

**Canadian Estimate of Vehicle  
Mileage and Hydrogen Cylinder Cycles**

**Transport Canada**

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## Canadian Estimate of Vehicle Mileage and Hydrogen Cylinder Cycles

This report provides detail to justify that the extreme-usage lifetime vehicle range of 590,000 km referenced in SGS-8-13re2 (A.5.1.1.5 e iv) is insufficient when compared to vehicle use reported from other Canadian sources. Statistics from an emission testing program and various taxi operations demonstrate ranges in excess of 1,000,000 km. There is a concern that the number of fueling cycles (5,500), calculated using 590,000 km, does not provide an adequate margin of safety.

### *AirCare Statistics*

AirCare is a vehicle emissions testing program in Vancouver and the Fraser Valley in British Columbia. Vehicles that are manufactured before 1992 are inspected annually. Vehicles that are 5-years or older and manufactured in or after 1992 are inspected biannually. Odometer readings are taken during the inspection of each vehicle.

Odometer readings collected during emissions testing in 2009 are shown in Figure 1. The figure shows the highest recorded odometer reading for each vehicle model year, as well as the mean, 3 sigma and 6 sigma odometer readings. The total number of vehicles tested is over 290,000 and the number of vehicles for each model year is shown.

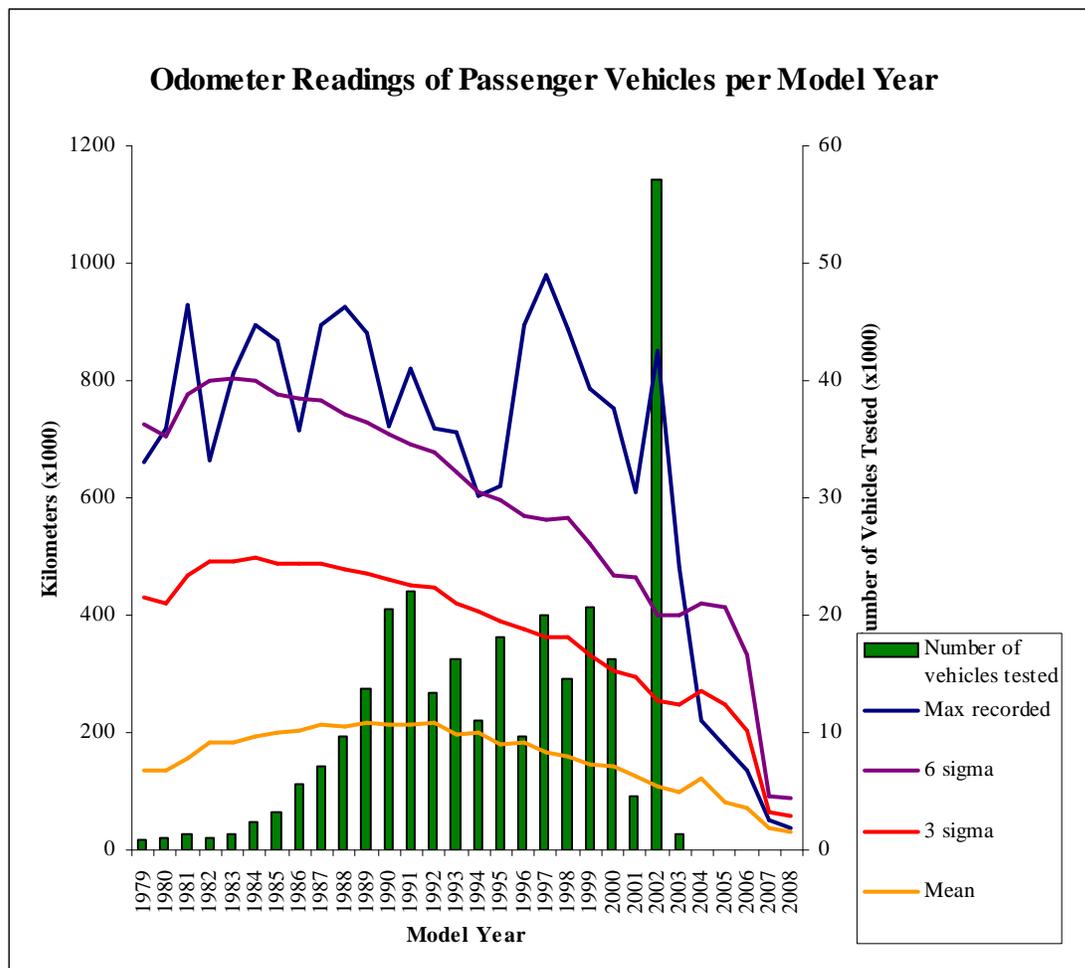


Figure 1 Odometer readings recorded during emissions testing in 2009

All models 13 years or older demonstrate 6 sigma values above 590,000 km. Contrary to the note in SGS-8-13re2 (A.5.1.1.5 e iv), for the majority of model years the maximum recorded odometer reading is well above the 6 sigma value. The highest recorded odometer reading is 981,000 km from a 12-year-old vehicle. [Note: Vehicles tested are still being driven and do not represent vehicles at the end of their life.]

## Taxi Statistics

### Ontario Airport Taxis

Two major airports in Ontario provided information on their taxi fleets. Both described average use above the extreme-usage lifetime vehicle range of 590,000 km.

Table 1 shows the estimated average usage of taxis at the two airports. The calculated average kilometers over service life does not take into account usage before and/or after the vehicles are in service. In Toronto, vehicle can be up to two years old before commencing service. In Ottawa, vehicles can be up to four years old. It was also noted that the families of the taxi drivers use many vehicles after they have been retired from service.

	Pearson International Airport	Ottawa International Airport
Fleet Size	350 taxis	150 taxis
Hours of Operation	20 hours a day, 7 days a week (each taxi has 2 drivers working 10 hours shifts)	60% of fleet run 20 hours a day, 7 days a week (each taxi has 2 drivers working 10 hours shifts)
Average number of trips per day	10 trips	18-24 trips
Average distance per trip	60 km (roundtrip to downtown)	30 km (roundtrip to downtown)
Average daily kilometers travelled	600 km	540 km – 720 km
Calculated yearly average kilometers travelled	219,000 km	197,100 – 262,800 km
Years in service	7 years	3 – 7 years
Calculated average kilometers over service life	1,533,000 km	591,300 - 1,876,000 km
Average fill ups	-	1.5 times per day

**Table 1 Values in the table are estimated based on information provided in telephone interviews with commercial vehicle operations representatives from each airport**

### New York Taxis

The New York City Taxicab Fact Book<sup>1</sup>, describes taxis running 7 days a week for two shifts averaging 72,000 miles (116,000 km) per year. Regulations state that taxis must be purchased brand new and can be driven for five years. Therefore over the service life of New York taxis they will, on average, accumulate 360,000 miles (580,000 km).

### Hybrid Taxis

The Hybrid Experience, a non-profit organization in Vancouver that provides information about real world performance of fuel efficient technologies has tracked hundreds of hybrids including a Prius that

<sup>1</sup>Schaller Consulting (2006). *The New York City Taxicab Fact Book* (page 42). Retrieved from <http://www.schallerconsult.com/taxi/taxifb.pdf>

has travelled over 600,000 km. They have also published the service logs of the first hybrid taxi in Vancouver demonstrating an average of over 160,000 km per year<sup>2</sup>.

### Beyond Service life

The average accumulation of kilometers as shown above, only represents the accumulation of kilometers during the taxis service life. Many of these vehicles are used before and/or after their commercial lives and these accumulated kilometers need to be taken into account. Assuming a vehicle life of 15 years and an average accumulation of 20,000 km (approx. 12,000 miles) per year<sup>3</sup> an additional accumulation of 200,000 km could be reasonably expected.

### Extreme Fueling Calculations

The extreme number of fuelings of 5500 is calculated in SGS-8-13r2e (A.5.1.1.5 e vi) using an extreme-usage lifetime vehicle range of 590,000 km, a minimal vehicle range per full fill of 320 km and a safety factor of 3. If this safety factor is removed, the number of fuelings predicted is 1833. In Figure 2, this value is compared with the number of fuelings calculated using mileage statistics from the sources presented in this paper (assuming the same minimal vehicle range per full fill of 320 km). Since the mileages are well above 590,000 km it is apparent that the corresponding number of fuelings is also above the predicted value.

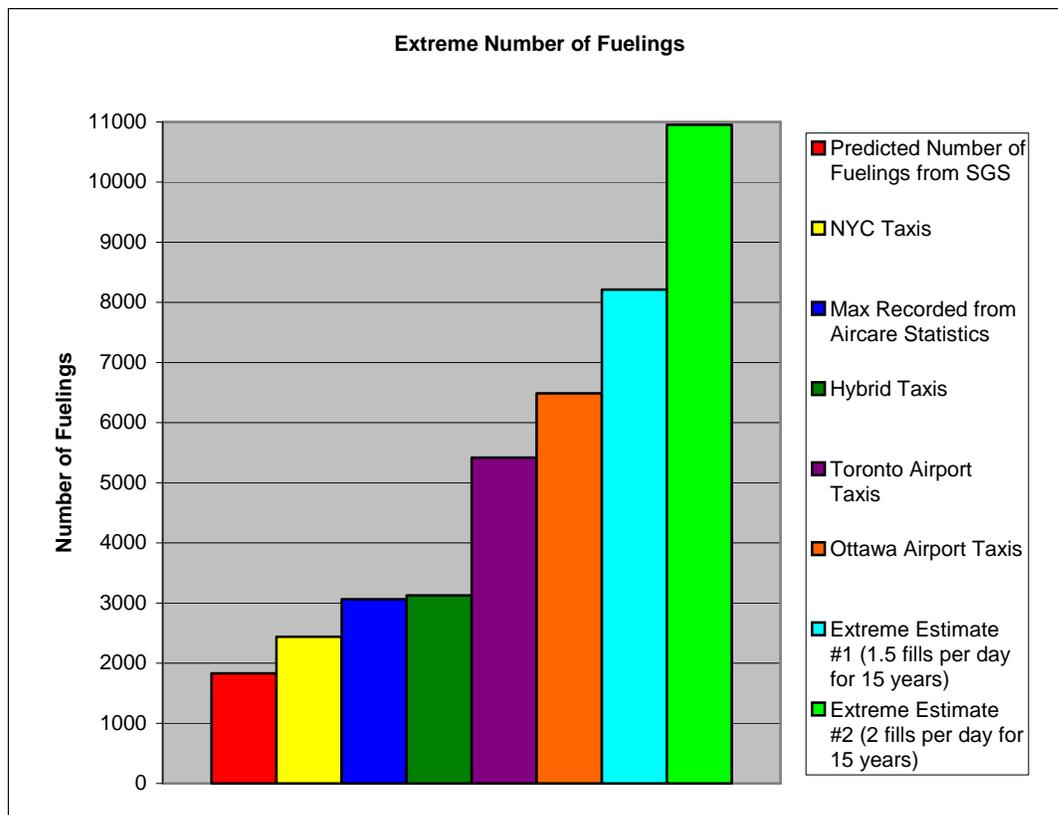


Figure 2 Comparison of calculated extreme number of fuelings

<sup>2</sup> Hybrid Experience. *Vehicle service logs* [data file]. Retrieved from <http://hybridexperience.com/documents/scan.pdf>  
<sup>3</sup> U.S. Energy Information Administration (2002). *Vehicle-Miles Traveled*. Retrieved from <http://www.eia.doe.gov/emeu/rtecs/chapter3.html>

As proposed, the cylinder itself will be certified for 15 years. There is a concern that in this time period a cylinder may be used in multiple vehicles. It is possible that a cylinder may outlast its original vehicle and could be transferred to another vehicle. It is also possible that a taxi operation may purchase or lease cylinders separate from the vehicle due to limited vehicle age requirements. An example of this took place in Canada with taxis fueled by natural gas. The cylinders were owned by a local utility and leased for a monthly fee to the operators. In such cases, high pressure hydrogen cylinders may be exposed to peak usage over their entire 15 year lifetime. Using the estimate of 1.5 fills per day from the Ottawa Airport, over 8000 fills would be possible and assuming an absolute worst-case of 2 fills per day, almost 11,000 fills would be achievable. Figure 2 demonstrates that these two extreme estimates exceed the predicted extreme number of fuelings by SGS-8-13r2e.

## ***Conclusion***

The extreme-usage lifetime vehicle range of 590,000 km is too low when compared to Canadian statistics. Aircare statistics demonstrate 6-sigma lifetime vehicle range above 590,000 km for vehicles less than 15 years old. Actual maximum odometer readings are shown to be above the 6-sigma value with many model years in the 700,000 – 1,000,000 km range.

Statistics from airport taxis usage demonstrate extremely high rates of mileage accumulation within their relatively short service life of 5-7 years. It is also apparent that these vehicles are being used after (and in some cases before) commercial use. Adding the non-commercial (assuming vehicle life of 15 years), the lifetime vehicle range can easily exceed 1,000,000 km.

As proposed, high-pressure hydrogen cylinders will be certified for 15 years. It is possible that a cylinder may outlast its original vehicle or be purchased/leased separately from a vehicle. In these cases, mileage of a single vehicle does not directly correspond to the number of cycles for a specific cylinder. Assuming peak use over a 15-year life, 11,000 cycles could be attainable.

Based on mileage statistics it is apparent that the reduced 5500 cycle test, as was recently proposed in SGS-8-13r2e, is insufficient. The fact that cylinders may not be limited to one vehicle during the 15-year lifespan also raises concern with the proposed number of cycles. To maintain an adequate margin of safety for high mileage vehicles and for the possibility of cylinders being used in multiple vehicles, Canada recommends that the 11,250-cycle life, as previously proposed for commercial vehicles, be applied to all vehicles.