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Energotest 2007: Fuel Consumption Test for Evaluating Freight Wing Trailer Side Skirts

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Introduction

Recent hikes in fuel prices have generated interest in technologies that promise to improve the energy efficiency of trucking company fleets. Consequently, trucking companies now wish to undertake projects to evaluate these technologies. FPInnovations – Feric Division is always ready to offer its support and contribute its expertise on energy efficiency in the transportation sector.

Robert Transport and Cascades Transport both participated in Energotest 2007, which aimed to evaluate, in an accelerated manner, potentially ecoenergetic technologies. The objective of the Energotest 2007 project was to provide a preliminary overview of viable solutions to achieve higher fuel efficiency and lower GHG emissions in the trucking industry.

Freight Wing was interested in having the trailer side skirts aerodynamic device tested during this test campaign. Figure 1 presents the device used during the tests.

Test methodology

The test consisted of a baseline stage (non-modified vehicles) followed by a test stage (vehicles equipped with the technology). Test procedure was based on SAE J1321 Joint TMC/SAE Fuel Consumption Test Procedure - Type II.

Test site

Testing for the Energotest 2007 project took place at Transports Canada's Motor Vehicle Test Centre (MVTC), in Blainville (Quebec), which is presently operated by PMG Technologies. The fuel consumption tests were performed on the high speed test track (BRAVO). The track is a high-banked, parabolic oval with a length of 6.4km (4 miles). The length of a test run was 100 km (approximate 15 laps). Figure 2 presents the description of the test site.

Test vehicles

- Test vehicle: 2005 Volvo VNL 630, powered by a Cummins ISX engine.
- Control vehicle: 2005 Volvo VNL 630, powered by a Cummins ISX engine.

The two trucks were equipped with Manac 53' Cube Van loaded trailers. Vehicle details are given in table 1.

Test equipment

The following equipment was used during the tests:

- Portable tanks with a capacity of 144 litres (38 gallons): Norcan Aluminium 103461.
- A calibrated scale with a capacity of 150 kg and 0.05 kg reading: RLWS IQ-355 134883; calibration certificate number 1298825 dated September 21, 2007.

The repeatability of the scale was periodically checked during the tests using a set calibration weight.

Figure 1. Tested technology.

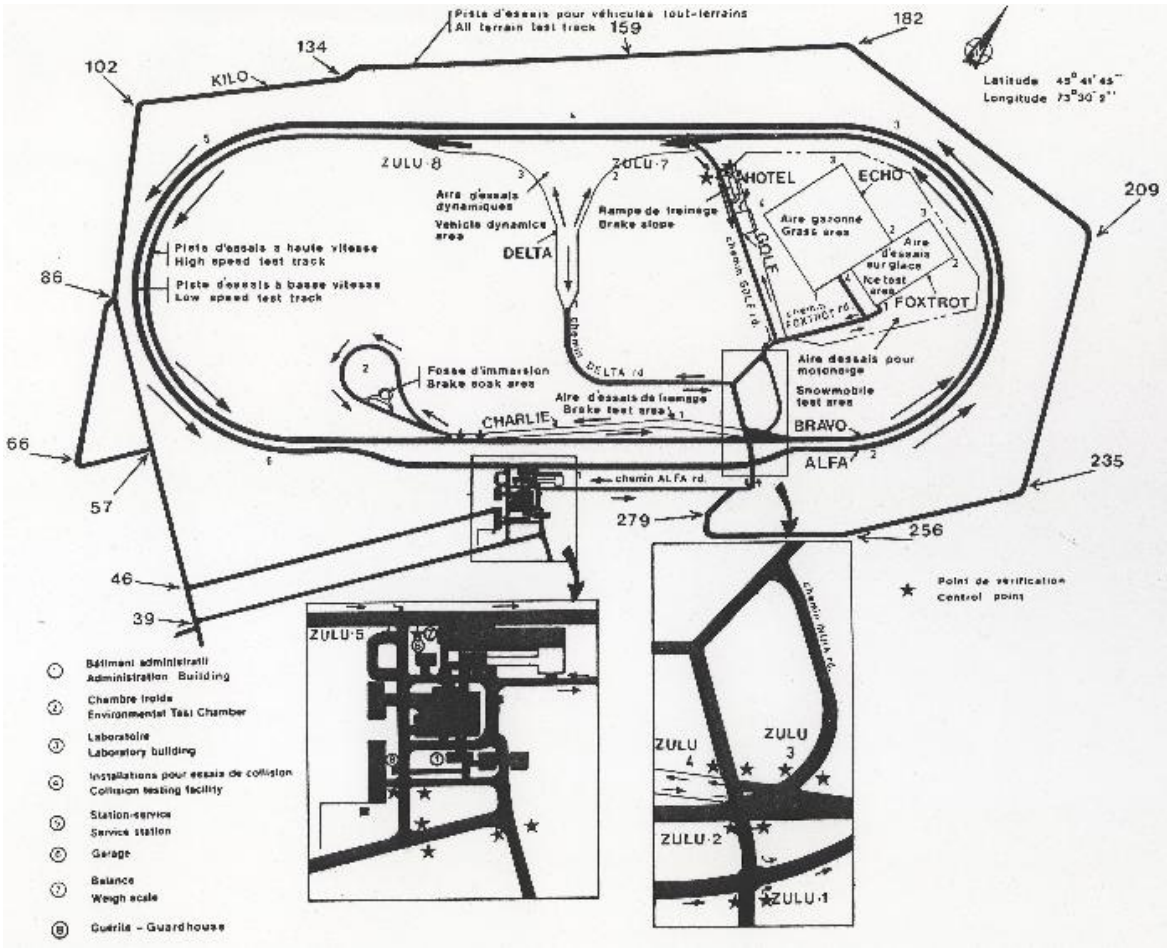

Figure 2. Test site.

Table 1. Vehicles data

Parameters	***Vehicles***	
	Control	***Test***
Tractors		
Vehicle test ID	R3	R2
Vehicle Fleet ID	102560	102550
VIN	4V4NC9TG95N386569	4V4NC9TH55N386609
Make and model	Volvo VNL 630	
Year	2005	
Engine make and model	Cummins ISX	
Rated power	450 hp / 2000 rpm	
Peak torque	1,550 lb-ft	
Transmission	MO 16Z12A-A ZF MERITOR	
Differential ratio	3.9	
Vehicle test weight	8,550 kg	8,600 kg
Tires	275/80 R22.5	445/50 R22.5
Tire pressure (cold)	100 psi	
Trailers		
Vehicle Test ID	TR5	TR1
Vehicle Fleet ID	212B554	812M516
VIN	2M5921619X705914	2M592161981117064
Make and model	Manac 53'	
No. of axles	2	
Year	1998	2007
Type	Cube Van 9425301 TRA/REM	
Tires	275/80 R22.5	445/50 R22.5
Tire pressure (cold)	100 psi	
Vehicle test weight	24,940 kg	25,030 kg

Driving procedure

Each day, before the testing started, all vehicles were warmed up at test speeds for the same amount of time.

The driver's influence on the results was minimized as much as possible by conducting the tests on a closed circuit and strictly controlling the driving cycle as follows:

- Fixed period of idle time;
- Start off with maximum acceleration;
- Cruising speed of 100 km/h;
- Driving on the right side of the track as close as possible to the painted line, without touching it;
- Constant driving speed: the vehicle was free to change lanes on the oval track;
- After the established duration, the driver ceased to use the speed regulator at the designated point;
- During deceleration, the driver used only the service brakes and did not accelerate;
- Once at the meeting point, the trucks stayed idle for equal periods of time before stopping the engine.

During the tests, the driving cycle was controlled with a radar gun and drivers received instructions by CB radio. The time interval between two consecutive trucks remained the same in order to avoid the effects of turbulence caused by other trucks and prevent multiple trucks at the same place and time on the track.

Description of tests

The fuel consumption test compared the fuel consumption of a test vehicle, operating under two different conditions, with the fuel consumption of a test vehicle. A control vehicle (at all times non-modified) and a test vehicle were used to test the technology. Fuel consumption was accurately measured by weighing the temporary tanks before and after each trip (figure 3).

The vehicles had the same general configuration and were in good working condition, with all settings adjusted to manufacturers' specifications. The load weights were representative of fleet operations and remained the same throughout the entire test period.

The test consisted of a baseline stage (non-modified vehicles) followed by a test stage (test vehicle equipped with the technology to be tested):

- **Baseline test**: An initial test was conducted before installing the technology on the test truck. For this test, the control and test trucks completed a number of test runs (minimum of three) until it was statistically established that the results of a group of three tests were within a 2% variation.
- **Final test**: The same trucks completed the same trips a second time, after being equipped with the technology to be tested. The control truck was maintained in its original state. As in the baseline test, the trucks completed the test trips a number of times (minimum of three) until it was statistically established that the results of a group of three tests were within a 2% variation.
- Details of the baseline and final trials are presented in Appendix A.

For both baseline and final trials, the representative result is the ratio between the average fuel consumed by the test truck and the average fuel consumed by the control truck. The result of the complete trial consists of the percentage difference between the final ratio and baseline ratio.

Figure 3. Temporary tank installation and weighing.

Test results

The fuel consumption tests resulted in the Freight Wing Trailer Side Skirts showing a 7.2% improvement.

Details on the fuel consumption results are presented in Appendix B.

Conclusions

The comparison of the ratio between the consumed quantities of fuel by the test vehicle equipped with Freight Wing Trailer Side Skirts and by the unmodified control vehicle in the test trial, with the ratio between the consumed quantities of fuel by the same vehicles in the baseline trial, shows a 7.2 % improvement in fuel consumption for the test vehicle equipped with the Freight Wing Trailer Side Skirts.

Disclaimer

The result refers only to the vehicles and to the specimen of technology tested according to the procedure and conditions described in this report. Feric cannot guarantee the reproducibility of this result for particular operating conditions.

Appendix A:
Test trial forms

ENERGOTEST 2007 **TEST TRIAL FORM**

Date: Oct. 2, 2007 **Trial:** Base **Test no.:** 3 **Vehicle:** R3-TR5 (102560-212B554)

Supplier (technology): **Control vehicle**

Meteorological conditions:

Run	*Temp. (^{0}C)*	*Wind speed (km/h)*	*Wind direction*	*Relative humidity*	*Weather*
1	10.6	0		95	Fog
2	14.0	4	E	90	Fog
3	18.5	7	E	67	Mostly Cloudy
4					
5					
6					

Test Runs Details:

Run	*Tank ID*	*Start*			*Finish*			*Difference*		
		Time	*Odometer (km)*	*Fuel tank weight (kg)*	*Time*	*Odometer (km)*	*Fuel tank weight (kg)*	*Time*	*Odometer (km)*	*Fuel tank weight (kg)*
1	5	7:05:00	530932	88.95	8:07:00	531032	54.70	1:02:00	100.0	34.25
2	10	8:35:00	531032	112.95	9:37:00	531132	79.05	1:02:00	100.0	33.90
3	1	10:28:00	531132	113.25	11:30:00	531232	79.10	1:02:00	100.0	34.15
4										
5										
6										

RESET TRIAL DATA

Observer	***Marius-Dorin Surcel, Cameron Rittich***
Prepared by	***Marius-Dorin Surcel***

Date: Oct. 2, 2007 **Trial:** Base **Test no.:** 3 **Vehicle:** R2-TR1 (102550-812M516)

Supplier (technology): **Freigt Wing (Side Skirts), Laydon (Side Skirts), Meka Form (Tractor Fender), Passing Lane (Liberator)**

Meteorological conditions:

Run	*Temp. (^{0}C)*	*Wind speed (km/h)*	*Wind direction*	*Relative humidity*	*Weather*
1	10.6	0		95	Fog
2	14.0	4	E	90	Fog
3	18.5	7	E	67	Mostly Cloudy
4					
5					
6					

Test Runs Details:

Run	*Tank ID*	*Start*			*Finish*			*Difference*		
		Time	*Odometer (km)*	*Fuel tank weight (kg)*	*Time*	*Odometer (km)*	*Fuel tank weight (kg)*	*Time*	*Odometer (km)*	*Fuel tank weight (kg)*
1	8	7:05:00	523921	111.55	8:07:00	524021	75.75	1:02:00	100.0	35.80
2	6	8:35:00	524021	99.80	9:37:00	524121	64.25	1:02:00	100.0	35.55
3	8	10:28:00	524121	120.55	11:30:00	524221	84.75	1:02:00	100.0	35.80
4										
5										
6										

RESET TRIAL DATA

Observer	***Marius-Dorin Surcel, Rob Jokai***
Prepared by	***Marius-Dorin Surcel***

Date: Oct. 3, 2007 **Trial:** Test **Test no.:** 6 **Vehicle:** R3-TR5 (102560-212B554)

Supplier (technology): **Control vehicle**

Meteorological conditions:

Run	*Temp. (^{0}C)*	*Wind speed (km/h)*	*Wind direction*	*Relative humidity*	*Weather*
1	18.1	6	N	81	Cloudy
2	21.0	9	S	73	Cloudy
3	24.2	15	S	60	Cloudy
4	25.4	22	S	58	Cloudy
5	22.4	14	S	65	Cloudy
6					

Test Runs Details:

Run	*Tank ID*	*Start*			*Finish*			*Difference*		
		Time	*Odometer (km)*	*Fuel tank weight (kg)*	*Time*	*Odometer (km)*	*Fuel tank weight (kg)*	*Time*	*Odometer (km)*	*Fuel tank weight (kg)*
1	5	9:05:00	531254	106.15	10:08:00	531354	73.30	1:03:00	100.0	32.85
2	8	10:28:00	531354	109.35	11:30:00	531454	76.00	1:02:00	100.0	33.35
3	2	11:46:00	531454	113.20	12:49:00	531554	80.30	1:03:00	100.0	32.90
4	8	14:02:00	531554	108.70	15:04:00	531654	74.35	1:02:00	100.0	34.35
5	7	16:54:00	531659	112.30	17:57:00	531759	78.10	1:03:00	100.0	34.20
6										

RESET TRIAL DATA

Observer	***Rob Jokai, Cameron Rittich***
Prepared by	***Marius-Dorin Surcel***

Date: Oct. 3, 2007 **Trial:** Test **Test no.:** 6 **Vehicle:** R2-TR1 (102550-812M516)

Supplier (technology): **Freight Wing (Side Skirts)**

Meteorological conditions:

Run	*Temp. (^{0}C)*	*Wind speed (km/h)*	*Wind direction*	*Relative humidity*	*Weather*
1	18.1	6	N	81	Cloudy
2	21.0	9	S	73	Cloudy
3	24.2	15	S	60	Cloudy
4	25.4	22	S	58	Cloudy
5	22.4	14	S	65	Cloudy
6					

Test Runs Details:

Run	*Tank ID*	*Start*			*Finish*			*Difference*		
		Time	*Odometer (km)*	*Fuel tank weight (kg)*	*Time*	*Odometer (km)*	*Fuel tank weight (kg)*	*Time*	*Odometer (km)*	*Fuel tank weight (kg)*
1	1	9:05:00	524876	114.00	10:08:00	524976	82.15	1:03:00	100.0	31.85
2	6	10:28:00	524976	105.65	11:30:00	525076	73.30	1:02:00	100.0	32.35
3	10	11:46:00	525076	112.60	12:49:00	525176	79.80	1:03:00	100.0	32.80
4	9	14:02:00	525176	110.95	15:04:00	525276	76.75	1:02:00	100.0	34.20
5	4	16:54:00	525282	116.40	17:57:00	525382	83.05	1:03:00	100.0	33.35
6										

RESET TRIAL DATA

Observer	***Rob Jokai, Cameron Rittich***
Prepared by	***Marius-Dorin Surcel***

Appendix B:
Test result form

ENERGOTEST 2007 **TEST RESULTS FORM**

Technology: Side Skirts
Supplier: Freight Wing

RESET BASE DATA

VALIDATE BASE DATA

BASE TRIAL **DATE:** Oct. 2, 2007

T/C ratio calculation			
Test run	*Consumed fuel (kg): vehicle "**C**" R3-TR5 (102560-212B554)*	*Consumed fuel (kg): vehicle "**T**" R2-TR1 (102550-812M516)*	*T / C ratio*
1	34.250	35.800	1.045
2	33.900	35.550	1.049
3	34.150	35.800	1.048
4			
5			
6			
Valid test runs and T/C average (T/CavB)			
Test run	1	2	3
T/C ratio	1.045	1.049	1.048
T/CavB	1.047		

RESET TEST DATA

VALIDATE TEST DATA

TEST TRIAL **DATE:** Oct. 3, 2007

T/C ratio calculation			
Test run	*Consumed fuel (kg): vehicle "**C**" R3-TR5 (102560-212B554)*	*Consumed fuel (kg): vehicle "**T**" R2-TR1 (102550-812M516)*	*T / C ratio*
1	32.850	31.850	0.970
2	33.350	32.350	0.970
3	32.900	32.800	0.997
4	34.350	34.200	0.996
5	34.200	33.350	0.975
6			
Valid test runs and T/C average (T/CavT)			
Test run	1	2	5
T/C ratio	0.970	0.970	0.975
T/CavT	0.972		

TEST RESULTS

Parameter	***Notation***	***Equation***	***Value***
Base trial T/C average	T/CavB		1.047
Test trial T/C average	T/CavT		0.972
Percent fuel saved	PS	100(T/CavB - T/CavT) ÷ T/CavB	7.163

Prepared by	***Marius-Dorin Surcel***