5 miles (8km), extensive idling, and others. This schedule called for performing certain operations such as oil changes at fairly low intervals.

A long trip/highway schedule was defined simply as only if none of the short trip definitions applied. And the service intervals were longer.

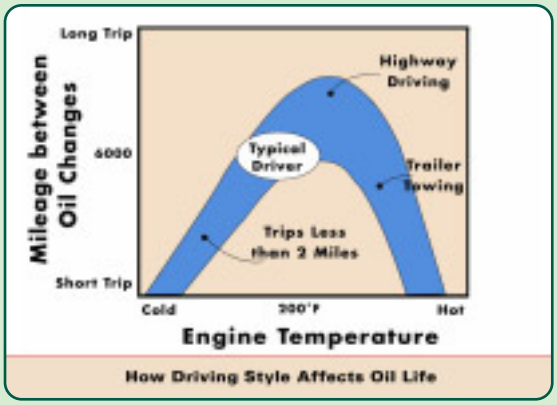
In addition, these schedules called for performing various operations according to mileage and/or time.

And, maintenance schedules required literally dozens of pages to describe fully in the owner's manual.

All of this is changing on those vehicles equipped with the GM Oil Life System.

First and foremost, oil changes are now done according to the GM Oil Life System, which is explained in an accompanying article, "GM Oil Life System Revisited."

Equally important, all other maintenance items are being keyed to the oil change intervals. Refer to individual vehicle maintenance schedules for specific requirements.



How Driving Style Affects Oil Life

Scheduled Maintenance

When the CHANGE ENGINE OIL light or message comes on, it means that service is required on the vehicle. It should be serviced as soon as possible within the next 600 miles (1000 km). It is possible that, under the best conditions, the engine oil life system may not indicate that vehicle service is necessary for over a year. However, engine oil and filter must be changed at least once per year, and at this time the system must be reset.

NOTICE: The owner should check oil regularly and keep it at the proper level. Failure to keep the oil at the proper level can cause damage to the engine not covered by warranty.

TIP: If the engine oil life system is accidentally reset, the vehicle must be serviced within 3000 miles (5000 km) since the last service. Reset the oil life system when the oil is changed.

Required services are described by the terms Maintenance I and Maintenance II. Generally, the first service should be Maintenance I, the second should be Maintenance II, and alternated between I and II thereafter. In some cases, Maintenance II may be required more often.

Maintenance I – Use Maintenance I if the CHANGE ENGINE OIL light comes on within 10 months since the vehicle was purchased or Maintenance II was performed.

Maintenance II – Use Maintenance II if the previous service performed was

Typical Maintenance Schedules

Service	Maintenance I	Maintenance II
Change engine oil and filter. Reset oil life system.	X	X
Lubricate chassis components.	X	X
Visually check for any leaks or damage.	X	X
Inspect engine air cleaner filter change indicator. If necessary, replace filter.	X	X
Rotate tires and check inflation pressures and wear.	X	X
Inspect brake system. (a)	X	X
Check engine coolant and windshield washer fluid levels and add as needed.	X	X
Perform any needed additional services.	X	X
Inspect suspension and steering components. (b)		X
Inspect engine cooling system. (c)		X
Inspect wiper blades. (d)		X
Inspect restraint system components. (e)		X
Lubricate body components. (f)		X
Check transmission fluid level and add fluid as needed.		X

Typical Additional Required Services

Service	25,000 (41,500)	50,000 (83,000)	75,000 (125,000)	100,000 (166,000)	125,000 (207,500)	150,000 (240,000)
Inspect fuel system for damage or leaks.	X	X	X	X	X	X
Inspect exhaust system for loose or damaged components.	X	X	X	X	X	X
Change automatic transmission fluid and filter (severe service). (h)						
Change automatic transmission fluid and filter (normal service).						
Change transfer case fluid.				X		X
Replace spark plugs and inspect spark plug wires.				X		
Inspect positive crankcase ventilation (PCV) valve.				X		
Engine cooling system service (or every 5 years, whichever occurs first). (i)						X

Mileage intervals and services vary with model line.

Maintenance I. Always use Maintenance II whenever the light comes on 10 months or more since the last service, or if the light has not come on at all for 1 year.

Additional Required Services

See the Typical Additional Required Services table on page 4.

These services should be performed at the first maintenance service (I or II) after the indicated miles (kilometers) shown for each item.

This table is a typical example. See the individual vehicle maintenance schedule for specifics.

Maintenance Footnotes

Maintenance footnotes may vary between vehicles. The following apply to the typical schedules above, and have been condensed. They are presented here only as an example. See individual vehicle maintenance schedules for details.

a. Visually inspect brake components.
b. Visually inspect front and rear suspension and steering, CV joints, boots and axle seals.
c. Visually inspect hoses.
d. Visually inspect wiper blades.
e. Check operation of seat belt system parts.
f. Lubricate locks, hinges, latches, seat hardware.
g. Add fluids as needed.
h. Change automatic transmission fluid if dictated by operating conditions.
i. Drain, flush and refill cooling system

Owner Checks and Services

The owner is instructed to perform certain checks and services at specified intervals, with the assistance of their GM Goodwrench dealer if desired. These typically include:

- Engine oil level check
- Engine coolant level check
- Tire inflation check
- Starter switch check
- Automatic transmission shift lock control system check
- Ignition transmision lock check
- Parking brake and automatic transmission park (P) mechanism check
- Underbody flushing service

- Thanks to Jerry Garfield and Chuck Burns

continued from page 3

2. Press RESET and hold for five seconds. OIL LIFE XXX% will appear and then when the button is released OIL LIFE 100% will be displayed.

2001 - 04 Bonneville

1. Display OIL LIFE on the DIC.

2. Press and hold the RESET button for more than five seconds. The oil life will change to 100%.

2001 - 04 LeSabre

2001 - 04 Park Avenue

1. Display OIL LIFE INDEX on the DIC.

2. Press and hold the RESET button on the DIC for more than five seconds. The oil life will change to 100%.

2001 - 04 Regal with DIC

1. Put the oil life display on the DIC.

2. Press the DIC RESET button for five seconds.

2001 - 04 Corvette

1. Turn the ignition to ON, with the engine off.

2. Press the TRIP button so the OIL LIFE percentage is displayed.

3. Press RESET and hold for two seconds. OIL LIFE REMAIN 100% will appear.

2001 - 02 Camaro

2001 - 02 Firebird

1. Turn the ignition to RUN but with the engine off.

2. Push the Trip/Oil Reset button located on the instrument panel for 12 seconds. The Oil Change light will start to flash to confirm that the system is reset. The reset is completed when the Oil Change light goes out.

2001 - 04 Grand Am

2001 - 04 Alero

1. Turn the ignition to ON.

2. Push the RESET button located in the driver's side instrument panel fuse block. The CHANGE OIL light will start to flash.

3. Press and hold the RESET button again. The reset is complete when you hear the chimes sound and the CHANGE OIL light goes out.

2004 Grand Prix

1. Press the options button on the DIC until ENGINE OIL MONITOR appears on the DIC screen.

2. Presss the set/reset button to reset the system.

The next screen indicates that the engine oil monitor has been reset.

If the vehicle is equipped with the trip computer DIC, when the gage button is pressed and the OIL LIFE REMAINING mode appears, it should read 100 % OIL LIFE REMAINING.

3. Turn the key OFF.

If the Change Oil Soon message comes back when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

2004 Malibu

1. Display OIL LIFE RESET on the DIC.

2. Press and hold the ENTER button for at least one second. An ACKNOWLEDGED display message will appear for three seconds or until the next button is pressed. This will tell you the system has been reset.

3. Turn the key OFF.

If the Change Oil Soon message comes back when you start the vehicle, the engine oil life system has not reset. Repeat the procedure.

2002-04 Saturn L and Vue

1. Remove the cover of the underhood fuse block (UHFB), which is located under the hood.

2. With the ignition key in RUN but the engine off, press the red OIL RESET button and hold for 5 seconds.

3. If the CHANGE OIL SOON light is flashing, the system is reset. The light will flash for up to 30 seconds or until the ignition is turned off.

4. If the light comes on again and stays on for 30 seconds at the next ignition cycle, it did not reset. Reset the system again.

2003-04 Saturn Ion

1. Press and release the trip/reset button until the OIL LIFE message is displayed.

2. Press and hold the trip/reset button until a chime sounds five times and RESET is displayed in the message center. When the system is reset, the odometer will again be displayed in the message center.

3. Turn the key OFF.

If the CHG OIL message comes back on when you start the vehicle, the system has not reset. Repeat the procedure.

- Thanks to Jerry Garfield

Tracker Windshield Replacement

Owners of some 2002 - 03 Chevrolet Trackers may comment that the windshield has a crack in the lower left hand or right hand corner.

This condition may be caused by excessive sealant that can create an uneven surface for the windshield to adhere to and may cause a stress crack.

Service Bulletin 03-08-48-001, issued January, 2003 provides windshield replacement procedures.

TIP: Do not use the dura-lock tabs that may be present.

- Thanks to Bill Denton

A New Kind of Oxygen Sensor

Some Background

The "conventional" O2 sensor in use since 1978 can tell the engine control system only that the exhaust is either too rich or too lean. It's called a switching sensor because it makes a sharp voltage transition when the air/fuel mixture varies a tiny amount either side of ideal (14.7:1 for a gasoline engine).

The engine controller responds to a rich signal from the O2 sensor by leaning the mixture, and responds to a lean signal by richening the mixture.

Even more precise fuel control would be possible if the O2 sensor could detect the exact deviation of the exhaust stream, lean or rich. The new wide-range air/fuel sensor can do this.

Wide-Range Air-Fuel Sensor (WRAF)

The wide-range air-fuel sensor, or WRAF sensor, discussed in this article will be used in the 4.6L LH2 engine in the 2004 Cadillac XLR and SRX. This sensor may also be referred to as a lambda sensor or wide-band sensor.

The WRAF sensor has been used in the past on select models of GM vehicles with the 3.0L L81 engine, first in the 1999-2001 Cadillac Catera, then in the 2000-2004 Saturn LS.

TIP: Throughout service information, the wide-range air-fuel sensor is referred to using the standard terminology of heated oxygen sensor or HO2S; in this article we will refer to it as the WRAF sensor.

Advantages of the WRAF

A typical V6 engine operating at 2500 rpm will produce approximately 62 cylinder pulses per second per cylinder bank. Refer to the graph below, which displays the voltage of a switching-style oxygen sensor. During one rich-to-lean and lean-to-rich transition of the oxygen sensor signal (1/2 second), there will be approximately 30 cylinder pulses

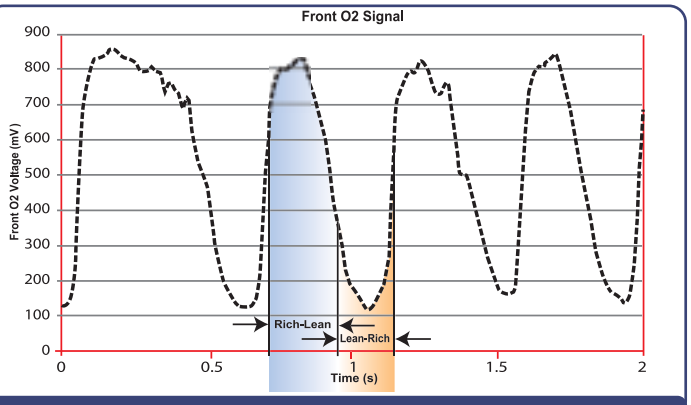
Each cycle or switch is the average air-fuel ratio of several cylinders.

With a switching-style sensor, the engine controller will merely continue to adjust fuel trim, rich or lean, until it sees a signal swing in the opposite direction. The process then reverses and continues transitioning rich-to-lean and lean-to-rich. This explains the constant cycling or switching of the switching-style sensor.

So, the first advantage of the WRAF sensor is that it can detect the exact deviation from 14.7:1, rich or lean, and allow the engine controller to precisely adjust the air-fuel ratio to the desired amount.

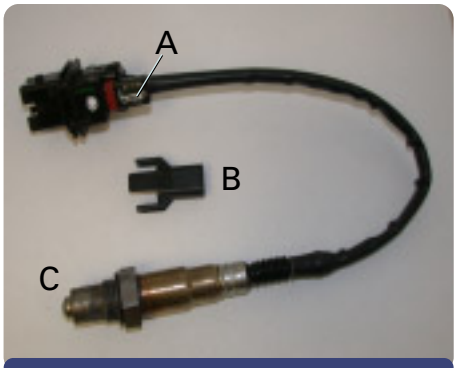
TIP: Ideal combustion occurs with an air-fuel ratio of 14.7:1, also referred to a stoichiometric.

Most switching-style oxygen sensors operate within a range of 0 to 1000 millivolts, and as a result will not provide an accurate reading when the air-fuel ratio exceeds approximately 14.6:1 when rich or 14.8:1 when lean.



Typical Switching-Style O2 Sensor Signal

The WRAF sensor can provide an accurate signal when the air-fuel ratio is as lean as 16:1 or as rich as 11:1, allowing the engine controller to continuously adjust fuel trim throughout this wide range of air-fuel ratios. So, a second advantage of the WRAF sensor is its ability to provide an accurate signal while operating in an air-fuel ratio, or lambda state, other than stoichiometric .



Typical WRAF Sensor and Connector
A-Trimming Resistor • B-Resistor Cover
C-Sensor

WRAF Wiring and Circuits

The WRAF sensor has six wires (circuits), divided among three functions.

Reference Voltage – The engine controller provides a fixed signal voltage to the WRAF sensor on two circuits. These circuits are called the reference voltage circuit and the low reference circuit.

Pump Current – There are two circuits called the input pump current and output pump current. They provide an electromotive force needed for the movement of oxygen ions inside the sensor.

Heater – As with a switching-style sensor, there are heater voltage supply and heater low control circuits. They are similar in operation to most switching-style sensors.

Each sensor contains a trimming resistor that is integral to the sensor connector. This trimming resistor is used during sensor manufacturing to calibrate each sensor to the desired performance specifications.

Operation

Here is what happens as exhaust flows past the sensor. Refer to the WRAF sensor cutaway.

1. As the exhaust stream passes the WRAF sensor, a sample of the exhaust gases enters the exhaust gas sample tube and moves through the diffusion gap.

2. When the air-fuel ratio of the sampled exhaust gas changes, there is a corresponding change to the voltage potential between the reference voltage circuit and the low reference circuit.

3. When the voltage on these circuits changes, the engine controller changes the amount of voltage on the input pump current circuit and the output pump current circuit.

4. As the voltage on the input and output pump current circuits changes, oxygen ions move into or out of the pumping cell through the porous layer. This brings the voltage potential between the reference voltage and low reference circuits back to a desired value.

5. By monitoring the required voltage and current level change on the input pump current and output pump current circuits, the engine controller can determine what the air-fuel ratio is at that moment.

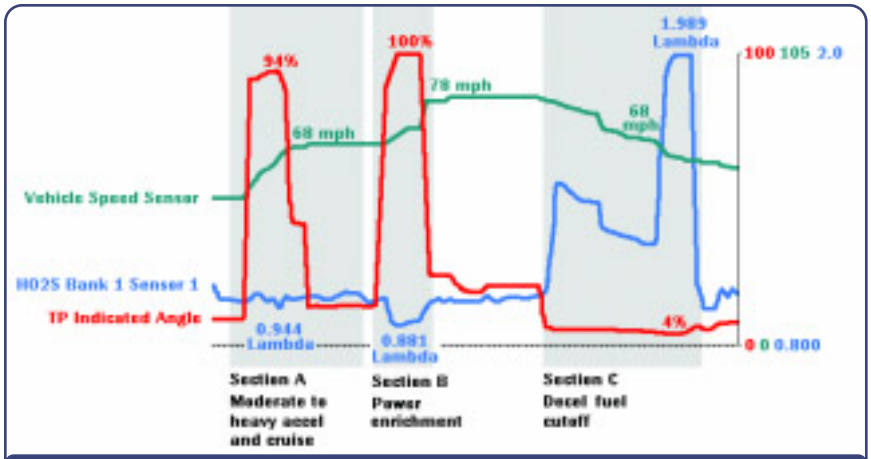
6. The engine controller can then determine exactly how much the air-fuel ratio needs to be adjusted to maintain the desired voltage potential and thus the desired air-fuel ratio.

The WRAF sensor is able to determine the exact amount of air-fuel ratio change required for the upcoming cylinder pulses. This is different from a switching-style sensor, which has a much larger estimating error of the air-fuel ratio change.

On a low level, there is closed-loop operation between the engine controller and the WRAF sensor pumping circuits, low

reference circuit, and reference voltage circuit.

On a high level, there is closed-loop operation between the exhaust sampling of the WRAF sensor and total fuel trim adjustment. The latter is similar to the most traditional closed-loop fuel systems.



Typical Lambda Values

How to Interpret WRAF Sensor Data on the Tech 2

TIP: Even though the engine controller and the WRAF sensor use various voltage levels during operation, the signal value displayed on the Tech 2 is a lambda value, NOT a voltage value.

The variable name "lambda" refers to the deviation above or below stoichiometric, or 14.7:1 air-fuel ratio. A lambda value of 1.000 is equivalent to a perfect stoichiometric ratio of 14.7:1. Depending on vehicle platform, the lambda value can be as low as 0.750 or as high as 3.999. A low lambda value represents a rich exhaust sample, and a high lambda value represents a lean exhaust sample.

The lambda value can be used to calculate the exact air-fuel ratio.

For example, a lambda value of 1.025 on the scan tool indicates that the system is operating lean. To find out exactly how lean, multiply 1.025 by 14.7. This gives the result of approximately 15.07:1. Conversely, a lambda value of 0.975 indicates the system is operating rich. Multiply 0.975 x 14.7 = 14.33:1. This gives you an idea of how the controller is able to determine the exact desired air-fuel ratio.

The Meaning of Extreme Lambda Values

How can a lambda value of 0.750 or 3.999 be meaningful? Multiply a lambda value of 3.999 x 14.7 = 58.79:1. This is clearly not an air-fuel ratio that any engine could operate under during cruise or acceleration.

Extreme lambda values are a result of the limits of the controller hardware and software. When a vehicle enters a fuel cut-off state during deceleration, the lambda value may move to a very high number (infinity) because the controller software and hardware are operating the pumping circuits at their maximum correction state to offset the extremely lean air-fuel ratio that is occurring. The controller software will not display infinity but will instead display a large number. Depending on the controller manufacturer, these maximum limits may be as low as 0.750 during a very rich condition, or as high as 3.999 during a very lean condition.

Typical WRAF Sensor Lambda Values

Acceleration and Cruise -- The lambda value stays fairly flat, close to 1.000, during the moderate to heavy acceleration and during cruise (Section A). This is because the sensor and the engine controller are in their own closed-loop operation and the lambda value only "drifts" above or below 1.000 as the engine controller makes its fuel trim adjustments. This closed-loop operation between the engine controller and the WRAF sensor is an instantaneous reaction to voltage deviations between the reference voltage circuit and low reference circuit and the resulting oxygen ion exchange via the pumping circuits.

Power Enrichment -- The lambda value moves lower when power enrichment is active (Section B).

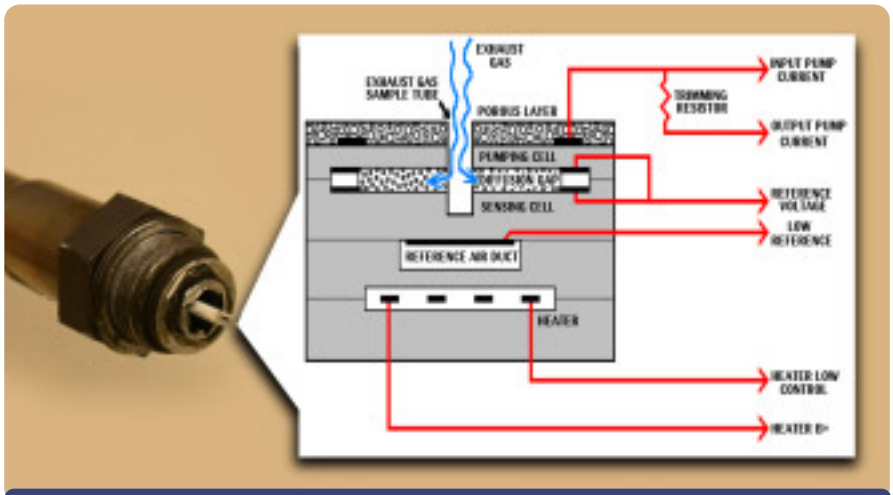
Deceleration -- During deceleration, the lambda value moves to 1.989. This is because the engine controller has commanded a deceleration fuel cut-off state and, as a result, the exhaust stream is extremely lean (Section C). Notice how the engine controller will regulate the closing of the throttle; the throttle plate must be less than five percent open before the lambda value will finally move to 1.989. On this particular vehicle, 1.989 is the limiting value of the hardware and software.

Diagnosing a WRAF Sensor

Here are a few points to remember when diagnosing a WRAF sensor:

- With the sensor disconnected and the ignition on, the voltage level measured on the input pump current circuit or the output pump current circuit, on the engine harness side, is very low and should be measured using the DMM millivolts scaling.

- In addition to the input and output pump current circuits, with the sensor disconnected and the ignition on, there will be a voltage present on the reference voltage circuit, low reference circuit, and possibly the heater low control circuit. The applicable DTC tables, when necessary, will provide the exact voltage values. Of course, there will be battery voltage present on the heater ignition voltage supply circuit.



WRAF Sensor Cutaway

- The voltage that may be present on the heater low control circuit is a diagnostic voltage produced by the engine controller. This voltage is used by the engine controller to discriminate between a heater circuit open, short to ground, or short to voltage condition. Depending on platform, the diagnostic voltage may or may not be present.

- Remember this when performing voltage measurements on the engine harness side. When a circuit fault is present, it may cause voltage level changes on the input pump current, output pump current, reference voltage or low reference circuits. So, you must not assume that because the voltage of the first circuit you measured is not within the correct range it is the problem circuit!

- As with any heated oxygen sensor, no circuit repairs should be attempted to the sensor harness.

- Thanks to Jim Hanna

Bulletins - April 2003

This review of service bulletins released through mid-April lists the bulletin number, superseded bulletin number (if applicable), subject and models.

PROGRAM BULLETIN

03011; Remote Keyless Entry System Inoperative; Specified 2003 Cadillac, Chevrolet, GMC Pickups and Utilities; Hummer H2

RECALL BULLETIN

03-008; Driver Air Bag Inflator; 2003 Buick Rendezvous, Cadillac DeVille, Chevrolet Venture, Impala, Monte Carlo, TrailBlazer, EXT, GMC Envoy, XL, Pontiac Montana

GENERAL INFORMATION:

03-00-91-001; Vibration Analysis Worksheet; 2003 and Prior Passenger Cars and Trucks, Hummer H2

HVAC

03-01-39-001; Rear HVAC Blower Control Knob May Fall Off (Install New Design Knob); 1998-2001 Cadillac Seville

SUSPENSION:

01-03-08-002A; replaces 01-03-08-002; Front Suspension Clunk/Rattle Noise Diagnosis; 1998-2003 Chevrolet Malibu, Oldsmobile Cutlass, Alero, Pontiac Grand Am

03-03-07-001; Revised Wheel Alignment Specifications; 2003 Chevrolet Silverado GMC Sierra 1500

DRIVELINE AXLE:

02-04-21-002A; replaces 02-04-21-002; Service 4WD Indicator Illuminated, DTC B2725 Set, Transfer Case Selector Switch in One Position – Indicator Lamp Indicates Another Range is Selected (Replace Transfer Case Shift Control Switch); 2002-03 Chevrolet TrailBlazer, EXT, GMC Envoy, XL, with 4-Wheel Drive

02-04-21-005A; replaces 02-04-21-005; Slips in 4-Wheel Drive, Noise, Vibration, Leaks, Hot Odor (Diagnose and Repair Front Differential and/or Transfer Case; Specified 1998-2003 Pickups and Utilities with Autotrak Transfer Case (RPO NP8) (Selector Pad on Instrument Panel Must Have Auto 4WD, 4HI, 4LO, and 2HI Selections)

02-04-21-008A; replaces 02-04-21-008; Shudder, Rocking Motion, Binding, Feels Like Vehicle is Stuck in 4WD (Crow Hop) when Turning at Low Speeds (Replace Transfer Case Encode Sensor and Reprogram TCCM); 2002-03 Chevrolet TrailBlazer, GMC Envoy, Oldsmobile Bravada

03-04-17-002; Whine Noise From Rear Axle (Diagnose and Replace Rear Propeller Shaft with New Tuned Torsional Damper Rear Prop Shaft); 2002-03 Chevrolet TrailBlazer, GMC Envoy, Oldsmobile Bravada with 4.10 Ratio Rear Axle (Standard Short Wheelbase) (RPO GT5)

03-04-17-003; Vibration/Noise from Auto/Manual Shifter During Drive/Gear Shifts (Replace Front Prop Shaft to Transmission Flange Retaining Bolts); 2003 Cadillac CTS

03-04-17-004; Revised Prop Shaft Replacement Procedure; 2003 Cadillac CTS

03-04-18-001; Availability of New Front Drive Axle Nut; 1997-2003 Chevrolet Malibu, Oldsmobile Alero, Pontiac Grand Am

03-04-19-001; Use of Synthetic Front Axle Lubricant for 4WD Vehicles Sold in Cold Weather Climates; Specified 2002-03 Chevrolet and GMC Pickups and Utilities with 4WD and 9.25-inch Front Axle Assembly

03-04-19-002; Squeak, Squeal or Whistle Noise from Front Axle (Replace Intermediate Axle Seal and/or Differential Carrier Seal); 2002-03 Chevrolet TrailBlazer, GMC Envoy with 4WD, Oldsmobile Bravada AWD

03-04-21-001; 4WD Light, 4WD Inoperative, DTCs C0327, P0836, P5000 (Permanent Fix Not Available At This Time); 2003 Chevrolet and GMC Pickup and Utility with NP1 (NVG 263EAU), NP8 (NVG 246EAU) Transfer Case

ENGINE/PROPULSION SYSTEM:

01-06-04-002A; replaces 01-06-04-002; CEL Concern – DTC P0101 Set (Reprogram PCM); 2000 Cadillac DeVille, Eldorado, Seville with 4.6L Engine (VINs 9, Y – RPOs L37, LD8)

03-06-01-005; Revised Crankshaft Rear Oil Seal Replacement, Crankshaft Rear Oil Seal Installation and Special Tools; 2003 Cadillac DeVille, Seville, Oldsmobile Aurora

03-06-01-006; Powertrain Qualilty Center for Performance Parts Engine Replacements; 2003 and Prior Passenger Cars and LD Trucks, Hummer H2

03-06-01-008; Crankshaft Rear Oil Seal Leaks During Extreme Cold Weather Operation (Modify Oil Separator); 2002-03 Chevrolet and GMC C/K, C4500/5500 with 6.6L Duramax Diesel Engine (VIN 1 – RPO LB7)

03-06-03-003; AC Delco Replacement Battery Warranty Procedures; 2003 and Prior Passenger Cars and Trucks, Hummer H2

03-06-04-014; Oil Present Around Turbo Area, Oil Level Low, Oil Pressure Gauge May Drop (Inspect/Replace Turbo Oi Feed Pipe Assembly); 1999-2002 Chevrolet and GMC MD Tilt Cab Models with 6HK1T Diesel Engine (VIN 3 – RPO LG4)

03-06-04-015; Revised Engine Cranks but Does Not Run Diagnostic; 2002-03 Chevrolet Silverado, Suburban, GMC Sierra with 5.3L Engine (VIN Z – RPO L59)

TRANSMISSION/TRANSAXLE:

02-07-30-051A; replaces 02-07-30-051; Transmission Shifting In and Out of 4th and 5th Gear (Hunting) When Pulling/Carrying a Load, Unable to Manually Select 4th Gear (Install 5th Gear Inhibit Switch); 2001-02 Chevrolet and GMC HD2500/HD3500 with 6.6L Diesel or 8.1L Gas Engine (VINs 1, G – RPOs LB7, L18) and Allison Auto Trans (RPO M74)

03-07-30-004; Introduction of New AISIN Transmission Quality Center; 2001-03 Chevrolet and GMC MD Tilt Cab Models with 4HE1-TC Diesel Engine and AISIN Auto Trans

03-07-30-005; SES Indicator Illuminated; Transmission Slips, Engine Flare, Delayed 2-3 Shifts, Shifts Missing, No Shift, DTC P0730, P0756, P0757 (Replace Accumulator Assembly/Service Transmission); Specified 2002 Chevrolet and GMC Pickups and Utilities with 4L80E (MT1) or 4L85E (MN8) Auto Trans

BODY AND ACCESSORIES:

01-08-50-014A; replaces 01-08-50-014; Driver' Seat Back Material Pulling Away from Side Impact Air Bag Module Bezel (Replace Side Impact Air Bag Bezel/Retainer); 2001-03 Chevrolet Monte Carlo

02-08-44-020B; replaces 02-08-44-020A; No Audio Out of Speakers at Times (Reprogram Radio and/or Replace Amplifier); 2003 Cadillac, Chevrolet, GMC Pickups and Utilities, Hummer H2

03-08-44-005; Poor Radio Reception or Radio Static/Increased Interference with Rear Window Defogger On or Some Window Defogger Grids May Be Inoperative (Diagnose and Repair Rear Window Defogger Heating Grid); 1997-2003 Buick Century, Regal, Chevrolet Impala, Monte Carlo, Oldsmobile Intrigue

03-08-44-006; Revised Entertainment Information for Class 2 Radios; 2002 Chevrolet Blazer, S-10, GMC Jimmy, Sonoma

03-08-50-005; Front Heated Seat Inoperative/Cold (Replace/Install Seat Heat Element); 1997-2002 Cadillac DeVille, Seville, Eldorado with RPO KA1

03-08-50-006; Uncomfortable Front Seat Cushions (Reposition Cushion Trim Cover); 2002 Pontiac Bonneville

03-08-52-001B; replaces 03-08-52-001A; Remote Keyless Entry System Inoperative (Reprogram Passenger Door Module); Specified 2003 Cadillac, Chevrolet and GMC Pickups and Utilities, Hummer H2

03-08-59-001; Ratle Noise from Front Center of Dash Area (Reroute/Insulate Accelerator Cable); 2002-03 Chevrolet Cavalier, Pontiac Sunfire with 2.2L Engine (VIN F – RPO L61)

03-08-98-001; Bubbles in Paint Around Perimeter of Roof (Replace Roof); 1999-2002 Chevrolet Camaro, Pontiac Firebird

03-08-110-002; Sun Visors May Not Stay in Extended Position (Replace Sun Visors and Retainers); 1997-2003 Buick Century, Regal

03-08-131-001; Power Take-Off Description of Operation and Programming; 2003 Chevrolet Kodiak, GMC Topkick with PTO

RESTRAINTS

02-09-40-005A; replaces 02-09-40-005; Availability of Rear Seat Shoulder Belt Comfort Guides; 2003 Buick Century, Regal, Pontiac Grand Prix, Cadillac Escalade, EXT; Chevrolet Avalanche, Silverado, Suburban, Tahoe, TrailBlazer EXT, GMC Envoy, Sierra, Yukon, XL

03-09-40-001; Squeak Type Nose Coming from Inside Front Seat When Seat Belt is Moved (Fix Not Yet Available); 2003 Cadillac CTS