Test Report

BASF

Emgard® 7103 XFE 75W-85

Freightliner Cascadia/DD15	Peterbilt 579/X15
0.67 gal/1000 miles	**1.14** gal/1000 miles
0.04 MPG	0.08 MPG
0.50% Percent	0.90% Percent

MESILLA VALLEY TRANSPORTATION SOLUTIONS
CERTIFIED
Fuel Economy Experts

MVT SOLUTIONS CERTIFIED™ FUEL ECONOMY TEST

May 2024

BASF
We create chemistry

1.0: INTRODUCTION

The purpose of this test was to conduct MVTS Certified testing on BASF axle lubricants. Testing was conducted on an interstate route of rolling hills at 65 MPH on two (2) types of Class 8 vehicles, including a Freightliner Cascadia with a DD15 engine and a Peterbilt 579 with a Cummins X15 engine. Both tractors were 2025 model year and were equipped with Meritor 6x4 drive axle configurations.

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" or "MVT") has relied on since 2012 to identify substantial fuel savings. The MVTS methods provide very accurate and reliable answers on real-world fuel savings in comparison to other test methods. This enables suppliers of fuel economy technologies to quantify the fuel savings of their technology quickly and reliably.

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.

Figure 1: Test Vehicle on Exit 51 Ramp

2.0: TEST SUMMARY

The **Freightliner Cascadia** with the Detroit Diesel DD15 engine and Meritor 6x4 drive axle configuration showed fuel savings of **0.67** gal/1000 miles (**0.5%**) with **Emgard® 7103 XFE 75W-85** compared to the reference axle lubricant, which was Emgard® FE 75W-90. The reference oil was the factory fill for both tractor brands and is used as the comparison oil throughout this report.

The **Peterbilt 579** with the X15 engine and Meritor 6x4 drive axle configuration showed fuel savings of **1.14** gal/1000 miles (**0.9%**) with **Emgard® 7103 XFE 75W-85** compared to the reference oil.

Units of measurement are explained in the Units of Measurement section of the report.

The Freightliner Cascadia experienced an axle oil temperature decrease of 2.6°C (3.3%) and 4.8°C (5.9%) on the front and rear axles, respectively, with Emgard® 7103 XFE 75W-85 compared to the reference oil and accounting for the Compare vehicle.

The Peterbilt 579 experienced an axle oil temperature decrease of 1.4°C (1.7%) and 2.7°C (3.2%) on the front and rear axles, respectively, with Emgard® 7103 XFE 75W-85 compared to the reference oil and accounting for the Compare vehicle.

All lubricants were changed in the differential housings and hubs using a double flush procedure. BASF provided all test lubricants.

Testing was conducted on a 41-mile interstate loop at 65 miles per hour with a Gross Vehicle Weight (GVW) of approximately 65,000 lbs. Vehicles were modern Class 8 sleepers with 53-foot dry van trailers. Table 1 shows the Test results for Emgard® 7103 XFE 75W-85.

Disclaimer: as with all MVT Solutions Certified™ tests, the Technology Provider (i.e., BASF) contracted MVTS to conduct the tests reported here. BASF is not responsible for any test results or procedures described in this report. BASF makes no warranty of any kind with respect to this report. Contact MVTS with any questions regarding the report, procedure, or products.

Table 1: Fuel Economy Results Summary

Trucks	Fuel Economy Improvement		
	Gal/1000 Miles	MPG	Percent
Freightliner Cascadia w/DD15 and Meritor Axles	**0.67**	0.04	0.5%
Peterbilt 579 w/X15 and Meritor Axles	**1.14**	0.08	0.9%

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3.0: TEST PROCEDURE

Prior to each test day, a pre-test checklist was followed to ensure vehicle preparation and consistency including regens, tire pressures and fueling.

Prior to beginning the test, vehicles were 'warmed up' during the 59-mile drive from the MVTS shop to the test site. Lubricant changes and flushes were performed at the MVTS shop.

Upon arriving at the test site, the test procedure shown below (Test Run Procedure) was followed for each vehicle. A gap of three (3) minutes was created between vehicles at the start of the test. The Test Engineer rode in the final vehicle and information was relayed to the engineer by phone from the other vehicles.

3.1: TEST VEHICLES

The first test vehicle was a 2025 Freightliner Cascadia with a DD15 engine, DT12 transmission and Meritor axles with a 2.47 final ratio. The second test vehicle was a 2025 Peterbilt 579 with a Cummins X15 engine, Eaton Endurant EEO-17F112C transmission and Meritor axles with a 2.79 final ratio. The Compare vehicle was a 2025 Kenworth T680 with an X15 engine, Eaton Endurant EEO-17F112C transmission and Meritor axles with a 2.64 final ratio. The trailers were 53-foot Hyundai dry vans. Gross Vehicle Weight (GVW) was approximately 65,000 lbs. The Compare vehicle remained unchanged for the duration of test days, however, during the Baseline the reference oil was changed using the same double flush procedure. The Test vehicle axles were flushed with Emgard® 7103 XFE 75W-85 following the procedure described in Section 3.2. Trucks and trailers used dual tires and tire pressures were set to 100 psi in the morning prior to incurring any effects of daytime heat.

Vehicles were thoroughly inspected and received regular maintenance prior to testing. It should also be noted, for the reader's peace of mind, Mesilla Valley Transportation (MVT) and MVT Solutions are 100% confident in the reliable condition of the test vehicles and MVT relies on the same test procedures for purchase decisions.

3.2: LUBRICANT CHANGES AND TEST RUNS

The lubricants in the drive axle were changed with a double flush procedure prior to the test run to eliminate crossover from prior lubricants. The flush procedure was conducted as shown in Table 2. Step #9 was conducted as the test warmup and drive to the test location.

Table 2: Test Vehicle Drive Axle Lubricant Flush Procedure

Step #	Description
1	Drain reference axle oil lubricant
2	Install new axle lubricant (Emgard® 7103 XFE 75W-85)
3	Drive 22.5 miles
4	Drain axle lubricant (Flush #1)
5	Install new axle lubricant (Emgard® 7103 XFE 75W-85)
6	Drive 22.5 miles
7	Drain axle lubricant (Flush #2)
8	Install new axle lubricant (3rd iteration of new oil) (Emgard® 7103 XFE 75W-85)
9	Drive 59 miles for warmup

Differential housings were filled to the fill plug hole and the wheel ends (*i.e.,* hubs) were also drained and refilled. This was conducted using a pneumatic pump with a handheld controller and digital display (Figure 2).

Figure 2: Axle Oil Pump

3.3: TEST RUN PROCEDURE

Upon conclusion of the flushing procedure in Table 2, the vehicles were driven to the test route (*i.e.,* warmup). Warmup data was not included in the test results.

Vehicle settings remained unchanged throughout testing following normal MVTS procedure. This included air conditioning, fan setting, radio and headlights.

Stationary regenerations (*i.e.,* regens) were completed prior to the beginning of each test day. Regens are a process the engine undertakes to clean the emissions system and a 'stationary' is performed while the truck is parked. This is conducted by manually starting the regen using a laptop/vehicle link.

3.4: TEST PROCEDURE STEPS

- Vehicle stops at Exit 51 Northbound on-ramp with right-side window aligned with 'seat belt' sign.
- Driver checklist procedure conducted by driver.
- Tractor OEM 'trip' reset (*i.e.,* 'zeroed').
- MVTS data acquisition fuel counters zeroed.
- Start test by accelerating at 100% throttle and entering highway.
- Enable Cruise Control (CC) at 65 MPH.
- Continue CC until crest of hill prior to Exit 71 Northbound where CC is deactivated, foundation brake is applied due to downhill gradient.
- Exit highway.
- Make two (2) left hand turns to enter on ramp Exit 71 Southbound.
- Stop with 'seat belt' sign at right-side window for 3 seconds.
- Accelerate at 100% throttle and enter highway.
- Enable CC at approximately 63 MPH to allow tractor to settle at 65 MPH CC speed.
- Continue CC to ½ Mile marker sign prior to Exit 51 Southbound where CC is deactivated, truck is coasted and light foundation brake is applied.
- Exit highway.
- Make two (2) left hand turns to enter on ramp Exit 51 Northbound.
- Stop with 'seat belt' sign at right-side window for 3 seconds.
- Repeat steps above five (5) more times to complete test driving.
- At the end of driving, stop at Exit 51 Southbound.
- Record OEM 'trip' using phone camera. Shut off engine.
- Download data from MVTS data acquisition system. End test driving.
- Return to Las Cruces, NM.
- Scale vehicles at T/A CAT Certified scales.
- Return to MVTS shop.
- Prepare vehicles for the next test day.

3.5: RUN 1: REFERENCE OIL EMGARD® FE 75W-90

The Baseline run utilized the reference oil Emgard® FE 75W-90 installed in the drive axles of the Test and Compare vehicles. This was the 'factory fill' oil for both test tractors, therefore the drive axles previously contained the same oil. The flush procedure followed that listed in Table 2. This reference oil was chosen as it was the OEM 'factory fill' product.

Figure 3: Peterbilt 579/X15 Spec sheet

Sales Code	Std/ Opt	Description	Weight
		PHP10 aluminum PreSet PLUS hubs air disc have a fully integrated spindle nut design, an optimized wheel spacer, magnetic fill plug, with a seal and bearings. Use with Front Axle.	
1380380	S	**Tenneco Shocks For Steer Axle** Integrated front suspension to suit heavy duty truck market, combining the air spring and the damper into one module.	0
1380470	O	**Meritor Wide Track IPO Standard, Front Axle** Meritor wide track front axle offers greater turning radius and ease of service. MFS+ 3.5" Drop / MFS 3.74" Drop. 71in KPI IPO 69in with MFS and MFS+ axles.	15
1392180	O	**Meritor EX+L Optimized Linehaul Air Disc Brakes** Steer Axle. Meritor EX+L Optimized Air Disc Brakes with calipers that are 11 to 15 pounds lighter, per wheel end, than current EX+L brake calipers.	0
Rear Axle & Equipment			
1526150	O	**Meritor MT40-14X 40,000 lb** Interaxle diff lock air rocker occupies space of one gauge. Laser factory axle alignment to improve handling & reduce tire wear. Magnetic rear axle oil drain plug captures & holds any metal fragments in drive axle lube to extend service life. Parking brakes on all drive axles for optimal performance. Cognis EMGARD® FE 75W-90 synthetic axle lube provides over 1% fuel economy improvement. Reduces wear & extends maintenance intervals, resulting in increased uptime. Provides improved fluid flow to protect components in extreme cold conditions & withstand the stress from high temperatures, extending component life.	174
1616290	O	**PHP10 Aluminum PreSet PLUS Hubs**	0
1680390	S	**Bendix ESP Electronic Stability Program With ATC** Tractor service only. The Bendix ESP system is designed to continuously monitor a variety of vehicle parameters and sensors to determine if the vehicle is reaching a critical stability threshold. If such a situation develops, the system will quickly and automatically intervene to assist the driver by selectively applying tractor and trailer brakes, and de-throttling the engine.	0
1680420	O	**X30 Brake Drums IPO Standard, Drive Axle(s)**	-79
1680490	O	**Gusseted Cam Brackets, Drive Axle(s)**	2
1680615	O	**RH Side Sensor For Bendix Collision Mitigation**	0
1680760	O	**Meritor Q+ Air Cam Rear Drum Brakes 16.5x8.625**	0
1680985	S	**Bendix Fusion** Bendix Fusion is an integrated driver assistance technology, utilizing a windshield mounted camera, bumper mounted radar and brake system information for the following features: Collison Mitigation, Stationary Vehicle Braking, Multi-lane Autonomous Emergency Braking, Highway Departure Warning and Braking, Following Distance Alerts, Lane	0

Price Level: January 1, 2024
Deal: 6X4 ULTRALOFT
Printed On: 9/29/2023 12:32:04 PM

Date: September 21, 2023
Quote Number: QUO-1065367-B4Q5F6

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Figure 4: Factory Filled Oil Emgard® FE 75W-90 Container Label

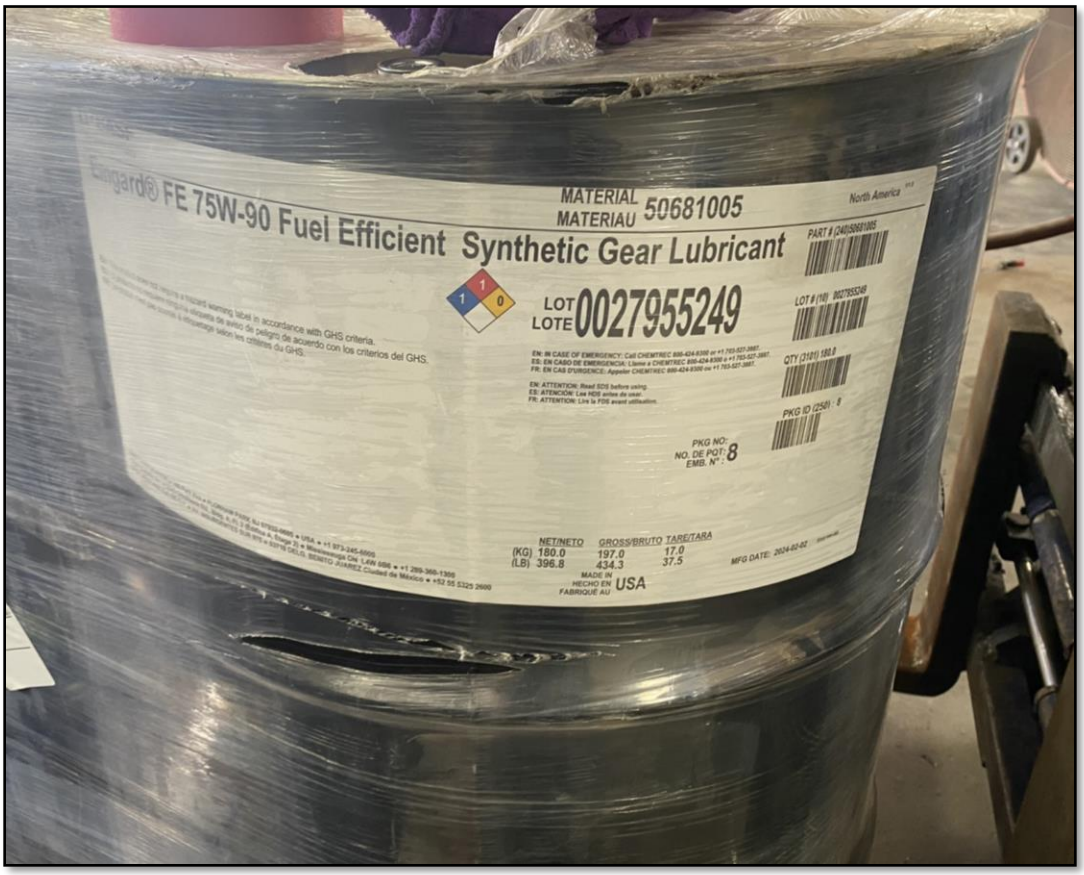


Figure 5: Draining Rear Drive Axle (Test Vehicle)

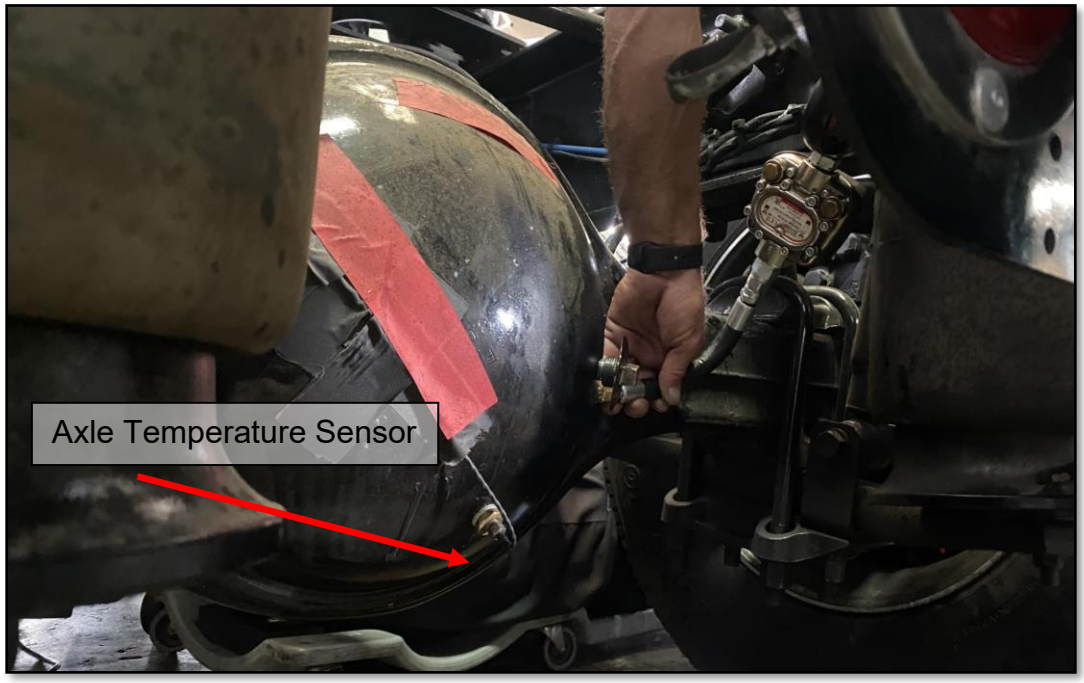


Figure 6: Draining Axle Wheel Hubs (Test Vehicle)

Figure 7: Filling Axle with Emgard® FE 75W-90 (Test Vehicle)

3.6: RUN 2: EMGARD® 7103 XFE 75W-85

Run 2 consisted of draining the Emgard® FE 75W-90 from the front and rear axles of the two (2) test vehicles and filling them with Emgard® 7103 XFE 75W-85 using the procedure outlined in Table 2. The Compare vehicle remained unchanged.

Figure 8: Emgard® 7103 XFE 75W-85 Container Drum

Figure 9: Draining Reference Oil from Drive Axles (Test Vehicle)

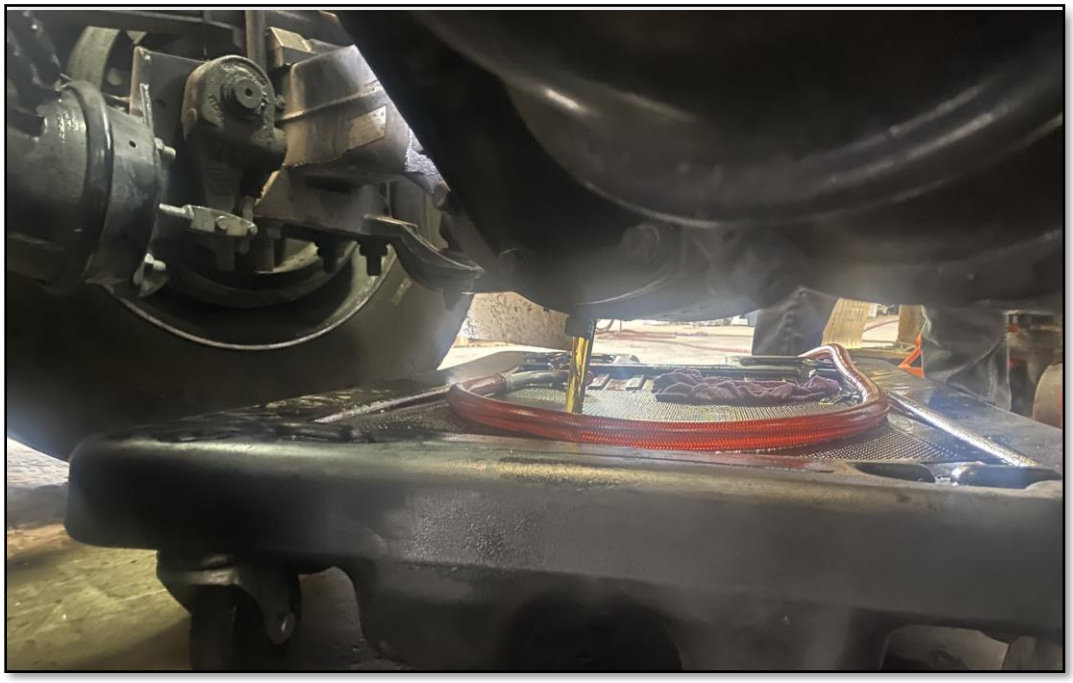


Figure 10: Draining Reference Oil from Axle Wheel Hubs (Test Vehicle)

Figure 11: Filling Drive Axles with Emgard® 7103 XFE 75W-85 (Test Vehicle)

4.0: VEHICLE FUEL ECONOMY TEST EQUIPMENT

MVTS' 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)
- Diesel fuel flow meter
- Axle lubricant temperature sensors
- 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)

Figure 12: Aerodynamic Sensors

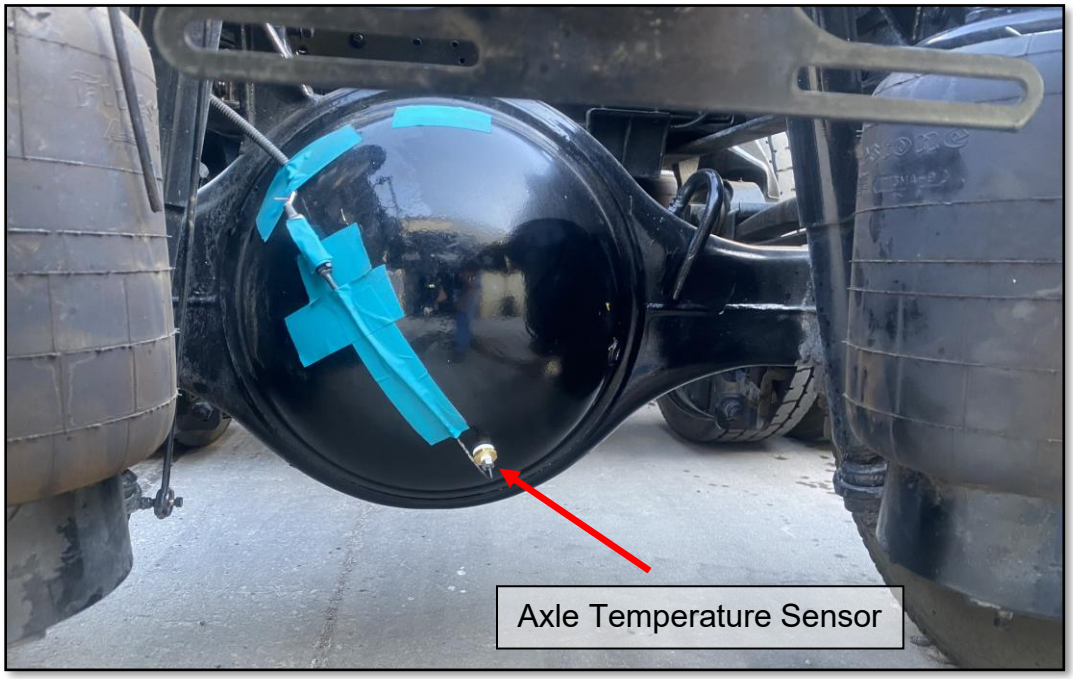
Figure 13: Data Acquisition System

Figure 14: Diesel Fuel Flow Meter

Figure 15: Ground Temp. Sensor

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

Figure 16: Drive Axle Temperature Sensor



5.0: TEST RESULTS

Test results were analyzed for fuel economy and axle temperature.

5.1: FUEL ECONOMY, FULL LAP (SCENARIO 3)

The Freightliner Cascadia with Meritor axles showed a fuel economy improvement of **0.67 gal/1000 miles (0.5%)** with **Emgard® 7103 XFE 75W-85** axle lubricant compared to the reference oil Emgard® FE 75W-90. The Peterbilt 579 with Meritor axles showed an improvement of **1.14 gal/1000 miles (0.9%)** with **Emgard® 7103 XFE 75W-85** compared to the reference oil**.** The results with accuracy are shown in Table 3. The results are shown graphically in Figure 17 through Figure 18.

Table 3: Test Results with Accuracy

	Freightliner Cascadia w/Meritor Axles					Peterbilt 579 w/Meritor Axles				
	Baseline	Test	BASF Emgard® E7103			Baseline	Test	BASF Emgard® E7103		
	MPG	MPG	MPG	Gal/1000 mi.	%	MPG	MPG	MPG	Gal/1000 mi.	%
Scenario 1 (36.6 miles, Steady State, Rolling Terrain)	8.68	8.70	**0.04**	**0.47**	**0.4%**	8.93	9.00	**0.09**	**1.13**	**1.0%**
Accuracy			+/- 0.04	+/- 0.43	+/- 0.4%			+/- 0.04	+/- 0.40	+/- 0.4%
Scenario 2 (38.7 miles, 1 Accel/Decel. & Rolling Terrain)	8.42	8.45	**0.03**	**0.47**	**0.4%**	8.69	8.77	**0.09**	**1.16**	**1.0%**
Accuracy			+/- 0.03	+/- 0.41	+/- 0.4%			+/- 0.04	+/- 0.44	+/- 0.4%
Scenario 3 (41.0 miles, Full Test Loop, 2 Accel/Decel.)	8.13	8.16	**0.04**	**0.67**	**0.5%**	8.35	8.42	**0.08**	**1.14**	**0.9%**
Accuracy			+/- 0.03	+/- 0.41	+/- 0.3%			+/- 0.03	+/- 0.46	+/- 0.4%

MVTS on-road testing combines results from multiple sections of the route (*i.e.,* lap), which are referred to as 'Splits'.

- Scenario 1 does not include the acceleration/deceleration Splits of the lap.
- Scenario 2 includes one (1) acceleration/deceleration.
- Scenario 3 includes two (2) accelerations/decelerations (*i.e.,* the full lap)

For the purpose of the BASF axle oil test, Scenario 3 (full lap) will be referenced. Scenarios 1 and 2 are included for completeness since that is standard on MVTS on-road tests. The reason for excluding Scenario 1 and 2 is partially due to the confusion caused by the Freightliner Detroit Diesel engine (DD15) fueling system. The DD15 has a fuel accumulator that acts as a reservoir and can skew results when analyzing short-term results, which can then in turn skew Scenario 1 and 2 test results (Table 3). This occurs mostly in periods of light and heavy load such as acceleration, deceleration and hills, which is why the results of Scenario 1 and 2 are lower than Scenario 3 for the Freightliner. This is explained further in the Fuel Economy by Terrain Type section. By comparison, the Peterbilt results are very consistent between Scenario 1, 2 and 3.

Figure 17: Scenario 3 Fuel Savings (gal/1000 miles)

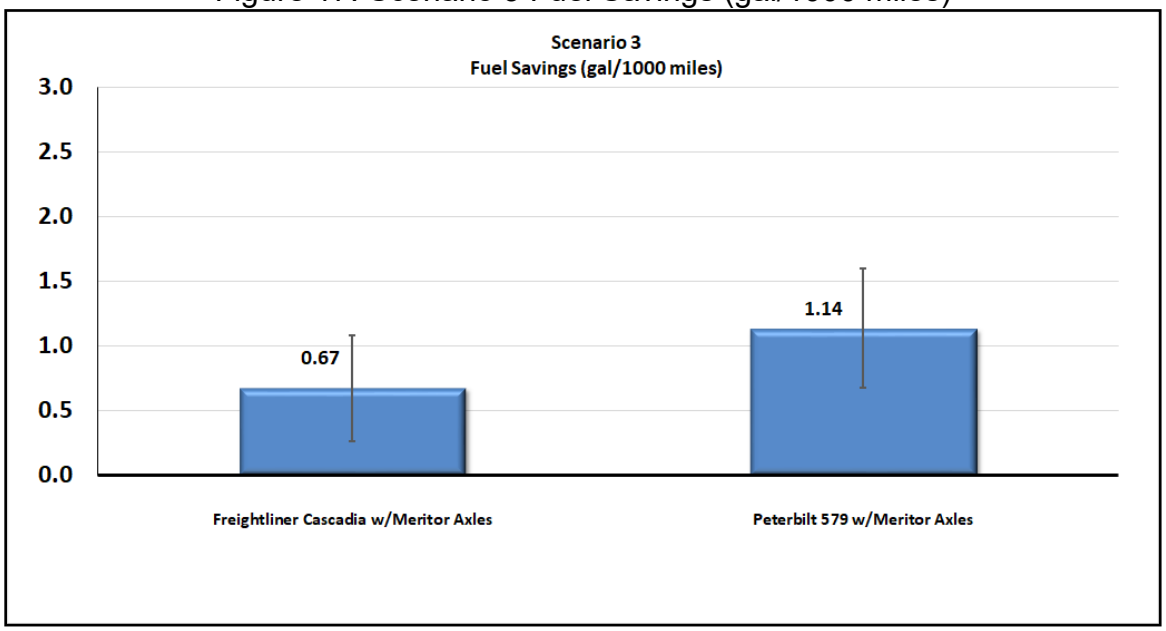
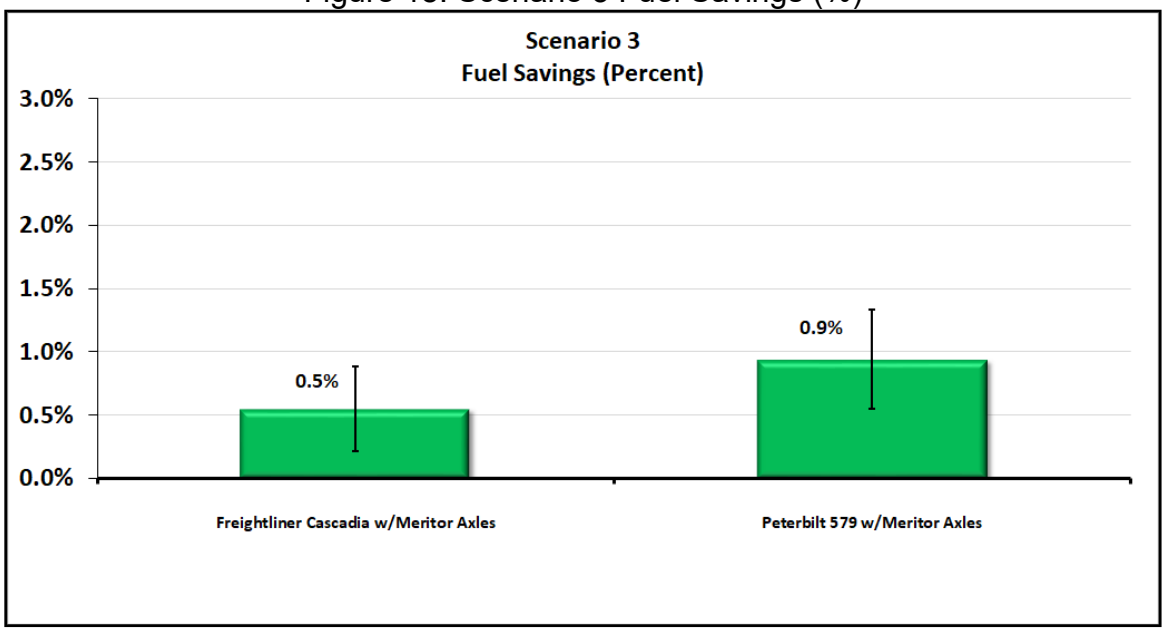


Figure 18: Scenario 3 Fuel Savings (%)



5.2: 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. This was critical for the lubricant tests reported here since the test values were relatively small.

Accuracy for all tests was calculated using a 95% confidence interval, a common standard for testing measurement. 95% confidence interval indicates that if the tests 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).

Accuracy (*i.e.,* 'margin of error') is shown in multiple locations: in Table 3 'Test Results with Accuracy' and as 'error bars' in the bar graphs in Figure 17 through Figure 18. The error bars are the small solid lines at the end of each bar.

Accuracy for the Freightliner Cascadia with Meritor axles test with Emgard® 7103 XFE 75W-85 was +/- 0.41 gal/1000 miles, which is exceptionally good for a full vehicle on-road test. Accuracy for the Peterbilt with the Meritor Axle Fuel with Emgard® 7103 XFE 75W-85 was +/- 0.46 gal/1000 miles, which is also particularly good accuracy. Accuracy in percent values will not be discussed individually since it is linearly related to gal/1000 miles and follows a similar pattern and conclusions. The reader may notice that test accuracy was within range of the magnitude of the test results. MVTS believes the results to be valid and accurate due to manual data analysis performed following testing and extensive experience with this testing.

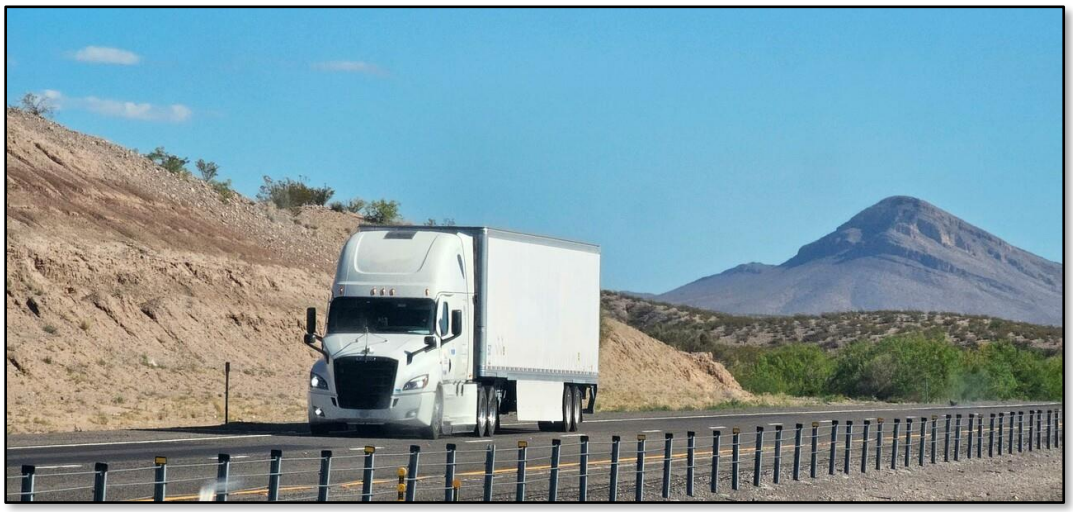
5.3: Fuel Economy by Terrain Type

In this section, fuel economy will be analyzed by individual terrain types including Acceleration, Uphill, Rolling Hills, Flat Road and Highway Exit. In the terrain sections, results will be shown as a percentage only since the miles per gallon or total fuel used does not transfer well to differences in grade or loading. In addition to analyzing fuel economy, the performance and characteristics of each tractor will also be analyzed. Table 4 shows the amount of fuel used on average for each terrain type encountered on the test route. The left column of values shows the percent of total fuel used per terrain type, which indicates the relative influence each terrain type had on the overall fuel economy and results. These values will be referred to throughout the terrain analysis sections.

Table 4: Fuel Economy by Terrain Type

Terrain Type	Percent of Total	Kenworth T680 w/ Meritor Axles		Freightliner Cascadia w/ Meritor Axles		Peterbilt 579 w/ Meritor Axles	
		mL	Gallon	mL	Gallon	mL	Gallon
Acceleration	12.8%	2410	0.64	2289	0.60	2418	0.64
Uphill	8.0%	1507	0.40	1457	0.38	1491	0.39
Rolling Hills	66.4%	12512	3.31	12625	3.34	12240	3.23
Flat	9.4%	1767	0.47	1876	0.50	1732	0.46
Deceleration	3.5%	657	0.17	778	0.21	607	0.16

Figure 19: 2025 Freightliner Cascadia on Test Route



5.3a: Terrain Results Reliability

MVTS does not typically include raw fuel numbers for terrain, however, this section has been added to explain the reliability issues for the vehicles and as a result may be confusing.

The reliability of the terrain results was affected by two (2) major factors: the small magnitude of change in fuel consumed relative to the total in each section and the complications of the Freightliner Detroit Diesel engine fuel accumulator, the latter of which applied only to the Freightliner (Figure 20). The Peterbilt terrain results were more reliable, since its Cummins powertrain does not include a fuel accumulator. The Freightliner still showed improvements, its values were simply less reliable when split into sections.

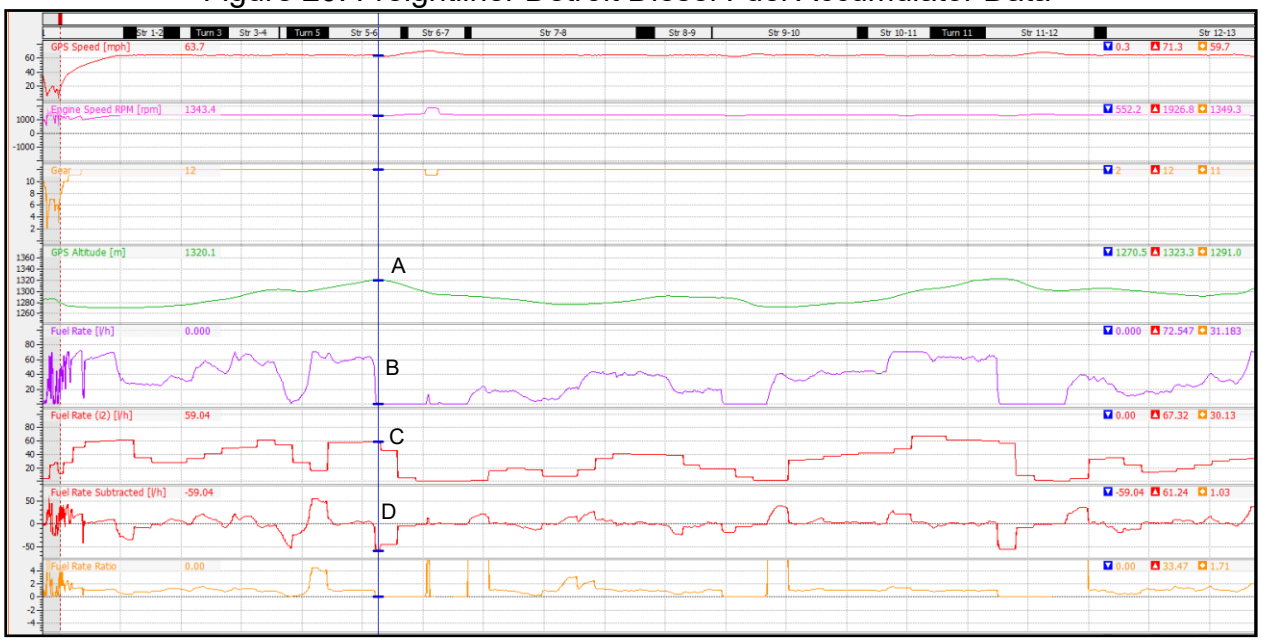
5.3b: Freightliner and Detroit Diesel Engine

Table 5 shows the differences in fuel consumption volume in milliliters, which are used to calculate the percentage change in fuel consumption for the respective terrain section. Figure 20 illustrates the behavior of the fuel accumulator. Point A is the vehicle altitude channel and shows the vehicle cresting the hill at the cursor. Point B is the Fuel Rate reported by the engine ECM by Detroit Diesel at that time, which is decreasing as expected as it crests the hill. Point C is the Fuel Rate measured in the flow meter, which is plumbed in series with the fuel lines and shows the high fuel rate continues as the vehicle crests the hill. This difference in fuel rate is the accumulator refilling. This variance in fuel flow rate is typical of the Detroit Diesel and must be considered in all specific terrain results that include the Freightliner. The behavior is not generally a factor on the full lap of the route since it balances out in the lap.

Table 5: Terrain Raw Fuel Used Differences

Terrain Type	Fuel Used Difference (mL)		% Fuel Used (+ = less fuel, i.e. improvement)	
	(Freightliner) - (Kenworth)	(Peterbilt) - (Kenworth)	Freightliner Cascadia w/Meritor Axles	Peterbilt 579 w/Meritor Axles
Acceleration	-14	8	0.6%	-0.3%
Uphill	-144	-33	9.5%	2.2%
Rolling Hills	42	-147	-0.3%	1.2%
Flat	36	22	-2.1%	-1.2%
Deceleration	-25	-27	3.7%	3.4%

Figure 20: Freightliner Detroit Diesel Fuel Accumulator Data



As an example, during Acceleration the Freightliner Test vehicle measured a reduction in fuel consumption of -14 mL. This was based on the difference between the Test and Compare vehicle during the Baseline and Test runs. The value of -14 was then divided by the Baseline fuel consumption of the Compare vehicle, which in this case was 2410 mL (as shown in Table 4 for the Kenworth in the Acceleration row). A change of 14 mL on a Class 8 vehicle is very small relative to the total fuel consumption (approximately one-half ounce) and therefore difficult to measure reliably. However, it can affect the consistency of the data and margin of error. MVTS does not typically report the margin of error for the terrain sections. Instead we manually analyze the data to determine its reliability. In the case of this test, the legitimacy varies and the Freightliner is specifically unreliable in the terrain analytics due to its fuel accumulator. Therefore, the terrain will be analyzed and explained individually. In the case of acceleration, MVTS expects the 0.6% improvement for the Freightliner during acceleration to be realistic, however, we do not suggest quoting the value.

The Uphill value of 9.5% is not valid; it is an effect of the Freightliner fuel accumulator. There was a decrease of -144 mL of fuel, which MVTS has found to be approximately 50% of the accumulator volume based on previous experience with this engine. During heavy load, the engine drains the fuel accumulator, which results in fuel used values appearing lower than they actually are.

During the Rolling Hills section, the fuel used value was 42 mL, indicating more fuel was used, which is not realistic, and the results showed -0.3% loss in fuel economy. The engine was likely adding fuel back to the accumulator since the engine load was low. MVTS has seen this behavior many times with Detroit Diesel engines, which are exclusive to Freightliner.

On the Flat terrain, the Fuel Used was 36 mL and showed a loss in fuel economy of -2.1%, which is again not realistic. It was a function of the accumulator replenishing during a low load condition.

5.3c: PETERBILT AND CUMMINS ENGINE

The Cummins engine does not include a fuel accumulator. Therefore, its fueling characteristics are much more consistent and reliable when analyzed finitely such as in the terrain sections.

During the Acceleration segment, a change in Fuel Used was 8 mL, which is very small in magnitude to the total Fuel Used. Although the test result showed a loss in fuel economy of -0.3%, MVTS believes this was within the margin of error due to the small magnitude of the change.

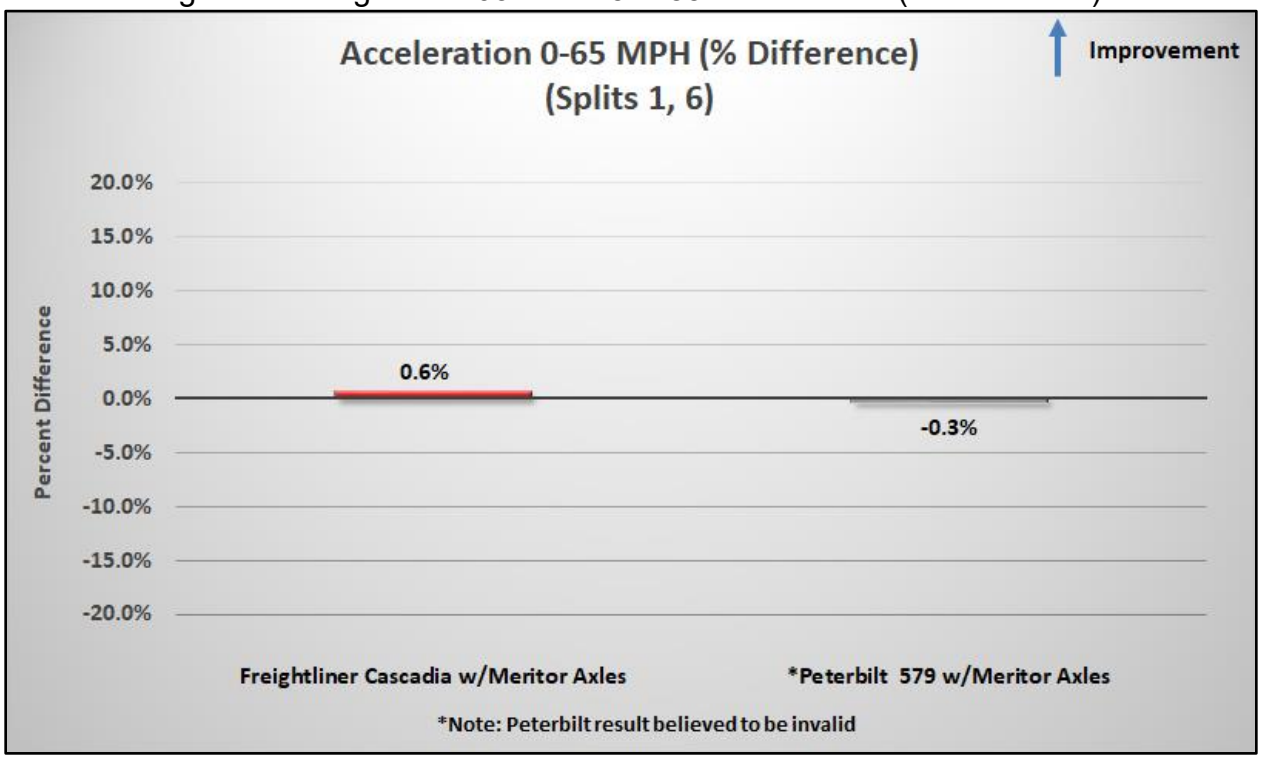
The Uphill result of 2.2% is realistic, as is the 1.2% on the Rolling Hills, which accounts for 66.4% of the fuel used in the lap and therefore has a major effect on the overall results.

The Deceleration test result of 3.4% is believed by MVTS to be a condition of possible driver influence, however, Deceleration comprises only 3.5% of the total fuel used in the lap and therefore has only a minor effect on overall results.

5.3d: TERRAIN TYPE: ACCELERATION

Acceleration occurred while entering the highway at both ends of the test lap, during Split 1 and Split 6. The trucks were stopped at the same location on the ramp where the right-side window was adjacent to a 'Buckle Up' sign. This ensured each Split had consistent distance and started from 0 MPH. During Split 1, after accelerating onto the highway, the terrain traveled slightly uphill. Acceleration represented 12.8% of the total fuel used per test lap and consisted of 5.9% of the total length of the Split at 3901 meters (2.4 miles).

Figure 21: Emgard® 7103 XFE 75W-85 Acceleration (% Difference)

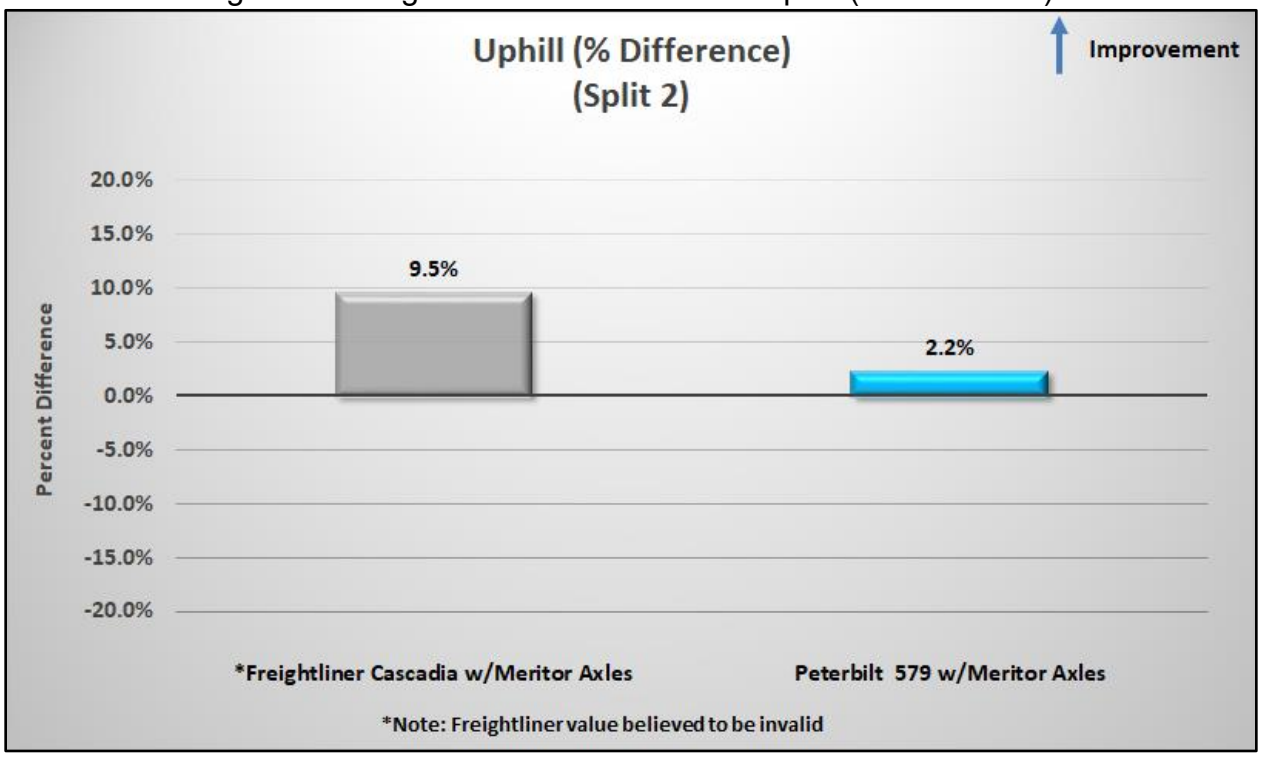


When using Emgard® 7103 XFE 75W-85, Freightliner Cascadia with Meritor Axles experienced an improvement of 0.6%, which is realistic. The Peterbilt 579 with Meritor axles measured a loss of 0.3% in the acceleration section of the test. MVTS believes it to be incorrect and a result of margin of error.

5.3e: TERRAIN TYPE: UPHILL

The Uphill section occurred on Split 2 and is considered a mild hill. This Split was 3,317 meters in length (2.1 miles) and climbed 48 meters (157 feet), which was an average grade of 1.45%. The Uphill Split created a 100% engine load condition with full throttle where both fuel consumption and performance were important. Uphill terrain represented 8.0% of the fuel used per test loop.

Figure 22: Emgard® 7103 XFE 75W-85 Uphill (% Difference)

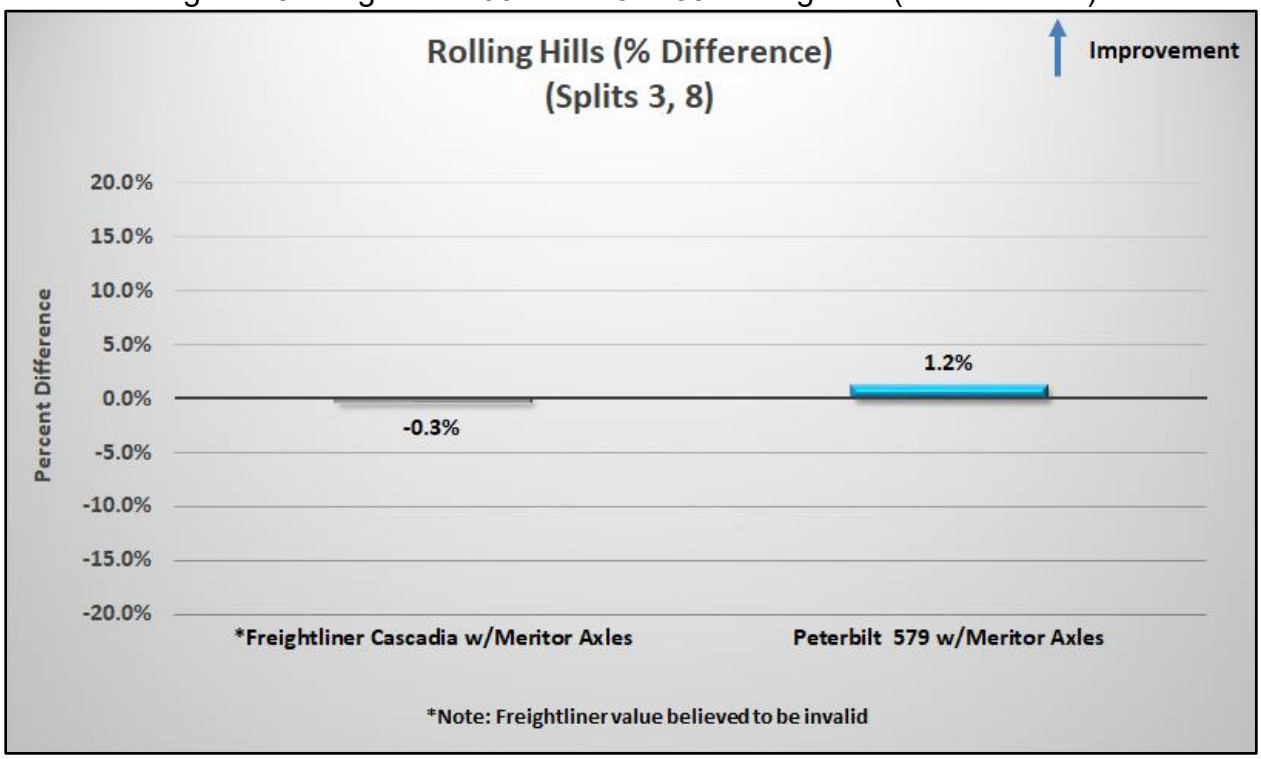


The Freightliner Cascadia with Meritor Axles showed an improvement of 9.5%, which as discussed above was mainly the result of the accumulator and is considered by MVTS to be invalid. The Peterbilt 579 with Meritor Axles showed an improvement of 2.2%, which MVTS believes to be realistic and valid.

5.3f: TERRAIN TYPE: ROLLING HILLS

The Rolling Hills section included mild to medium hills and consisted of Split 3 and Split 8, which were the same sections of highway driven in opposite directions. The altitude difference from minimum to maximum was approximately 100 meters (328 feet) and the combined total distance of this terrain section was 48,781 meters (30.5 miles). This section represented 66.4% of the fuel used per test loop, which was a considerable amount and therefore significantly affected the total results.

Figure 23: Emgard® 7103 XFE 75W-85 Rolling Hills (% Difference)

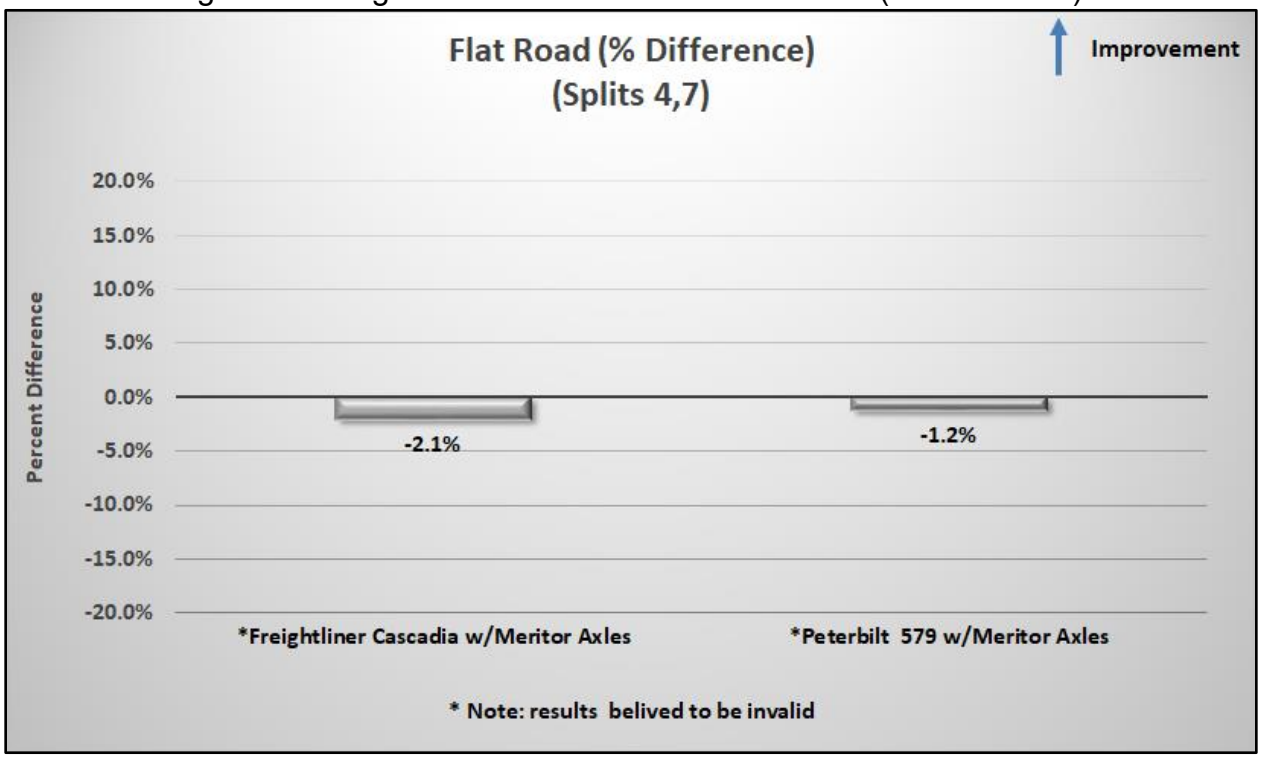


The Freightliner Cascadia with Meritor Axles showed a decrease of 0.3%, however, MVTS believes this was the result of the fuel accumulator replenishing and therefore finds the result to be invalid. The Peterbilt 579 with Meritor Axles showed an improvement of 1.2%, which MVTS believes to be valid.

5.3g: TERRAIN TYPE: FLAT ROADS

Flat Road fuel economy was measured on Splits 4 and 7 and totaled 6,778 meters in length (4.2 miles). Flat Road terrain represented 9.4% of the total fuel used during the test loop. The purpose of the Flat Road section is to isolate the data into areas of mainly aerodynamic and rolling resistance at low torque requirements and remove the influence from Cruise Control parameters.

Figure 24: Emgard® 7103 XFE 75W-85 Flat Road (% Difference)

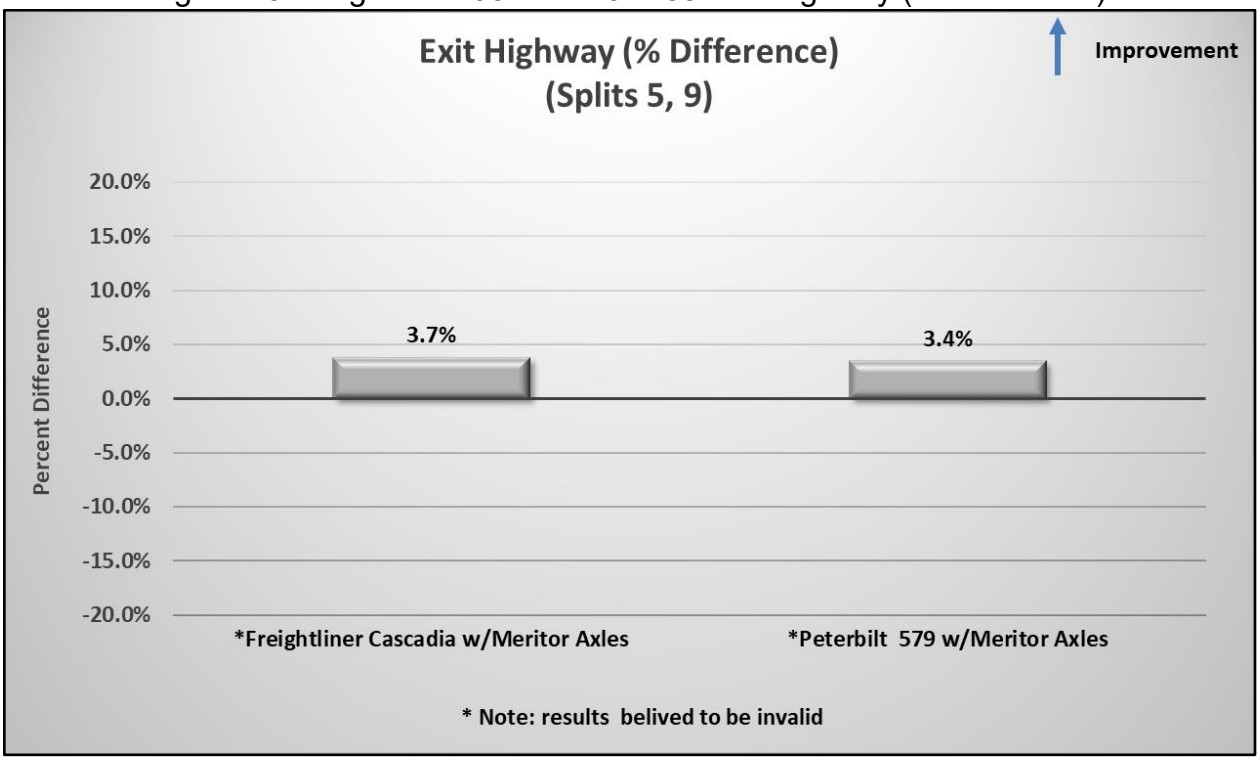


The Freightliner Cascadia with Meritor Axles had a decrease in fuel economy of 2.1%, which MVTS believes to be result of the accumulator and not valid. The Peterbilt 579 with Meritor Axles showed a loss in fuel economy of 1.2%, which MVTS does not believe to be correct since the vehicles have previously shown improvements in similar conditions.

5.3h: TERRAIN TYPE: HIGHWAY EXIT (DECELERATION)

Highway Exits (Deceleration) occurred while exiting the highway and traveling to the start of the next Acceleration point at both ends of the test loop, during Split 5 and Split 9. The combined Splits totaled 3,121 meters in length (1.9 miles). Highway Exits represented 3.5% of the fuel used during the test loop.

Figure 25: Emgard® 7103 XFE 75W-85 Exit Highway (% Difference)



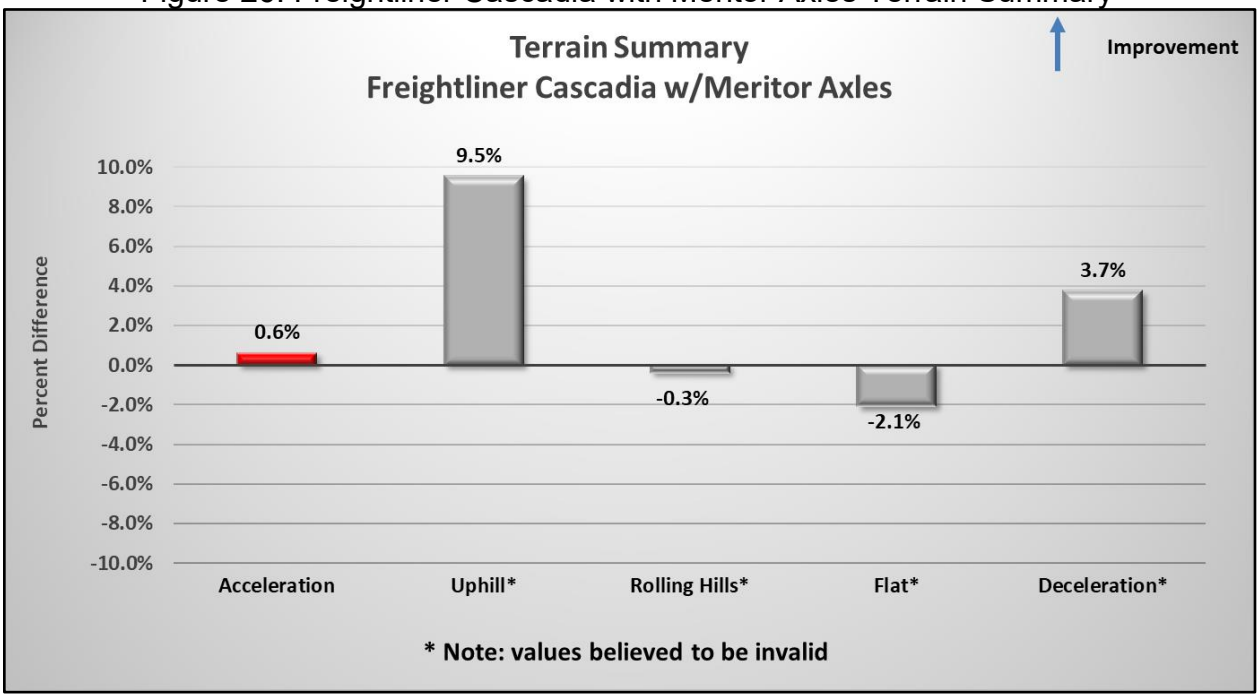
When exiting the highway, both tractors showed an improvement in fuel consumption, however, since this section represents only a small amount of the total fuel used, it has a very minor effect on the overall results and MVTS does not consider either result to be a significant indication of fuel savings.

5.3i: TERRAIN SUMMARY

This section summarizes the terrain results for the two (2) tractors with visuals to compare the tractors against one another as well as the percentages each individual section contributed to the overall total lap.

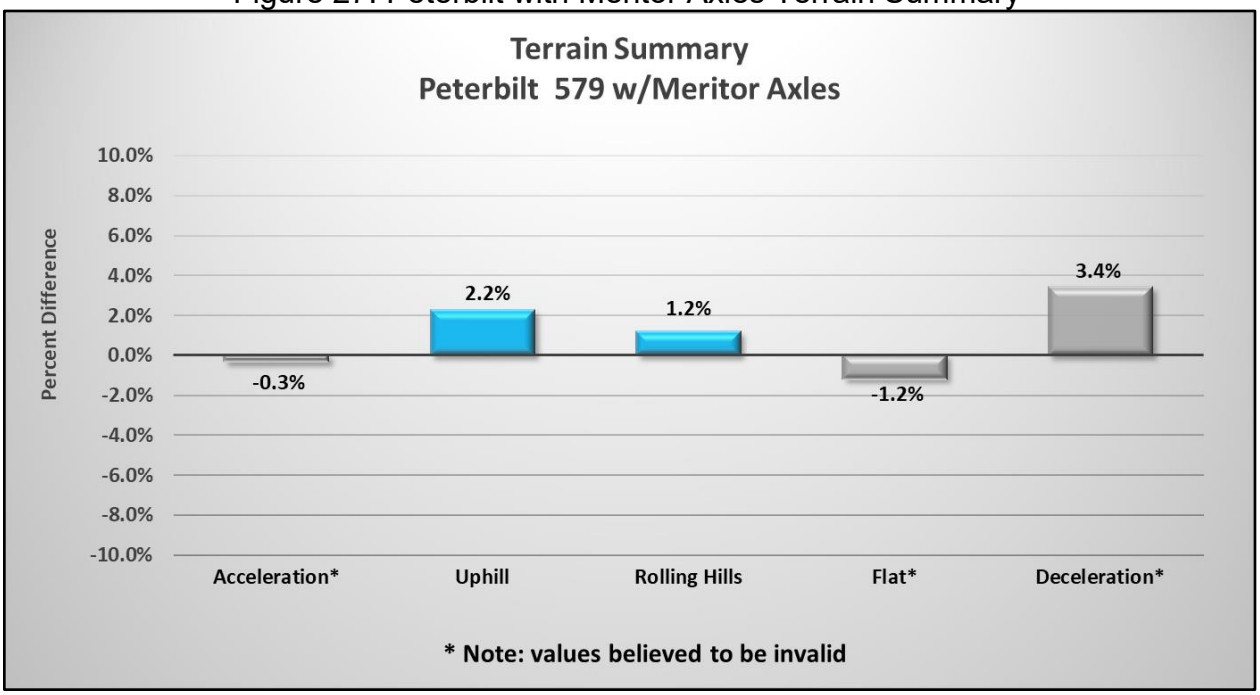
MVTS believes the Freightliner terrain results to be unreliable as a result of its accumulator, which was explained at the beginning of the terrain section and also in each section individually referencing Fuel Used (mL) and percent values. This does not suggest the total lap results are unreliable; it is when splitting the data by segment that the accumulator skews values. For example, the -0.3% loss in the Rolling Terrain was the result of refilling the accumulator, which was drained during the Uphill and showed a 9.5% savings.

Figure 26: Freightliner Cascadia with Meritor Axles Terrain Summary



The results for Peterbilt with Cummins X15 were more reliable in terms of overall magnitude, however, MVTS still does not recommend utilizing the individual terrain values. It showed savings in Uphill and Rolling Hills where the torque requirements and fuel used were greatest. The -0.3% measured in Acceleration may be due to margin of error. The Flat terrain result of -1.2% is surprising and MVTS is not confident in it since previous testing showed savings with Emgard® 7103 XFE 75W-85 on a flat test track.

Figure 27: Peterbilt with Meritor Axles Terrain Summary



5.4: AXLE TEMPERATURE RESULTS

The temperatures varied between runs as a result of the ambient conditions and torque through the axles. Torque can change during a test as a result of wind and temperature conditions. The formula is as follows:

$$Change\ in\ Axle\ Temp.(°C)\ = (T-C)Test\ Run - \ (T-C)Baseline$$

Where:

- T is the Test vehicle
- C is the Compare vehicle
- Baseline is the Emgard® FE 75W-90 reference oil run
- Test Run is the Emgard® 7103 XFE 75W-85 lubricant run

Axle oil temperatures improved (*i.e.,* decreased) with Emgard® 7103 XFE 75W-85 lubricant installed as shown throughout Figure 28, Figure 29 and Figure 30).

The change in temperature values was calculated as shown below. The lubricants were changed in the differential housings and hubs. Changes in axle temperatures are listed below in Table 6.

$$Change\ in\ Axle\ Temp.\ (\%) = \frac{(T-C)Test\ Run - \ (T-C)Baseline}{(T)Baseline}$$

Where:

- Formula identifications are the same as those listed for the previous formula.

Table 6: Axle Temperature Results Summary

Axle Lubricant	Δ Cascadia Front Axle		Δ Cascadia Rear Axle		Δ Peterbilt Front Axle		Δ Peterbilt Rear Axle	
	°C	°F	°C	°F	°C	°F	°C	°F
Emgard® XFE 7103 75W-85 (E7103)	-2.6	-4.7	-4.8	-8.6	-1.4	-2.6	-2.7	-4.8

Figure 28: Drive Axle Average Temperatures (°C)

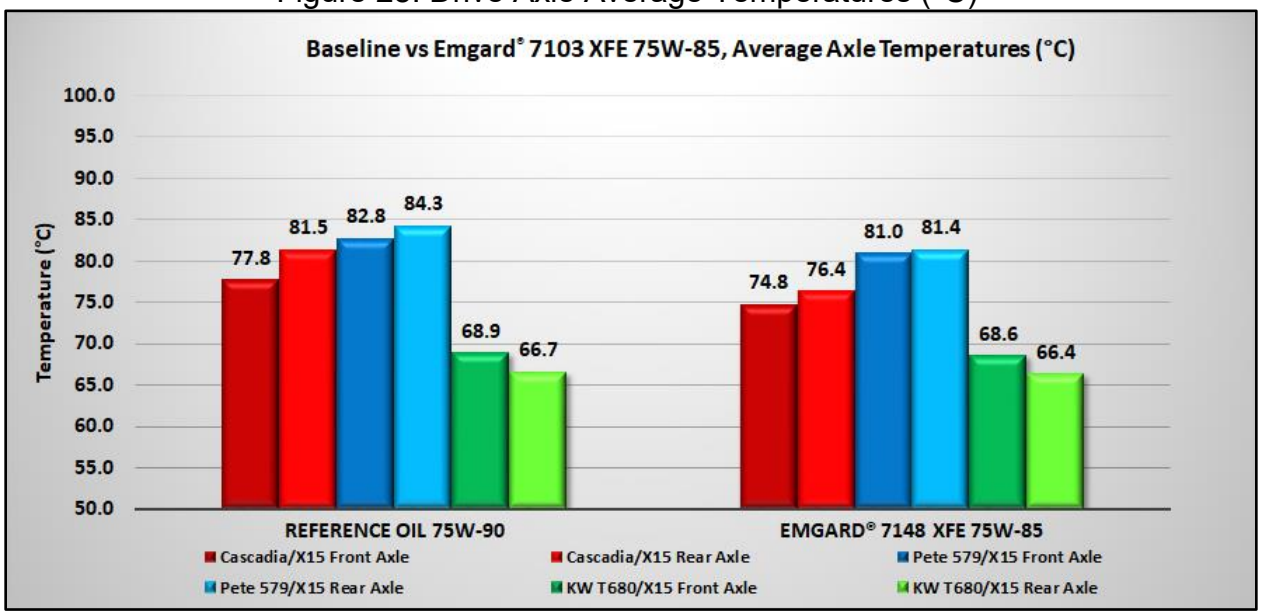


Figure 29: Change in Freightliner Cascadia Front and Rear Axle Temperature (°C)

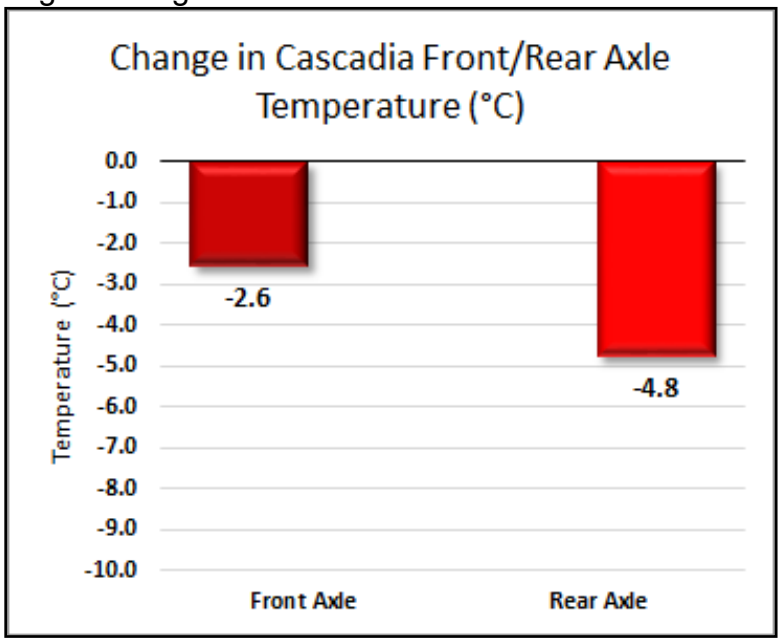


Figure 30: Change in Freightliner Cascadia Front and Rear Axle Temperature (%)

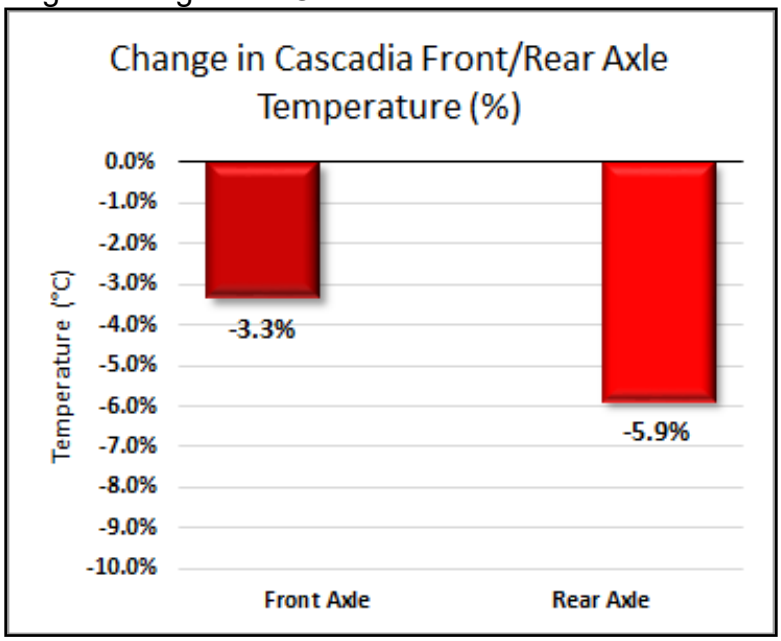


Figure 31: Change in Peterbilt Front and Rear Axle Temperature (°C)

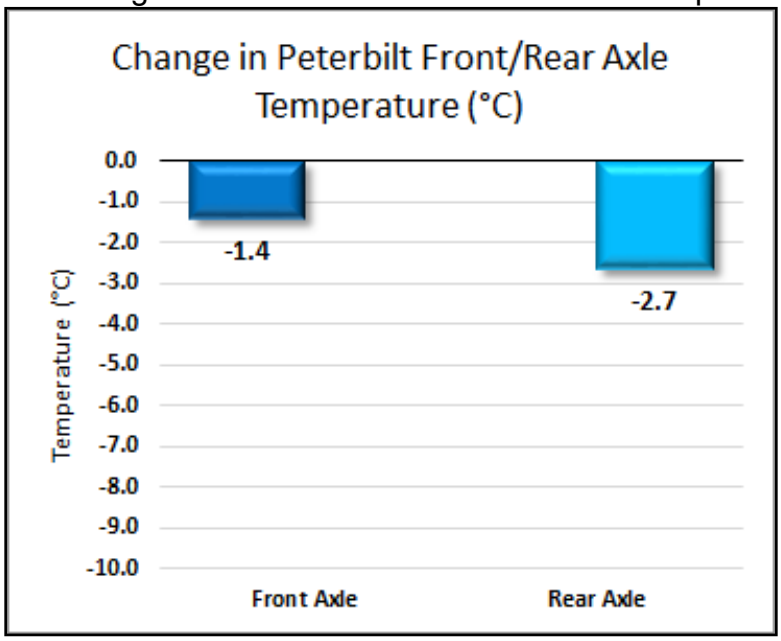
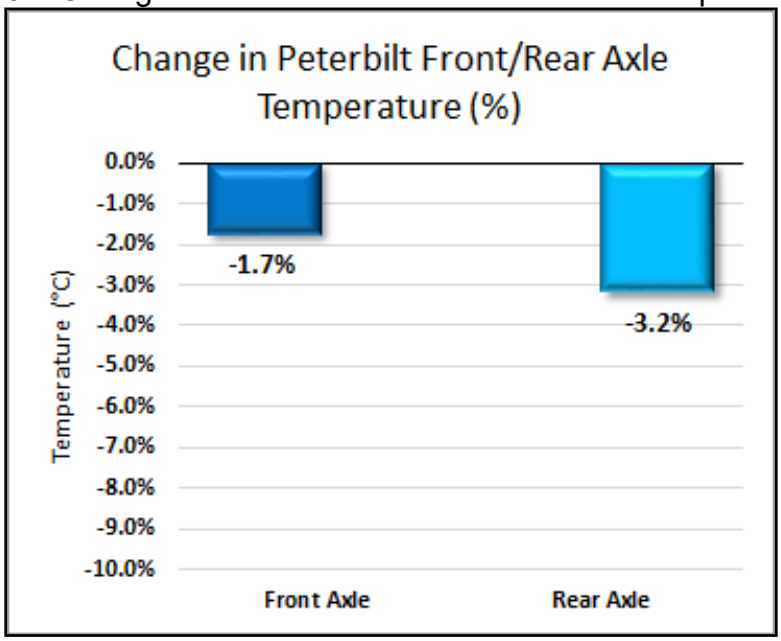


Figure 32: Change in Peterbilt Front and Rear Axle Temperature (%)



5.5: 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.

Note: the following paragraphs were created mainly for aerodynamic and tire fuel economy tests and may vary for axle lubricant fuel savings. While gal/1000 miles are the preferred units for aerodynamics and tire rolling resistance, MVTS testing has identified a pattern showing these units are also consistent for axle lubricants.

In the case of aerodynamics or tire rolling resistance, units of gal/1000 miles are more reliable for calculating fuel savings when compared to other units such as miles per gallon (MPG) or percentage (%). Those units are prone to error from changing variables such as vehicle baseline fuel economy, load, driver behavior and duty cycle. For example, a vehicle achieving 9 MPG with a highly aerodynamic configuration will save the same amount of fuel in terms of gal/1000 miles as a vehicle achieving 6 MPG. However, the percentage fuel savings will be different since that is based on the baseline fuel economy and the 6 MPG vehicle will use more fuel, which will make the percentage savings value lower.

Units of gal/1000 miles are also more reliable for a fleet's real-world savings since this unit is not affected by vehicle speed. The fuel savings from tires are nearly the same at 20 MPH as they are at 65 MPH (*i.e.,* savings are nearly linear with speed). Therefore, it is important to use units of gal/1000 miles. To convert from MPG to gal/1000 miles, simply use 1000 divided by MPG (ex. 1000 / 7.15 MPG = 139.9 gal/1000 miles).

5.6: WEATHER CONDITIONS SUMMARY

Ambient temperature during this testing ranged from 69°F to 91°F with winds indicating 0 to 12 MPH.

Weather data was acquired from a local Weather Underground weather station and complete data can be found in the Weather Conditions section of this report.

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 (in normal conditions).

5.7: SAVINGS CALCULATIONS

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

5.8: FUEL SAVINGS CALCULATIONS

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

$$Fuel\ Savings\ (gal/year) = (Test\ result)\ x\ \frac{(Thousands\ of\ miles\ traveled\ per\ year)}{1000}$$

Test result must be in units of gal/1000 miles (*i.e.,* not percent or MPG)

5.8a: FREIGHTLINER CASCADIA WITH MERITOR AXLES SAVING CALCULATIONS

$$Fuel\ Savings = (0.67\ gal/1000\ miles)x\ \frac{(125{,}000\ miles/year)}{1000} = 84\ gal/year$$

Therefore, the Emgard® 7103 XFE 75W-85 in Cascadia would save 84 gallons of fuel per year for this vehicle traveling 125,000 miles.

5.8b: PETERBILT 579 WITH MERITOR AXLES SAVING CALCULATIONS

$$Fuel\ Savings = (1.14\ gal/1000\ miles)x\ \frac{(125{,}000\ miles/year)}{1000} = 142\ gal/year$$

Therefore, the Emgard® 7103 XFE 75W-85 in Peterbilt would save 142 gallons of fuel per year for this vehicle traveling 125,000 miles.

5.9: FINANCIAL SAVINGS CALCULATIONS

Financial calculations can be made by multiplying the fuel saved by the fuel price:

$$Savings\ (\$/year) = (Fuel\ Savings)\ x\ (Price\ of\ fuel)$$

Example: using the example above and U.S. average retail price of diesel fuel in 2023, which was $4.214[1] / gallon. **Note**: MVTS uses average retail fuel prices from the year prior to the test being conducted. Fleets can use the formula below with an alternate fuel price if preferred.

5.9a: FREIGHTLINER CASCADIA WITH MERITOR AXLES FINANCIAL SAVING CALCULATIONS

$$Savings\ (\$/year) = \left(84\ \frac{gal}{year}\right)\ x\ \left(\frac{\$4.214}{gal}\right) = \$354\ /year$$ in fuel savings

Therefore, the Emgard® 7103 XFE 75W-85 would save $354 per year for a vehicle traveling 125,000 miles.

5.9b: PETERBILT 579 WITH MERITOR AXLES FINANCIAL SAVING CALCULATIONS

$$Savings\ (\$/year) = \left(142\ \frac{gal}{year}\right)\ x\ \left(\frac{\$4.214}{gal}\right) = \$598\ /year$$ in fuel savings

Meaning the Emgard® 7103 XFE 75W-85 would save $598 per year for a vehicle traveling 125,000 miles.

[1] https://afdc.energy.gov/fuels/prices.html

5.10: TECHNOLOGY PAYBACK AND RETURN-ON-INVESTMENT

Buyers of fuel economy technologies are highly interested in saving money. For a technology supplier to be successful, their technology must save their potential customers money. Many fleets consider the number of months required for the technology to pay for itself as a buying qualification, which is referred to as 'payback' in trucking or sometimes 'return on investment' (ROI).

$$Payback\ (aka\ ROI)\ (months) = \frac{(Product\ cost)}{(Savings\ (\$/year)}\ x\ (12\ months/year)$$

Where the 'Product cost' in the case of axle lubricants is the difference between the two brands. MVTS advises fleets to ensure they are comparing prices based on fleet size and not retail or a mixture of both.

5.10a: FREIGHTLINER CASCADIA WITH MERITOR AXLES TECHNOLOGY PAYBACK AND ROI

$$Payback\ (months) = \frac{(\$50)}{(\$354\ /year)}\ x\ \left(12\frac{months}{year}\right) = 1.7\ months$$

Therefore, with a difference of $50 per vehicle, Emgard® 7103 XFE 75W-85 axle lubricant would pay for itself (*i.e.,* payback or ROI) in 1.7 months. **Note:** the price of $50 is fictitious and MVTS is unaware what price difference, if any, would exist compared to other axle lubricants. Fleets are advised to investigate their own pricing and use the formulas above with their own values.

5.10b: PETERBILT 579 WITH MERITOR AXLES TECHNOLOGY PAYBACK AND ROI

$$Payback\ (months) = \frac{(\$50)}{(\$598\ /year)}\ x\ \left(12\frac{months}{year}\right) = 1\ month$$

Therefore, with a difference of $50 per vehicle, BASF Emgard® 7103 XFE 75W-85 axle lubricant would pay for itself (*i.e.,* payback or ROI) in 1 month. This is extremely fast in comparison to other technologies. **Note:** the price of $50 is fictitious and MVTS is unaware what price difference, if any, would exist compared to other axle lubricants. Fleets are advised to investigate their own pricing and use the formulas above with their own values.

5.11: TECHNOLOGY PROFIT

Since saving money is the end goal, calculating profit is another principal factor.

$$Profit\ (\$) = (Savings) - (Cost)$$

Example @ $50 'Product cost': using annual values from above.

5.11a: FREIGHTLINER CASCADIA WITH MERITOR AXLES TECHNOLOGY PROFIT

$$Profit\ (\$) = (\$354) - (\frac{\$50}{5\ years})$$ = $344 saved annually in profits per tractor.

For a 5-year truck life, this would equate to $1,720 per truck. For a 1,000 truck fleet this would equate to $1,720,000 in profit.

5.11b: PETERBILT 579 WITH MERITOR AXLES TECHNOLOGY PROFIT

$$Profit\ (\$) = (\$598) - (\frac{\$50}{5\ years})$$ = $588 saved annually in profits per tractor.

For a 5-year truck life, this would equate to $2,940 per truck. For a 1,000 truck fleet this would equate to $2,940,000 in profit.

5.12: CO_2 Reduction Calculations

Carbon dioxide (CO_2) is directly related to diesel fuel consumption in the amount of **10,180**[2] grams CO_2 per gallon of diesel consumed (0.01018 metric tons CO_2 per gallon of diesel). Therefore, the same value applies to the amount of fuel saved and correlates to a reduction in CO_2.

$$CO_2\ Reduction\ (metric\ tons) = (Fuel\ Savings)\ x\ (0.01018\ metric\ tons)$$

Where:

- Fuel savings must be measured in gallons.
- 0.01018 metric tons is the amount of CO_2 resulting from one gallon of diesel fuel.

5.12a: Freightliner Cascadia with Meritor Axles CO_2 Reduction Calculations

Example: using the values from the example financial calculations above and a fuel savings of 84 gallons per year.

$$CO_2\ Reduction\ (metric\ tons) = (84)x(0.01018) = 0.86 \text{ metric tons } CO_2$$

Therefore, the Emgard® 7103 XFE 75W-85 in the Freightliner Cascadia DD15 would save 0.86 metric tons of CO_2 per year for this vehicle traveling 125,000 miles.

5.12b: Peterbilt 579 with Meritor Axles CO_2 Reduction Calculations

Example: using the values from the example financial calculations above and a fuel savings of 142 gallons per year.

$$CO_2\ Reduction\ (metric\ tons) = (142)x(0.01018) = 1.45 \text{ metric tons } CO_2$$

Therefore, the Emgard® 7103 XFE 75W-85 on the Peterbilt 579/X15 would save 1.45 metric tons of CO_2 per year for this vehicle traveling 125,000 miles.

Source:
https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

6.0: CONCLUSION

Emgard® 7103 XFE 75W-85 lubricant improved fuel economy for the Freightliner Cascadia DD15 with Meritor axles by 0.67 gal/1000 miles (0.5%) when compared to the reference oil (Emgard® FE 75W-90). It likewise improved fuel economy for the Peterbilt 579 X15 with Meritor axles by 1.14 gal/ 1000 miles (0.9%).

On the Freightliner Cascadia with Meritor axles, the front axle temperature decreased from 77.8℃ (using Emgard® FE 75W-90) to 74.8℃ (using Emgard® 7103 XFE 75W-85), while the rear axle temperature decreased from 81.5℃ (using Emgard® FE 75W-90) to 76.4℃ (using Emgard® 7103 XFE 75W-85).

On the Peterbilt 579 with Meritor axles, the front axle temperature decreased from 82.8℃ (using Emgard® FE 75W-90) to 81.0℃ (using Emgard® 7103 XFE 75W-85), while the rear axle temperature decreased from 84.3℃ (using Emgard® FE 75W-90) to 81.4℃ (using Emgard® 7103 XFE 75W-85).

Segmenting the data into terrain sections had varied results, mainly due to the magnitude of fuel used versus the change in fuel economy and to a lesser extent due to the Freightliner fuel accumulator. Overall, the Peterbilt truck with the Cummins engine showed reliable results for most terrain sections, however the Freightliner results should be considered invalid.

These results were used to calculate the savings of the Emgard® 7103 XFE 75W-85 lubricant on the Freightliner Cascadia with Meritor axles and on the Peterbilt 579 with Meritor axles. Calculations showed that in 125,000 miles, the Freightliner Cascadia with Meritor axles would save 84 gallons with 65,000-lbs. GVW vehicle. Similarly, the Peterbilt 579 with Meritor axles would save 142 gallons with 65,000-lbs. GVW vehicle. Using the 2023 average retail cost of diesel fuel of $4.214/gal, the Freightliner Cascadia with Meritor axles saved $344 per year while the Peterbilt 579 with Meritor axles saved $588 per year as a result of using Emgard® 7103 XFE 75W-85 axle lubricant.

Using an example cost difference, the ROI (or payback) for the Freightliner Cascadia with Meritor axles was 1.7 months while the Peterbilt 579 with Meritor axles had a 1-month ROI. Using an assumption that both trucks have a 5-year lifespan, the Freightliner Cascadia with Meritor axles will have a $1,720 profit per truck. This means that a 1,000 truck fleet of Freightliner Cascadias with Meritor axles will see $1,720,000 in profit. Similarly, the Peterbilt 579 with Meritor axles would have a $2,940 profit per truck, meaning a 1,000 truck fleet of Peterbilt 579s with Meritor axles will see $2,940,000 in profit. When looking at the CO_2 reduction the Freightliner Cascadia with Meritor axles would save 0.86 metric tons per year, while the Peterbilt 579 with Meritor axles would save 1.45 metric tons per year.

Overall, the Emgard® 7103 XFE 75W-85 improved fuel economy and axle oil temperature when compared to the reference oil Emgard® FE 75W-90.

7.0: APPENDIX

7.1: TEST VEHICLE DETAILS

Figure 33: Truck Info, Freightliner Cascadia (Test Vehicle A)

Test Date	Monday May 13, 2024		
Vehicle Provider			
Test Location	Las Cruces, NM		
Test Venue/Route	I-25 NM, Exit 51-71-51		
TRUCK ID:	**Veh. A**		
Brand	Freightliner		
Date of Manufacture (MY)	2025		
Model	Cascadia (Sleeper Cab)		
Engine	DD15 Gen 5 (425 HP)		
VIN	3AKJHHDR5SSVM2178		
Mileage (miles):	957		
Transmission	DT12-1750-DHE Efficient On-Highway 12 Speed		
Front Drive Axle	Meritor MT-40-14X 40,000# R-SRS		
Rear Drive Axle	Meritor MT-40-14X 40,000# R-SRS		
Rear Gear	2.47:1		
Wheelbase (inches)	227		
Fifth Wheel Location	10.25 / 2.25		
Fuel Load	Full		
Fuel Type & Batch	No. 2 diesel		
Axle Weights (S,D,T) (lbs)	11,440	26,700	27,380
Total weight	65,520		
TRAILER ID:	**Trailer B**		
Brand	Hyundai		
VIN	3H3V532K0SS026278		
Date of Manufacture (MY)	2025		
Type	dry van		
Size	53-foot		
King Pin Location	36 inches		
Tandem Setting	40-feet California spec		
Cab to Trailer Gap (inches)	51.6 inches		
Aero Trailer Gap (inches)	23.9 inches		
Add-ons	Trailer skirts		

Figure 34: Tire Info, Freightliner Cascadia (Test Vehicle A)

Truck Veh. A

LF		Front Axle		RF
Michelin X Line Energy Z+		Type		Michelin X Line Energy Z+
295/75R22.5		Size		295/75R22.5
18		Tread Depth (32nds)		18
100		Pressure (psi)		100
Aluminum		Wheel Type		Aluminum

LF-Outer Drive	LF-Inner Drive	Drive Axle	RF-Inner Drive	RF-Outer Drive
Michelin XDA Energy +	Michelin XDA Energy +	Type	Michelin XDA Energy +	Michelin XDA Energy +
275/80R22.5	275/80R22.5	Size	275/80R22.5	275/80R22.5
17	18	Tread Depth (32nds)	17	18
100	100	Pressure (psi)	100	100
Aluminum	Aluminum	Wheel Type	Aluminum	Aluminum

LR-Outer Drive	LR-Inner Drive	Drive Axle	RR-Inner Drive	RR-Outer Drive
Michelin XDA Energy +	Michelin XDA Energy +	Type	Michelin XDA Energy +	Michelin XDA Energy +
275/80R22.5	275/80R22.5	Size	275/80R22.5	275/80R22.5
17	19	Tread Depth (32nds)	17	18
100	100	Pressure (psi)	100	100
Aluminum	Aluminum	Wheel Type	Aluminum	Aluminum

Trailer Trailer B

LF-Outer Trailer	LF-Inner Trailer	Tandem Front	RF-Inner Trailer	RF-Outer Trailer
Bridgestone R123 Ecopia	Bridgestone R123 Ecopia	Type	Bridgestone R123 Ecopia	Bridgestone R123 Ecopia
295/75R22.5	295/75R22.5	Size	295/75R22.5	295/75R22.5
11	11	Tread Depth (32nds)	11	11
100	100	Pressure (psi)	100	100
Steel	Steel	Wheel Type	Steel	Steel

LR-Outer Trailer	LR-Inner Trailer	Tandem Rear	RR-Inner Trailer	RR-Outer Trailer
Bridgestone R123 Ecopia	Bridgestone R123 Ecopia	Type	Bridgestone R123 Ecopia	Bridgestone R123 Ecopia
295/75R22.5	295/75R22.5	Size	295/75R22.5	295/75R22.5
11	11	Tread Depth (32nds)	11	11
100	100	Pressure (psi)	100	100
Steel	Steel	Wheel Type	Steel	Steel

Figure 35: Vehicle Info, Peterbilt (Test Vehicle C)

Test Date	Monday May 13, 2024		
Vehicle Provider			
Test Location	Las Cruces, NM		
Test Route	I-25 NM, Exit 51-71-51		
TRUCK ID:	**Veh. C**		
Brand	Peterbilt		
Date of Manufacture (MY)	2025		
Model	579 EPIQ (Sleeper Cab)		
Engine	X15 400EX (400 HP)		
VIN	1XPBD49X2SD716705		
Mileage (miles):	663		
Transmission	Eaton Endurant EEO-17F112C		
Front Drive Axle	Meritor MT40-14X		
Rear Drive Axle	Meritor MT40-14X		
Rear Gear	2.79:1		
Wheelbase (inches)	234		
Fifth Wheel Location	8.25 / 4.25		
Fuel Load	Full		
Fuel Type & Batch	No. 2 diesel		
Axle Weights (S,D,T) (lbs)	11,440	26,740	27,080
Total weight	65,260		
TRAILER ID:	**Trailer A**		
Brand	Hyundai		
VIN	3H3V532K7SS026102		
Date of Manufacture (MY)	2025		
Type	dry van		
Size	53-foot		
King Pin Location	36 inches		
Tandem Setting	40-feet California spec		
Cab to Trailer Gap (inches)	53.1 inches		
Aero Trailer Gap (inches)	27.5 inches		
Add-ons	Trailer skirts		

Figure 36: Tire Info, Peterbilt (Test Vehicle C)

Truck Veh. C

LF		Front Axle		RF
Bridgestone R213 Ecopia		Type		Bridgestone R213 Ecopia
295/75R22.5		Size		295/75R22.5
17		Tread Depth (32nds)		17
100		Pressure (psi)		100
Aluminum		Wheel Type		Aluminum

LF-Outer Drive	LF-Inner Drive	Drive Axle	RF-Inner Drive	RF-Outer Drive
Michelin XDA Energy +	Michelin XDA Energy +	Type	Michelin XDA Energy +	Michelin XDA Energy +
275/80R22.5	275/80R22.5	Size	275/80R22.5	275/80R22.5
12	12	Tread Depth (32nds)	13	13
100	100	Pressure (psi)	100	100
Aluminum	Aluminum	Wheel Type	Aluminum	Aluminum

LR-Outer Drive	LR-Inner Drive	Drive Axle	RR-Inner Drive	RR-Outer Drive
Michelin XDA Energy +	Michelin XDA Energy +	Type	Michelin XDA Energy +	Michelin XDA Energy +
275/80R22.5	275/80R22.5	Size	275/80R22.5	275/80R22.5
11	14	Tread Depth (32nds)	12	11
100	100	Pressure (psi)	100	100
Aluminum	Aluminum	Wheel Type	Aluminum	Aluminum

Trailer Trailer A

LF-Outer Trailer	LF-Inner Trailer	Tandem Front	RF-Inner Trailer	RF-Outer Trailer
Bridgestone R123 Ecopia	Bridgestone R123 Ecopia	Type	Bridgestone R123 Ecopia	Bridgestone R123 Ecopia
295/75R22.5	295/75R22.5	Size	295/75R22.5	295/75R22.5
11	11	Tread Depth (32nds)	11	11
100	100	Pressure (psi)	100	100
Steel	Steel	Wheel Type	Steel	Steel

LR-Outer Trailer	LR-Inner Trailer	Tandem Rear	RR-Inner Trailer	RR-Outer Trailer
Bridgestone R123 Ecopia	Bridgestone R123 Ecopia	Type	Bridgestone R123 Ecopia	Bridgestone R123 Ecopia
295/75R22.5	295/75R22.5	Size	295/75R22.5	295/75R22.5
11	11	Tread Depth (32nds)	11	11
100	100	Pressure (psi)	100	100
Steel	Steel	Wheel Type	Steel	Steel

7.2: COMPARE VEHICLE DETAILS

Figure 37: Vehicle Info, Kenworth (Compare Vehicle B)

Test Date	Monday May 13, 2024		
Vehicle Provider			
Test Location	Las Cruces, NM		
Test Route	I-25 NM, Exit 51-71-51		
TRUCK ID:	**Veh. B**		
Brand	Kenworth		
Date of Manufacture (MY)	2025		
Model	T680 (Sleeper Cab)		
Engine	X15 400EX (400 HP)		
VIN	1XKYD49X1SJ138775		
Mileage (miles):	1,525		
Transmission	Eaton Endurant EEO-17F112C		
Front Drive Axle	Meritor MT40-14X		
Rear Drive Axle	Meritor MT40-14X		
Rear Gear	2.64:1		
Wheelbase (inches)	228		
Fifth Wheel Location	8.25 / 4.25		
Fuel Load	Full		
Fuel Type & Batch	No. 2 diesel		
Axle Weights (S,D,T) (lbs)	11,560	26,220	27,300
Total weight	65,080		
TRAILER ID:	**Trailer C**		
Brand	Hyundai		
VIN	3H3V532K3SS026551		
Date of Manufacture (MY)	2025		
Type	dry van		
Size	53-foot		
King Pin Location	36 inches		
Tandem Setting	40-feet California spec		
Cab to Trailer Gap (inches)	55.8 inches		
Aero Trailer Gap (inches)	29.6 inches		
Add-ons	Trailer skirts		

Figure 38:Tire Info, Kenworth (Compare Vehicle B)

Truck **Veh. B**

LF
Michelin X Line Energy Z+
295/75R22.5
18
100
Aluminum

Front Axle
Type
Size
Tread Depth (32nds)
Pressure (psi)
Wheel Type

RF
Michelin X Line Energy Z+
295/75R22.5
18
100
Aluminum

LF-Outer Drive	LF-Inner Drive
Michelin XDA Energy +	Michelin XDA Energy +
275/80R22.5	275/80R22.5
12	14
100	100
Aluminum	Aluminum

Drive Axle
Type
Size
Tread Depth (32nds)
Pressure (psi)
Wheel Type

RF-Inner Drive	RF-Outer Drive
Michelin XDA Energy +	Michelin XDA Energy +
275/80R22.5	275/80R22.5
12	12
100	100
Aluminum	Aluminum

LR-Outer Drive	LR-Inner Drive
Michelin XDA Energy +	Michelin XDA Energy +
275/80R22.5	275/80R22.5
13	13
100	100
Aluminum	Aluminum

Drive Axle
Type
Size
Tread Depth (32nds)
Pressure (psi)
Wheel Type

RR-Inner Drive	RR-Outer Drive
Michelin XDA Energy +	Michelin XDA Energy +
275/80R22.5	275/80R22.5
12	13
100	100
Aluminum	Aluminum

Trailer **Trailer C**

LF-Outer Trailer	LF-Inner Trailer
Bridgestone R123 Ecopia	Bridgestone R123 Ecopia
295/75R22.5	295/75R22.5
11	11
100	100
Steel	Steel

Tandem Front
Type
Size
Tread Depth (32nds)
Pressure (psi)
Wheel Type

RF-Inner Trailer	RF-Outer Trailer
Bridgestone R123 Ecopia	Bridgestone R123 Ecopia
295/75R22.5	295/75R22.5
11	11
100	100
Steel	Steel

LR-Outer Trailer	LR-Inner Trailer
Bridgestone R123 Ecopia	Bridgestone R123 Ecopia
295/75R22.5	295/75R22.5
11	11
100	100
Steel	Steel

Tandem Rear
Type
Size
Tread Depth (32nds)
Pressure (psi)
Wheel Type

RR-Inner Trailer	RR-Outer Trailer
Bridgestone R123 Ecopia	Bridgestone R123 Ecopia
295/75R22.5	295/75R22.5
11	11
100	100
Steel	Steel

7.3: TEST ROUTE

7.3a: LAS CRUCES, NM ROLLING HILLS TERRAIN

The test route in Las Cruces, NM was a 41-mile 'loop' that traveled between mile markers 51 and 71 on I-25 North of Las Cruces (Figure 39). Various terrain and low traffic made this route ideal for testing fuel economy. The test loop was repeated between 6 and 8 times per test day. The number of laps does not affect overall test results.

Figure 39: Loop 1, I-25, Exit 51 to 71

Figure 40: 2025 Kenworth T680 on Test Route

7.4: WEATHER CONDITIONS

Wind conditions for the Baseline day ranged from 0 to 8 MPH while wind conditions on the Testing day ranged from 0 to 12 MPH. 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 7: Weather Data, May 13, 2024 (Baseline)

Time	Temperature	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
11:15 PM	66 °F	18 °F	16 %	W	9 mph	0 mph	25.43 in	0.0 in	Fair
12:15 AM	68 °F	19 °F	16 %	WNW	10 mph	0 mph	25.43 in	0.0 in	Fair
1:15 AM	64 °F	19 °F	18 %	WNW	9 mph	0 mph	25.42 in	0.0 in	Fair
2:15 AM	62 °F	20 °F	20 %	N	7 mph	0 mph	25.43 in	0.0 in	Fair
3:15 AM	59 °F	21 °F	23 %	CALM	0 mph	0 mph	25.44 in	0.0 in	Fair
4:15 AM	55 °F	20 °F	26 %	CALM	0 mph	0 mph	25.44 in	0.0 in	Fair
5:15 AM	53 °F	19 °F	27 %	CALM	0 mph	0 mph	25.46 in	0.0 in	Fair
6:15 AM	61 °F	23 °F	23 %	CALM	0 mph	0 mph	25.46 in	0.0 in	Fair
7:15 AM	69 °F	25 °F	19 %	CALM	0 mph	0 mph	25.49 in	0.0 in	Fair
8:15 AM	72 °F	26 °F	18 %	CALM	0 mph	0 mph	25.50 in	0.0 in	Fair
9:15 AM	76 °F	26 °F	16 %	CALM	0 mph	0 mph	25.50 in	0.0 in	Fair
10:15 AM	81 °F	26 °F	13 %	CALM	0 mph	0 mph	25.49 in	0.0 in	Fair
11:15 AM	82 °F	25 °F	12 %	NW	3 mph	0 mph	25.47 in	0.0 in	Fair
12:15 PM	84 °F	25 °F	11 %	NW	6 mph	17 mph	25.46 in	0.0 in	Partly Cloudy
1:15 PM	86 °F	24 °F	10 %	SW	8 mph	0 mph	25.44 in	0.0 in	Fair
2:15 PM	86 °F	22 °F	10 %	WNW	3 mph	0 mph	25.42 in	0.0 in	Fair
3:15 PM	86 °F	22 °F	10 %	CALM	0 mph	0 mph	25.40 in	0.0 in	Fair
4:15 PM	85 °F	21 °F	9 %	WSW	3 mph	0 mph	25.40 in	0.0 in	Fair
5:15 PM	85 °F	21 °F	9 %	SW	7 mph	0 mph	25.40 in	0.0 in	Fair
6:15 PM	83 °F	21 °F	10 %	CALM	0 mph	0 mph	25.40 in	0.0 in	Fair
7:15 PM	79 °F	20 °F	11 %	SW	6 mph	0 mph	25.41 in	0.0 in	Fair
8:15 PM	76 °F	20 °F	12 %	W	10 mph	0 mph	25.43 in	0.0 in	Fair
9:15 PM	71 °F	22 °F	16 %	WNW	5 mph	0 mph	25.44 in	0.0 in	Fair
10:35 PM	66 °F	22 °F	19 %	WNW	6 mph	0 mph	25.45 in	0.0 in	Fair

Source: https://www.wunderground.com/history/daily/us/nm/las-cruces/KLRU/date/2024-5-13

Table 8: Weather Data, May 14, 2024 (Test Day)

Time	Temperature	Dew Point	Humidity	Wind	Wind Speed	Wind Gust	Pressure	Precip.	Condition
11:15 PM	65 °F	22 °F	20 %	NW	7 mph	0 mph	25.44 in	0.0 in	Fair
12:35 AM	62 °F	23 °F	22 %	N	3 mph	0 mph	25.44 in	0.0 in	Fair
1:35 AM	62 °F	24 °F	24 %	NNW	8 mph	0 mph	25.43 in	0.0 in	Fair
2:35 AM	59 °F	24 °F	26 %	N	5 mph	0 mph	25.43 in	0.0 in	Fair
3:35 AM	58 °F	25 °F	27 %	NNW	8 mph	0 mph	25.43 in	0.0 in	Fair
4:35 AM	57 °F	25 °F	29 %	NNW	5 mph	0 mph	25.44 in	0.0 in	Fair
5:35 AM	56 °F	25 °F	29 %	CALM	0 mph	0 mph	25.45 in	0.0 in	Fair
6:35 AM	66 °F	28 °F	24 %	CALM	0 mph	0 mph	25.46 in	0.0 in	Fair
7:55 AM	74 °F	28 °F	18 %	SW	3 mph	0 mph	25.47 in	0.0 in	Fair
8:55 AM	77 °F	28 °F	17 %	WSW	3 mph	0 mph	25.47 in	0.0 in	Fair
9:55 AM	82 °F	28 °F	14 %	SSW	6 mph	0 mph	25.46 in	0.0 in	Fair
10:55 AM	85 °F	27 °F	12 %	CALM	0 mph	0 mph	25.46 in	0.0 in	Fair
11:55 AM	87 °F	24 °F	10 %	WSW	12 mph	18 mph	25.43 in	0.0 in	Fair
12:55 PM	88 °F	25 °F	10 %	SW	7 mph	17 mph	25.40 in	0.0 in	Fair
1:55 PM	89 °F	24 °F	10 %	SW	3 mph	18 mph	25.39 in	0.0 in	Fair
2:55 PM	91 °F	23 °F	9 %	WSW	8 mph	22 mph	25.37 in	0.0 in	Fair
3:55 PM	90 °F	23 °F	9 %	W	10 mph	23 mph	25.36 in	0.0 in	Fair
4:55 PM	88 °F	21 °F	9 %	WSW	8 mph	17 mph	25.35 in	0.0 in	Fair
5:55 PM	87 °F	21 °F	9 %	SW	10 mph	0 mph	25.35 in	0.0 in	Fair
6:55 PM	84 °F	20 °F	10 %	WSW	9 mph	0 mph	25.35 in	0.0 in	Fair
7:55 PM	75 °F	19 °F	12 %	W	6 mph	0 mph	25.36 in	0.0 in	Fair
8:55 PM	70 °F	18 °F	14 %	NW	6 mph	0 mph	25.38 in	0.0 in	Fair
9:55 PM	73 °F	19 °F	13 %	CALM	0 mph	0 mph	25.39 in	0.0 in	Fair
10:55 PM	69 °F	19 °F	15 %	W	8 mph	0 mph	25.39 in	0.0 in	Fair

Source: https://www.wunderground.com/history/daily/us/nm/las-cruces/KLRU/date/2024-5-14

8.0: PRODUCT DETAILS

Test oil: Emgard® 7103 XFE 75W-85
Reference oil: Emgard® FE 75W-90

9.0: MVT SOLUTIONS TEST PERSONNEL

Daryl Bear, Lead Engineer & COO
Jonathan Ruppert, Test Engineer
Arturo Via, Technician
John Rintelen, Technician, Driver

10.0: MVT SOLUTIONS DRIVERS

Carlos Aragon, Driver
Gene McGarey, Driver
John Rintelen, Technician, Driver

11.0: BASF

Arjun Goyal, Technical Marketing Manager – Axle Lubricants
Donna Mosher, Technical Service Manager – Transportation Lubricants

12.0: MVT SOLUTIONS CONTACT INFO

Daryl Bear, Lead Engineer & COO
Daryl.Bear@m-v-t-s.com
317-603-9325

Jonathan Ruppert, Test Engineer
Jonathan.Ruppert@m-v-t-s.com
575-405-5015