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AutoSmart

Learn the facts: Variable valve timing and its impact on fuel consumption

What is the issue?

Progressively more stringent greenhouse gas emission standards for light-duty vehicles are in place in Canada, leading vehicle manufacturers to improve engine efficiency by using innovative technologies such as variable valve timing (VVT).

What do I need to know?

VVT and lift systems optimize the intake and exhaust valve timing relative to the engine speed, in contrast to conventional systems in which the valve timing and lift are fixed. This variability allows for improved engine efficiency and power over a broad range of engine operating speeds. VVT and lift can reduce fuel consumption by 1 to 6%, saving you money and reducing your impact on the environment.

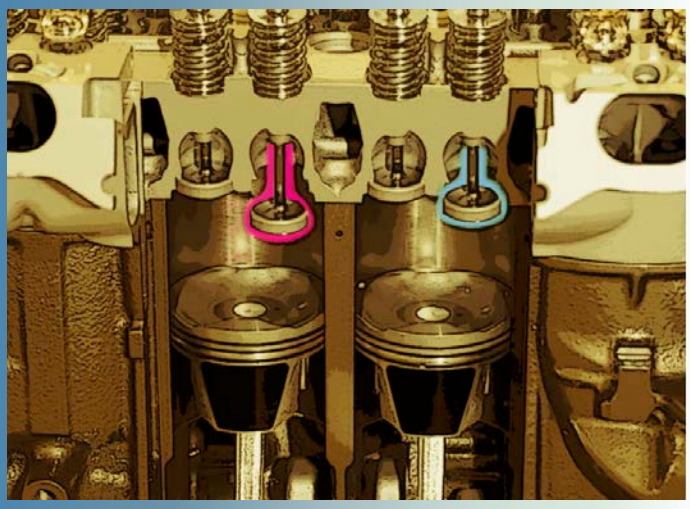

Figure 1: Intake stroke for an engine equipped with VVT and an engine without; note the timing is different. Illustration taken from Toyota's VVT-I video available on YouTube.

How does variable valve timing work?

- Just like humans, a car engine needs to breathe. Engine valves control the intake of fresh air and the fuel mixture and the exhaust of combustion gases. And, just like humans, an engine's breathing rate is based on exertion; VVT adjusts the engine's timing and breathing based on the operating conditions of the engine. Conventional valve control systems provide a single fixed timing duration, which means engine breathing is not adjusted or optimized for the differing requirements.
- Good timing between the intake and exhaust valves is crucial for optimal engine efficiency. If this timing can be controlled and changed in real-time, based on engine operating parameters, the engine could perform better. The engine would need less fuel to provide the same amount of power.
- VVT helps to optimize combustion, which provides several benefits, including improved engine operation, increased engine power (which allows the use of a smaller engine to achieve the same performance), reduced fuel consumption and decreased emissions.
- Manufacturers have adopted various VVT design approaches and technologies to control the timing and how long the intake and exhaust valves remain open. The simpler approaches provide just two timing modes (e.g. a camshaft that has lobes of different heights used for lower and higher engine speeds). More sophisticated approaches provide continuously variable timing (e.g. a camshaft that dynamically adjusts its position and timing).

How can I help?

Be a knowledgeable buyer. Research before you buy and include a lifetime estimate of fuel consumption as a cost and performance requirement.

What are the savings and benefits?

Improvements in engine technology and efficiency can save you money, as illustrated in the following table. VVT can reduce fuel consumption and emissions by 1 to 6% compared to conventional technology. Over 10 years, this reduction corresponds to fuel cost savings of $160 to $2,180 and carbon dioxide (CO_2) reductions of 280 to 3 860 kg. At the high end, this is equivalent to:

- three quarters of an Olympic-sized swimming pool of CO_2
- removing a mid-size car from Canadian roads
- nearly 20% of our annual per capita emissions in Canada, which is 22.1 tonnes

Fuel consumption			Potential annual savings		Potential 10-yr savings	
Average (L/100 km)	With a 1% reduction (L/100 km)	With a 6% reduction (L/100 km)	Fuel cost savings	CO_2 reduction	Fuel cost savings	CO_2 reduction
14.0	13.86	13.16	$36-218	64-386 kg	$360-2,180	640-3 860 kg
12.0	11.88	11.28	$31-187	55-331 kg	$310-1,870	550-3 310 kg
10.0	9.90	9.40	$26-156	46-276 kg	$260-1,560	460-2 760 kg
8.0	7.92	7.52	$21-125	37-221 kg	$210-1,250	370-2 210 kg
6.0	5.94	5.64	$16-94	28-166 kg	$160-940	280-1 660 kg

Note: For illustrative purposes, savings are based on an annual driving distance of 20 000 km, a fuel price of $1.30/L and a CO_2 emissions factor of 2.3 kg/L of gasoline

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Aussi disponible en français sous le titre : Les faits : La distribution à programme variable et son impact sur la consommation de carburant

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