MESILLA VALLEY TRANSPORTATION SOLUTIONS CERTIFIED
Fuel Economy Experts

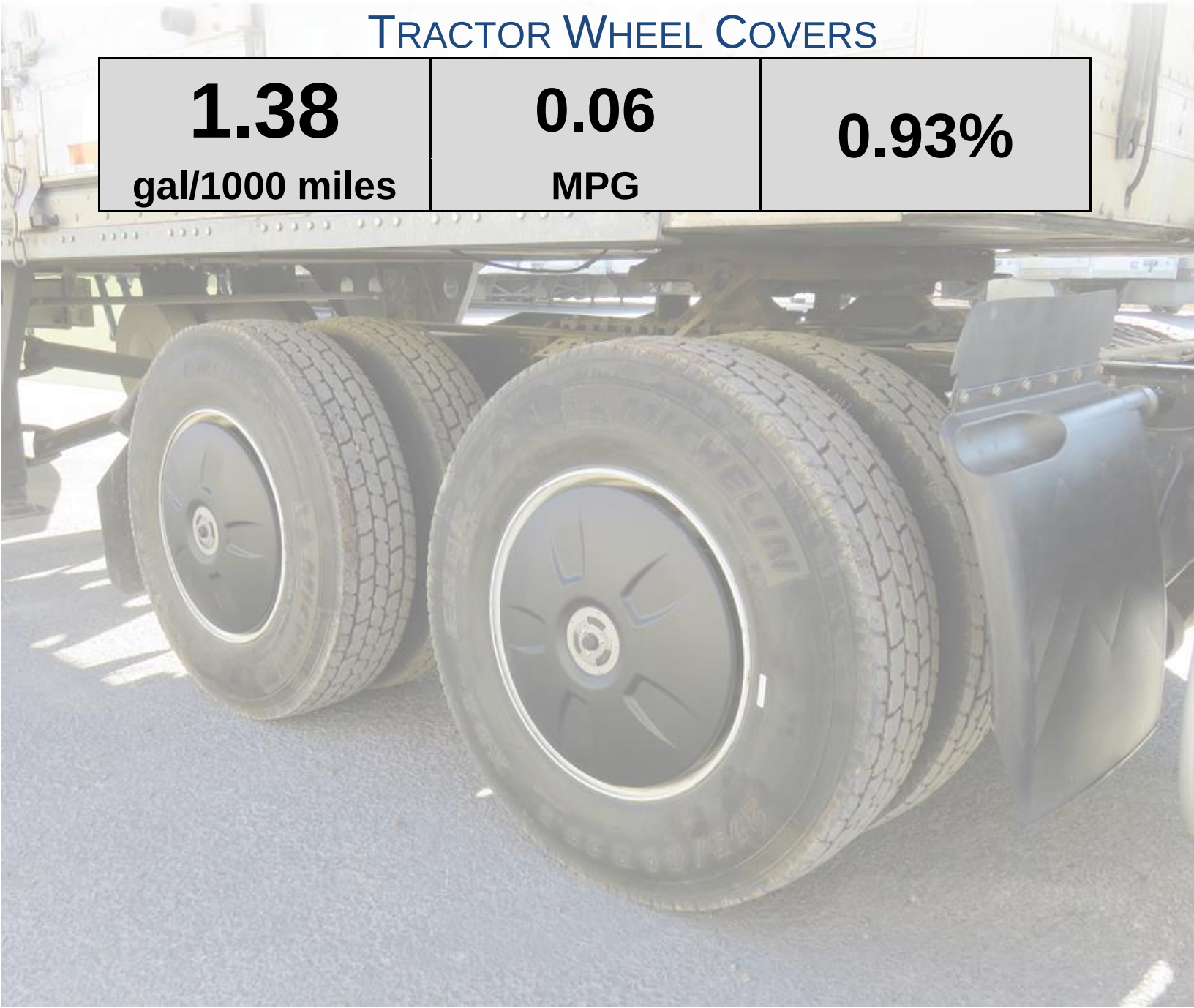
TEST REPORT

MVT SOLUTIONS CERTIFIED™ FUEL ECONOMY TEST
DECEMBER 2020

FLOWBELOW AERO, INC

TRACTOR WHEEL COVERS

1.38	0.06	0.93%
gal/1000 miles	MPG	



1.0: INTRODUCTION

Mesilla Valley Transportation Solutions (MVTS) certifies the fuel savings from this product are as described in this report. **Note:** this report was designed for carriers and providing information relevant to their needs. Therefore, the format varies from traditional fuel economy and technical reports. The report Summary provides the reader a quick synopsis of the product's fuel savings. Following the Summary is the body of the report and further details on the subjects. This fuel economy test was performed using MVTS proprietary fuel economy test methods. These test methods were developed from race car engineering and advanced vehicle test methods, which the Mesilla Valley Transportation (fleet) has relied on since 2012 to identify substantial fuel savings. The MVTS methods provide highly accurate and reliable answers on real-world fuel savings in comparison to other test methods, which enables carriers to make the best decisions for their company.

Contact MVTS with any questions regarding the product or test. As part of an MVTS Certified™ test, MVTS supports product inquiries, which we encourage carriers to utilize.

Note: blue text indicates a link to the topic. Click to follow. Alt + ← returns the reader to the initial location.

2.0: TEST SUMMARY

The FlowBelow Tractor Wheel Covers showed a fuel savings of **1.38 gal/1000 miles (0.93%).** Testing was conducted on a day cab Freightliner Cascadia with a 48-foot refrigerated trailer. Results are shown below in Table 1.

Table 1: Fuel Economy Test Results

	Fuel Economy Improvement		
	Gal/1000 miles	MPG	Percent
Tractor Wheel Covers	**1.38**	0.06	0.93%

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3.0: TEST PROCEDURE

The two (2) vehicles ran simultaneously, at 65 mph, on the 9-mile circle track near Pecos, Texas. The vehicles were 1-minute apart, avoiding any aerodynamic influence on either vehicle during testing. The vehicles were termed “Compare Vehicle” and “Test Vehicle”. The Compare Vehicle remained unchanged throughout testing; it was used solely for comparison. The Test Vehicle had modifications made during the test (*i.e.* FlowBelow components installed).

The test procedure may appear similar to the SAE J1321 method traditionally used in the trucking industry; however, the MVTS methods are a much more advanced and precise form of on-road and track testing. The vehicles are equipped with sensors and data recording systems that collect data on fuel consumption, aerodynamics, rolling resistance, driver behavior and many other variables that affect fuel consumption. The data is analyzed using MVTS proprietary methods, which provide very accurate answers on fuel savings. Additionally, the test results can be scientifically translated to a carrier’s real-world daily operations and long-term savings, which is a feature unique to these methods. Overall, the MVTS test methods are a much more advanced and reliable tool for predicting fuel savings than the trucking industry has used previously.

3.1: TEST VEHICLES

Test vehicles were 2018 Freightliner Cascadia models with DD13 13 Liter engines and Detroit 12-speed Automated Manual Transmissions (AMT). Trailers were Refrigerated Utility VS2RA 48-ft. The Gross Vehicle Weight (GVW) was 72,000 lbs. Both trucks were equipped with Ex-Guard grill guards, which were previously tested and showed no negative influence on fuel consumption. The Compare vehicle remained unchanged throughout all tests. The Test vehicle configuration was changed between test runs and shown in more detail below. Trucks and trailers used dual tires. Tire pressures were set at 110 psi in the morning, prior to incurring any affect of daytime heat. Vehicle info can be found in the Appendix.

Vehicles were thoroughly inspected and received regular maintenance prior to testing. MVTS Certified testing is typically conducted on Mesilla vehicles; however, this test was performed on fleet client day cabs and refrigerated trailers. The vehicles were thoroughly inspected, and items were repaired as needed.

Figure 1: Test Vehicle

Figure 2: Compare Vehicle

As shown below, five (5) runs were completed (Table 2), which will be explained in greater detail following the table. Only Runs 3 and 5 were used for the Tractor Wheel Cover test results. The additional runs pertain to separate tests that can be found at www.m-v-t-s.com.

Table 2: Test Runs

Run	Run Description	Start	End
1	Baseline	8:15 AM	10:10 AM
2	Trailer Wheel Covers (Test #1)	10:26 AM	12:05 PM
3	Trailer Wheel Covers (Test#2)	12:33 PM	2:12 PM
4	Re-Baseline	2:12 PM	3:26 PM
5	Wheel Covers Truck and Trailer (Added Tractor Wheel Covers)	4:36 PM	6:15 PM
6	Tractor AeroKit (added Center and Rear Pieces)	6:47 PM	8:26 PM

3.1a: Run 1: Baseline (No Aerodynamic Technologies)

The FlowBelow tractor wheel cover test was part of several FlowBelow tests conducted on the same day. Baseline runs were conducted as Run 1 and Run 4. The Baseline vehicle configuration is shown in Figure 1 through Figure 4.

Figure 3: Baseline Tractor Configuration (Without Wheel Covers)

Figure 4: Baseline Trailer Configuration (Without Covers)

3.1b: Run 2: Trailer Wheel Covers (Test #1)

Run 2 consisted of installing the FlowBelow wheel covers on the trailer. The results of the FlowBelow trailer wheel covers can be found at www.m-v-t-s.com.

3.1c: Run 3: Trailer Wheel Covers (Test #2)

Run 3 was a repeat of Run 2, which was conducted to verify the trailer wheel cover values and is also described in more detail in the trailer wheel cover report at www.m-v-t-s.com.

Figure 5: Trailer Wheel Covers Configuration

3.1d: Run 4: Re-Baseline

The baseline test was repeated in Run 4 and the trailer wheel covers were removed.

3.1e: Run 5: Wheel Covers Tractor and Trailer Installed

Run 5 consisted of installing FlowBelow wheel covers on the tractor and trailer (Figure 6). Since the trailer wheel covers were previously installed during Run 3, comparing Run 5 and 3 provided values for the tractor wheel covers only.

Figure 6: Truck and Trailer Wheel Covers Installed

3.2: VEHICLE FUEL ECONOMY TEST EQUIPMENT

MVT Solutions fuel economy testing utilizes a data acquisition system and sensors specifically for this testing. This style of testing is derived from race car engineering where reliable sensor data is critical to understanding vehicle modifications.

MVTS test sensors include:

- Data acquisition system (records sensor data)
- Fuel flow meter (accurate to 0.2%)
- Fuel temperature sensor
- Tire temperature sensor (infrared, mounted on left-front drive tire)
- Ground/road temperature sensor (infrared, mounted ahead of left-front drive tire)
- Wind speed air pressure sensor (truck hood)
- Wind direction sensor (truck hood)
- Ambient air temperature sensor (truck hood)
- Ambient air pressure sensor (truck cab)
- High Precision GPS (latitude, longitude, altitude, time)

Click this link to see a video of MVTS sensors and testing: How We Test

Figure 7: Aerodynamic Sensors

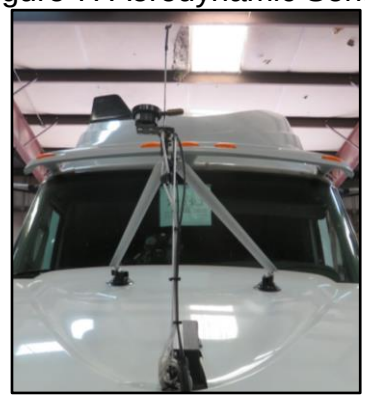
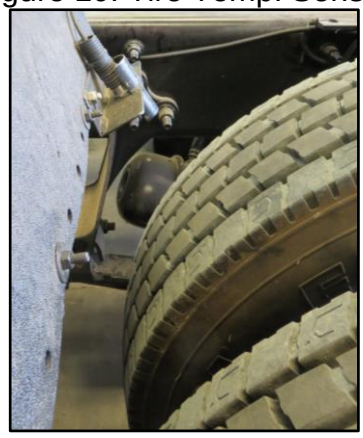


Figure 8: Data Acquisition System

Figure 9: Fuel Flow Meter

Figure 10: Tire Temp. Sensor



4.0: 4.0: Test Results

As listed in the Summary, the FlowBelow Tractor Wheel Covers achieved a fuel savings of **1.38 gal/1000 miles (0.93%)**. Results are shown in Table 3 and include test result accuracy. Wheel covers are a known fuel-savings technology on tractor trailers; however, not all wheel covers save fuel equally. The FlowBelow wheel covers have been tested many times by MVTS and have shown quantifiable and repeatable fuel savings.

Table 3: Test Results with Accuracy

	Fuel Economy Improvement		
	Gal/1000 miles	MPG	Percent
Tractor Wheel Covers	**1.38**	0.06	0.93%
Accuracy	**+/- 1.30**	+/- 0.06	+/- 0.88%

These results are shown graphically in gal/1000 miles below in Figure 11 and as a percent in Figure 12.

Figure 11: Fuel Savings (gal/1000 miles)

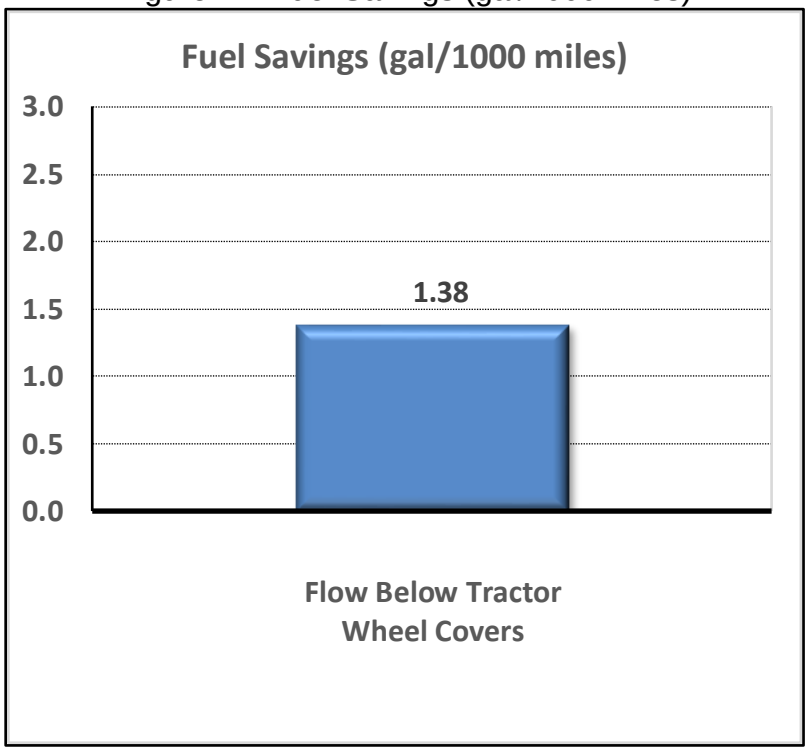
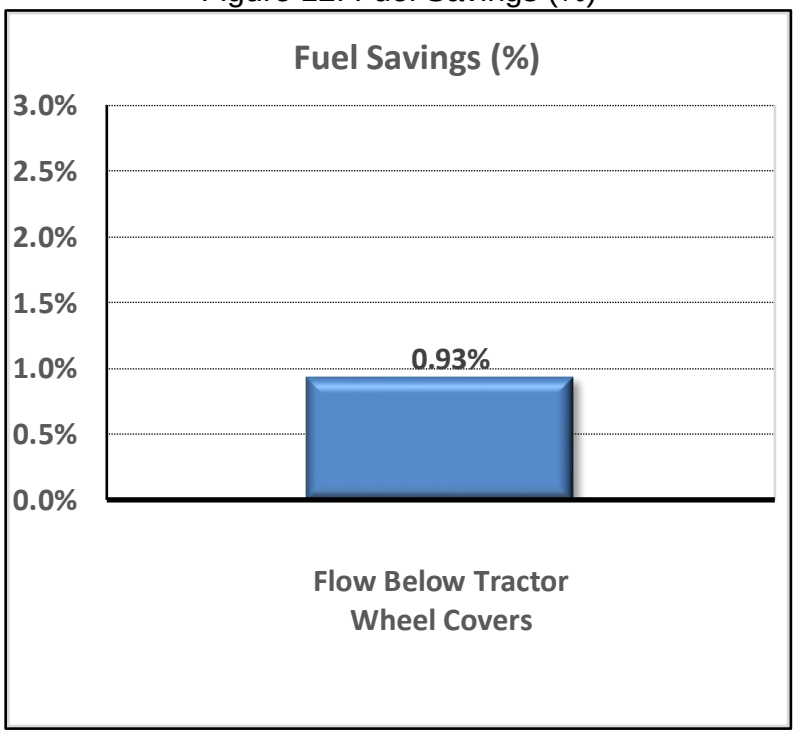


Figure 12: Fuel Savings (%)



4.1: UNITS OF MEASUREMENT

The reader may not be familiar with units of gal/1000 miles (gallons per 1000 miles) since it is not traditionally used in the trucking industry. The following paragraphs briefly explain the reasons for these units and how they help carriers better calculate fuel savings.

Units of gal/1000 miles more reliably calculate fuel savings when compared to other units such as miles-per-gallon (MPG) and percent (%). Those units are prone to error from changing variables such as vehicle baseline fuel economy, load, driver behavior, and duty cycle. For example, gal/1000 miles values are not affected by load for an aerodynamic product. Any empty Class-8 unit at 34,000 lbs. will save the same fuel in gal/1000 miles as one loaded to 80,000 lbs. However, when viewed in percent (%) or MPG the values change with load. This causes a carrier to experience varied results in real-world operation and difficulty predicting the financial benefits of the product unless units of gal/1000 miles are used.

Units of gal/1000 miles are the most reliable units of measurement for aerodynamic fuel savings due to their scientific and mathematical relationship to fuel consumption. Further detail is beyond the scope of this report and the reader is encouraged to contact MVT Solutions if more information is desired.

4.2: WEATHER CONDITIONS SUMMARY

Temperatures ranged from 34.0°F to 46.0°F. Winds ranged from 12 mph to 25 mph and gust conditions were omitted from the test results based on the consistency of test data. It should be noted that the MVTS test methods account for these variables and their effects on fuel savings. Therefore, the range in climate conditions did not impede the test results shown in this report. Complete weather data can be found in the Appendix.

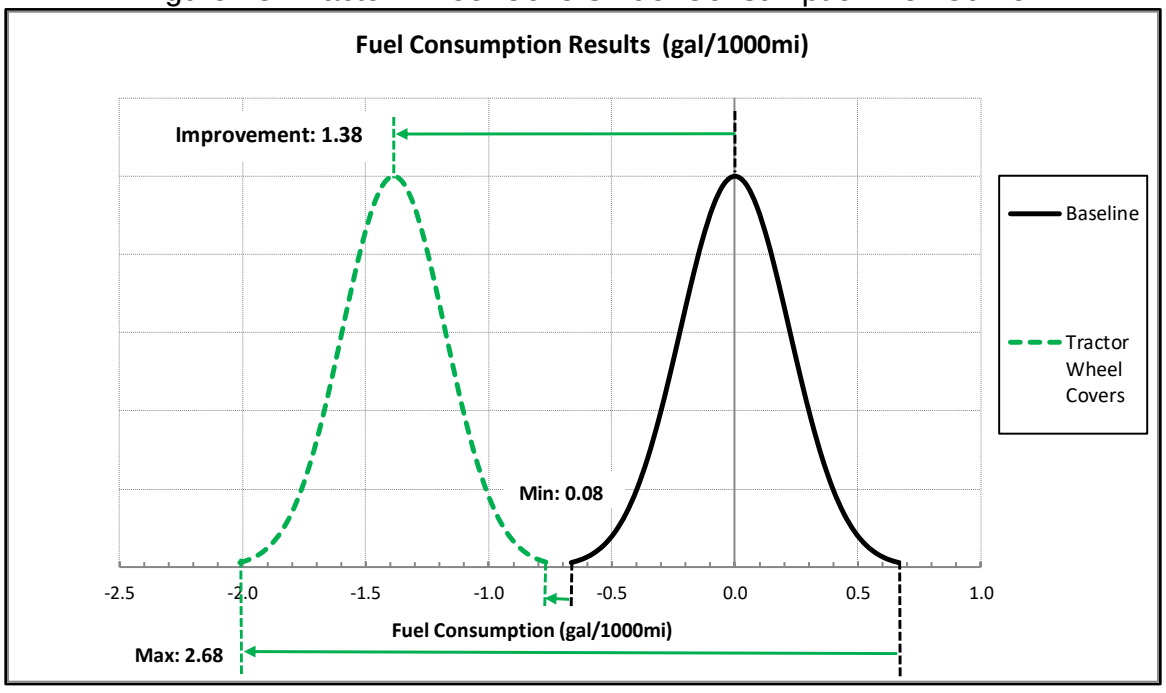
4.3: MEASUREMENT ACCURACY

The accuracy of fuel economy measurements is critical in determining the trustworthiness of test results. Historically, this has been a major difficulty in the trucking industry with fuel economy testing, which has led to confusion and misleading results. The MVTS test methods overcome this issue by achieving better accuracy, which is one of the ways it provides more reliable test results.

Accuracy for all the tests was calculated using a 95% confidence interval, a common standard for testing measurement. 95% confidence interval indicates that if the test were repeated 100 times, values would fall within the range in 95 out of the 100 tests (*i.e.* the reader would be 95% confident the value would be within that range).

Figure 13 below shows the statistical bell curves of the FlowBelow Tractor Wheel Covers. The Baseline and Tractor Wheel Covers test clearly show two separate bell curves, indicating the test had valid accuracy and results were reliable. The graph shows the arrow pointing to the left, illustrating less fuel used (*i.e.* fuel saved). The distance between the peaks of the bell curves is the test result average, which was a fuel savings of 1.38 gal/1000 miles. Minimum and maximum values were calculated as the test result plus or minus the accuracy values (1.38 +/-1.30), which were 0.08 and 2.68 gal/1000 miles. Although the bell curves and accuracy suggest a low minimum value, this was only a result of the accuracy of the test. MVTS is confident in the fuel savings of 1.38 gal/1000 miles. This confidence is due to multiple tests of FlowBelow wheel covers, including on the trailer individually (see report at www.m-v-t-s.com) and the knowledge of manually analyzing the test data to confirm its validity.

Figure 13: Tractor Wheel Covers Fuel Consumption Bell Curve



5.0: CONCLUSION

MVTS testing proved the fuel savings of the FlowBelow Tractor Wheel Covers with answers that were clear and precise showing the increase in fuel economy utilizing this technology.

The FlowBelow Tractor Wheel Covers showed fuel savings of **1.38 gal/1000 miles (0.93%)**. These are relatively high fuel savings values for wheel covers, which illustrate the ease in which fleets can capitalize on fuel savings.

The test values shown can be used to estimate a carrier's savings in real-world operations. More precision can be obtained by using a carrier's vehicle and duty cycle information. Contact MVT Solutions for assistance or more information.

6.0: APPENDIX

6.1: MODIFIED (I.E. TEST) TRUCK/TRAILER VEHICLE DETAILS

Figure 14: Vehicle Info, Test Vehicle

Date	December 2, 2020					
Company	Fleet Client					
Location	Pecos, Texas					
Test Route	Pecos 9-mile Test Track					
TRUCK ID:	**Veh. B**					
Brand	Freightliner					
Year	2018					
Model	Cascadia Day Cab					
Engine	Detroit DD13					
VIN	3AKJGBDV8JSKB0291					
Mileage (miles):	284,806					
Transmission	Detroit 12 Speed AMT					
Rear Gear	N/A					
Fuel Load	Full at start of test					
Fuel Type & Batch	No. 2 Diesel					
Axle Weights	11,720		29,360		30,980	
Total weight	72,060					
Photo/Video/Audio folder name:						
TRAILER ID:	**8206532**					
Model	Utility VS2RA					
VIN	1UY VS2487 GU4274 20					
Year	2015					
Model	Refrigerated					
Size	48-ft					
Trailer Gap (inches)	47.5 inches					
Add-ons	Transtex skirts					

Figure 15: Tire Info, Test Vehicle

TIRES					
		Truck	**Veh. B**		
LF:		**Front Axle Tires**			RF: Same
Bridgestone R268		Type			Bridgestone R268
11R 22.5		Size			275/80R22.5
14/32		Tread Depth (32nds)			15/32
110		Pressure (psi)			110
LF-Outer Drive:	LF-Inner Drive:	**Drive Axle Tires**		RF-Inner Drive:	RF-Outer Drive
Michelin X Line XDA Energy +	Michelin X Line XDA Energy +	Type		Michelin X Line XDA Energy +	Michelin X Line XDA Energy +
275/80R22.5	275/80R22.5	Size		275/80R22.5	275/80R22.5
22/32	22/32	Tread Depth (32nds)		22/32	22/32
110	110	Pressure (psi)		110	110
LR-Outer Drive:	LR-Inner Drive:	**Drive Axle Tires**		RR-Inner Drive:	RR-Outer Drive
Michelin X Line XDA Energy +	Michelin X Line XDA Energy +	Type		Michelin X Line XDA Energy +	Michelin X Line XDA Energy +
275/80R22.5	275/80R22.5	Size		275/80R22.5	275/80R22.5
22/32	22/32	Tread Depth (32nds)		22/32	22/32
110	110	Pressure (psi)		110	110
		Trailer	**8206532**		
LF-Outer Trailer:	LF-Inner Trailer:	**Tandem Front**		RF-Inner Trailer	RF-Outer Trailer
Michelin X Line Energy T	Michelin X Line Energy T	Type		Michelin X Line Energy T	Michelin X Line Energy T
275/80R22.5	275/80R22.5	Size		275/80R22.5	275/80R22.5
12/32	12/32	Tread Depth (32nds)		12/32	12/32
110	110	Pressure (psi)		110	110
LR-Outer Trailer:	LR-Inner Trailer:	**Tandem Rear**		RR-Inner Trailer	RR-Outer Trailer
Michelin X Line Energy T	Michelin X Line Energy T	Type		Michelin X Line Energy T	Michelin X Line Energy T
275/80R22.5	275/80R22.5	Size		275/80R22.5	275/80R22.5
12/32	12/32	Tread Depth (32nds)		12/32	12/32
110	110	Pressure (psi)		110	110

6.2: COMPARE TRUCK/TRAILER VEHICLE DETAILS

Figure 16: Vehicle Info, Compare Vehicle

Date	December 2, 2020		
Company	Fleet Client		
Location	Pecos, Texas		
Test Route	Pecos 9-mile Test Track		
TRUCK ID:	**Veh. C**		
Brand	Freightliner		
Year	2021		
Model	Cascadia Day Cab		
Engine	Detroit DD13		
VIN	3AKJHTDV1MSMU3246		
Mileage (miles):	719		
Transmission	Detroit 12 Speed AMT		
Rear Gear	N/A		
Fuel Load	Full at start of test		
Fuel Type & Batch	No. 2 Diesel		
Axle Weights	11,720	29,360	30,980
Total weight	72,060		
Photo/Video/Audio folder name:			
TRAILER ID:	**8206530**		
Model	Utility VS2RA		
VIN	1UY VS2480 GU4274 22		
Year	2015		
Model	Refrigerated		
Size	48-ft		
Trailer Gap (inches)	47.5 inches		
Add-ons	Transtex skirts		

Figure 17: Tire Info, Compare Vehicle

TIRES					
		Truck	**Veh. C**		
LF:		**Front Axle Tires**			RF: Same
Bridgestone R283a		Type			Bridgestone R283a
295/75R22.5		Size			295/75R22.5
17/32		Tread Depth (32nds)			17/32
110		Pressure (psi)			110
LF-Outer Drive:	LF-Inner Drive:	**Drive Axle Tires**		RF-Inner Drive:	RF-Outer Drive
Michelin X Line XDA Energy +	Michelin X Line XDA Energy +	Type		Michelin X Line XDA Energy +	Michelin X Line XDA Energy +
275/80R22.5	275/80R22.5	Size		275/80R22.5	275/80R22.5
22/32	22/32	Tread Depth (32nds)		22/32	22/32
110	110	Pressure (psi)		110	110
LR-Outer Drive:	LR-Inner Drive:	**Drive Axle Tires**		RR-Inner Drive:	RR-Outer Drive
Michelin X Line XDA Energy +	Michelin X Line XDA Energy +	Type		Michelin X Line XDA Energy +	Michelin X Line XDA Energy +
275/80R22.5	275/80R22.5	Size		275/80R22.5	275/80R22.5
22/32	22/32	Tread Depth (32nds)		22/32	22/32
110	110	Pressure (psi)		110	110
		Trailer	**8206530**		
LF-Outer Trailer:	LF-Inner Trailer:	**Tandem Front**		RF-Inner Trailer	RF-Outer Trailer
Bridgestone Ecopia R123	Bridgestone Ecopia R123	Type		Bridgestone Ecopia R123	Bridgestone Ecopia R123
295/75R22.5	295/75R22.5	Size		295/75R22.5	295/75R22.5
11/32	11/32	Tread Depth (32nds)		11/32	11/32
110	110	Pressure (psi)		110	110
LR-Outer Trailer:	LR-Inner Trailer:	**Tandem Rear**		RR-Inner Trailer	RR-Outer Trailer
Bridgestone Ecopia R123	Bridgestone Ecopia R123	Type		Bridgestone Ecopia R123	Bridgestone Ecopia R123
295/75R22.5	295/75R22.5	Size		275/80R22.5	295/75R22.5
11/32	11/32	Tread Depth (32nds)		11/32	11/32
110	110	Pressure (psi)		110	110

6.3: TEST ROUTE

Pecos, Texas 9-mile circle track (Figure 18). Counter-clockwise direction, middle lane (of 3).

Figure 18: Pecos Test Track

6.4: SAVINGS CALCULATIONS

Below is a brief outline of how to use the test results to calculate savings. For more detail or assistance contact MVT Solutions.

6.4a: Fuel Savings Calculations

Fuel savings resulting from this test can be calculated as follows:

Test result (gal/1000 miles) x Thousands of miles travelled per year, per vehicle

Example: Tractor Wheel Covers fuel savings = 1.38 gal/1000 miles. If a vehicle travels 125,000 miles per year, fuel savings are:

1.38 x 125 = 173 gallons saved annually

6.4b: Financial Savings Calculations

Financial calculations can be made by multiplying the fuel saved by the fuel price. Using the U.S. average retail price of diesel fuel in 2019, $3.056 /gal:

173 gallons/year x $3.056 /gal = $529 /year in fuel savings

To continue calculating the net financial savings requires input of the product investment and other pertinent variables unique to each carrier. Contact MVTS for assistance if required.

6.5: WEATHER CONDITIONS

Weather during testing was cold with relatively high winds. Weather data was acquired from a local Weather Underground weather station. Source shown below.

The reader should be aware that MVTS methods include instantaneous and constant weather data acquisition on each vehicle, and this testing has minimal dependency on external weather data collection. MVTS test data accounts for changes in wind, temperature, and other pertinent variables instantaneously. Note, darkened rows pertain to test times.

Table 4: Weather Data, December 2, 2020

	Temperature	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
12:53 AM	41 F	22 F	47 %	N	13 mph	0 mph	27.02 in	0.0 in	Fair
1:53 AM	39 F	20 F	46 %	NNW	13 mph	0 mph	27.04 in	0.0 in	Fair
2:53 AM	38 F	19 F	47 %	N	12 mph	0 mph	27.06 in	0.0 in	Fair
3:53 AM	37 F	19 F	48 %	N	10 mph	0 mph	27.09 in	0.0 in	Fair
4:53 AM	37 F	19 F	48 %	N	15 mph	0 mph	27.10 in	0.0 in	Fair
5:53 AM	35 F	20 F	54 %	NNW	10 mph	0 mph	27.13 in	0.0 in	Fair
6:53 AM	35 F	23 F	61 %	NNW	12 mph	0 mph	27.16 in	0.0 in	Fair
7:53 AM	35 F	24 F	64 %	NNW	10 mph	0 mph	27.19 in	0.0 in	Fair
8:53 AM	39 F	26 F	60 %	N	15 mph	0 mph	27.21 in	0.0 in	Fair
9:53 AM	42 F	26 F	53 %	N	22 mph	0 mph	27.24 in	0.0 in	air / Windy
10:53 AM	44 F	26 F	49 %	N	25 mph	31 mph	27.26 in	0.0 in	air / Windy
11:53 AM	46 F	25 F	44 %	N	25 mph	33 mph	27.26 in	0.0 in	air / Windy
12:53 PM	43 F	24 F	47 %	N	20 mph	28 mph	27.25 in	0.0 in	Cloudy
1:53 PM	42 F	25 F	51 %	NNW	18 mph	0 mph	27.25 in	0.0 in	Cloudy
2:53 PM	42 F	24 F	49 %	N	18 mph	29 mph	27.24 in	0.0 in	Cloudy
3:53 PM	41 F	23 F	49 %	NNW	22 mph	28 mph	27.25 in	0.0 in	idy / Windy
4:53 PM	40 F	21 F	47 %	N	15 mph	0 mph	27.25 in	0.0 in	Cloudy
5:53 PM	39 F	22 F	50 %	N	17 mph	26 mph	27.27 in	0.0 in	stly Cloudy
6:53 PM	37 F	21 F	52 %	N	12 mph	0 mph	27.28 in	0.0 in	stly Cloudy
7:53 PM	36 F	20 F	52 %	N	16 mph	0 mph	27.30 in	0.0 in	Fair
8:53 PM	34 F	18 F	52 %	NNW	16 mph	0 mph	27.32 in	0.0 in	Fair
9:53 PM	32 F	18 F	56 %	NNW	13 mph	0 mph	27.33 in	0.0 in	Fair
10:53 PM	30 F	18 F	61 %	NNW	10 mph	0 mph	27.32 in	0.0 in	Fair
11:53 PM	29 F	18 F	64 %	NW	10 mph	0 mph	27.32 in	0.0 in	Fair

Source: https://www.wunderground.com/history/daily/us/tx/midland/KMAF/date/2020-12-2

6.6: PRODUCT DETAILS

- FlowBelow Tractor Wheel Covers

6.7: TEST PERSONNEL

6.7a: MVT Solutions

- Daryl Bear, Lead Engineer & COO
- Jacob Schwartz, Test Engineer

6.7b: Drivers

- Allan Dahringer
- Carlos Aragon
- Jack Burchell
- Seth Knight

6.7c: FlowBelow Aero, Inc.

- Josh Butler, President

6.8: MVT SOLUTIONS CONTACT INFO

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