MESILLA VALLEY TRANSPORTATION SOLUTIONS
CERTIFIED
Fuel Economy Experts

Test Report

# Michelin
## X Line Energy Tractor Tires

**MVT SOLUTIONS CERTIFIED™ FUEL ECONOMY TEST**

August 2023

**XLEZ+ / XLED+ (Dual)**

| | | |
|---|---|---|
| **4.53** gal/1000 miles | 0.35 MPG | 3.91% |

**XLEZ+ / X One LED2 (WBS)**

| | | |
|---|---|---|
| **8.15** gal/1000 miles | 0.65 MPG | 7.04% |

## 1.0: INTRODUCTION

Mesilla Valley Transportation Solutions (MVTS) certifies the fuel savings described in this report. **Note:** this report was designed for carriers and provides information relevant to their needs. Therefore, the format varies from traditional fuel economy and technical reports. The Report Summary provides the reader with a quick synopsis of the 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 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 purpose of this test was to quantify the difference in fuel economy of three (3) long-haul, fuel-efficient tractor tire configurations from Michelin. The combination of Michelin X Line Energy Z steers (XLEZ) and X Line Energy D (XLED, dual) drives were the base comparison tire combination, which was compared to Michelin X Line Energy Z+ (XLEZ+) steers and X Line Energy D+ (XLED+, dual) drives. The XLEZ/XLED combination was also compared to XLEZ+ steers paired with X One Line Energy D2 (X One LED2) drives, which was a Wide Based Single (WBS) tire. The **XLEZ+/XLED+ tractor tire configuration improved fuel economy by 4.53 gal/1000 miles (3.91%)** compared to the XLEZ/XLED combination. The **XLEZ+/X One LED2 (WBS) tractor tire configuration improved fuel economy by 8.15 gal/1000 miles (7.04%)** compared to the XLEZ/XLED combination.

Table 1: Results Summary

| Product | Fuel Economy Improvement | | | Annual Savings per Tractor | |
|---|---|---|---|---|---|
| | Gal/1000 miles | MPG | Percent | Money in Fuel ($) | $CO_2$ (Metric Tons) |
| XLEZ/XLED (Dual) | Base | Base | Base | Base | Base |
| XLEZ+/XLED+ (Dual) | 4.53 | 0.35 | 3.91% | $2,796 | 5.77 |
| XLEZ+/X One LED2 (WBS) | 8.15 | 0.65 | 7.04% | $5,053 | 10.37 |

Testing was conducted on a 9-mile test track at 65 miles per hour and a Gross Vehicle Weight (GVW) of 78,000 lbs. Tires were EPA SmartWay approved in all cases. Tires had 500 miles break-in using the same vehicle and load as was used for the fuel economy test. More detailed information can be found in the body of the report. Trailer tires remained unchanged throughout testing.

In terms of savings, the Michelin XLEZ+/XLED+ would save 566 gallons of diesel fuel annually, which equates to $2,796[1] and 5.77 metric tons of $CO_2$ per year. The Michelin XLEZ+/X One LED2 (WBS) combination would save 1,019 gallons of diesel fuel annually, equating to $5,083 and 10.37 metric tons per year. Calculations were based on 125,000 miles travelled annually.

Table 2: Michelin Tire Test Sets

| Set # | Type | Size / Tire | Report Nomenclature |
|---|---|---|---|
| A | Steer | 275/80R22.5 X Line Energy Z LRH | XLEZ |
| A | Drives | 275/80R22.5 X Line Energy D LRG | XLED (Dual) |
| B | Steer | 295/75R22.5 X Line Energy Z+ LRH | XLEZ+ |
| B | Drives | 275/80R22.5 X Line Energy D+ LRG | XLED+ (Dual) |
| B | Steer | 295/75R22.5 X Line Energy Z+ LRH | XLEZ+ |
| D | Drives | 445/50R22.5 X One Line Energy D2 LRL | X One LED2 (WBS) |

Tests were conducted on behalf of Michelin North America, Inc, however, all work was conducted independently by MVTS, including tire mounting, break-in miles and testing. Tires were purchased by MVTS independently of Michelin with the exception of the X Line Energy Z+ steers, which were not yet available to the market and, therefore, were provided directly by Michelin.

**Note**: GVW versus fuel savings: fuel savings from tires are dependent on axle weight and will increase as GVW increases. This report includes a guide on how to calculate savings for a fleet's specific GVW along with cost savings. These can be found in the Savings Calculations section.

**Note:** Set B steers, which were X Line Energy Z+, were utilized in combination with the X Line Energy D+ (dual) drives and X One Line Energy D2 (WBS) drives.

[1] Using the U.S. average retail price of diesel fuel in 2022, $4.989/gal.

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## 3.0: PROCEDURE

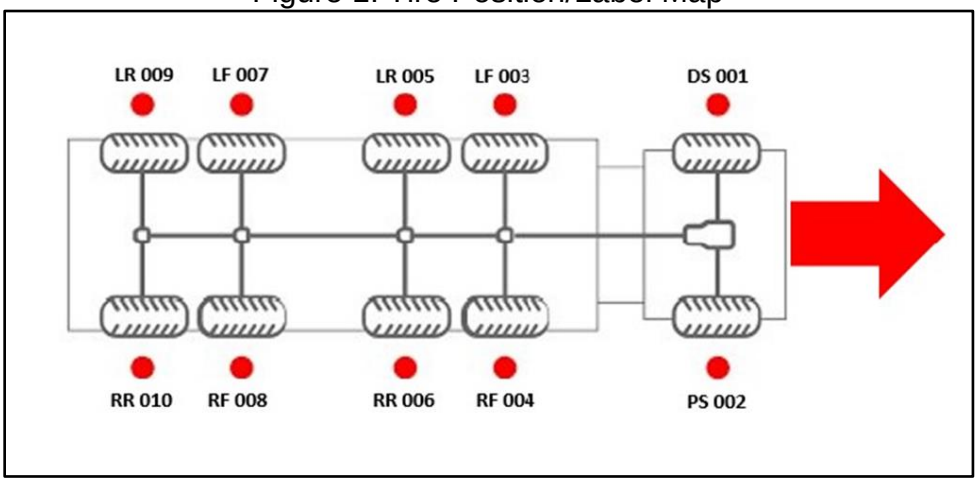
Fuel economy testing of tires varies compared to other technologies since tire performance changes over time, both long term and short term. During a fuel economy test, fuel economy can change due to tire temperature and pressure. Many extra steps were taken during these tire tests to ensure accuracy and consistency including tire preparation, tire pressure management and monitoring.

### 3.1: TIRES TESTED

All tires were acquired in new condition for this test and received 500 break-in miles prior to testing. Test tire information was shown above in Table 2. All tires were SmartWay approved fuel-efficient offerings. Therefore, tires tested are considered direct and fair competitors.

Tires were installed in the same positions for the break-in miles and fuel economy tests, as labeled in Figure 1 below.

Figure 1: Tire Position/Label Map




**Note**: Tire images shown may include footprints and/or dirt. It was decided not to clean the tires with any chemicals prior to testing. Footprints were caused by MVTS technicians walking on the tires while checking pressures and dirt was contracted during break-in miles as the vehicle was parked in a secure dirt yard during break-in mile operations.

### 3.2: TIRE SOURCING & MOUNTING

Michelin tires were purchased through regular supply chains, which were sourced independently by MVTS through Border Tire in Las Cruces, NM. An exception was the Michelin X Line Energy Z+ tires, which were provided by Michelin because the test break-in occurred prior to the tire being available on the market.

All tires were mounted in the MVT shop on aluminum wheels prior to break-in and remained mounted until testing was completed. Drive tires were not balanced, following common industry practice, whereas the Steer tires were balanced since that is also

common practice. Trailer tires remained constant throughout testing and were not changed.

Table 3: Wheels and Balancing

| Position | Wheels | Balanced? |
|---|---|---|
| Steer | Aluminum | Yes |
| Drive | Aluminum | No |
| Trailer | Aluminum | No |

## 3.3: TIRE BREAK-IN

All tires received a break-in distance of 500 miles in the weeks prior to testing on the test track where the fuel economy tests were also conducted. A distance of 500 miles was chosen because of industry standard expectations for tire consistency[2] and break-in. All tires had break-in miles using the same truck, trailer, speed, and load to ensure consistency.

All tires were inflated to 100 psi cold pressure during break-in. Each set remained in the shop overnight prior to conducting break-in miles the following day. After installation, tire pressures were again verified to be at 100 psi. All tires were labeled as to their position on the vehicle to ensure consistency when reinstalled during the actual fuel economy test.

## 3.4: TEST RUN TIRE PREPARATION

Tire pressures were set to 100 psi cold pressure in the test track shop at 6 a.m. the morning of the test. All tires were stored in the shop overnight prior to setting pressures in the morning, which provided adequate time for the tires to stabilize with the same ambient conditions.

One calibrated digital tire pressure gauge was utilized for all initial tire pressure checks.

Tire pressures were not adjusted after 7 a.m. the morning prior to testing, they were only checked to verify and record pressure values.

[2] J1321 Revised FEB2012 Page 13 of 50 4.2.2 Vehicle Type and Configuration

## 3.5: FUEL ECONOMY TEST PROCEDURE

Testing was conducted in Pecos, TX on a 9-mile test track. Test speed was 65 mph. Wheel revolution counts were changed in accordance with the Drive tire revolutions per mile for the tires tested.

The test procedure was as follows:

1) Complete four (4) warm-up laps to allow tire pressures and temperatures to stabilize.
2) Stop in pits to record tire pressures.
3) Complete 12 laps (108 miles).
4) End test run. Record tire pressures (16 total laps).
5) Change tires for following test run.
6) Repeat steps 1 – 5.

Table 4: Warm-up and Test Laps

| Lap # | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Check Pressures | Warm-up Laps | | | | Stop. Check Pressures. Accelerate. | Test Laps | | | | | | | | | | | End Test. Pit. Check Pressures. |

To calculate fuel economy changes, laps 6 through 16 were analyzed. The warm-up lap values were not included in the fuel economy calculations, nor was lap 5, which was an acceleration lap after warm-up tire pressure checks. Tire pressure values are shown here and the comparisons are summarized in the Test Results section.

## 3.6: TEST VEHICLES

Test vehicles were 2019 International LT 625s with Cummins X15 15-Liter engines and Eaton Endurant 12-speed Automated Manual Transmissions (AMT). Trailers were 53-foot Hyundai dry vans with Michelin Energy Guard aerodynamic solutions installed. Gross Vehicle Weight (GVW) was 78,000 lbs. Both trucks were equipped with Ex-Guard grill guards, which were previously tested and showed to have no influence on fuel economy. Tires on the Compare vehicle remained unchanged, as did all trailer tires. Only tires on the tractor of the test vehicle were changed during testing. Vehicle info can be found in the Appendix.

Vehicles were thoroughly inspected and received regular maintenance prior to testing. It should also be noted, for the reader's peace of mind, MVT and MVTS are 100% confident in the reliable condition of the test vehicles. The MVT fleet uses the same vehicle data and test procedures for their own internal purchase decisions.

Figure 2: Test Vehicles, Compare Vehicle (L) and Test Vehicle (R)

Figure 3: Test Trailers Included Michelin Energy Guard Aerodynamics

**Note**: previous fuel economy testing by MVTS on tires and the Michelin Energy Guard can be found at https://www.m-v-t-s.com/company/michelin/.

## 3.7: 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)
- 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)

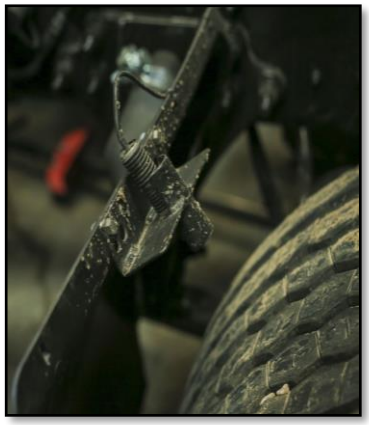
Click this link to see a video of MVTS sensors and testing: How We Test

Figure 4: Aerodynamic Sensors

Figure 5: Data Acquisition System

Figure 6: Fuel Flow Meter

Figure 7: Tire Temp. Sensor



## 4.0: TEST RUNS AND RESULTS

Three (3) runs were conducted to complete this fuel economy test (Table 5). The tires used for comparison were tested during Run 5, which were the Michelin X Line Energy Z steers and X Line Energy D drives.

Table 5: Test Run Sequence

| Run | Test Name/Description | Start | End |
|---|---|---|---|
| 2 | Michelin X Line Energy Z+ and X Line Energy D+ (Dual) | 9:59 AM | 12:11 PM |
| 4 | Michelin X Line Energy Z+ and X One Line Energy D2 (WBS) | 3:33 PM | 5:45 PM |
| 5 | Michelin X Line Energy Z and X Line Energy D (Dual) | 6:16 PM | 8:28 PM |

Table 6: Test Results with Accuracy

| Product | Fuel Economy Improvement | | | Annual Savings per Tractor | |
|---|---|---|---|---|---|
| | Gal/1000 miles | MPG | Percent | Money in Fuel ($) | $CO_2$ (Metric Tons) |
| **XLEZ/XLED (Dual)** | **Base** | Base | Base | Base | Base |
| **XLEZ+/XLED+ (Dual)** | **4.53** | 0.35 | 3.91% | $2,826 | 5.77 |
| Accuracy | **+/- 0.52** | +/- 0.04 | +/- 0.45% | | |
| **XLEZ+/X One LED2 (WBS)** | **8.15** | 0.65 | 7.04% | $5,083 | 10.37 |
| Accuracy | **+/- 0.57** | +/- 0.04 | +/- 0.49% | | |

Figure 8: Test Results Graph (gal/1000 miles)

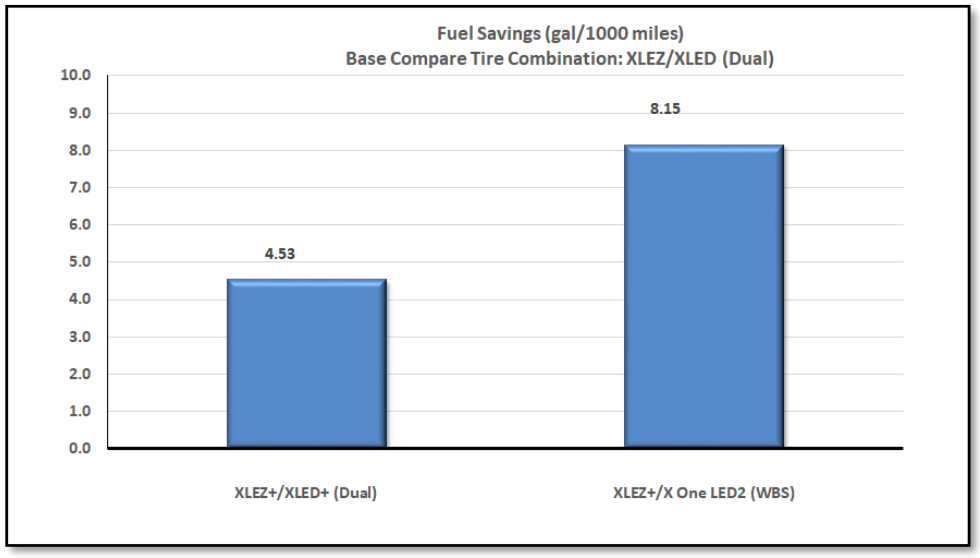
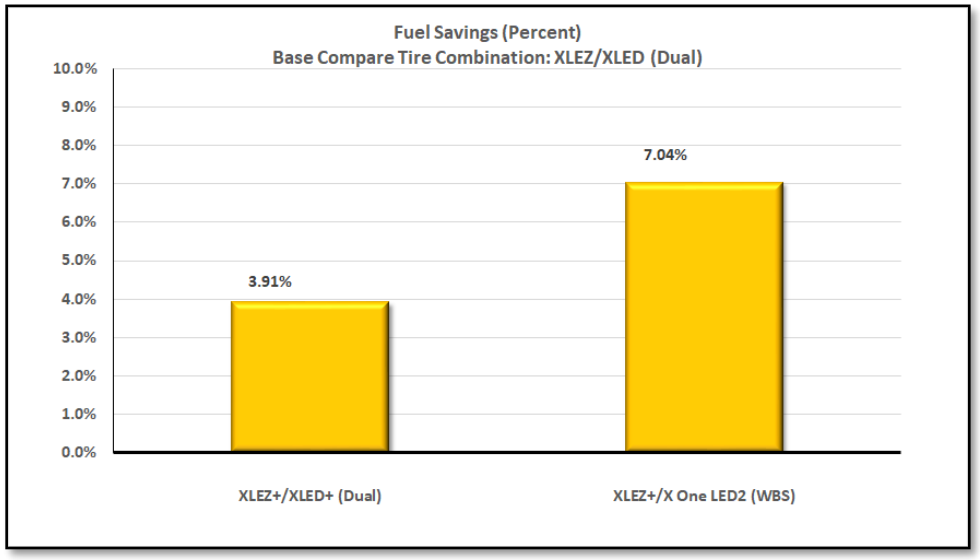



Figure 9: Test Results Graph (Percent)



## 4.1: Run 2: Michelin X Line Energy Z+ Steers and X Line Energy D+ Drives

This set of tires is Michelin's most fuel-efficient offering in dual drive tires. The XLEZ+ steer tire was new to the market at the time of testing, which is why this tire was sourced directly from Michelin whereas the XLED+ (dual) drive tire was purchased through a retail chain. This tire package saved **4.53 gal/1000 miles (3.91%)** when compared to the Michelin XLEZ steers and XLED (dual) drives (Table 6). Accuracy[3] of this test was +/- 0.52 gal/1000 miles (+/- 0.45%), which can be considered very good for a fuel economy test. The fuel savings are significant considering they can be achieved by simply upgrading a tire package and applying it to the tractor alone. Figure 8 and Figure 9 illustrate the fuel savings in graphical form, along with error bars illustrating test accuracy.

Figure 10: Michelin XLEZ+ Steer Tire (Position 001)

[3] 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 11: Michelin XLED+ Drive Tire (Position 003)

Figure 12: Michelin XLED+ Drive Tires (RH Positions)

Figure 13: Michelin XLED+ Drives Ready for Installation

Figure 14: Run 2 Tire Pressure Measurement

Table 7 shows the Average Tire Pressure Comparison of the Test and Compare vehicles as recorded from pressures after the lap 5 warm-up and lap 16 conclusion of the test. This table illustrates the tire pressure value difference between the two (2) vehicles during the run. The lower rows show the Test vehicle had an average lower pressure by -1.9 psi, a minimum difference of -5.0 psi and a maximum difference of 1.0 psi. The average of -1.9 psi can be considered consistent, and the overall lower pressures suggest the Test vehicle tires (*i.e.,* XLEZ+ and XLED+) maintained a slightly lower tire temperature since their growth was nearly identical as is shown below with a difference of -0.7 psi, however, the overall average was slightly lower.

Table 7: Run 2 Average Tire Pressure Comparison (XLEZ+/XLED+)

| **Average Tire Pressure Comparison** | | | | |
|---|---|---|---|---|
| (Test Vehicle - Compare Vehicle) | | | | |
| | | | | |
| -1.3 | | Steers (psi) | | -2.3 |
| | | | | |
| -1.8 | -5.0 | Drives-Front (psi) | -3.2 | -3.5 |
| | | | | |
| -3.3 | -4.5 | Drives-Rear (psi) | -4.5 | -3.5 |
| | | | | |
| -0.8 | -1.5 | Trailer-Front (psi) | 0.3 | 1.0 |
| | | | | |
| -0.3 | 1.0 | Trailer-Rear (psi) | -0.3 | 0.0 |
| | | | | |
| -1.9 | | Average Pressure Variance (psi) | | |
| -5.0 | | Minimum Pressure Variance (psi) | | |
| 1.0 | | Maximum Pressure Variance (psi) | | |

Table 8 shows the Average Tire Pressure Growth Comparison of the Michelin package from Run 2. These values represent the change in tire pressure during the run of the Test vehicle and Compare vehicle during laps 6 to 16 when the fuel economy was being quantified (*i.e.,* after the warm-up). The lower rows of the table show the average pressure variance between the Compare and Test vehicles was -0.7 psi, the minimum was -2.0 psi, the maximum was 2.5 psi. A positive value indicates the Test vehicle tire pressure was higher. All tire pressure values can be found in the Appendix. Since all tires were the same pressure and temperature prior to any driving occurring (*i.e.,* prior to any warm-up laps), the -0.7 psi overall average tire pressure growth difference between the vehicles indicates they were very consistent and neither had a significant temperature difference that affected its growth rate.

Table 8: Run 2 Tire Pressure Comparison (XLEZ+/XLED+)

| Tire Pressure Growth Comparison | | | | |
|---|---|---|---|---|
| (End Pressure - Start Pressure) of (Test Veh - Compare Veh) | | | | |
| | | | | |
| -0.7 | | Steers (psi) | | -0.5 |
| | | | | |
| 2.5 | -1.0 | Drives-Front (psi) | -1.5 | 0.0 |
| | | | | |
| -0.5 | 0.0 | Drives-Rear (psi) | -1.0 | 0.0 |
| | | | | |
| -1.5 | -1.0 | Trailer-Front (psi) | -1.5 | -1.0 |
| | | | | |
| -1.5 | -2.0 | Trailer-Rear (psi) | -0.5 | -1.0 |
| | | | | |
| -0.7 | | Average Pressure Variance (psi) | | |
| -2.0 | | Minimum Pressure Variance (psi) | | |
| 2.5 | | Maximum Pressure Variance (psi) | | |

## 4.2: Run 4: Michelin X Line Energy Z+ Steers and X One Line Energy D2 Drives

Wide Based Single (WBS) drive tires, X One Line Energy D2, was installed in the drive positions. The savings of this tire package compared to the XLEZ steer and XLED (dual) drive was **8.15 gal/1000 miles (7.04%)** as shown in Table 6**.** Accuracy of this test was +/- 0.57 gal/1000 miles (0.49%). These are very significant fuel savings that were once again applied to only the tractor.

Comparing the WBS X One LED2 to the dual package XLED+ from Run 2, the fuel savings were 3.62 gal/1000 miles (3.18%), which is also a significant fuel savings when considering these are both already high fuel efficiency Drive tires.

Figure 15: Preparing to Install X One LED2 (WBS) Drives

Figure 16: Michelin X One LED2 (WBS) Drive Tires Installed

Figure 17: Michelin X One LED2 (WBS) Drive Tires Installed

Table 9 shows the average tire pressure variance was 1.4 psi, indicating the Test vehicle pressures (Z+ and D2 vehicle) were slightly higher. The minimum was -1.3 psi, and the maximum was 3.1 psi. Overall, the pressures can be considered consistent. Table 10 indicates that the average growth was also 1.4 psi, indicating the Test vehicle had slightly more tire pressure growth than the Compare vehicle, however, this can also be considered consistent.

Table 9: Run 4 Tire Pressures Comparison (XLEZ+/X One LED2)

| Average Tire Pressure Comparison | | | | |
|---|---|---|---|---|
| (Test Vehicle - Compare Vehicle) | | | | |
| | | | | |
| -0.8 | | Steers (psi) | | -1.3 |
| | | | | |
| 3.1 | | Drives-Front (psi) | | 2.6 |
| | | | | |
| 1.6 | | Drives-Rear (psi) | | 1.9 |
| | | | | |
| 1.0 | 1.0 | Trailer-Front (psi) | 1.5 | 2.8 |
| | | | | |
| 1.5 | 1.3 | Trailer-Rear (psi) | 1.8 | 1.0 |
| | | | | |
| 1.4 | | Average Pressure Variance (psi) | | |
| -1.3 | | Minimum Pressure Variance (psi) | | |
| 3.1 | | Maximum Pressure Variance (psi) | | |

Table 10: Run 4 Tire Test Pressure Growth (XLEZ+/X One LED2)

| **Tire Pressure Growth Comparison** | | | | |
|---|---|---|---|---|
| (End Pressure - Start Pressure) of (Test Veh - Compare Veh) | | | | |
| | | | | |
| 0.5 | | Steers (psi) | | 0.5 |
| | | | | |
| 2.3 | | Drives-Front (psi) | | 3.3 |
| | | | | |
| 2.8 | | Drives-Rear (psi) | | 3.3 |
| | | | | |
| 2.0 | 1.0 | Trailer-Front (psi) | 2.0 | 0.5 |
| | | | | |
| 1.0 | -0.5 | Trailer-Rear (psi) | 0.5 | 0.0 |
| | | | | |
| 1.4 | | Average Pressure Variance (psi) | | |
| -0.5 | | Minimum Pressure Variance (psi) | | |
| 3.3 | | Maximum Pressure Variance (psi) | | |

## 4.3: Run 5: Michelin X Line Energy Z and X Line Energy D

Run 5 consisted of installing the XLEZ steer tires and XLED (dual) drive tires, which were the tires Run 2 and 4 listed above were compared to. Therefore, this run does not provide a fuel economy comparison, however, its tire information is shown below for consistency.

Figure 18: Michelin XLEZ Installation

Figure 19: Michelin X LEZ Steer Tire (Position 002)

Figure 20: Michelin XLED (Dual) Drive Tire

Figure 21: Michelin XLED (Dual) Drives Installed

Table 11 shows the average tire pressure variance was 1.2 psi, indicating the Test vehicle had slightly higher tire pressures during the test run. The minimum was -1.3 psi, and the maximum was 3.3 psi. These values can be considered consistent and reliable. Table 12 shows the average tire pressure growth and indicates the Test vehicle experienced 0.9 psi greater growth than the Compare vehicle. The minimum was -1.0 psi, and the maximum was 2.0 psi. These can be considered consistent and reliable.

Table 11: Run 5 Tire Pressures Comparison (XLEZ/XLED)

| Average Tire Pressure Comparison | | | | |
|---|---|---|---|---|
| (Test Vehicle - Compare Vehicle) | | | | |
| | | | | |
| 0.5 | | Steers (psi) | | 0.5 |
| | | | | |
| 1.8 | -0.5 | Drives-Front (psi) | 0.8 | -0.3 |
| | | | | |
| 1.3 | -1.3 | Drives-Rear (psi) | 0.8 | 0.0 |
| | | | | |
| 3.0 | 1.0 | Trailer-Front (psi) | 3.0 | 3.3 |
| | | | | |
| 2.0 | 2.3 | Trailer-Rear (psi) | 3.0 | 1.0 |
| | | | | |
| 1.2 | | Average Pressure Variance (psi) | | |
| -1.3 | | Minimum Pressure Variance (psi) | | |
| 3.3 | | Maximum Pressure Variance (psi) | | |

Table 12: Run 5 Tire Test Pressure Growth (XLEZ/XLED)

| Tire Pressure Growth Comparison | | | | |
|---|---|---|---|---|
| (End Pressure - Start Pressure) of (Test Veh - Compare Veh) | | | | |
| | | | | |
| 1.0 | | Steers (psi) | | 1.0 |
| | | | | |
| 1.5 | 2.0 | Drives-Front (psi) | 1.5 | 1.5 |
| | | | | |
| 1.5 | 1.5 | Drives-Rear (psi) | 1.5 | 2.0 |
| | | | | |
| -1.0 | -1.0 | Trailer-Front (psi) | 2.0 | -0.5 |
| | | | | |
| 0.0 | 0.5 | Trailer-Rear (psi) | 1.0 | 0.0 |
| | | | | |
| 0.9 | | Average Pressure Variance (psi) | | |
| -1.0 | | Minimum Pressure Variance (psi) | | |
| 2.0 | | Maximum Pressure Variance (psi) | | |

## 4.4: 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 to have difficulty predicting the financial benefits of the product unless units of gal/1000 miles are used.

Units of gal/1000 miles are also more reliable for a fleet's real-world savings due to this unit not being 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).

## 4.5: WEATHER CONDITIONS SUMMARY

Ambient temperature during testing ranged from 74°F to 103°F with winds ranging from 0-10 MPH, mostly in mild conditions throughout the day. Weather data was acquired from a local Weather Underground weather station and complete weather data can be found in the Appendix.

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.

## 5.0: SAVINGS CALCULATIONS

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

### 5.1: FUEL SAVINGS CALCULATIONS

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

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

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

Example: Michelin XLEZ steer tires and XLED (dual) drive tires compared to XLEZ+ steer tires and X One LED2 (WBS) drive tires fuel savings with 125,000 miles traveled annually:

$$Fuel\ Savings = (8.15\ gal/1000\ miles)x\ \frac{(125{,}000\ miles/year)}{1000} = 1{,}019\ gal/year$$

Therefore, the XLEZ+ and X One LED2 (WBS) combination would save 1,019 gallons of fuel per year for this vehicle traveling 125,000 miles.

The XLEZ+ and XLED+ (dual) would save 566 gallons in the same conditions (calculations not shown).

### 5.2: 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 2022, $4.989[4] /gal. **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.

$Savings\ (\$/year) = \left(1{,}019\ \frac{gal}{year}\right)\ x\ \left(\frac{\$4.989}{gal}\right) = \$5{,}083\ /year$ in fuel savings

Therefore, the XLEZ+ and X One LED2 (WBS) combination would save $5,083 per year in fuel for the vehicle traveling 125,000 miles.

The XLEZ+ and XLED+ (dual) combination would save $2,826 per year in fuel in the same conditions (calculations not shown).

[4] https://www.eia.gov/dnav/pet/hist/LeafHandler.ashx?n=PET&s=EMD_EPD2DXL0_PTE_NUS_DPG&f=W

## 5.3: TECHNOLOGY PAYBACK AND RETURN-ON-INVESTMENT

Buyers of fuel economy technologies are most interested in saving money. For a technology supplier to be successful, their technology must save their potential customers money and 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 ROI.

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

Where the 'Product cost' in the case of tires is the difference between two (2) tire configurations. MVTS advises fleets to ensure they are comparing prices based on fleet size and not retail or a mixture of both.

Example @$150 'Price cost': Example pricing using the Michelin XLEZ+ with a $15 price addition over the XLEZ, and $30 increase for the X One LED2 (WBS) over two (2) XLED (dual) tires, the total of two (2) steers and four (4) WBS drives the price cost per tractor is $150 as shown below. **Note:** pricing is for example purposes only, contact a Michelin representative for actual pricing.

$$Payback\ (months) = \frac{(\$150)}{(\$5{,}083\ /year)}\ x\ \left(12\frac{months}{year}\right) = 0.4\ months$$

Therefore, with a $150 per vehicle set difference in pricing, the Michelin XLEZ+ and X One LED2 (WBS) combination over the XLEZ and XLED (dual) would pay for itself (*i.e.,* payback or ROI) in 0.4 months. This is extremely fast by comparison to add-on technologies.

The XLEZ+ and XLED+ (dual) combination would also have an example cost difference of $150 and its ROI would be 0.6 months (calculations not shown).

## 5.4: $CO_2$ REDUCTION CALCULATIONS

Carbon Dioxide ($CO_2$) is directly related to diesel fuel consumption in the amount of 10,180[5] 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] https://www.epa.gov/energy/greenhouse-gases-equivalencies-calculator-calculations-and-references

Example: Using the values from above and a fuel savings of 1,019 gallons per year.

$CO_2\ Reduction\ (metric\ tons) = (1{,}019)\ x\ (0.01018\ metric\ tons)$ = 10.37 metric tons $CO_2$

Therefore, the XLEZ+ and X One LED2 (WBS) combination would save 10.37 metric tons of $CO_2$ per year for this vehicle travelling 125,000 miles.

The XLEZ+ and XLED+ (dual) combination would save 5.77 metric tons of $CO_2$ per year under the same conditions (calculations not shown).

## 5.5: FUEL SAVINGS FOR DIFFERENT GVW

A fleet that operates at a GVW other than the 78,000 lbs. at which this test was conducted can still calculate their fuel savings from MVTS test results. Units of gal/1000 miles must be used.

$$Fleet\ Fuel\ Savings = \frac{(Fleet\ GVW)}{(Test\ GVW)}\ x\ (MVTS\ Test\ Result)$$

Example: Fleet GVW = 47,500 lbs., comparing Michelin XLEZ steer tires and XLED (dual) drive tires to XLEZ+ steer tires and X One LED2 (WBS) drives:

$$Fleet\ Fuel\ Savings = \frac{(47{,}500)}{(78{,}000)}\ x\ \left(8.15\ \frac{gal}{1000}miles\right) = \mathbf{4.96}\ \frac{\boldsymbol{gal}}{\mathbf{1000}}\boldsymbol{miles}$$

Therefore, the fleet with an average GVW of 47,500 lbs. would see savings of 4.96 gal/1000 miles instead of 8.15 gal/1000 miles for the Michelin XLEZ+ steer tires and X One LED2 (WBS) drives.

**Note**: greater accuracy can be achieved by calculating with individual axle weights as opposed to full vehicle weight.

## 6.0: CONCLUSION

Tires were tested on the tractor only. Michelin X Line Energy Z (XLEZ) steers combined with Michelin X Line Energy D (XLED) drives were compared to:

- Michelin X Line Energy Z+ (XLEZ+) steers combined with Michelin X Line Energy D+ (XLED+) dual drives, and
- Michelin XLEZ+ steers combined with Michelin X One LED2 (WBS) drives

The XLEZ+ and XLED+ (dual) showed savings of 4.53 gal/1000 miles (3.91 %). The X LEZ+ and X One LED2 (WBS) tires showed savings of 8.15 gal/1000 miles (7.04%). The X One LED2 drives saved 3.62 gal/1000 miles (3.18%) when compared to the dual X Line Energy D+ drives. Trailer tires remained unchanged throughout testing.

Vehicles were tested at 65 MPH, GVW of 78,000 lbs., and all tires had 500 miles of break-in prior to testing. Tire pressures were closely managed and monitored during testing and were very consistent.

Tires were tested in new condition, apart from a 500-mile break-in period. Therefore, the difference in fuel consumption tested will be the highest value in the life of the tire unless irregular wear were to occur. As tire tread depths decrease with miles driven, the difference in fuel consumption can also be expected to decrease. To quantify this decrease would require further testing as the tires wear, which was out of the scope of this test. The MVT fleet uses 'new condition' tire test values to make decisions on tires and fuel economy. Although the values will lessen over the life of the tires, the new condition test results provide a fast and consistent opportunity to quantify the differences in tires. In most cases, this filters the poor performing tires and narrows decision choices to one or two options.

After conducting many tires tests at MVTS, savings of 8.15 gal/1000 miles between tire models is not surprising, despite all tires being fuel-efficient SmartWay approved. Tires and rolling resistance contribute significantly to fuel consumption, and therefore provide a great opportunity for savings. Tires can also provide an excellent ROI since the fleet is already purchasing tires and therefore fuel savings are acquired with little or no additional cost, as shown in the financial calculations section above.

Savings calculations compared the Michelin XLEZ steers and XLED (dual) drives to the X LEZ+ steers and X One LED2 (WBS) drives. Calculations showed that in 125,000 miles traveled annually, the XLEZ+ and XLED+ (dual) combination would save 566 gallons of fuel at 78,000 lbs. GVW. Using the 2022 average retail cost of diesel fuel of $4.989/gal this equated to $2,826 per year in fuel savings. The XLEZ+ and X One LED2 (WBS) combination would save 1,019 gallons of fuel and $5,083 per year in fuel savings.

$CO_2$ emission reduction of the XLEZ+ steers and X One LED2 (WBS) drives amounted to 10.37 metric tons per year. The XLEZ+ and XLED+ (dual) would save 5.77 metric tons of $CO_2$.

Fuel savings from an example GVW of 47,500 lbs. GVW for the Michelin XLEZ+ steers and X One LED2 (WBS) drives would be 4.96 gal/1000 miles instead of 8.15 gal/1000 miles at 78,000 lbs. GVW.

# 7.0: APPENDIX

## 7.1: TEST VEHICLE DETAILS

**Note**: tire details for each test run can be found in the Tire Details and Pressures section.

Figure 22: Vehicle Info, Test Vehicle

| | | | |
|---|---|---|---|
| Date | August 16, 2023 | | |
| Company | Mesilla Valley Transportation Solutions | | |
| Location | Pecos, Texas | | |
| Test Route | Pecos 9-mile Test Track | | |
| | | | |
| **TRUCK ID:** | **Veh. A** | | |
| Brand | International | | |
| Date of Manufacture (MY) | 20-Sep-2018 (2019) | | |
| Model | LT 625 | | |
| Engine | Cummins X15 (450 HP/1650 ft-lbs) | | |
| VIN | 3HSDZAPR4KN562972 | | |
| Starting Mileage (miles): | 57,193 | | |
| Transmission | Eaton Endurant 12-speed AMT | | |
| Front Drive Axle | Meritor MT-40-14X-3CFR | | |
| Rear Drive Axle | | | |
| Rear Gear | 2.79 : 1 | | |
| Fuel Load | Full | | |
| Fuel Type & Batch | No. 2 Diesel | | |
| Axle Weights (S,D,T) (lbs) | 11,440 | 33,300 | 33,100 |
| Total weight | 77,840 | | |
| Photo/Video/Audio folder name: | | | |
| | | | |
| **TRAILER ID:** | **T-1** | | |
| Model | Hyundai Translead (VC2530152-AJS) | | |
| VIN | 3H3C532C6MR248009 | | |
| Date of Manufacture (MY) | 12/19 (2020) | | |
| Type | Dry Van | | |
| Size | 53-ft | | |
| King Pin Location | 36-in | | |
| Tandem Setting | 40-ft 'California' | | |
| Cab to Trailer Gap | 57-in from cab extender to trailer (Adjustable 5th Wheel 41 to 65-in) | | |
| Aero Trailer Gap | 35-in from cab extender to trailer (Adjustable 5th Wheel 19 to 43-in) | | |
| Add-ons | Michelin Energy Guard Full Solution | | |
| | | | |
| | | | |

## 7.2: COMPARE VEHICLE DETAILS

Figure 23: Vehicle Info, Compare Vehicle

| | | | |
|---|---|---|---|
| Date | August 16, 2023 | | |
| Company | Mesilla Valley Transportation Solutions | | |
| Location | Pecos, Texas | | |
| Test Route | Pecos 9-mile Test Track | | |
| | | | |
| **TRUCK** **ID:** | **Veh. B** | | |
| Brand | International | | |
| Date of Manufacture (MY) | 20-Sep-2018 (2019) | | |
| Model | LT 625 | | |
| Engine | Cummins X15 (450 HP/1650 ft-lbs) | | |
| VIN | 3HSDZAPR3KN562087 | | |
| Starting Mileage (miles): | 56,585 | | |
| Transmission | Eaton Endurant 12-speed AMT | | |
| Front Drive Axle | Meritor MT-40-14X-3CFR | | |
| Rear Drive Axle | | | |
| Rear Gear | 2.79 : 1 | | |
| Fuel Load | Full | | |
| Fuel Type & Batch | No. 2 Diesel | | |
| Axle Weights (S,D,T) (lbs) | 11,460 | 33,220 | 33,200 |
| Total weight | 77,880 | | |
| Photo/Video/Audio folder name: | | | |
| | | | |
| **TRAILER** **ID:** | **T-2** | | |
| Model | Hyundai Translead (VC2530152-AJS) | | |
| VIN | 3H3V532C6LR282006 | | |
| Date of Manufacture (MY) | 12/19 (2020) | | |
| Type | Dry Van | | |
| Size | 53-ft | | |
| King Pin Location | 36-in | | |
| Tandem Setting | 40-ft 'California' | | |
| Cab to Trailer Gap | 57-in from cab extender to trailer (Adjustable 5th Wheel 41 to 65-in) | | |
| Aero Trailer Gap | 35-in from cab extender to trailer (Adjustable 5th Wheel 19 to 43-in) | | |
| Add-ons | Michelin Energy Guard Full Solution | | |
| | | | |
| | | | |

## 7.3: TEST ROUTE

Pecos, TX 9-mile circle track. Clockwise direction, middle lane (of 3).

Figure 24: Pecos Test Track

## 7.4: TIRE DETAILS AND PRESSURES

**Note**: tire pressure values shown below were used to calculate the Pressure Comparison and Pressure Growth tables in the Test Results section.

### 7.4a: RUN 2: MICHELIN X LINE ENERGY Z+ AND X LINE ENERGY D+

Figure 25: Run 2 Tire Details (Test Vehicle)

| VehA: Michelin (Test Vehicle) | | | | | | |
|---|---|---|---|---|---|---|
| Set B | | | | | | |
| | | | Truck | A | | |
| LF | | Wheel | Front Axle Tires | Wheel | | RF |
| Michelin X Line Energy Z+ LRH | | | Type | | | Michelin X Line Energy Z+ LRH |
| 295/75R22.5 | | | Size | | | 295/75R22.5 |
| 18 | | Aluminum | Tread Depth (32nds) | Aluminum | | 18 |
| 115.0 | | | Measured Warm-up (psi) | | | 114.0 |
| 115.0 | | | Pressure (psi) Bled to | | | 114.0 |
| 116.0 | | | Pressure (psi) End | | | 115.5 |
| **115.5** | | | **Pressure (psi) Avg.** | | | **114.8** |
| | | | | | | |
| LF-Outer Drive | LF-Inner Drive | | **Drive Axle Tires** | | RF-Inner Drive | RF-Outer Drive |
| Michelin X Line Energy D+ LRG | Michelin X Line Energy D+ LRG | | Type | | Michelin X Line Energy D+ LRG | Michelin X Line Energy D+ LRG |
| 275/80R22.5 | 275/80R22.5 | | Size | | 275/80R22.5 | 275/80R22.5 |
| 21 | 21 | Aluminum | Tread Depth (32nds) | Aluminum | 21 | 21 |
| 111.0 | 112.5 | | Measured Warm-up (psi) | | 112.5 | 111.0 |
| 111.0 | 112.5 | | Pressure (psi) Bled to | | 112.5 | 111.0 |
| 115.0 | 114.0 | | Pressure (psi) End | | 113.5 | 112.5 |
| **113.0** | **113.3** | | **Pressure (psi) Avg.** | | **113.0** | **111.8** |
| | | | | | | |
| LR-Outer Drive | LR-Inner Drive | | **Drive Axle Tires** | | RR-Inner Drive | RR-Outer Drive |
| Michelin X Line Energy D+ LRG | Michelin X Line Energy D+ LRG | | Type | | Michelin X Line Energy D+ LRG | Michelin X Line Energy D+ LRG |
| 275/80R22.5 | 275/80R22.5 | | Size | | 275/80R22.5 | 275/80R22.5 |
| 21 | 21 | Aluminum | Tread Depth (32nds) | Aluminum | 21 | 21 |
| 111.0 | 113.0 | | Measured Warm-up (psi) | | 113.0 | 111.5 |
| 111.0 | 113.0 | | Pressure (psi) Bled to | | 113.0 | 111.5 |
| 112.5 | 115.5 | | Pressure (psi) End | | 115.0 | 113.0 |
| **111.8** | **114.3** | | **Pressure (psi) Avg.** | | **114.0** | **112.3** |
| | | | | | | |
| | | | Trailer | T1 | | |
| LF-Outer Trailer | LF-Inner Drive | | **Tandem Front** | | RF-Inner Drive | 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 |
| 19 | 19 | Aluminum | Tread Depth (32nds) | Aluminum | 19 | 19 |
| 112.5 | 114.0 | | Measured Warm-up (psi) | | 115.0 | 115.0 |
| 112.5 | 114.0 | | Pressure (psi) Bled to | | 115.0 | 115.0 |
| 113.5 | 115.5 | | Pressure (psi) End | | 116.5 | 116.0 |
| **113.0** | **114.8** | | **Pressure (psi) Avg.** | | **115.8** | **115.5** |
| | | | | | | |
| LR-Outer Trailer | LR-Inner Drive | | **Tandem Rear** | | RR-Inner Drive | 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 |
| 19 | 19 | Aluminum | Tread Depth (32nds) | Aluminum | 19 | 19 |
| 112.5 | 114.5 | | Measured Warm-up (psi) | | 115.5 | 114.5 |
| 112.5 | 114.5 | | Pressure (psi) Bled to | | 115.5 | 114.5 |
| 114.0 | 115.5 | | Pressure (psi) End | | 117.0 | 115.5 |
| **113.3** | **115.0** | | **Pressure (psi) Avg.** | | **116.3** | **115.0** |

Figure 26: Run 2 Tire Details (Compare)

# D2R2

## VehB: Michelin (Compare Vehicle)

| | | | Truck | B | | |
|---|---|---|---|---|---|---|
| LF: | | Wheel | Front Axle Tires | Wheel | | RF: |
| Michelin X Line Energy Z | | | Type | | | Michelin X Line Energy Z |
| 275/80R22.5 | | | Size | | | 275/80R22.5 |
| 14 | | Aluminum | Tread Depth (32nds) | Aluminum | | 14 |
| 116.0 | | | Measured Warm-up (psi) | | | 116.0 |
| 116.0 | | | Pressure (psi) Bled to | | | 116.0 |
| 117.7 | | | Pressure (psi) End | | | 118.0 |
| **116.9** | | | **Pressure (psi) Avg.** | | | **117.0** |
| LF-Outer Drive: | | | **Drive Axle Tires** | | | 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 |
| 14 | 15 | Aluminum | Tread Depth (32nds) | Aluminum | 14 | 14 |
| 114.0 | 117.0 | | Measured Warm-up (psi) | | 115.0 | 114.5 |
| 114.0 | 117.0 | | Pressure (psi) Bled to | | 115.0 | 114.5 |
| 115.5 | 119.5 | | Pressure (psi) End | | 117.5 | 116.0 |
| **114.8** | **118.3** | | **Pressure (psi) Avg.** | | **116.3** | **115.3** |
| LR-Outer Drive: | | | **Drive Axle Tires** | | | 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 |
| 14 | 13 | Aluminum | Tread Depth (32nds) | Aluminum | 14 | 13 |
| 114.0 | 117.5 | | Measured Warm-up (psi) | | 117.0 | 115.0 |
| 114.0 | 117.5 | | Pressure (psi) Bled to | | 117.0 | 115.0 |
| 116.0 | 120.0 | | Pressure (psi) End | | 120.0 | 116.5 |
| **115.0** | **118.8** | | **Pressure (psi) Avg.** | | **118.5** | **115.8** |
| | | | Trailer | T2 | | |
| LF-Outer Trailer: | | | **Tandem Front** | | | RF-Outer Trailer |
| Michelin X Line Energy T | Michelin X Line Energy T | | Type | | Michelin X Line Energy T | Bridgestone R123 Ecopia |
| 295/75R22.5 | 295/75R22.5 | | Size | | 295/75R22.5 | 295/75R22.5 |
| 11 | 11 | Aluminum | Tread Depth (32nds) | Aluminum | 10 | 8 |
| 112.5 | 115.0 | | Measured Warm-up (psi) | | 114.0 | 113.5 |
| 112.5 | 115.0 | | Pressure (psi) Bled to | | 114.0 | 113.5 |
| 115.0 | 117.5 | | Pressure (psi) End | | 117.0 | 115.5 |
| **113.8** | **116.3** | | **Pressure (psi) Avg.** | | **115.5** | **114.5** |
| LR-Outer Trailer: | | | **Tandem Rear** | | | 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 |
| 8 | 8 | Aluminum | Tread Depth (32nds) | Aluminum | 8 | 8 |
| 112.0 | 112.5 | | Measured Warm-up (psi) | | 115.5 | 114.0 |
| 112.0 | 112.5 | | Pressure (psi) Bled to | | 115.5 | 114.0 |
| 115.0 | 115.5 | | Pressure (psi) End | | 117.5 | 116.0 |
| **113.5** | **114.0** | | **Pressure (psi) Avg.** | | **116.5** | **115.0** |

## 7.4b: Run 4: Michelin X Line Energy Z+ and X One D2

Figure 27: Run 4 Tire Details (Test Vehicle)

| VehA: Michelin (Test Vehicle) | | | | | | |
|---|---|---|---|---|---|---|
| Set B Steers, Set D Drives | | | | | | |
| | | | Truck | A | | |
| LF | | Wheel | Front Axle Tires | Wheel | | RF |
| Michelin X Line Energy Z+ LRH | | | Type | | | Michelin X Line Energy Z+ LRH |
| 295/75R22.5 | | | Size | | | 295/75R22.5 |
| 18 | | Aluminum | Tread Depth (32nds) | Aluminum | | 18 |
| 118.0 | | | Measured Warm-up (psi) | | | 117.0 |
| 118.0 | | | Pressure (psi) Bled to | | | 117.0 |
| 118.5 | | | Pressure (psi) End | | | 118.0 |
| **118.3** | | | **Pressure (psi) Avg.** | | | **117.5** |
| LF | | | **Drive Axle Tires** | | | RF |
| Michelin X One Line Energy D2 LRL | | | Type | | | Michelin X One Line Energy D2 LRL |
| 445/50R22.5 | | | Size | | | 445/50R22.5 |
| 20 | | Aluminum | Tread Depth (32nds) | Aluminum | | 20 |
| 119.5 | | | Measured Warm-up (psi) | | | 119.0 |
| 119.5 | | | Pressure (psi) Bled to | | | 119.0 |
| 122.0 | | | Pressure (psi) End | | | 122.0 |
| **120.8** | | | **Pressure (psi) Avg.** | | | **120.5** |
| LR | | | **Drive Axle Tires** | | | RR |
| Michelin X One Line Energy D2 LRL | | | Type | | | Michelin X One Line Energy D2 LRL |
| 445/50R22.5 | | | Size | | | 445/50R22.5 |
| 20 | | Aluminum | Tread Depth (32nds) | Aluminum | | 20 |
| 119.0 | | | Measured Warm-up (psi) | | | 119.5 |
| 119.0 | | | Pressure (psi) Bled to | | | 119.5 |
| 122.0 | | | Pressure (psi) End | | | 123.5 |
| **120.5** | | | **Pressure (psi) Avg.** | | | **121.5** |
| | | | Trailer | T1 | | |
| LF-Outer Trailer | LF-Inner Drive | | **Tandem Front** | | RF-Inner Drive | 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 |
| 19 | 19 | Aluminum | Tread Depth (32nds) | Aluminum | 19 | 19 |
| 116.0 | 118.5 | | Measured Warm-up (psi) | | 118.5 | 118.5 |
| 116.0 | 118.5 | | Pressure (psi) Bled to | | 118.5 | 118.5 |
| 116.5 | 119.5 | | Pressure (psi) End | | 120.0 | 119.0 |
| **116.3** | **119.0** | | **Pressure (psi) Avg.** | | **119.3** | **118.8** |
| LR-Outer Trailer | LR-Inner Drive | | **Tandem Rear** | | RR-Inner Drive | 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 |
| 19 | 19 | Aluminum | Tread Depth (32nds) | Aluminum | 19 | 19 |
| 116.5 | 118.5 | | Measured Warm-up (psi) | | 119.5 | 118.0 |
| 116.5 | 118.5 | | Pressure (psi) Bled to | | 119.5 | 118.0 |
| 117.0 | 119.0 | | Pressure (psi) End | | 120.5 | 118.0 |
| **116.8** | **118.8** | | **Pressure (psi) Avg.** | | **120.0** | **118.0** |

Figure 28: Run 4 Tire Details (Compare Vehicle)

# D2R4

## VehB: Michelin (Compare Vehicle)

| | | | | | | |
|---|---|---|---|---|---|---|
| | | | Truck | B | | |
| LF: | | Wheel | Front Axle Tires | Wheel | | RF: |
| Michelin X Line Energy Z | | | Type | | | Michelin X Line Energy Z |
| 275/80R22.5 | | | Size | | | 275/80R22.5 |
| 14 | | Aluminum | Tread Depth (32nds) | Aluminum | | 14 |
| 119.0 | | | Measured Warm-up (psi) | | | 118.5 |
| 119.0 | | | Pressure (psi) Bled to | | | 118.5 |
| 119.0 | | | Pressure (psi) End | | | 119.0 |
| **119.0** | | | **Pressure (psi) Avg.** | | | **118.8** |
| | | | | | | |
| LF-Outer Drive: | | | **Drive Axle Tires** | | | 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 |
| 14 | 15 | Aluminum | Tread Depth (32nds) | Aluminum | 14 | 14 |
| 115.0 | 120.0 | | Measured Warm-up (psi) | | 119.0 | 117.0 |
| 115.0 | 120.0 | | Pressure (psi) Bled to | | 119.0 | 117.0 |
| 115.5 | 120.0 | | Pressure (psi) End | | 118.5 | 117.0 |
| **115.3** | **120.0** | | **Pressure (psi) Avg.** | | **118.8** | **117.0** |
| | | | | | | |
| LR-Outer Drive: | | | **Drive Axle Tires** | | | 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 |
| 14 | 13 | Aluminum | Tread Depth (32nds) | Aluminum | 14 | 13 |
| 116.5 | 121.0 | | Measured Warm-up (psi) | | 121.5 | 117.0 |
| 116.5 | 121.0 | | Pressure (psi) Bled to | | 121.5 | 117.0 |
| 117.0 | 121.0 | | Pressure (psi) End | | 121.5 | 118.5 |
| **116.8** | **121.0** | | **Pressure (psi) Avg.** | | **121.5** | **117.8** |
| | | | | | | |
| | | | Trailer | T2 | | |
| LF-Outer Trailer: | | | **Tandem Front** | | | RF-Outer Trailer |
| Michelin X Line Energy T | Michelin X Line Energy T | | Type | | Michelin X Line Energy T | Bridgestone R123 Ecopia |
| 295/75R22.5 | 295/75R22.5 | | Size | | 295/75R22.5 | 295/75R22.5 |
| 11 | 11 | Aluminum | Tread Depth (32nds) | Aluminum | 10 | 8 |
| 116.0 | 118.0 | | Measured Warm-up (psi) | | 118.0 | 116.0 |
| 116.0 | 118.0 | | Pressure (psi) Bled to | | 118.0 | 116.0 |
| 114.5 | 118.0 | | Pressure (psi) End | | 117.5 | 116.0 |
| **115.3** | **118.0** | | **Pressure (psi) Avg.** | | **117.8** | **116.0** |
| | | | | | | |
| LR-Outer Trailer: | | | **Tandem Rear** | | | 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 |
| 8 | 8 | Aluminum | Tread Depth (32nds) | Aluminum | 8 | 8 |
| 115.5 | 117.0 | | Measured Warm-up (psi) | | 118.0 | 117.0 |
| 115.5 | 117.0 | | Pressure (psi) Bled to | | 118.0 | 117.0 |
| 115.0 | 118.0 | | Pressure (psi) End | | 118.5 | 117.0 |
| **115.3** | **117.5** | | **Pressure (psi) Avg.** | | **118.3** | **117.0** |

## 7.4c: Run 5: Michelin X Line Energy Z and X Line Energy D (Comparison Tires)

Figure 29: Run 5 Tire Details (Test Vehicle)

| VehA: Michelin (Test Vehicle) | | | | | | |
|---|---|---|---|---|---|---|
| Set A | | | | | | |
| | | | Truck | A | | |
| LF | | Wheel | Front Axle Tires | Wheel | | RF |
| Michelin X Line Energy Z LRH | | | Type | | | Michelin X Line Energy Z LRH |
| 275/80R22.5 | | | Size | | | 275/80R22.5 |
| 14 | | Aluminum | Tread Depth (32nds) | Aluminum | | 14 |
| 118.0 | | | Measured Warm-up (psi) | | | 117.5 |
| 118.0 | | | Pressure (psi) Bled to | | | 117.5 |
| 118.0 | | | Pressure (psi) End | | | 117.0 |
| **118.0** | | | **Pressure (psi) Avg.** | | | **117.3** |
| | | | | | | |
| LF-Outer Drive | LF-Inner Drive | | **Drive Axle Tires** | | RF-Inner Drive | RF-Outer Drive |
| Michelin X Line Energy D LRG | Michelin X Line Energy D LRG | | Type | | Michelin X Line Energy D LRG | Michelin X Line Energy D LRG |
| 275/80R22.5 | 275/80R22.5 | | Size | | 275/80R22.5 | 275/80R22.5 |
| 14 | 15 | Aluminum | Tread Depth (32nds) | Aluminum | 14 | 14 |
| 115.0 | 117.5 | | Measured Warm-up (psi) | | 117.5 | 115.5 |
| 115.0 | 117.5 | | Pressure (psi) Bled to | | 117.5 | 115.5 |
| 115.5 | 118.5 | | Pressure (psi) End | | 117.5 | 115.0 |
| **115.3** | **118.0** | | **Pressure (psi) Avg.** | | **117.5** | **115.3** |
| | | | | | | |
| LR-Outer Drive | LR-Inner Drive | | **Drive Axle Tires** | | RR-Inner Drive | RR-Outer Drive |
| Michelin X Line Energy D LRG | Michelin X Line Energy D LRG | | Type | | Michelin X Line Energy D LRG | Michelin X Line Energy D LRG |
| 275/80R22.5 | 275/80R22.5 | | Size | | 275/80R22.5 | 275/80R22.5 |
| 13 | 14 | Aluminum | Tread Depth (32nds) | Aluminum | 13 | 13 |
| 116.0 | 117.0 | | Measured Warm-up (psi) | | 119.0 | 116.0 |
| 116.0 | 117.0 | | Pressure (psi) Bled to | | 119.0 | 116.0 |
| 116.5 | 117.5 | | Pressure (psi) End | | 119.0 | 116.0 |
| **116.3** | **117.3** | | **Pressure (psi) Avg.** | | **119.0** | **116.0** |
| | | | | | | |
| | | | Trailer | T1 | | |
| LF-Outer Trailer | LF-Inner Drive | | **Tandem Front** | | RF-Inner Drive | 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 |
| 19 | 19 | Aluminum | Tread Depth (32nds) | Aluminum | 19 | 19 |
| 115.5 | 118.0 | | Measured Warm-up (psi) | | 118.5 | 118.5 |
| 115.5 | 118.0 | | Pressure (psi) Bled to | | 118.5 | 118.5 |
| 113.5 | 116.5 | | Pressure (psi) End | | 117.0 | 116.0 |
| **114.5** | **117.3** | | **Pressure (psi) Avg.** | | **117.8** | **117.3** |
| | | | | | | |
| LR-Outer Trailer | LR-Inner Drive | | **Tandem Rear** | | RR-Inner Drive | 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 |
| 19 | 19 | Aluminum | Tread Depth (32nds) | Aluminum | 19 | 19 |
| 116.0 | 118.0 | | Measured Warm-up (psi) | | 119.5 | 117.0 |
| 116.0 | 118.0 | | Pressure (psi) Bled to | | 119.5 | 117.0 |
| 114.0 | 116.5 | | Pressure (psi) End | | 117.5 | 115.0 |
| **115.0** | **117.3** | | **Pressure (psi) Avg.** | | **118.5** | **116.0** |

Figure 30: Run 5 Tire Details (Compare Vehicle)

# D2R5

## VehB: Michelin (Compare Vehicle)

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | | Truck | B | | | |
| LF: | | Wheel | Front Axle Tires | Wheel | | | RF: |
| Michelin X Line Energy Z | | | Type | | | | Michelin X Line Energy Z |
| 275/80R22.5 | | | Size | | | | 275/80R22.5 |
| 14 | | Aluminum | Tread Depth (32nds) | Aluminum | | | 14 |
| 118.0 | | | Measured Warm-up (psi) | | | | 117.5 |
| 118.0 | | | Pressure (psi) Bled to | | | | 117.5 |
| 117.0 | | | Pressure (psi) End | | | | 116.0 |
| **117.5** | | | **Pressure (psi) Avg.** | | | | **116.8** |
| | | | | | | | |
| LF-Outer Drive: | | | **Drive Axle Tires** | | | | 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 |
| 14 | 15 | Aluminum | Tread Depth (32nds) | Aluminum | 14 | | 14 |
| 114.0 | 119.0 | | Measured Warm-up (psi) | | 117.5 | | 116.5 |
| 114.0 | 119.0 | | Pressure (psi) Bled to | | 117.5 | | 116.5 |
| 113.0 | 118.0 | | Pressure (psi) End | | 116.0 | | 114.5 |
| **113.5** | **118.5** | | **Pressure (psi) Avg.** | | **116.8** | | **115.5** |
| | | | | | | | |
| LR-Outer Drive: | | | **Drive Axle Tires** | | | | 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 |
| 14 | 13 | Aluminum | Tread Depth (32nds) | Aluminum | 14 | | 13 |
| 115.5 | 119.0 | | Measured Warm-up (psi) | | 119.0 | | 117.0 |
| 115.5 | 119.0 | | Pressure (psi) Bled to | | 119.0 | | 117.0 |
| 114.5 | 118.0 | | Pressure (psi) End | | 117.5 | | 115.0 |
| **115.0** | **118.5** | | **Pressure (psi) Avg.** | | **118.3** | | **116.0** |
| | | | | | | | |
| | | | Trailer | T2 | | | |
| | | | | | | | |
| LF-Outer Trailer: | | | **Tandem Front** | | | | RF-Outer Trailer |
| Michelin X One Line Energy T2 | Michelin X One Line Energy T2 | | Type | | Michelin X Line Energy T | | Bridgestone R123 Ecopia |
| 295/75R22.5 | 295/75R22.5 | | Size | | 295/75R22.5 | | 295/75R22.5 |
| 11 | 11 | Aluminum | Tread Depth (32nds) | Aluminum | 10 | | 8 |
| 112.0 | 116.5 | | Measured Warm-up (psi) | | 116.5 | | 115.0 |
| 112.0 | 116.5 | | Pressure (psi) Bled to | | 116.5 | | 115.0 |
| 111.0 | 116.0 | | Pressure (psi) End | | 113.0 | | 113.0 |
| **111.5** | **116.3** | | **Pressure (psi) Avg.** | | **114.8** | | **114.0** |
| | | | | | | | |
| LR-Outer Trailer: | | | **Tandem Rear** | | | | 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 |
| 8 | 8 | Aluminum | Tread Depth (32nds) | Aluminum | 8 | | 8 |
| 114.0 | 116.0 | | Measured Warm-up (psi) | | 117.0 | | 116.0 |
| 114.0 | 116.0 | | Pressure (psi) Bled to | | 117.0 | | 116.0 |
| 112.0 | 114.0 | | Pressure (psi) End | | 114.0 | | 114.0 |
| **113.0** | **115.0** | | **Pressure (psi) Avg.** | | **115.5** | | **115.0** |

## 7.5: WEATHER CONDITIONS

Weather during testing was fair with low wind for most of the testing period. Maximum wind was 10 MPH with gusts up to 16 MPH for a 1-hour period. Temperatures ranged from 74°F to 103°F. Weather data was acquired from a local Weather Underground weather station. Source shown in Table 13 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 13: Weather Data, August 16, 2023

| Time | Temperature | Dew Point | Humidity | Wind | Wind Speed | Wind Gust | Pressure | Precip. | Condition |
|---|---|---|---|---|---|---|---|---|---|
| 12:10 AM | 84 °F | 54 °F | 36 % | CALM | 0 mph | 0 mph | 27.38 in | 0.0 in | Fair |
| 1:10 AM | 80 °F | 54 °F | 40 % | CALM | 0 mph | 0 mph | 27.38 in | 0.0 in | Fair |
| 2:10 AM | 79 °F | 54 °F | 41 % | CALM | 0 mph | 0 mph | 27.37 in | 0.0 in | Fair |
| 3:10 AM | 77 °F | 54 °F | 44 % | CALM | 0 mph | 0 mph | 27.36 in | 0.0 in | Fair |
| 4:10 AM | 76 °F | 54 °F | 46 % | CALM | 0 mph | 0 mph | 27.37 in | 0.0 in | Fair |
| 5:10 AM | 74 °F | 54 °F | 49 % | CALM | 0 mph | 0 mph | 27.36 in | 0.0 in | Fair |
| 6:10 AM | 74 °F | 53 °F | 49 % | CALM | 0 mph | 0 mph | 27.37 in | 0.0 in | Fair |
| 7:10 AM | 74 °F | 54 °F | 48 % | CALM | 0 mph | 0 mph | 27.37 in | 0.0 in | Fair |
| 8:10 AM | 74 °F | 55 °F | 51 % | CALM | 0 mph | 0 mph | 27.38 in | 0.0 in | Fair |
| 9:10 AM | 80 °F | 56 °F | 44 % | CALM | 0 mph | 0 mph | 27.39 in | 0.0 in | Fair |
| 10:10 AM | 84 °F | 57 °F | 39 % | CALM | 0 mph | 0 mph | 27.39 in | 0.0 in | Fair |
| 11:10 AM | 90 °F | 57 °F | 32 % | CALM | 0 mph | 0 mph | 27.39 in | 0.0 in | Fair |
| 12:10 PM | 94 °F | 56 °F | 27 % | SSW | 3 mph | 0 mph | 27.37 in | 0.0 in | Fair |
| 1:10 PM | 96 °F | 54 °F | 24 % | CALM | 0 mph | 0 mph | 27.34 in | 0.0 in | Fair |
| 2:10 PM | 99 °F | 53 °F | 21 % | CALM | 0 mph | 0 mph | 27.32 in | 0.0 in | Fair |
| 3:10 PM | 101 °F | 51 °F | 19 % | CALM | 0 mph | 0 mph | 27.29 in | 0.0 in | Fair |
| 4:10 PM | 102 °F | 48 °F | 16 % | ENE | 10 mph | 16 mph | 27.26 in | 0.0 in | Fair |
| 5:10 PM | 103 °F | 47 °F | 15 % | SW | 3 mph | 0 mph | 27.24 in | 0.0 in | Partly Cloudy |
| 6:10 PM | 102 °F | 47 °F | 15 % | E | 3 mph | 0 mph | 27.22 in | 0.0 in | Fair |
| 7:10 PM | 101 °F | 48 °F | 17 % | CALM | 0 mph | 0 mph | 27.21 in | 0.0 in | Fair |
| 8:10 PM | 99 °F | 49 °F | 18 % | CALM | 0 mph | 0 mph | 27.21 in | 0.0 in | Fair |
| 9:10 PM | 94 °F | 47 °F | 20 % | ESE | 8 mph | 0 mph | 27.23 in | 0.0 in | Fair |
| 10:10 PM | 89 °F | 47 °F | 23 % | CALM | 0 mph | 0 mph | 27.24 in | 0.0 in | Fair |
| 11:10 PM | 87 °F | 48 °F | 26 % | CALM | 0 mph | 0 mph | 27.26 in | 0.0 in | Fair |

Source: https://www.wunderground.com/history/daily/us/tx/pecos/KPEQ/date/2022-8-16

## 7.6: PRODUCT COMPANY INFORMATION

- Michelin North America, Inc.
  One Parkway South, Greenville, SC 29615 USA
  www.michelintruck.com

## 7.7: TEST PERSONNEL

7.7a: MVT SOLUTIONS

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

7.7b: DRIVERS

- Allan Dahringer
- John Rintelen
- Carlos Aragon
- Jack Burchell

7.7c: MICHELIN

- Bill Walmsley, Product Category Manager: Line Haul & Coach Tires
  Business Line - Long Distance Transportation
- Jim Garrett, AMN B2B Product Marketing
  Long Distance Transportation (LB4)
- Robert Powell, Product Performance & Data Manager

## 7.8: MVT SOLUTIONS CONTACT INFO

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