

NYSERDA Report Summary

The following is a condensed summary of the LHG Student Transportation application testing report overseen by HiDesign Product Engineering, LLC and prepared for the New York Energy Research and Development Authority (NYSERDA)

Introduction

About the LHG

The Ventech Model LHG513 was used during this test. The LHG513 generates 13kW (45,000 Btu's) of supplemental heat, with an effective heat increase of 26kW (90,000 Btu's).

Note: Currently, the newer LHG700 is provided for Student Transportation applications. The heat generation properties of the LHG513 and LHG700 are identical, while the LHG700 is smaller and has an updated clutch, sensors, and Electronic Control Unit.

Test Methodology

A series of 26 on-road tests were performed. Four tests were idling-only, while twenty-two tests were performed following a 21-mile, 50-minute urban route.

Fuel Consumption Tests: IDLING

Test Objective

Determine the impact on fuel consumption on an **idling bus** with and without a Ventech LHG?

Results

The LHG impacted fuel consumption by ~ **0.05 gallons** during a warm-up period of 15 minutes. It should be noted that the LHG usually disengages after ~ 15 minutes of operation (the time it normally takes for the LHG to bring the coolant to 85°C / 185°F).

Note: Separate defrost tests have illustrated that 15 minutes is more than enough time for a bus equipped with the Ventech LHG to thoroughly defrost the window.

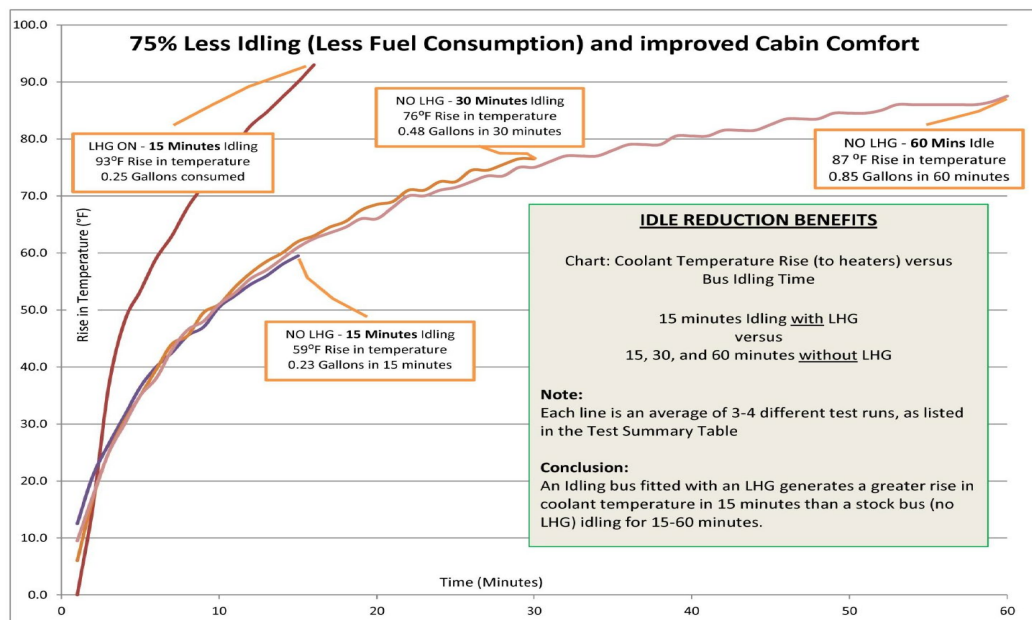
Fuel Consumption Test: LHG versus NO LHG

Test Objective

Compare fuel consumption and cabin comfort achieved during engine warm-up idling with and without the LHG.

Results

From the preceding tests, it can be seen on the graph below that the bus with the LHG active, idling for 15 minutes, achieves better cabin comfort than idling without the LHG for 60 minutes. As mentioned above, **the fuel consumed by idling with the LHG for 15 minutes is comparable to idling for 15 minutes *without* the LHG**, noting, of course, that the bus idled without the LHG has not achieved cabin comfort.



Fuel Consumption Test: LHG versus FOH/FFH

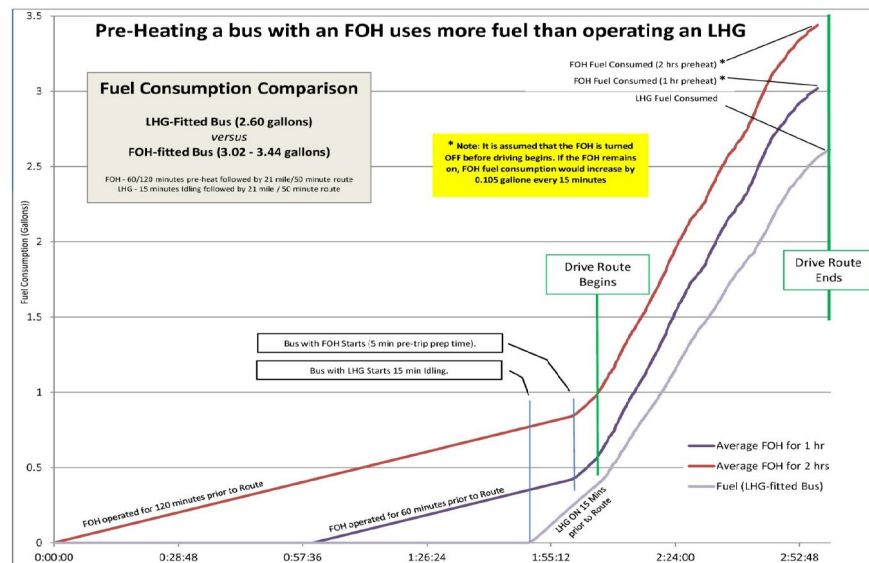
Enumerate the impact on fuel consumption during a typical urban drive cycle, comparing the Ventech LHG versus Fuel-Operated / Fuel-Fired Heaters of similar heating capacity.

Publicized fuel consumption of FHO/FFH systems:

Product	Manufacturer	Heat Output	Fuel Consumption Gal. / hr.
DBW2010	Webasto	13.1 kW (45,000 Btu's)	0.40
E12	Espar	12 kW (42,000 Btu's)	0.40
X45	ProHeat	13 kW (45,000 Btu's)	0.45

A fuel-operated heater consumes 0.4 to 0.45 gallons per hour. Based on published data, the average fuel consumption of an FOH / FFH is 0.42 gallons per hour.

Results



A bus with any FOH / FFH consumes more fuel than the LHG equipped bus during the pre-drive period (60 minutes of FOH operation plus 5 minutes pre-trip idling) and over the complete drive cycle. Even when the FOH / FFH is run only during pre-drive.

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Note that the above data assumed that the FOH would be turned OFF during driving, while the LHG remains “on” but only engages if the coolant temperature drops below its ideal. If the FOH is left on for supplemental heat during the drive, the savings with an LHG would be even higher.

As a part of the fuel consumption comparison, interviews were conducted with several school bus operators to determine typical practices under real-world conditions. Questions asked included:

- How long do you operate the FOH before beginning a route?
- How many busses in your fleet operate an FOH in this manner?

The following table includes interview results from these questions:

Fleet Number	Location	Brand of FOH Heater	# of Busses	FOH Pre-heat Time (Minutes)
1	Jenison, MI	Webasto	30	60
2	Farmington, MI	Espar	98	120
3	Walled Lake, MI	Espar, ProHeat	60	60
4	Peace River, AB	Webasto	15	120
5	Zeeland, MI	Webasto	40	30
6	Genesee, MI	ProHeat	134	45
7	Forest Hills, MI	ProHeat	85	60

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Based on the above data, the following *pre-route (stationary/warm-up) fuel consumption use and costs* were calculated for each fleet.

				FOH		
FLEET #	Fleet Size	FOH pre-heat use/day		Pre-heat diesel cost/fleet/day based on \$5.50/gal		
		Pre-heat Minutes (per bus)	Total Pre-heat Hours (per fleet)	FOH pre-heat cost (average 0.42 gals/hr)	+ 5 min pre-route idling @ 0.1 gals	diesel cost per day for pre-heat
1	30	60	30	\$ 69.30	\$ 16.50	\$ 85.80
2	98	120	196	\$ 452.76	\$ 107.80	\$ 560.56
3	60	60	60	\$ 138.60	\$ 33.00	\$ 171.60
4	15	120	30	\$ 69.30	\$ 16.50	\$ 85.80
5	40	30	20	\$ 46.20	\$ 11.00	\$ 57.20
6	134	45	101	\$ 232.16	\$ 55.28	\$ 287.43
7	85	60	85	\$ 196.35	\$ 46.75	\$ 243.10

FLEET #	Fleet with FOH		Fleet with LHG		Savings with LHG
	based on \$5.50/gallon FOH pre-heat + 5 min. engine idle		15 minutes LHG & engine idle pre-heat (.33 gallons @ \$5.50)		Bus pre-heating Only
	Total diesel cost per day (pre-heat only)	Total diesel pre-heat cost per 100-day season	Total diesel cost per day (pre-heat only)	Total diesel pre-heat cost per 100-day season	Assuming a 100-day pre-heating season
1	\$ 85.80	\$ 8,580	\$ 54.45	\$ 5,445	\$3,135
2	\$ 560.56	\$ 56,056	\$ 355.74	\$ 35,574	\$20,482
3	\$ 171.60	\$ 17,160	\$ 108.90	\$ 10,890	\$6,270
4	\$ 85.80	\$ 8,580	\$ 54.45	\$ 5,445	\$3,135
5	\$ 57.20	\$ 5,720	\$ 36.30	\$ 3,630	\$2,090
6	\$ 287.43	\$ 28,743	\$ 182.41	\$ 18,241	\$10,502
7	\$ 243.10	\$ 24,310	\$ 154.28	\$ 15,428	\$8,883

Note: the above calculations do not include the significant additional savings the LHG provides when replacing a FOH/FFH bus heater used for additional supplemental heat during the route.

Conclusions

Testing demonstrates that the Ventech LHG is a viable and effective supplemental heater that provides the following benefits to school bus operators:

Benefits of the Ventech Liquid Heat Generator

- Rapid vehicle warm Up
- Improved Passenger Comfort (higher cabin temperatures)
- Up to 75% reduction in idling to achieve heater coolant temperatures similar to that of a bus idling for 1 hour.
- Significant fuel savings versus extensive bus idling
- Significant fuel savings versus operating a fuel-fired heater for one or more hours.

Other observations

- The LHG is less expensive than a comparably sized FOH/FFH, irrespective of brand.
- The LHG can be installed in 2-4 hours, significantly less time than the installation of an FOH / FFH, irrespective of brand.
- The LHG requires little or no maintenance and no “summer service” (an FOH / FFH typically requires summer maintenance in preparation for the upcoming season).
- The LHG does not directly produce emissions or combust fuel and relies on the vehicle engine as the propulsion of the LHG. The vehicle’s after-treatment system cleans vehicle emissions. By contrast, FOH / FFH emissions are exhausted directly into the atmosphere and are not cleaned.
- The LHG is simple, effective, and has no flame.

HiDesign Product Engineering, LLC Statement

“To whom it may concern,

“HiDesign Product Engineering, LLC (HiDesign) was commissioned ... by Ventech, LLC to perform an independent review of their testing activities and to audit the subsequent results obtained from the application of their LHG product to a typical school bus, intended to improve the performance of its cabin heater system, and as detailed within their technical report on this subject.

“A representative of HiDesign, Mr. Tom Brindley, met with the technical staff at Ventech to become familiar with the LHG concept, theory of operation, and the anticipated performance that would be expected in a school bus application. The intended Test Plan was reviewed and HiDesign agreed that the approach to testing would adequately demonstrate the performance of the technology in a typical actual on-highway environment. HiDesign inspected the test equipment employed and its installation. The equipment was appropriate to the task and its installation was professional and thorough. HiDesign was satisfied that for the straightforward type of on-highway testing performed, the caliber, accuracy, and resolution of the various instrumentation components was acceptable.

“A matrix of 26 vehicle tests was scheduled ... HiDesign attended a sampling of these idling and road trip tests, witnessing the methodology employed and monitoring data-gathering techniques. During the tests witnessed by HiDesign, the LHG hardware functioned consistently and was not adjusted in any way. Upon completion of all tests, HiDesign reviewed the raw and compiled test data, audited the data for inconsistencies, finding none and can confirm that the information detailed in the Ventech Report is an accurate representation of the results gathered from the tests.

“In conclusion, HiDesign witnessed the Ventech LHG technology in operation in an actual and typical on-highway school bus application and confirmed it to be an effective way to rapidly generate supplemental heat into the cabin heater system for the purpose of rapid cabin comfort.”

The original letter from HPE is shown in Section 8 of the full report.