



# VEHICLE HEALTH INDEX™

## 2017

## INTRODUCTION

The CarMD® Vehicle Health Index™ reports on the most common check engine light-related problems, repairs and associated costs. CarMD distributes this Index each April during Car Care Awareness Month as a reminder to pay attention to maintenance needs in order to help in avoiding unscheduled repairs and problems that may trigger the check engine light. Published annually since 2011, this Index provides consumers, media, the automotive industry and fleet managers with year-over-year car repair data, shedding light on trends influencing the type and cost of repairs. In this Index you will find:

- The 25 Most Common Vehicle Repairs in the U.S. – 2016
- Overview of 10 Most Common Check Engine Light Repairs – 2016
- Average Age of Vehicles Needing Check Engine Light Repairs – 2016 (New To This Report)
- 11-Year History of U.S. Car Repair Costs, Including Parts & Labor – 2006 – 2016
- Breakdown of Car Repair Issues by Region – 2016
- 10 Most Expensive Check Engine Light Repairs – 2016
- 10 Least Expensive Check Engine Light Repairs – 2016

## WHAT IS DISTINCTIVE ABOUT CarMD'S INDEX?

For nearly two decades, CarMD has been building the most comprehensive database of failures, fixes and repairs related to vehicles' on-board diagnostics (OBD2), which were required to be on all cars, light trucks, vans and SUVs sold in the United States since 1996. The system provides health and safety information for roughly 80% of a vehicle's systems and is currently installed on more than 85% of vehicles nationwide to trigger the check engine light when a problem is found; alerting the driver to issues that affect emissions, fuel economy, drivability and cost of ownership. CarMD's database stems from the cars themselves and the professionals who service them. Each CarMD® Vehicle Health Index™ draws from this database and CarMD's network of Automotive Service Excellence (ASE)-certified technicians who have validated related failures and fixes. As a result, CarMD is able to provide unbiased data on repair costs and trends in Index form. This 2017 Index statistically analyzes more than 5 million failures and recommended repairs for vehicles in the U.S.



## SUMMARY OF FINDINGS

After two years of flat U.S. car repair costs, 2016 saw a 2.7% increase comprised of a 4.7% uptick in labor and a 1.4% increase in average parts costs.

The oxygen sensor remained the no. 1 most common check engine light culprit, followed by no. 2 catalytic converter, no. 3 ignition coil and spark plugs, no. 4 loose or damaged gas cap and no. 5 mass air flow sensor. Car repair costs were up across three of the four U.S. regions. The West was the only area to enjoy a slight drop in average car repair costs – down 1.1%, while Midwest drivers paid on average 5.7% more in 2016 to have their vehicle's check engine light repaired.

For the first time, CarMD looked at the age of vehicles reporting check engine light problems.

CarMD found that the average age of a vehicle with a check engine light is 11.9 years old. A model year 2005 vehicle is most likely to have a check engine light on, accounting for 10.7% of check engine problems in 2016, followed by model year 2006 vehicles (10%) and model year 2004 vehicles (9.25%). Newer cars are less likely to have experienced a check engine light – model year 2014, 2015, 2016 and 2017 vehicles each comprised just 1 percent of vehicles to report a check engine issue in calendar year 2016.

The most expensive repair seen in 2016 by CarMD's network was “replace engine,” costing \$7,600.

However, drivers should not panic when their car's check engine light comes on. Some of the least expensive repairs included “tighten or replace gas cap,” “replace oil cap” and “replace secondary air injection control solenoid valve vacuum hose” – which typically cost under \$30.

Dropping in repair frequency this year were “replace thermostat” and “replace intake manifold gasket” while “replace ECT” and “replace ECIM valve” continue to rise in frequency.

New to the list of 25 most common repairs in 2016 were “replace EVAP vent control valve” and “replace CKP.” Both are designed to help make sure your car is not emitting too many pollutants. When they are not working properly they will cause your car's check engine light to turn on and keep you from passing an emissions test.



**CarMD also offers a free service called CarMD® Garage** to see if your vehicle has any maintenance due, technical service bulletins or upcoming check engine light problems. Available online at: [www.carmd.com/garage](http://www.carmd.com/garage)



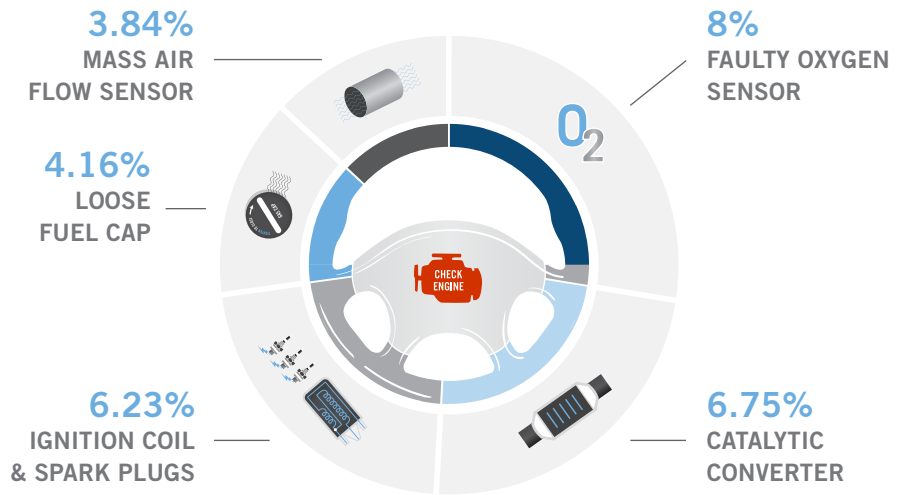
## HIGHLIGHTS

### THE FIVE MOST COMMON PROBLEMS

that trigger the “check engine” light are a faulty oxygen sensor, catalytic converter, ignition coil & spark plug(s), loose fuel cap and mass air flow sensor.

### TOP 5 CHECK ENGINE LIGHT REPAIRS

2016

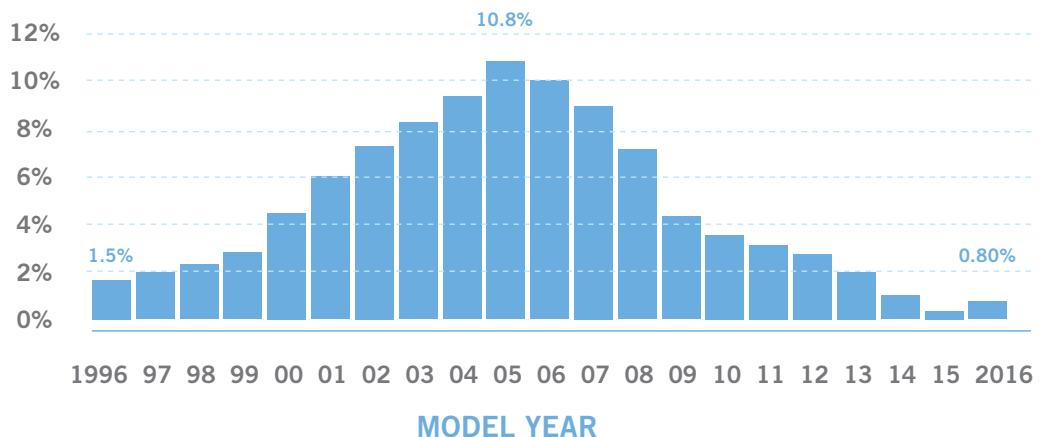


### MODEL YEAR 2005 VEHICLES

are most likely to have a check engine light on.

### % OF REPORTED CHECK ENGINE LIGHT ISSUES BY VEHICLE AGE

U.S. CALENDAR YEAR 2016



### MODEL YEAR 2016 OR NEWER VEHICLES

are least likely to have a check engine light on.

### 11.9 YEARS OLD

is the median age for a vehicle with a check engine light problem.

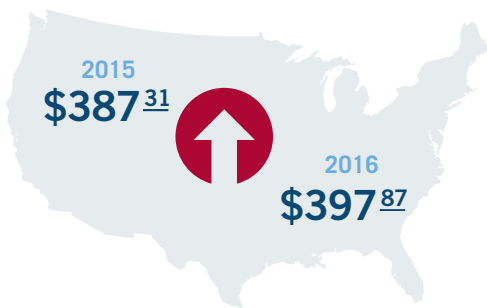


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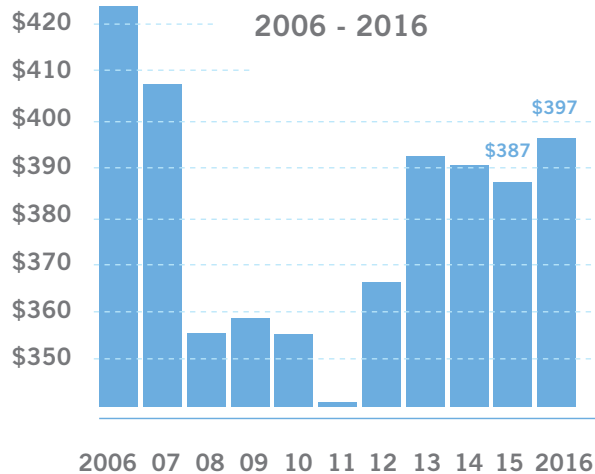
## HIGHLIGHTS

### U.S. CAR REPAIR COSTS WERE UP 2.7% IN 2016.

Average repair costs in 2016 were \$397.87 versus \$387.31 in 2015.



### TOTAL AVG. CHECK ENGINE LIGHT REPAIR COST



### THE WEST WAS THE ONLY REGION TO ENJOY A DROP IN REPAIR COSTS.

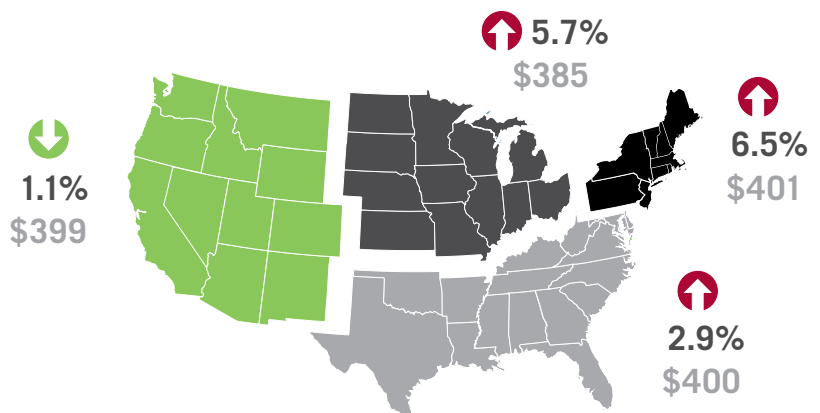
Drivers in the **West** were down 1.1% in 2016 with all other regions up slightly.

Drivers in the **Northeast** paid most for check engine repairs (\$401).

Drivers in the **Midwest** paid least on average for parts and labor (\$385).

### REGIONAL CAR REPAIR COSTS

2016














WEST // MIDWEST // SOUTH // NORTHEAST



# 2017 CarMD® VEHICLE HEALTH INDEX™

## THE TOP 25 MOST COMMON CHECK ENGINE VEHICLE REPAIRS IN THE U.S. – 2016

Rank	Vehicle Repair	Total Average Repair Cost (Parts & Labor)	% 2016 Repairs	Change in Rank Since 2015
1	Replace Oxygen Sensor(s) (O2S)	\$258.63	8.00%	No Change
2	Replace Catalytic Converter(s) with new OE Catalytic Converter(s)	\$1,190.18	6.75%	No Change
3	Replace Ignition Coil(s) and Spark Plug(s)	\$401.22	6.23%	No Change
4	Inspect for Loose Fuel Cap and Tighten or Replace as Necessary	\$16.88	4.16%	No Change
5	Replace Mass Air Flow (MAF) Sensor	\$378.15	3.84%	Up From No. 7 
6	Replace Ignition Coil(s)	\$243.42	3.44%	No Change
7	Replace Spark Plug Wires and Spark Plugs	\$341.71	3.13%	Up From No. 8 
8	Replace Evaporative Emissions (EVAP) Purge Control Valve	\$176.45	2.92%	Up From No. 9 
9	Replace Thermostat	\$225.40	2.91%	Down From No. 5 
10	Replace Evaporative Emissions (EVAP) Purge Solenoid	\$195.95	2.52%	No Change
11	Replace Fuel Injector(s)	\$467.01	1.96%	No Change
12	Replace Exhaust Gas Recirculation (EGR) Valve and Clean All EGR ports	\$352.68	1.80%	No Change
13	Replace Camshaft Position Sensor (CMP)	\$207.12	1.49%	Up From No. 14 
14	Replace Evaporative Emissions (EVAP) Canister Vent Solenoid	\$221.47	1.33%	Down From No. 13 
15	Replace Fuel Tank Pressure (FTP) Sensor	\$334.32	1.29%	No Change
16	Replace Throttle Body Assembly	\$578.35	1.17%	No Change
17	Replace Knock Sensor(s)	\$389.06	1.10%	Up From No. 20 
18	Replace Spark Plug(s)	\$242.16	1.09%	Up From No. 19 
19	Clean Fuel Injector(s)	\$122.66	1.08%	Up From No. 21 
20	Replace Emission System Integrity Monitor (ESIM)	\$152.21	1.04%	Up From No. 22 
21	Replace Engine Coolant Temperature Sensor (ECT)	\$166.79	1.04%	Down From No.18 
22	Replace Evaporative Emissions (EVAP) Vent Control Valve	\$249.36	0.99%	New To List
23	Replace Intake Manifold Gasket(s)	\$404.19	0.97%	Down From No.17 
24	Replace Evaporative Emissions (EVAP) Canister Vent Valve	\$208.30	0.89%	Up From No. 25 
25	Replace Crankshaft Position Sensor (CKP)	\$215.49	0.88%	New To List

*(25 most common vehicle repairs are based on 5,345,588 repairs recommended in calendar year 2016 on 1996-2016 model year vehicles. This data applies to > 85% of cars, light trucks, minivans, SUVs and hybrids on the road in the U.S. – foreign and domestic. Source: CarMD.com Corp.)*



## MOST COMMON REPAIRS – 2016

WHEN THE CHECK ENGINE LIGHT CAME ON, THESE WERE THE MOST COMMON CULPRITS FOR U.S. DRIVERS DURING CALENDAR YEAR 2016

1

**The most common car repair (8.01%) in 2016 was “replace oxygen sensor.”** Extremely important to a car’s engine performance and to the environment, the O2 sensor measures the amount of unburned oxygen in the exhaust and tells a car’s computer when there is either too much, or not enough fuel as compared with oxygen for ideal operation. O2 sensors fail prematurely due to a variety of causes, including lack of maintenance like neglecting oil changes or engine contamination from internal coolant leaks. A faulty O2 sensor costs about \$250 to fix but can lead to as much as a 40% reduction in gas mileage if ignored. Many drivers ignore the O2 sensor because their car often seems like it’s driving just fine, but in reality it’s reducing your fuel economy and slowly doing more damage to your car.

- The average cost to replace O2 sensor in 2016 was \$258, comprised of \$106 in labor and \$152 in parts.



2

**The second most common repair, “replace catalytic converter(s),” accounted for 6.75% of repairs in 2016.** In most cases, a catalytic converter won’t fail unless a related root cause – such as a faulty spark plug – is ignored for too long.

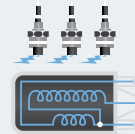
- The average cost to replace a catalytic converter in 2016 was \$1,190, comprised of \$171 in labor and \$1,019 in parts.



3

**“Replace ignition coil and spark plugs” is the third most common repair accounting for 6.23% of recommended repairs in 2016.** This is an example of how ignoring a smaller problem like a spark plug can snowball into the need for more than one repair. Spark plugs and ignition coils work together to help the engine start, and keep running. The coils take the battery’s 12-volt current and step it up to ignite the spark plugs. Faulty spark plugs can trigger ignition coil failure, which is why they are often replaced simultaneously. High underhood temperatures and age can also cause them to fail.

- The cost to replace ignition coil(s) and spark plug(s) in 2016 was \$401 – up nearly 3% from \$390 the previous year. It includes \$222 in labor and \$179 in parts.



4

**“Tighten or replace fuel cap” is the fourth most common repair.** It accounted for 4.16% of repairs in 2016. Missing or damaged gas caps can cost time and money, triggering the check engine light and a repair shop visit. If left unchecked, a gas cap problem can cause reduced fuel economy and harm the environment.

- The average cost to replace a loose gas cap is \$16, and most can be purchased at the local auto parts store or online retailer.



5

**“Replace Mass Airflow Sensor” is now the fifth most common repair (3.84%), moving up from no. 7 in 2015.** The MAF is responsible for metering the air coming into your car’s engine and determining how much fuel to inject into the engine. When malfunctioning, it can lower fuel economy by 10% to 25%.

- It costs on average \$378 on average to repair, but is vital to saving dollars at the pump.

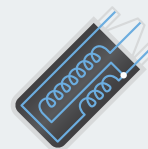


## MOST COMMON REPAIRS – 2016

6

**The no. 6 most common repair (3.44%) in 2016 was “replace ignition coil(s).”** Ignition coils help the engine start and keep running. They take the battery’s 12-volt current and step it up to ignite the spark plugs. Your car may have only one ignition coil, or as many as it has cylinders. Several conditions can contribute to its failure, including faulty spark plugs, high underhood temperatures and age. A driver should pay attention to possible symptoms surrounding engine coil failure as it will soon affect other vehicle systems, such as the costly catalytic converter, and can leave them stranded by the roadside.

- The cost to replace ignition coil(s) in 2016 was \$243.



7

**The spark plug is the seventh most common check engine-related repair (3.13%).** Responsible for igniting a car’s air/fuel ratio, spark plugs are essential. When they fail they can cause a “misfire,” reduce gas mileage and eventually damage a catalytic converter. When the weather turns cold fuel doesn’t vaporize as easily so droplets can form and foul the plug. The cost to replace a spark plug yourself can be as little as \$10, but can save thousands down the road.

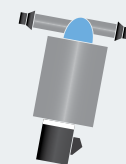
- The average cost to replace spark plug(s) and spark plug wire(s) in 2016 was \$341, comprised of \$191 in labor and \$150 in parts.



8

**The eighth most common check engine-related repair is “replace evaporative emissions (EVAP) purge control valve, which was no. 9 last year and no. 14 in 2014.** This valve is part of the car’s EVAP system, which prevents fuel tank vapors from escaping into the atmosphere. When the engine is running and fully warmed up, the engine computer gradually opens the purge valve to allow some amount of fuel vapor to be moved from the charcoal canister to be burned in the engine. If the purge flow is less or more than is expected, the car’s computer turns on the “check engine” light. When purge valves get stuck they often need to be replaced, which is a fairly simple fix.

- The average cost to replace an EVAP Purge Control Valve in 2016 was \$176, comprised of \$100 in labor and \$76 in parts.



9

**The ninth most common repair was “replace thermostat” (2.91%) moving down from no. 5 in the previous CarMD Index.** The car’s thermostat regulates the engine coolant temperature to warm and cool to ideal “operating temperature.” It opens and closes as needed to regulate temperature. When a thermostat fails, it often gets stuck open. If the vehicle’s computer doesn’t see the engine coolant temperature rise to “operating temperature” within a fixed amount of time, it will set the check engine light. A vehicle’s thermostat can rust and fail if the coolant is not changed at recommended mileage intervals, or the vehicle is subjected to extreme temperatures.

- The average cost to replace a thermostat was \$225 in 2016.



10

**Rounding out the top 10 is “replace evaporative emissions (EVAP) purge solenoid.”** It helps control how much fuel vapor escapes into the atmosphere from your car. The purge solenoid is controlled by the engine control module or powertrain control module. It operates on a duty cycle and could be left partially open.

- The average cost to replace an EVAP purge solenoid in 2016 was \$196, comprised of \$104 in labor and \$92 in parts.



## AVERAGE VEHICLE AGE FOR CHECK ENGINE LIGHT ISSUES (NEW REPORT!)

Of the more than 5 million in-use vehicles reporting check engine light problems in 2016, vehicles that were 10 to 11 years old were most likely to experience such problems. Nearly 11 percent of model year 2005 vehicles had a check engine light on last year. Not surprising, newer model 1- to 2-year-old vehicles were least likely to have a check engine light problem (<1 percent).

Vehicle Age	Model Year	% of Reported Check Engine Light Issues in Calendar Year 2016
20 Years Old	1996	1.50%
19 Years Old	1997	2.00%
18 Years Old	1998	2.50%
17 Years Old	1999	3.00%
16 Years Old	2000	4.50%
15 Years Old	2001	6.00%
14 Years Old	2002	7.50%
13 Years Old	2003	8.50%
12 Years Old	2004	9.50%
11 Years Old	2005	10.80%
10 Years Old	2006	10.00%
9 Years Old	2007	9.00%
8 Years Old	2008	7.30%
7 Years Old	2009	4.20%
6 Years Old	2010	3.50%
5 Years Old	2011	3.20%
4 Years Old	2012	2.80%
3 Years Old	2013	2.00%
2 Years Old	2014	1.00%
1 Year Old	2015	0.40%
Less Than 1 Year Old	2016 or Newer	0.80%



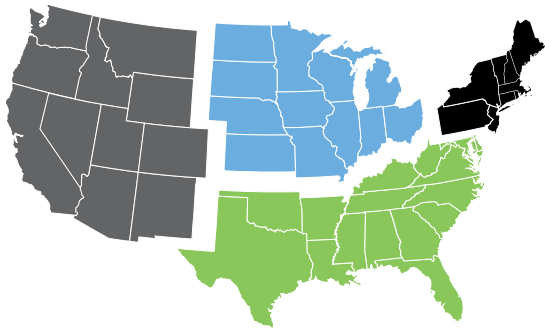
## REPAIR COSTS & NATIONAL DATA

**U.S. Average Car Repair Cost Trends (11-Year History)  
(2006 – 2016); Source: CarMD.com Corp.**

Year	Labor	Parts	Total Average Repair Cost
2016	\$162.46	\$235.41	\$397.87
2015	\$155.15	\$232.16	\$387.31
2014	\$161.61	\$228.77	\$390.38
2013	\$157.23	\$235.26	\$392.49
2012	\$138.96	\$228.88	\$367.84
2011	\$118.61	\$215.32	\$333.93
2010	\$143.61	\$212.44	\$356.05
2009	\$138.37	\$221.13	\$359.50
2008	\$135.21	\$220.98	\$356.19
2007	\$152.92	\$256.98	\$409.90
2006	\$131.06	\$291.30	\$422.36

## REPAIR COSTS & NATIONAL DATA

### U.S. National & Regional Average Check Engine-Related Repair Costs 2016 vs. Previous Year (Source: CarMD.com Corp.)



In 2016, the national average for automotive repair labor costs increased 2.7% from the previous year. Labor costs were up 4.7% and parts costs increased 1.5%.









- Repair costs were up across each U.S. region except the West
- Vehicle owners in the Northeast paid the most for check engine-related car repair – 4% more than drivers in the Midwest, who paid the least.

Region	Total Average Repair Costs (2015)	Total Average Repair Costs (2016)	% Increase / Decrease From Previous Year
U.S.	\$387.31	\$397.87	Up 2.7%
West	\$403.42	\$398.95	Down 1.1%
South	\$388.64	\$399.95	Up 2.9%
Northeast	\$391.17	\$401.22	Up 2.6%
Midwest	\$364.61	\$385.40	Up 5.7%

# 2017 CarMD® VEHICLE HEALTH INDEX™

## REPAIR COSTS & REGIONAL DATA

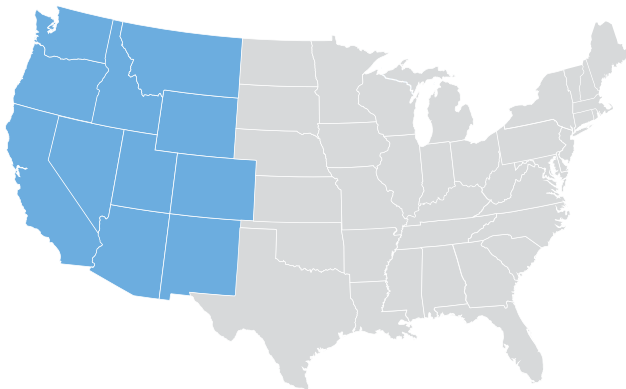
### The Top 10 Most Common Check Engine Vehicle Repairs in the Western U.S. – 2016

Rank	Vehicle Repair	Total Average Repair Cost (Parts & Labor)	% 2016 Western U.S. Repairs	Change In Western Rank Since 2015
1	Replace Oxygen Sensor(s) (O2S)	\$260.98	7.93%	2 - 
2	Replace Catalytic Converter(s) with new OE Catalytic Converter(s)	\$1,188.53	6.91%	1 - 
3	Replace Ignition Coil(s) and Spark Plug(s)	\$401.63	5.94%	4 - 
4	Inspect for Loose Fuel Cap and Tighten or Replace as Necessary	\$16.34	4.51%	3 - 
5	Replace Mass Air Flow (MAF) Sensor	\$381.69	3.95%	6 - 
6	Replace Ignition Coil(s)	\$244.26	3.41%	8 - 
7	Replace Spark Plug Wires and Spark Plugs	\$344.46	3.13%	No Change
8	Replace Evaporative Emissions (EVAP) Purge Control Valve	\$176.21	2.94%	9 - 
9	Replace Thermostat	\$228.69	2.87%	5 - 
10	Replace Evaporative Emissions (EVAP) Purge Solenoid	\$196.37	2.47%	No Change

*(Top 10 most common vehicle repairs in the Western U.S. are based on 2,547,809 repairs in 2016 in AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA and WY. This data applies to roughly 85% of cars, light trucks, minivans and SUVs on the road in the U.S. – foreign and domestic. Source: CarMD.com Corp.)*

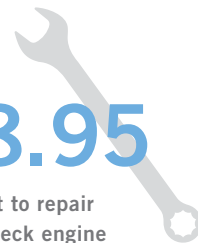


1.1%



**\$398.95**

Average cost to repair a vehicle's check engine light problem in the Western U.S. in 2016.



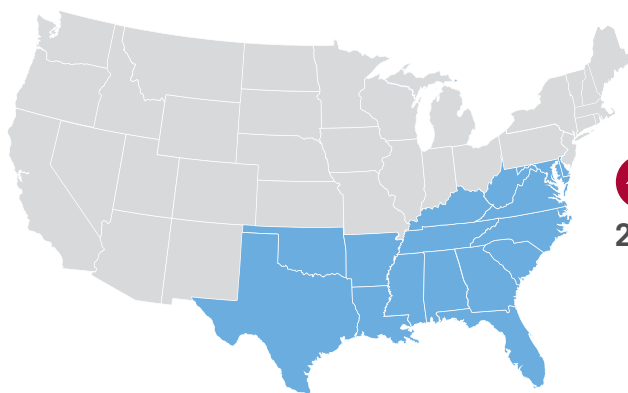
# 2017 CarMD® VEHICLE HEALTH INDEX™

## REPAIR COSTS & REGIONAL DATA

### The Top 10 Most Common Check Engine Vehicle Repairs in the Southern U.S. – 2016

Rank	Vehicle Repair	Total Average Repair Cost (Parts & Labor)	% 2016 Southern U.S. Repairs	Change In Southern Rank Since 2015
1	Replace Oxygen Sensor(s) (O2S)	\$259.46	7.40%	3 -
2	Replace Catalytic Converter(s) with new OE Catalytic Converter(s)	\$1,185.80	6.98%	1 -
3	Replace Ignition Coil(s) and Spark Plug(s)	\$404.94	6.57%	2 -
4	Inspect for Loose Fuel Cap and Tighten or Replace as Necessary	\$16.70	4.20%	No Change
5	Replace Mass Air Flow (MAF) Sensor	\$379.32	3.86%	6 -
6	Replace Ignition Coil(s)	\$242.87	3.56%	5 -
7	Replace Spark Plug Wires and Spark Plugs	\$339.69	3.18%	8 -
8	Replace Thermostat	\$223.57	3.11%	7 -
9	Replace Evaporative Emissions (EVAP) Purge Control Valve	\$176.64	2.91%	No Change
10	Replace Evaporative Emissions (EVAP) Purge Solenoid	\$194.98	2.42%	No Change

*(Top 10 most common vehicle repairs in the Southern U.S. are based on 2,094,649 repairs in 2016 in AL, AR, DC, DE, FL, GA, KY, LA, MD, MS, NC, OK, TN, VA, SC, TX and WV. This data applies to roughly 85% of cars, light trucks, minivans and SUVs on the road in the U.S. – foreign and domestic. Source: CarMD.com Corp.)*



2.9%

**\$399.95**








Average cost to repair a vehicle's check engine light problem in the Southern U.S. in 2015.



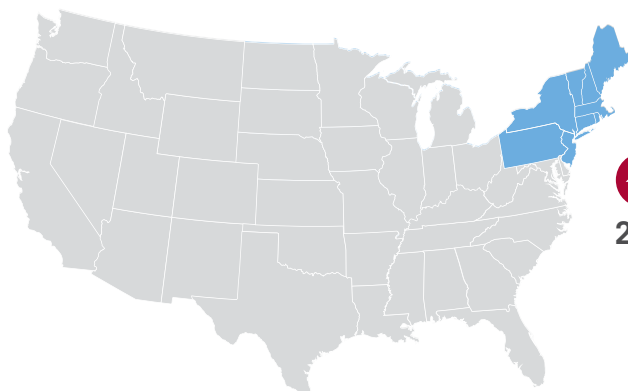
# 2017 CarMD® VEHICLE HEALTH INDEX™

## REPAIR COSTS & REGIONAL DATA

### The Top 10 Most Common Check Engine Vehicle Repairs in the Northeastern U.S. – 2016

Rank	Vehicle Repair	Total Average Repair Cost (Parts & Labor)	% 2016 Northeastern U.S. Repairs	Change In NE Rank Since 2015
1	Replace Oxygen Sensor(s) (O2S)	\$266.33	8.62%	No Change
2	Replace Catalytic Converter(s) with new OE Catalytic Converter(s)	\$1,176.50	7.52%	No Change
3	Replace Ignition Coil(s) and Spark Plug(s)	\$401.29	5.63%	4 - 
4	Inspect for Loose Fuel Cap and Tighten or Replace as Necessary	\$15.40	4.97%	3 - 
5	Replace Mass Air Flow (MAF) Sensor	\$383.09	3.88%	7 - 
6	Replace Ignition Coil(s)	\$241.69	3.49%	5 - 
7	Replace Spark Plug Wires and Spark Plugs	\$342.82	3.33%	6 - 
8	Replace Evaporative Emissions (EVAP) Purge Control Valve	\$178.72	2.92%	9 - 
9	Replace Thermostat	\$230.76	2.92%	8 - 
10	Replace Evaporative Emissions (EVAP) Purge Solenoid	\$196.24	2.48%	No Change

*(Top 10 most common vehicle repairs in the Northeastern U.S. are based on 695,004 repairs in 2016 in CT, MA, ME, NH, NJ, NY, PA, RI and VT. This data applies to roughly 85% of cars, light trucks, minivans and SUVs on the road in the U.S. – foreign and domestic. Source: CarMD.com Corp.)*



  
2.6%

**\$401.22**





Average cost to repair a vehicle's check engine light problem in the Northeastern U.S. in 2016.



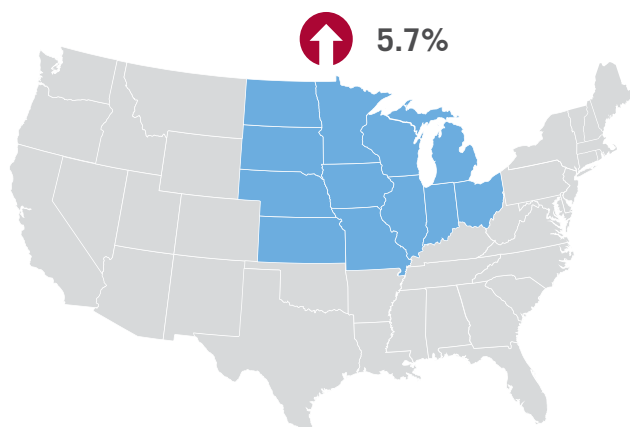
# 2017 CarMD® VEHICLE HEALTH INDEX™

## REPAIR COSTS & REGIONAL DATA

### The Top 10 Most Common Check Engine Vehicle Repairs in the Midwestern U.S. – 2016

Rank	Vehicle Repair	Total Average Repair Cost (Parts & Labor)	% 2016 Midwestern U.S. Repairs	Change In Mid-West Rank Since 2015
1	Replace Oxygen Sensor(s) (O2S)	\$253.81	8.44%	No Change
2	Replace Catalytic Converter(s) with new OE Catalytic Converter(s)	\$1,159.94	6.95%	No Change
3	Replace Ignition Coil(s) and Spark Plug(s)	\$405.83	5.54%	No Change
4	Inspect for Loose Fuel Cap and Tighten or Replace as Necessary	\$15.42	4.62%	No Change
5	Replace Spark Plug Wires and Spark Plugs	\$340.50	3.53%	6 - 
6	Replace Mass Air Flow (MAF) Sensor	\$374.43	3.51%	9 - 
7	Replace Evaporative Emissions (EVAP) Purge Control Valve	\$176.87	3.28%	8 - 
8	Replace Thermostat	\$228.50	3.20%	New to Mid-West top 10
9	Replace Ignition Coil(s)	\$244.28	3.19%	7 - 
10	Replace Evaporative Emissions (EVAP) Purge Solenoid	\$190.72	2.81%	No Change

*(Top 10 most common vehicle repairs in the Midwestern U.S. are based on 955,233 repairs in 2016 in IA, IL, IN, KS, MI, MN, MO, ND, NE, OH, SD and WI. This data applies to roughly 85% of cars, light trucks, minivans and SUVs on the road in the U.S. – foreign and domestic. Source: CarMD.com Corp.)*



**\$364.61**

Average cost to repair a vehicle's check engine light problem in the Midwestern U.S. in 2015.

## MOST EXPENSIVE CAR REPAIRS – 2016

The **most expensive repair** in the CarMD database in 2016 was “replace engine” (\$7,124). This repair is indicative of the fact that cars are being made to outlast parts such as their engine. The good news is that most expensive repairs remain extremely rare in terms of percentage of occurrence. **The top 5 most expensive repairs** combined only **account for less than 1% of all repairs** seen by CarMD’s network.

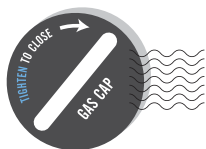


### The 10 Most Expensive Check Engine-Related Vehicle Repairs in the U.S. – 2016

Rank	Vehicle Repair	Most Expensive Repair Cost (Parts & Labor)
1	Replace Engine	\$7,124.48
2	Replace Transmission and Torque Converter	\$5,321.62
3	Replace Hybrid Battery and Reprogram Engine Control Module (ECM)	\$4,280.92
4	Replace Transmission Assembly	\$3,927.33
5	Replace Hybrid Battery	\$3,709.96
6	Replace Balance Shaft Gear	\$3,583.35
7	Replace Transmission Speed Sensor and Reprogram Transmission Control Module (TCM)	\$3,571.38
8	Perform Cylinder Compression Test	\$2,879.04
9	Replace Diesel Particulate Filter (DPF)	\$2,688.19
10	Replace Cylinder Head Assembly and Replace Spark Plug(s)	\$2,493.12

*Ten most/least expensive repairs are based on 1,019,904 verified repairs made and input into the CarMD database by the company's team of factory trained repair professionals in 2015. This data is for model year 1996 to 2015 OBD2 cars, light trucks, minivans and SUVs in the U.S. – foreign and domestic. Source: CarMD.com Corp.*

## LEAST EXPENSIVE CAR REPAIRS – 2016



The **least expensive repair** is “Inspect for Loose Fuel Cap and Tighten or Replace as Necessary” at an average cost of \$17.

### The 10 Least Expensive Check Engine-Related Vehicle Repairs In The U.S. – 2016

Rank	Vehicle Repair	Least Expensive Repair Cost (Parts & Labor)
1	Inspect for Loose Fuel Cap and Tighten or Replace as Necessary	\$16.88
2	Replace Fuel Tank Gas Cap	\$27.50
3	Replace Oil Cap	\$34.00
4	Replace Electronic Engine Control (EEC) Fuse	\$34.05
5	Replace Secondary Air Injection Control Solenoid Valve Vacuum Hose	\$34.92
6	Replace Air Conditioning (A/C) Compressor Clutch Relay	\$43.34
7	Inspect for correct air filter and air box is securely latch properly	\$46.89
8	Perform DTC Confirmation Procedure	\$53.33
9	Repair Ground Wire From The Front of The Engine To The Body	\$54.18
10	Replace Exhaust Gas Recirculation (EGR) Boost Sensor Vacuum Hose	\$56.44

*(Ten most/least expensive repairs are based on 5,345,588 verified repairs made and input into the CarMD database by the company's team of factory trained repair professionals in 2016. This data is for model year 1996 to 2016 OBD2 cars, light trucks, minivans and SUVs in the U.S. – foreign and domestic. Source: CarMD.com Corp.)*



## INDEX METHODOLOGY

### CarMD HAS COMPILED THE INDUSTRY'S MOST COMPREHENSIVE DATABASE OF OBD2-RELATED PROBLEMS AND ASSOCIATED FIXES UPLOADED BY AUTOMOTIVE TECHNICIANS AND VEHICLE OWNERS SINCE 1996.

The data for the 2017 CarMD® Vehicle Health Index™ was procured from repairs uploaded to the CarMD diagnostic database from Jan. 1, 2016 to Dec. 31, 2016. The entire vehicle problems uploaded is from the vehicle ECU to the CarMD database directly without any human interface. This database is also used to support the fleet, consumer automotive tools, Software as a Service (SaaS) and CarMD Garage products offered by CarMD.

The data was collected and analyzed was from between Jan. 26, 2017 and Mar. 6, 2017.

Virtually all makes and models of cars, light trucks, minivans, SUVs and hybrids made since 1996 – foreign and domestic – with on board diagnostic second generation (OBD2) technology are included in the Index. Those makes and models with more registered vehicles on the road may have a larger statistical weighting in the Index findings, as will vehicles that experience more failures or whose owners seek guidance from sources that report to the CarMD database.

The 2017 Index statistically analyzes 5,345,588 repairs. Each recommended repair has also been reviewed and validated by CarMD's team of ASE-certified Master Technicians and then output based on a probability algorithm that takes into account the vehicle's year, make, model, mileage, postal code, DTCs and similar vehicle problems to produce a most likely repair. Because the data stems from those U.S. vehicle owners and automotive technicians

who elected to use the diagnostic devices and/or upload data into the CarMD database; no estimates of theoretical sampling error can be calculated.

All 50 U.S. states, plus the District of Columbia, are represented in this Index. The states with larger registered vehicle populations and participating ASE-certified technicians may have a larger quantity of logged repairs; however, all have been averaged into the overall Index findings. For regional data, CarMD used the U.S. Census Bureau Regions and Division Map to define regions.

Repair costs are based on parts and dealer list plus 10% markup. Labor rates are procured from several sources, including the *Undercar Digest* National and Regional Hourly Shop Labor Rate reports, as well as the average amount of time required for each repair. Both are updated annually.

CarMD has contracted with an independent consulting company to create and maintain the database for compiling and generating this Index.

On a daily basis, CarMD's nationwide network of thousands of automotive service excellence (ASE)-certified technicians recommend, confirm and upload repairs and costs by region to the CarMD database. As a result, subsequent CarMD Vehicle Health Index reports will draw from an updated sampling of diagnostic trouble codes, expert fixes and repair costs.



**ADDITIONAL, CUSTOMIZED REPORTS ARE AVAILABLE UPON REQUEST.**

Please email [data@carmd.com](mailto:data@carmd.com) for more information.

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