

**NATIONAL TRANSPORTATION SAFETY
BOARD**

Vehicle Performance Division Washington, D.C.
20594

July 29, 2020

Brake Performance Study

By Shane K. Lack

A. Crash Information

Date: October 6, 2018

Location: Intersection of New York State Routes 30 and 30A, near
Schoharie, Schoharie County, New York

Vehicle #1: 2001 Ford Excursion 18-passenger limousine

Operator #1: Prestige Limousine & Chauffeur Service, Gansevoort, New York

Vehicle #2: 2015 Toyota Highlander

Operator #2: Private citizen

NTSB #: HWY19MH001

B. Group

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C. Crash Summary

For a summary of the crash, refer to the *Crash Summary Report* in the docket for this investigation.

D. Details of Study

1.0 Introduction

In this accident a 2001 Ford Excursion, which had been modified into a limousine, crashed at a high rate of speed after descending a steep grade along State Route 30. The limousine failed to stop at a stop sign at the intersection of State Routes 30 and 30A. It crossed State Route 30A and entered a restaurant parking lot, where it collided with a parked 2015 Toyota Highlander. The limousine continued across the parking lot into a ravine, where it collided with the earthen embankment.

The vehicle involved in the accident was a 2001 Ford Excursion, which had been modified into a limousine by extending the length and modifying the interior to accommodate a bar and additional passenger seating. As a result of the modifications the estimated weight of the limousine at the time of the accident, 13565 lbs, exceeded the original gross vehicle weight rating (GVWR) of the Excursion when it was manufactured by Ford, which was 8600 lbs. No evidence was found during the investigation that the limousine or its brake system had been certified as conforming to the Federal Motor Vehicle Safety Standard (FMVSS) 105 (49 Code of Federal Regulations (CFR) Part 571.105) *Hydraulic and Electrical Brake Systems* requirements at the accident weight. The testing described in this report addresses concerns that the limousine at the accident weight (13565 lbs) with properly functioning brakes would not have had sufficient braking capacity to have safely negotiated the accident route or to have met the FMVSS 105 stopping distance requirements.

Following the accident NTSB investigators proposed using the performance-based criteria of FMVSS 105 as a baseline to evaluate the service brake performance of an Excursion operating at the accident weight with a properly functioning brake system. Additional inertia brake dynamometer testing was also proposed to simulate braking performance over the route the vehicle traveled. In order to accomplish this testing a contract was awarded to Greening Testing Laboratories, Inc. (GTL), of Detroit, Michigan.

As part of the NTSB contract with Greening, testing was conducted by the Nevada Automotive Test Center (NATC), Carson City, Nevada, with an exemplar Excursion, loaded to the accident weight and equipped with Ford recommended (Original Equipment – OE) brake components. The brake parts used in the testing were identified based on the Vehicle Identification Number (VIN) of the accident vehicle. The objective of the brake evaluation was to estimate if the limousine at the accident weight with a properly functioning brake system would have been able to meet the FMVSS 105 stopping distance and fade and recovery requirements for a vehicle other than a school bus with a GVWR greater than 10000 lbs. The first and second fade and recovery maneuvers are optional for vehicles with a GVWR of greater than 10000 lbs, but these tests were included in the study to address specific concerns regarding brake fade. The exemplar testing was also used to develop vehicle-specific data such as brake cooling and coast down curves for use in subsequent simulations.

Additional testing was conducted by Greening at its test facilities in Detroit, using Ford Motor Company branded replacement brake parts available through the Ford distribution channel for the unmodified Excursion in a dual-end inertia brake dynamometer. (These parts were identified based in the VIN of the accident vehicle.) This testing included using the dynamometer to simulate the braking

performance over the accident route. The objective of the simulations was to estimate if the limousine at the accident weight with a properly functioning brake system could have safely negotiated the accident route at the posted speed limit. Data on brake cooling and parasitic drag measured during the exemplar testing was used in the simulations to model brake cooling and parasitic energy losses. Energy losses/gains due to the road grade were accounted for in the simulations.

The remainder of this report contains a summary and discussion of the testing and the results. The full results of the testing are available in the attachments to this report.

2.0 Brake Components used in Testing

For the purposes of this report, brake components are broken down into categories as follows:

- Original Equipment Manufacturer (OEM) - Brake components (brakes, pads, rotors, etc.) that are installed during the vehicle build at the factory.
- Original Equipment Service (OES) - Brake components (brakes, pads, rotors, etc.) installed/purchased at the dealership, generally available for the first three years of the vehicle's life. Distributed under the vehicle manufacturer's name (General Motors (GM), Ford, Fiat Chrysler Automobiles (FCA)) through a channel different than the aftermarket distribution channel. These 'brands' are not usually available for makes/models other than those of the OEM. Additionally, these parts may be the same as the OEM as described above. If not the same as the OEM, they would most likely carry a different part number than the parts distributed through the Original Equipment Aftermarket.
- Original Equipment Aftermarket (OEA) – Brake components (brakes, pads, rotors, etc.) installed/purchased at the dealership or authorized distributor, available for a minimum of 10 years after the vehicle's last build date as required by law. Distributed under the vehicle manufacturer's aftermarket channel (GM = ACDelco, Ford = Motorcraft, FCA = Mopar, etc.) These 'brands' also many times have parts available for makes/models other than those of the OEM.
Please note that the OES and OEA products can also sometimes be one in the same.
- Traditional Aftermarket - Brake components (brakes, pads, rotors etc.) available through companies or retailers not generally engaged in providing products at the OEM or OES level.

These categories are based on discussions with industry. The reason for separating the brake parts into these categories is that performance of the brake components may differ depending on which category it falls under. The parts used in the testing for this investigation fall under the "OEA" category and are referred to as "OEA" or "Ford recommended OEA" in the text of this report (OES and OEM parts were no longer available). When OEA parts are referred to in this report it is referring to the Ford recommended OEA parts for the original unmodified 2001 Ford Excursion on which the accident limousine was built. These are the parts that a customer would purchase if they walked into the Ford dealership or supplier and purchased replacement parts based on the VIN number on the limousine.

In the text of the report the term "aftermarket" is used solely to describe parts that fall under the "traditional aftermarket" category. There are no FMVSS standards requiring that any replacement brake parts such as rotors and pads perform the same as the OE brake parts when placed on the vehicle. With the exceptions of federal requirements regarding brake hoses (FMVSS 106) and brake fluids (FMVSS 116) there are no federal requirements governing the quality or performance of replacement brake

components.

The brakes from the accident vehicle were not tested for this investigation. The objective of this project was to assert what would have been possible had the vehicle been properly maintained, independent of whatever brake and suspension upfitting should have been undertaken at the time of the limousine conversion. (It would be unlikely that someone would intentionally reduce the braking capacity when increasing the weight of a vehicle.) The tests were conducted using Ford recommended brake calipers, pads, and rotors (OEA) specified for the unmodified Excursion on which the accident limousine was built. OEA parts were chosen for the study because it is believed they best represent how Ford, the original manufacturer of the vehicle, intended the braking system to function. As indicated earlier these are the parts that a customer would purchase if they walked into the Ford dealership or supplier and purchased replacement parts based on the VIN number on the limousine. There is no evidence (such as FMVSS 105 certification) that Ford ever intended the brake design on the unmodified Ford Excursion to be used on a vehicle at the accident weight of 13565 lbs.

Due to an ongoing law enforcement investigation the brake parts from the accident vehicle were not available to the NTSB to be used in the testing and there was limited access for inspection. The manufacturer of the front brake pads on the accident vehicle could not be identified so it was not possible to test exemplar parts that were the same make and model as those on the accident vehicle.

3.0 Vehicle Testing/ FMVSS 105 Testing/ Brake Performance

3.1 Introduction

As part of the NTSB contract with Greening a brake performance evaluation was conducted by NATC using the test procedures in the National Highway Traffic Safety Administration's (NHTSA) Federal Motor Vehicle Safety Standard (FMVSS) 105 *Hydraulic and Electrical Brake Systems* for vehicles with a GVWR of greater than 10000 lbs. The testing focused on the performance standard portions of the FMVSS 105 testing specifically addressing brake fade and stopping distances since these were considered most relevant to the accident. This section of the report contains a short summary of the testing. A complete description of the testing is contained in Attachment 1. The 105 testing did not cover the entire FMVSS protocol since the results were intended as a performance baseline and not to establish regulatory compliance.

The vehicle used in the evaluation was a 2000 Ford Excursion XLT 4X2 shown in Figure 1. Brake components used in the testing were new OEA brake components that would have been specified for the unmodified accident vehicle. The vehicle instrumentation for the testing is described in Attachment 1.

Two different vehicle weights were used in the testing. The Heavy Test Load (HTL), 13555 lbs, was used to represent the estimated weight of the limousine when the accident occurred. The Light Test Load (LTL) used in the testing was 10145 lbs, which was the estimated weight of the limousine with a driver, fluids, and instrumentation.



Figure 1 – Test Vehicle

3.2 Evaluation of FMVSS 105 Stopping Distance Requirements

The purpose of the FMVSS 105 standard is to ensure safe braking performance under normal and emergency conditions. To ensure safe braking performance the standard requires that the service brakes be capable of stopping each vehicle in effectiveness tests within specific distances and speeds.

To estimate if the limousine at the accident weight with a properly functioning brake system would have been able to meet the stopping distance requirements for a vehicle other than a school bus with a GVWR of greater than 10000 lbs, a series of FMVSS 105 test procedures were performed using the exemplar Excursion. The FMVSS 105 test procedures performed as part of the evaluation include the first, second and third effectiveness tests, the system partial failure tests, antilock brake systems (ABS) failure test, and the inoperative power assist test. This set of maneuvers included all the tests required to evaluate the FMVSS 105 stopping distance requirements for a vehicle with a GVWR of greater than 10000 lbs. For a complete description of the testing and requirements please refer to Attachment 1 and the *49 CFR Part 571.105*. In the FMVSS 105 test procedures the HTL weight (13555 lbs) was used for the GVWR weight and the LTL weight (10145 lbs) was used for the Lightly Loaded Vehicle Weight (LLVW).

The results of the FMVSS 105 testing performed with the exemplar Excursion are summarized in Table 1 along with the applicable stopping distance requirements from FMVSS 105. As indicated by the data in the table the exemplar Excursion was able to meet all the FMVSS 105 stopping distance requirements for a vehicle with GVWR above 10000 lbs with the exception of the inoperative power boost requirement, which resulted in stopping distances that exceeded the standard's requirement.

The original GVWR of the accident Excursion as it was manufactured by Ford was 8600 lbs. As indicated by the data in Table 1 if the FMVSS stopping distance requirements for vehicles with a GVWR of 8000 to 10000 lbs were applied to the results of the exemplar Excursion testing it would have exceeded six of the thirteen stopping distance requirements for a vehicle with a GVWR of 8600 lbs.

Result summary: The testing with the exemplar Excursion indicates that the limousine at the accident weight of 13565 lbs with a properly functioning braking system would have been able to meet all of the FMVSS 105 stopping distance requirements for a vehicle with a GVWR above 10000 lbs, with the exception of the inoperative power boost requirement.

(It should be noted that there are two options available when performing the inoperative power boost test. The “Regular Procedure” was used for the testing and consists of rendering the brake assist unit inoperative and exhausting the reserve before performing the stopping maneuvers. A second option for the inoperative brake boost test, the “Optional Procedure”, does not deplete the power boost prior to the stopping portion of the test. The “Optional Procedure” was not performed as part of this study.)

3.3 FMVSS 105 Fade and Recovery Testing

One of the concerns in this accident was the potential for increased risk of brake fade associated with the greater vehicle weight resulting from the modifications.

The portion of the FMVSS 105 testing which deals most directly with the brake fade are the first and second fade and recovery tests. The FMVSS 105 first and second fade and recovery test maneuver procedures for a vehicle over 10000 lbs consists of a series of brake snubs from speeds of 40 to 20 mph. (FMVSS defines a “snub” as the braking deceleration of a vehicle from a higher reference speed to a lower reference speed that is greater than zero.) Timing and/or distances between the snubs are specified in the text of FMVSS 105. In order to pass the test, the vehicle must meet requirements for deceleration rates and pedal force listed in the text of the FMVSS 105.

A FMVSS 105 first and second fade recovery test was conducted with the exemplar Excursion at the accident (HTL) weight.

The results of the first and second fade and recovery tests are described in Table 9 of Attachment 1. The results of the tests indicate that the exemplar Excursion was able to meet the FMVSS 105 requirements for the first and second fade/recovery test procedures for vehicles with a GVWR of over 10000 lbs.

Result Summary: The results of the testing with the exemplar Excursion indicates that the limousine at the accident weight of 13565 lbs with a properly functioning brake system would have been able to pass the FMVSS 105 test requirements for the first and second fade and recovery procedures for vehicles with a GVWR over 10000 lbs.

3.4 Comparisons of Stopping Distance Results with Ford Data

Ford Motor Company also provided their FMVSS 105 test results for vehicles with a similar braking system. The stopping distances from the FMVSS 105 testing with the exemplar Excursion are shown in Table 2 along with the results of Ford's FMVSS 105 tests. As indicated by the data in the table the stopping distances were significantly greater for the exemplar Excursion which was heavier than the two vehicles used in the 105-test examples provided by Ford. While the data indicates the stopping distances were greater for the exemplar Excursion than for the vehicles Ford tested, the results still fell within the FMVSS 105 stopping distance requirements for vehicles with a GVWR of greater than 10000 lbs with the exception of the inoperative power boost stopping distance requirement.

Table 1 – Stopping Distances from the Exemplar Excursion Test (HTL weight = 13555 lbs, LTL weight = 10145 lbs)

Meets ≥ 8000 lb & ≤ 10,000 lb and > 10,000 lb	Only meets requirements for > 10,000 lb	Does not meet any Requirements
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FMVSS 105 Test Procedure for Stopping Distance Evaluation	FMVSS 105 Requirement For ≥ 8000 lbs & ≤ 10000 lbs (ft)	FMVSS 105 Requirement For >10000 lbs (ft)	Measured Stopping Distance (ft)	Measured Pedal Force (lbs) **
First Effectiveness (HTL) 30 mph*	72	88	84.2	135.5
First Effectiveness (HTL) 60mph	267	388	337.4	142.6
Second Effectiveness (HTL) 30 mph	57	78	64.2	142.2
Second Effectiveness (HTL) 60 mph	216	310	268.8	137.5
Third effectiveness (LTL) 60 mph	242	335	208.5	134.0
Partial Systems Fail front (LTL) 60 mph	517	613	445.2	144.6
Partial Systems Fail Rear (LTL) 60 mph	517	613	361.7	140.9
Partial Systems Fail Front (HTL) 60 mph	517	613	594.1	146.5
Partial Systems Fail Rear (HTL) 60 mph	517	613	466.9	124.8
ABS Failure (HTL), 60 mph	517	613	269.7	128.7
Inoperative Power Assist (HTL), 60 mph	517	613	718.5	151.7
Fourth Effectiveness 30 mph* (HTL)	72	88	70.8	130.6
Fourth effectiveness 60 mph* (HTL)	267	388	260.7	129.7

*Not Required for non-school buses with GVWR's of Greater than 10,000 lbs

** Pedal Force limits are 15 to 150 lbs

Table 2 – Comparison of Exemplar Excursion Stopping Distances with Results of Ford FMVSS 105 Tests with Similar Brake Systems. The First Two Columns of the Table Contain the Data Provided by Ford. The Weights in the Top Row of the Table are the GVW's of the vehicle used in the Testing.

Test	2000 Ford Excursion 8600 lbs Stopping Distance (ft)	1999 Ford Pickup Truck 11253 lbs Stopping Distance (ft)	Exemplar NATC 2000 Ford Excursion 13565 lbs Stopping Distance (ft)
First Effectiveness (GVW) 30 mph*	49.5	54.8	84.2
First Effectiveness (GVW) 60mph	192.0	209.3	337.4
Second Effectiveness (GVW) 30 mph	47.6	52.9	64.2
Second Effectiveness (GVW) 60 mph	174.3	200.7	268.8
Third Effectiveness (LLVW) 60 mph	170.3	169.4	208.5
Partial Systems Fail Front (LLVW) 60 mph	364	393.4	445.2
Partial Systems Fail Rear (LLVW) 60 mph	241	251.9	361.7
Partial Systems Fail Front (GVW) 60 mph	352.1	449.2	594.1
Partial Systems Fail Rear (GVW) 60 mph	289.5	414.0	466.9
ABS Failure (GVW) 60 mph	174.1	243.7	269.7
Inoperative Power Assist (GVW) 60 mph	416.8	494.2	718.5
Fourth Effectiveness (GVW) 30 mph*	46.1		70.8
Fourth effectiveness (GVW) 60 mph*	161.7		260.7
Fourth effectiveness (GVW) 80 mph* (Ford)	305.5		

*Not Required of for non-school buses with GVWR's of Greater than 10,000 lbs

4.0 Dual- End Dynamometer Tests

4.1 Description of Dynamometer Testing

The accident vehicle was equipped with four-wheel disc brakes. When applied, the brakes generate torque which slow the rotation of the tires. As the tires rotate more slowly the contact patch with the road deforms or “stretches” generating forces which in turn slow the vehicle. During normal braking (when tire slip is low) most of the kinetic energy is dissipated as heat generated by the friction between the brake pad and the rotor.

The magnitude of the torque generated by a brake can vary significantly depending on the brake’s temperature, speed, and pressure. A tool used to measure the relationships among brake torque, speed, brake pressure and brake temperature is an inertia brake dynamometer. An inertia brake dynamometer uses a rotating mass and actual brake components to measure braking performance.

To evaluate the braking performance of the OEA brakes for the accident vehicle a series of tests were conducted using a dual-end dynamometer and Ford recommended OEA brake components. A dual-end brake dynamometer is a brake dynamometer in which two brake assemblies can act simultaneously on a common rotating inertia mass. Typically, a front and rear brake assembly of a vehicle are tested together to simulate a vehicle braking system. A sketch and photograph of the dynamometer used in this testing are shown in Figure 2. In order to model the energy of a vehicle using a dual-end dynamometer, one-half the total vehicle inertia is installed on the dynamometer according to equation (1). Various braking conditions can be modeled by rotating the inertia at targeted speeds and applying braking to slow the rotating mass. The brake torque, pressure, speed, and temperature values are recorded during the testing. One of the advantages of a dual-end dynamometer is that since the pressure is applied simultaneously at each brake as it is in a vehicle, the work fraction at each brake is known.

$$(1) \quad \text{Test Inertia} = \frac{1}{2} * \left(\frac{\text{Vehicle Weight}}{\text{Gravity}} \right) * (\text{Rolling Radius of Tires})^2$$

It is possible to model the cooling of the brakes by varying the air flow across the brakes during testing to reflect the cooling rates as measured on the vehicle. Air flow can be calibrated using vehicle specific brake data. The effects of road grades can be modeled by adding or reducing energy (inertia) using the drive motor in Figure 2.

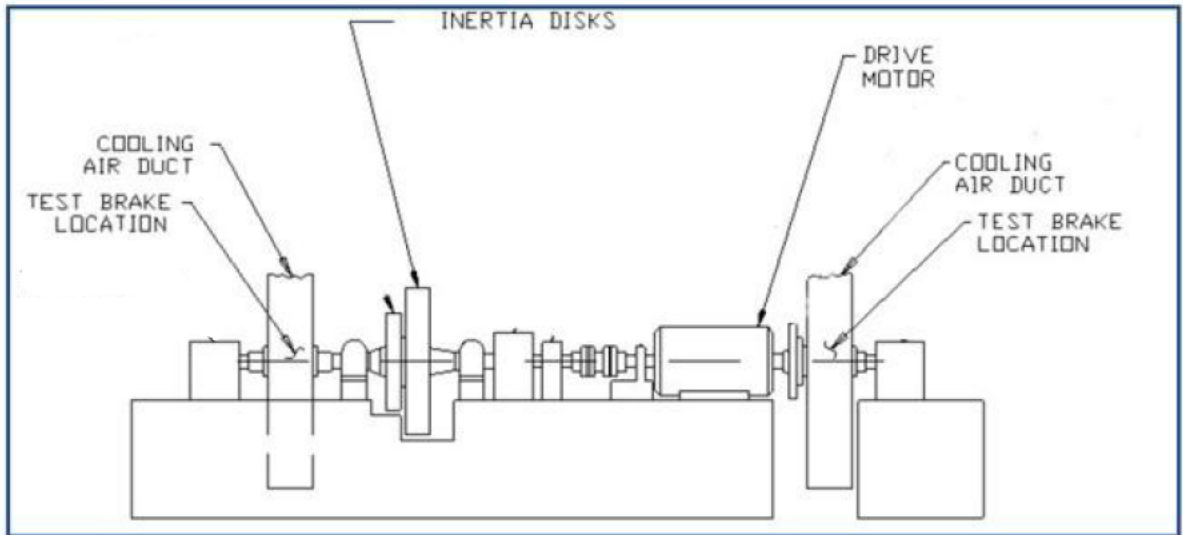


Figure 2 – Dual-End Brake Dynamometer

4.2 Brake Performance Matrix

To evaluate the overall brake performance a series of tests were conducted by Greening at its testing facility in Detroit using the dual-end inertia brake dynamometer. The brake parts used in the testing were new OEA brake components that are specified for the unmodified accident vehicle. The weight of the vehicle modeled in the tests was the accident weight of 13565 lbs. The objective of the testing was to measure the brake torques over a wide range of speeds, brake temperatures, and brake pressures.

The brake performance test matrix used in the testing consisted of a series of 10 mph snubs over ranges of initial speeds (50 to 65 mph in 5 mph increments), initial brake pressures (400 psi to 1800 psi, in 200 psi increments), and initial front brake temperatures (300 F to 900 F, in 150 F increments). Since the testing was performed on a dual-end dynamometer the initial temperature of the rear brake was less than the initial temperature for the front brake. (The rear brake is cooler than the front brake in the matrix test because it did less work than the front and the energy absorbed by the rear disc as a fraction of its mass (KE/kg) may be less, allowing it to dissipate heat more quickly than the front. The use of a dual-end dynamometer does not automatically create a situation in which the rear brake must be cooler.) In addition to the snubs the performance matrix included a full effort stop from 55 mph to 0, at 1800 psi which was performed at each initial application temperature (300 F to 900 F in 150 F increments). In order to evaluate repeatability, the test matrix was performed twice. A simulated FMVSS 105 burnish was performed prior to the matrix sequences.

The results of the test matrix are contained in Attachment 2 of this report.

5.0 Simulations

5.1 Introduction/Description of the Dynamometer Simulations

Due to GVWR restrictions on vehicles with brake systems similar to those of the limousine's it was not possible to drive an exemplar vehicle at the accident weight over the same route the limousine traveled to test how a properly functioning brake system would have performed. To evaluate the braking of the limousine along the accident route a series of simulations were performed using the dual-end inertia brake dynamometer with OEA brake parts specified for the unmodified Excursion at the Greening test facility in Detroit. A summary of the simulations/results are contained in this section. For the actual test reports please refer to Attachments 3-6 of this report.

The route of the limousine modeled in the simulations is shown in Figure 3. The simulated route included the portion of the limousine's route from where it first entered Interstate 90 up to the stop sign at the intersection of New York State Route 30 and New York State Route 30A where the crash occurred. In total more than 30 miles of the limousine's route prior to the crash were modeled in the simulations. The road profile along the simulated route is shown in Figure 4. As illustrated by the diagram the simulated route included two long descents that occurred prior to the crash. These descents are where the brake temperatures would have tended to increase significantly, and the risk of brake fade would be the greatest.

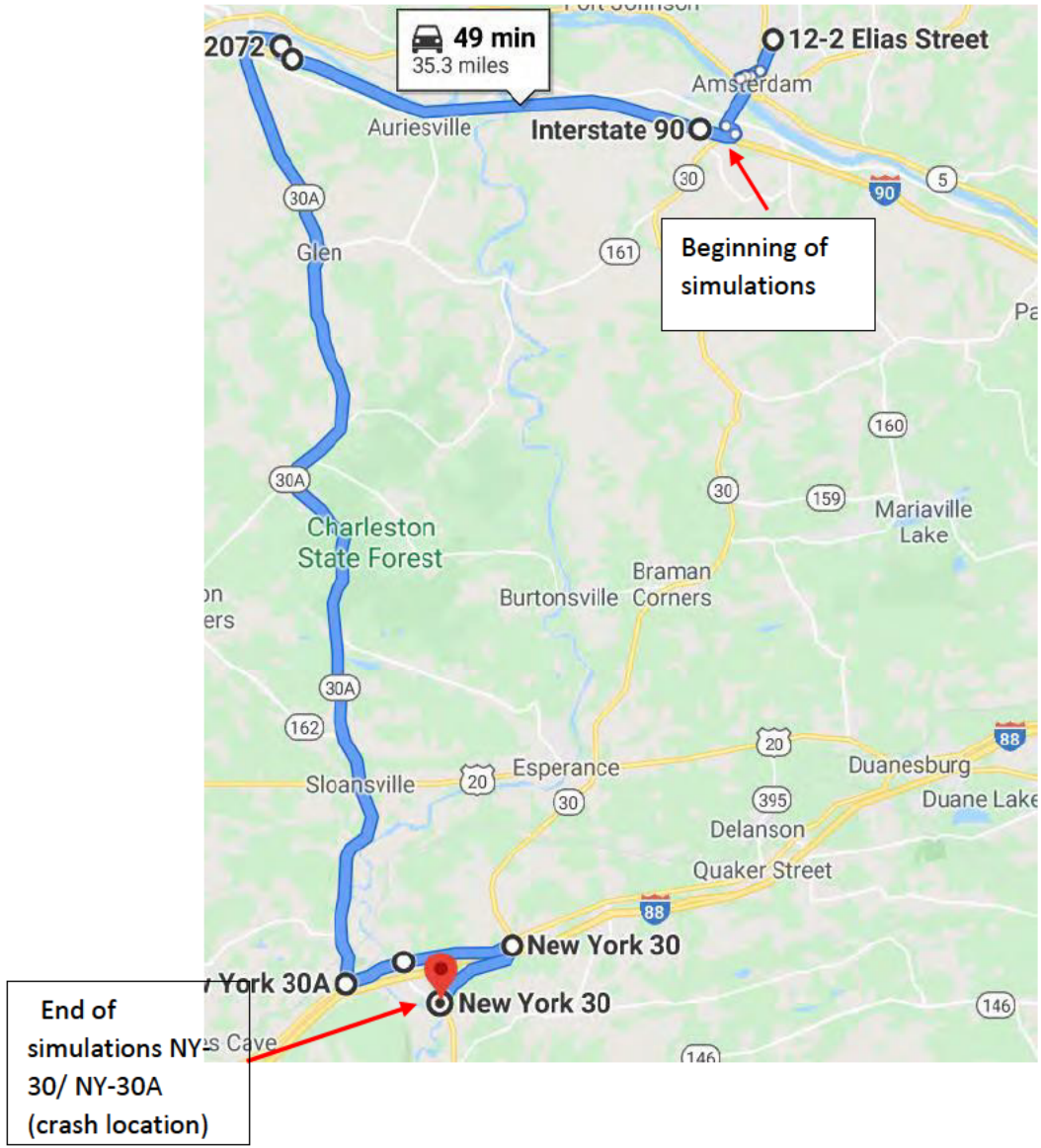


Figure 3 – Route of accident limousine modeled in the simulations

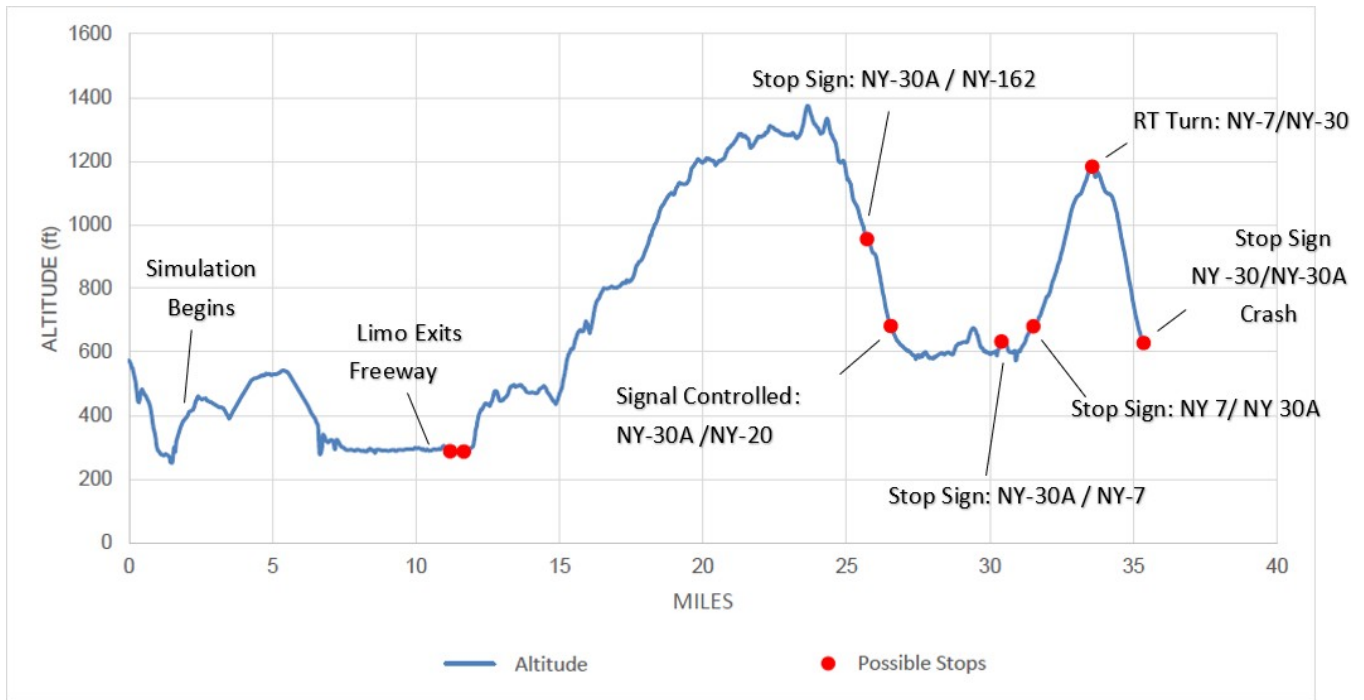


Figure 4 – Route Profile

The control logic used in the simulations was as follows:

- Speed limit and warning signs were identified along the simulated route and used to control speed.
- At stop signs and controlled signalized intersections along the simulated route complete stops were modeled.
- During downhill portions of the simulations if the speed exceeded the posted speed limit by 5 mph braking was applied at a maximum of 0.2 g to reduce the speed to the posted speed limit.
- During all brake applications the maximum braking applied was 0.2 g.

A description of the location of braking points (snubs and stops) based on this logic is contained in Attachments 2-6 of this report.

In the simulations the effects of the road grades were modeled by adding or subtracting energy through the drive motor on the dynamometer.

5.2 Brake Cooling and Parasitic Drag

Cooling of the brakes during the simulations was modeled by controlling air flow across the brakes to match brake cooling data measured from the NATC testing of the exemplar Excursion (see Attachment 1). An example of a cooling curve calibration used in the simulations is shown in Figure 5. Refer to Attachment 7 for additional calibration curves.

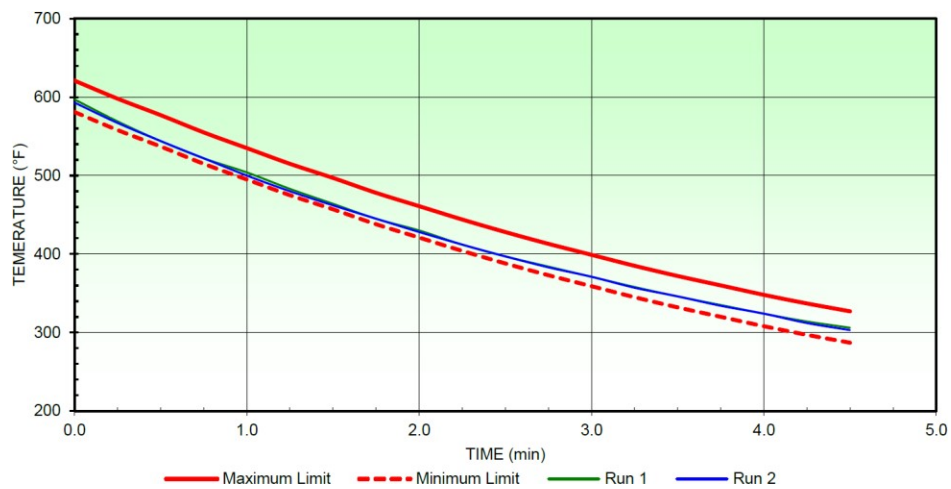


Figure 5 – Example cooling calibration curve for the simulations. The limit curves represent the brake cooling curve data collected during the NATC testing with the exemplar Excursion. The blue and green curves represent the brake rotor temperature measurements from the calibration on the dynamometer.

Parasitic drag losses in the simulations were modeled based on data from the NATC testing of the exemplar Excursion. This data indicated that at 50 to 60 mph the parasitic drag would have been approximately 0.03 g. An example of a coast down curve used to measure the parasitic drag is shown in Figure 6.

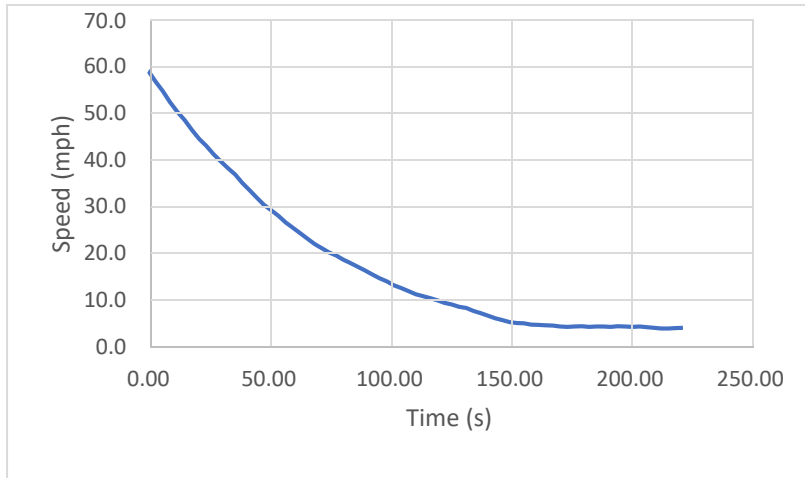


Figure 6 – Example of coast down curve from Excursion testing. Transmission is in drive; no throttle applied.

A summary of the vehicle conditions modeled in the simulations is provided in Table 3. The 8600 lb weight used in the simulations represents the GVWR of the Excursion when it was manufactured by Ford. The 13565 lb weight is the estimated weight of the limousine at the time of the accident.

Table 3

Vehicle	Description	Brake function
8600 lbs	Original GVWR of Excursion	All brakes functioning properly
13565 lbs	Accident weight	All brakes functioning properly
13565 lbs	Accident weight	No rear brakes
13565 lbs	Accident weight	½ rear brakes

5.3 Simulation Results

This section summarizes the key results of the simulations. The complete results and details of the simulations are contained in Attachments 3-7 of this report.

The results of the simulations are summarized in Table 4. As indicated by the data in the table in each of the simulations the limousine was able to safely stop at the intersection of NY30 and NY30A at the bottom of the final descent where the crash occurred.

Table 4 – Simulation Results

Vehicle Weight	Brake function	Simulation Result
8600 lbs	All brakes functioning properly	Vehicle stops at the bottom of final descent at NY 30 and NY30 A
13565 lbs	All brakes functioning properly	Vehicle stops at the bottom of final descent at NY 30 and NY30 A
13565 lbs	No rear brakes	Vehicle stops at the bottom of final descent at NY 30 and NY30 A
13565 lbs	½ rear brakes	Vehicle stops at the bottom of final descent at NY 30 and NY30 A

The maximum brake temperatures in the simulations occurred at the bottom of the final descent during the stop at New York State Route 30 and New York State Route 30A. Table 5 shows a comparison between the maximum temperatures from the 900 F full effort stop tests performed as part of the test matrix and the maximum brake temperatures from the simulations. (The maximum temperatures reached in the test matrix occurred during the full effort stop performed at 900 F.)

5.4 Discussion/Summary of Simulations at the Accident Weight with all Brakes Functioning Properly

In the simulations performed at the accident weight (13565 lbs) with all brakes functioning properly the simulated vehicle was able to negotiate the simulated route and stop at the intersection of New York State Route 30 and New York State Route 30A at the bottom of the final descent where the crash occurred.

The results of the test matrix measurements shown in table 5 indicate that a fully functioning brake system would have additional braking capacity beyond what was required to safely negotiate the simulated route at the accident weight (as indicated by the greater brake temperatures and torques for the full-effort stop maneuver from the test matrix). The temperature and torque data from the full effort stop indicates that the limousine with all brakes functioning properly would have been able to brake to a stop at temperatures several hundred degrees higher than the maximum temperatures

predicted in the downhill simulation performed at the accident weight with all brakes functioning. This additional braking capacity would have provided a margin of safety and allowed for additional braking.

Table 5 – Maximum brake Rotor Temperatures from Simulations vs Maximum temperatures for Full-Effort Stop at 900 °F from the Test Matrix. The Initial Temperature is the Brake Temperature when the Brakes are Applied. (The maximum rotor temperatures in the simulations occurred during the stop at the bottom of the final descent were the accident occurred.)

	Front Rotor Temp (Initial/Max) (°F)	Rear Rotor Temp (Initial/Max) (°F)	Sustained Torque Front (lbf-ft)	Sustained Torque Rear (lbf-ft)
13565 lb, Full Effort Stop-1800 psi, 55-0 mph (Test Matrix)	(900/1143)	(723/985)	3225	2526
8600 lb, all brakes functioning, 50-0 mph, (Simulation)	(388/618)	(388/598)	847	579
13565 lbs, all brakes functioning, 50-0 mph, (Simulation)	(544/784)	(537/744)	1346	868
13565 lbs, Front brakes only, 50- 0 mph (Simulation)	(773/1054)	N/A	1889	N/A
13565 lbs ½ rear brake, 50 -0 mph, (Simulation)	(622/904)	(471/633)	1602	971

5.5 Comparison of Simulated Braking Conditions

Table 6 contains a comparison of the maximum brake rotor temperatures for the different simulated vehicle conditions.

Table 6

Description: Condition 1 vs Condition 2	Max Temperature Front Brake Rotor Condition 1 vs Condition 2	Max Temperature Rear Brake Rotor Condition 1 vs Condition 2
8600 lbs vs 13565 lbs	618 °F vs 784 °F (+23%)	598 °F to 744 °F (+24%)
13556 lbs vs 13565 lbs no rear brakes	784 °F vs 1054°F (+34%)	-----
8600 lbs vs 13565 lbs no rear brakes	618 °F vs 1054 °F (+70%)	-----
13565 lbs vs 13565 lbs ½ rear	784 °F vs 904 °F (+15 %)	744 °F vs 633 °F (-22 %)
8600 lbs vs 13565 lbs ½ rear	618 °F vs 904 °F (+46%)	598 °F vs 633 °F (+ 6%)

Table 7 shows the change in maximum brake rotor temperatures between different simulated vehicle conditions. Positive values in the table indicate that the temperature is higher for condition 2 than condition 1.

Table 7

Description: Condition 1 vs Condition 2	Change in Max Temperature Front Brake Rotor	Change in Max Temperature Rear Brake Rotor
8600 lbs vs 13565 lbs	+166 °F	+146 °F
13556 lbs vs 13565 lbs no rear brakes	+270 °F	-----
8600 lbs vs 13565 lbs no rear brakes	+436 °F	-----
13565 lbs vs 13565 lbs ½ rear brakes	+120 °F	-111 °F
8600 lbs vs 13565 lbs ½ rear brakes	+286 °F	+35 °F

5.6 Summary/Discussion of Simulation Results

The results of the braking simulations conducted on the dynamometer indicate that the limousine at the accident weight (13565 lbs) with properly functioning brakes would have had sufficient braking capacity to safely negotiate the simulated route at the posted speed limit.

In the simulations increasing the weight of the limousine from 8600 lbs to 13565 lbs resulted in increases in maximum brake rotor temperatures of between 146 °F to 166 °F. These higher temperatures would have increased the risk of brake fade.

The highest brake temperatures occurred in the simulations in which no rear braking was modeled. This resulted in front brake rotor temperatures of 1054 °F which were approximately 270 °F greater than for simulations conducted at the accident weight with all brakes functioning properly.

6.0 Post-Test inspection of the Brake Rotors and Pads

The post-test photographs of the brake pads and rotors from the dynamometer testing are contained in Attachments 2-6 along with a description of their condition. The post-test inspections of the pads noted light glazing, light grooving, moderate pitting, and resin bleed. The post-test inspections of the rotors noted conditions such as light grooving, light hot spots, brake lining transfer from pad onto rotor and the rotor being black/blue grey in color. All these conditions occurred without severe brake fade or loss of braking occurring during the testing.

7.0 Discussion

The testing in this report was conducted with Ford recommended OEA brake components (pads, rotors, calipers, etc.) purchased through the Ford supply chain. Until the brake parts on the accident vehicle are tested, correlation between the accident brakes and the those used in the testing is unknown. The point of this project was to assert what would have been possible had the vehicle been properly maintained, independent of whatever brake and suspension upfitting should have been undertaken at the time of the limousine conversion.

E. Summary of Findings/Testing

A braking performance evaluation was conducted using test procedures in FMVSS 105 for vehicles with a GVWR of greater than 10000 lbs. The purpose of the FMVSS 105 standard is to ensure safe braking performance under normal and emergency conditions. The vehicle used in the testing was an exemplar Ford Excursion equipped with new Ford recommended (OEA) brake components specified for the unmodified accident vehicle.

To ensure safe braking performance the FMVSS 105 standard requires that a vehicle be able to stop within specific distances and speeds subject to the test procedures described in the standard. The results of the testing with the exemplar Excursion indicate that the limousine at the accident weight of 13565 lbs with a properly functioning brake system would have been able to meet all of the FMVSS 105 stopping distance requirements for a vehicle with a GVWR of greater than 10000 lbs, with the exception of the inoperative power boost stopping distance requirement.

A specific concern in this accident was the risk of brake fade. The FMVSS 105 first and second fade and recovery procedures are the FMVSS test procedures which address fade and recovery performance on dry surfaces. This test is optional for vehicles with GVWR's of greater than 10000 lbs that are not school buses but was included in the evaluations for this investigation. The results of the testing with the exemplar Excursion indicates that the limousine at the accident weight of 13565 lbs with a properly functioning brake system would have been able to meet the FMVSS 105 performance requirements for the first and second fade and recovery procedures for vehicles with a GVWR of greater than 10000 lbs.

Additional testing was conducted using a dual-end brake dynamometer and new Ford recommended OEA brake components specified for the unmodified 2001 Ford Excursion on which the accident limousine was built. This testing included using the dynamometer to simulate the braking performance of the limousine over several miles prior to where the crash occurred at New York State Route 30 and New York State Route 30A. Vehicle specific brake cooling data and parasitic drag measurements were used in the simulations to model brake cooling and parasitic energy losses. Energy losses/gains due to the road grade were accounted for in the simulations.

The results of the braking simulations conducted on the dynamometer indicate that at the accident weight of 13565 lbs the limousine with a properly functioning brake system would have had sufficient braking capacity to have safely negotiated the accident route at the posted speed limit and stopped safely at the bottom of the final descent at the intersection of New York State Route 30 and New York State Route 30A.

In the simulations increasing the weight of the limousine from 8600 lbs (the original GVWR weight of the Excursion when it was manufactured) to 13565 lbs, (the accident weight) increased the maximum temperatures of the brake rotors by 146 °F to 166 °F. The higher brake temperatures associated with the greater weight could increase the risk of brake fade in certain situations.

F. Attachments Included in this Report

The following attachments are included at the end of this report:

Attachment 1: Brake Cooling and Performance Evaluation for Ford Excursion XLT 4x2

Attachment 2: Dynamometer Testing Report: Performance Matrix O.E. Brake Parts- 2001 Ford Excursion with Limousine Conversion, 13565 lbs

Attachment 3: Dynamometer Testing Report: Downhill Braking Simulation Test- 2001 Ford Excursion with Limousine Conversion, 8600 lbs

Attachment 4: Dynamometer Testing Report: Downhill Braking Simulation Test- 2001 Ford Excursion with Limousine Conversion, 13565 lbs

Attachment 5: Dynamometer Testing Report: Downhill Braking Simulation Test- 2001 Ford Excursion with Limousine Conversion, 13565 lbs – Front Brakes Only

Attachment 6: Dynamometer Testing Report: Downhill Braking Simulation Test- 2001 Ford Excursion with Limousine Conversion, 13565 lbs – ½ rear brake

Attachment 7: Dynamometer Testing Report: Example Cooling Curve Calibration for Simulations

Attachments



**Brake Performance Study Attachment 1 – 2000 Ford Excursion XLT 4x2 Brake Cooling
and Performance Evaluations**

Schoharie, NY

HWY19H001

NTSB Performance Study

FINAL REPORT
PREPARED FOR

GREENING TESTING LABORATORIES, INC.
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2000 FORD EXCURSION XLT 4X2
BRAKE COOLING AND PERFORMANCE EVALUATIONS

AUTHORIZATION:
PURCHASE ORDER NO. 24425

NATC PROJECT NO. 22330
NATC DOCUMENT NO. 22330-FR-REV 0

JANUARY – MARCH 2020

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1.0 BACKGROUND

Greening Testing Laboratories, Inc. (GTL) contracted the Nevada Automotive Test Center (NATC), under Purchase Order number 24425, to conduct brake cooling and performance evaluations on a 2000 Ford Excursion XLT 4X2.

2.0 OBJECTIVE

The objective of these evaluations is to characterize the brake cooling and performance of a Ford Excursion at axle weights that exceed the gross vehicle weight rating (GVWR).

3.0 TEST ARTICLE

The test article was a 2000 Ford Excursion XLT 4X2, as shown in Figure 1. Test article information is listed in Table 1.



Figure 1
Test Article in Tested Configuration

Table 1
Test Article Data

Model Year	2000
Make	Ford
Model	Excursion
Trim	XLT
Drive	4X2
Vehicle Identification Number (VIN)	1FMNU40L4YEC33336
Exterior Color	Oxford White Clearcoat
Engine	5.4 liter V-8 Gasoline
Transmission	Electronic 4-speed Automatic
Tire Make	BF Goodrich
Tire Model	All-Terrain T/A M+S
Tire Size	LT 265/75R16
Brakes	4-wheel Power Disk with Anti-Lock Braking System (ABS)
Axle Ratio	3.75
GVWR	8,400 pounds (lb)

4.0 TEST ARTICLE MODIFICATIONS

The suspension springs were replaced with components of greater capacity. The front wheel-end brake components were replaced. The rear wheel-end brake components were replaced. The parts that were installed on the vehicle are listed in Table 2; all replacement parts were Ford, or Ford Motorcraft brand. In addition to replacing the parts listed, the brake fluid was flushed and replaced with the manufacturer’s recommended fluid.

Table 2
Replacement Parts List

Part Number	Quantity	Description
F81Z-2B292-AB	2	Front Caliper Bracket
BR1266 (2V001)	2	Front Brake Pads
BRR262 (1V102)	2	Front Brake Rotors
BRCF111 (2B120)	1	Roadside Front Caliper
BRCF112 (2B121)	1	Curbside Front Caliper
F81Z-5310-RA	2	Front F-250 Coil Spring
BR1275 (2V200)	2	Rear Brake Pads
BRRF102 (2C206)	2	Rear Brake Rotors
BRC344RM (2V553)	1	Roadside Rear Caliper
BRCLF109 (2552)	1	Curbside Rear Caliper
518-00555A	2	Rear F-250 Leaf Spring
F81Z-5705-AA	4	Rear F-250 Axle U-Bolt

5.0 WEIGHT EVALUATION

The test article was weighed in three configurations as follows.

Heavy Test Load (HTL) – HTL comprised the test article with all operational fluids full, driver, occupant simulator, bumper weight, four ballast bags, and five ballast blocks with ballast cradle.

Light Test Load (LTL) – LTL comprised the test article with all operational fluids full, driver, occupant simulator, bumper weight, and two ballast blocks with ballast cradle.

Cooling Test Load (CTL) – CTL comprised the test article with all operational fluids full, driver, assistant driver, bumper weight, six ballast bags, and five ballast blocks with ballast cradle.

5.1 Weight Evaluation Instrumentation and Equipment

Drive-over scales are used to perform this evaluation.

The equipment used for this measurement includes:

- Tire pressure gauge

5.2 Weight Evaluation Courses and Facilities

Weights are measured on a level, concrete area.

5.3 Weight Evaluation Conduct

Weight is measured as follows.

1. Zero the scales.
2. Drive the front axle of the test article onto the scales.
3. Wait until scales record measurement.
4. Drive the rear axle of the test article onto the scales.
5. Wait until scales record measurement.
6. Drive the vehicle off the scales.
7. Print the weight record.
8. Repeat steps 1 through 7 two more times.

5.4 Weight Evaluation Data Processing

The weights recorded for the test article are averaged at each location, summed for each side, each axle, and overall weight.

5.5 Weight Evaluation Results

The test article weights are listed in Table 3 through Table 5.

**Table 3
Test Article HTL Weight**

Axle	Roadside (lb)	Curbside (lb)	Total (lb)
1	2,860	3,010	5,870
2	3,905	3,780	7,685
Total	6,765	6,790	13,555

**Table 4
Test Article LTL Weight**

Axle	Roadside (lb)	Curbside (lb)	Total (lb)
1	2,650	2,655	5,305
2	2,505	2,335	4,840
Total	5,155	4,990	10,145

**Table 5
Test Article CTL Weight**

Axle	Roadside (lb)	Curbside (lb)	Total (lb)
1	2,840	3,025	5,865
2	3,915	3,760	7,675
Total	6,755	6,785	13,540

6.0 BRAKE COOLING EVALUATION

The brake cooling evaluation was performed using the Society of Automotive Engineers (SAE) Surface Vehicle Recommended Practice J1247 Simulated Mountain-Brake Performance Test Procedure, section 5.5 First Simulated Mountain Descent Procedure, to heat the brakes. After the brakes were heated, the brake temperature was recorded over time while maintaining nominal steady state speeds of 60 miles per hour (mph), 50 mph, 40 mph, and zero mph.

6.1 Brake Cooling Evaluation Instrumentation and Equipment

Test and measurement equipment used in this evaluation and in the brake performance evaluation was calibrated using measurement standards and reference instruments whose accuracy are traceable to the National Institute of Standards and Technology (NIST) or nationally accepted systems. NATC measurement equipment is calibrated on a schedule that is adjusted to ensure traceability at the required accuracy levels.

The instrumentation included two digital data acquisition devices sampling at 100 samples per second (s/s). The description of the data collected is listed in Table 6.

Table 6
Brake Cooling Evaluation Instrumentation

Instrument	Parameter	Location
GPS Antenna	Speed	Roof
GPS Antenna	Distance	Roof
GPS Antenna	Longitudinal Acceleration	Roof
Thermocouple	Ambient Temperature	Roof
Thermocouple	Brake Pad Temperature	Roadside Front (RF) Brake Pad
Thermocouple	Brake Pad Temperature	Curbside Front (CF) Brake Pad
Thermocouple	Brake Pad Temperature	Roadside Rear (RR) Brake Pad
Thermocouple	Brake Pad Temperature	Curbside Rear (CR) Brake Pad
Thermocouple	Brake Rotor Temperature	RF Brake Rotor
Thermocouple	Brake Rotor Temperature	CF Brake Rotor
Thermocouple	Brake Rotor Temperature	RR Brake Rotor
Thermocouple	Brake Rotor Temperature	CR Brake Rotor
Thermocouple	Brake Fluid Temperature	RF Brake Caliper
Thermocouple	Brake Fluid Temperature	CF Brake Caliper
Thermocouple	Brake Fluid Temperature	RR Brake Caliper
Thermocouple	Brake Fluid Temperature	CR Brake Caliper
Pressure Transducer	Brake Pressure	Front Circuit Master Cylinder
Pressure Transducer	Brake Pressure	Rear Circuit Master Cylinder
Pressure Transducer	Brake Pressure	RF Brake Caliper
Pressure Transducer	Brake Pressure	CF Brake Caliper
Pressure Transducer	Brake Pressure	RR Brake Caliper
Pressure Transducer	Brake Pressure	CR Brake Caliper
Inertial Measurement Unit (IMU)	Lateral Acceleration	Approximate Center of Gravity (CG)
IMU	Longitudinal Acceleration	Approximate CG
IMU	Vertical Acceleration	Approximate CG
IMU	Roll Rate	Approximate CG
IMU	Pitch Rate	Approximate CG
IMU	Yaw Rate	Approximate CG
Load Cell	Pedal Force	Brake Pedal

The equipment used for this evaluation includes:

- Tire pressure gauge
- Digital video camera
- Digital photographic camera

6.2 Brake Cooling Evaluation Courses and Facilities

NATC's WesTrack paved oval course was used for this evaluation. The section that was used is flat (with less than 2% grade in all directions). Prior to the start of testing, the course was inspected to ensure that it was dry and free of debris or damage that would influence test results.

6.3 Brake Cooling Evaluation Conduct

The test article was at CTL for the brake cooling evaluation, which is performed as follows.

1. Visually inspect the test article; if any unusual conditions are noted they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within manufacturer's recommended range.
3. Check fuel level to ensure the fuel tank is full.
4. Accelerate the test article to 35 (+ 0, - 2) mph.
5. After a period of 15 seconds (s), use the brakes to decelerate to 20 mph while limiting the deceleration rate to 8 feet per second per second (fpsps).
6. Repeat steps 4 and 5 until a total of 80 snubs are completed.
7. Accelerate to 60 mph.
8. Maintain speed until the hottest brake rotor and pad temperature has decreased to less than 200 degrees Fahrenheit (°F).
9. Repeat steps 3 through 8 three times.
10. Repeat steps 3 through 9 achieving the speeds of 50 mph, 40 mph, and zero mph in step 7.

6.4 Brake Cooling Evaluation Data Processing

Speed and temperature data were processed into time history plots. Raw data in comma separated variable (CSV) format was provided to Greening for further analysis.

6.5 Brake Cooling Evaluation Results

Representative plots of the 60 mph, 50 mph, 40 mph, and 0 mph brake cooling evaluations are shown in Figure 2 through Figure 5.

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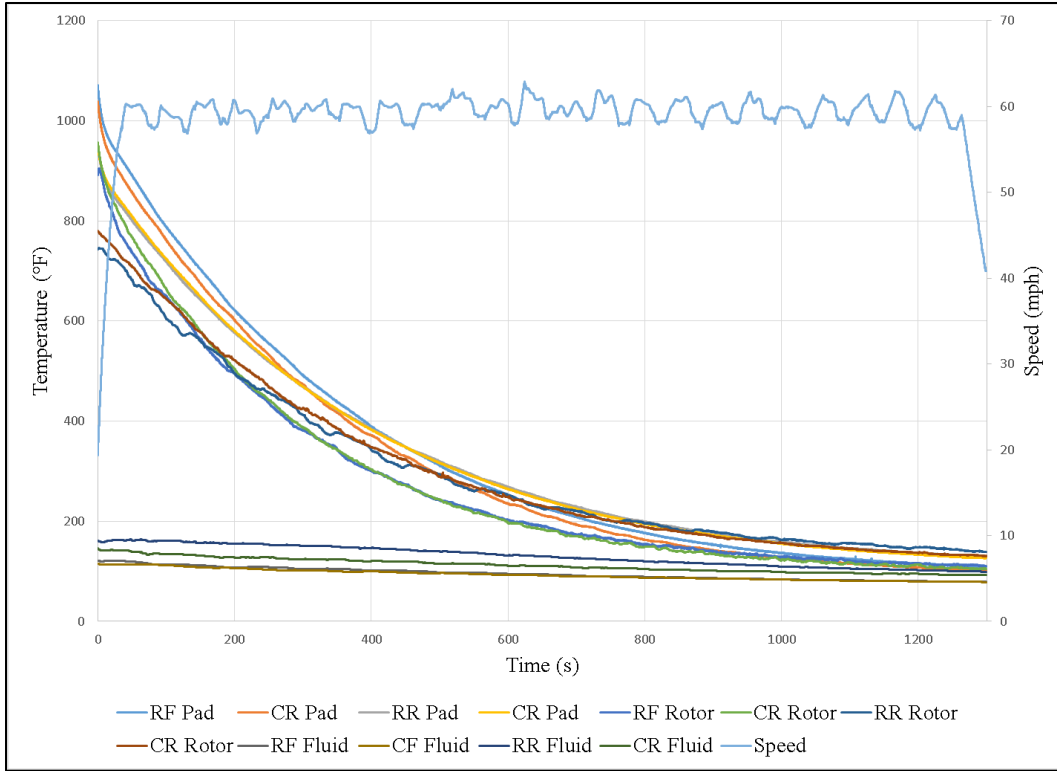


Figure 2
Representative Brake Cooling Data at Nominal 60 mph

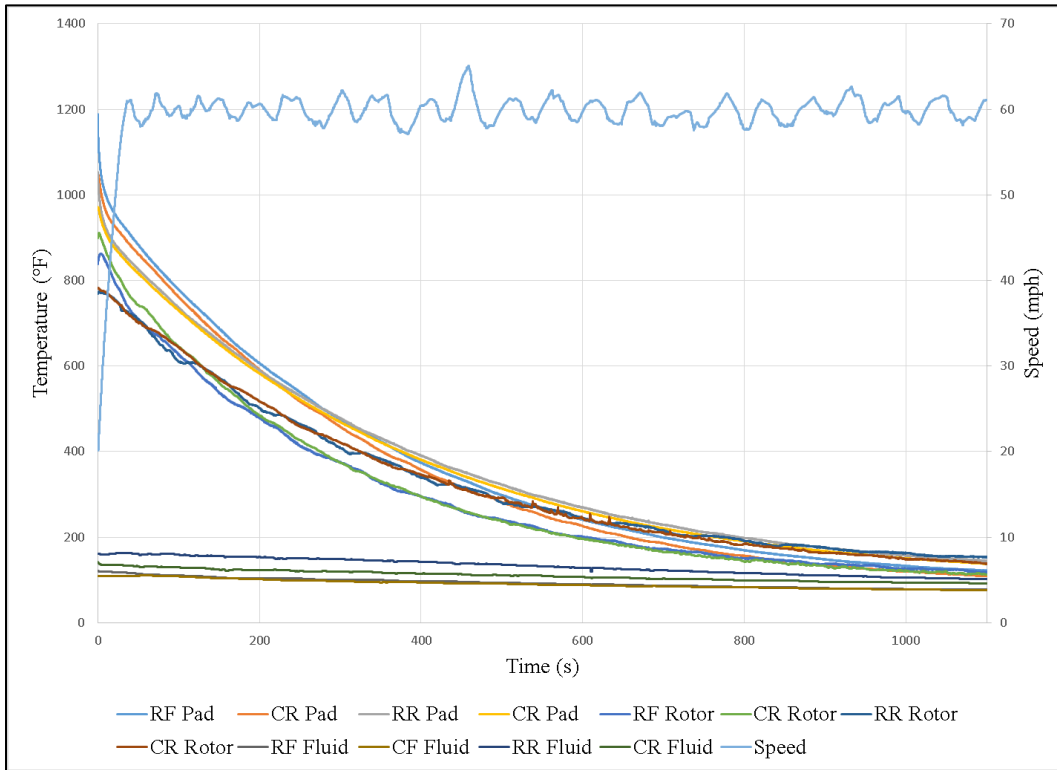


Figure 3
Representative Brake Cooling Data at Nominal 50 mph

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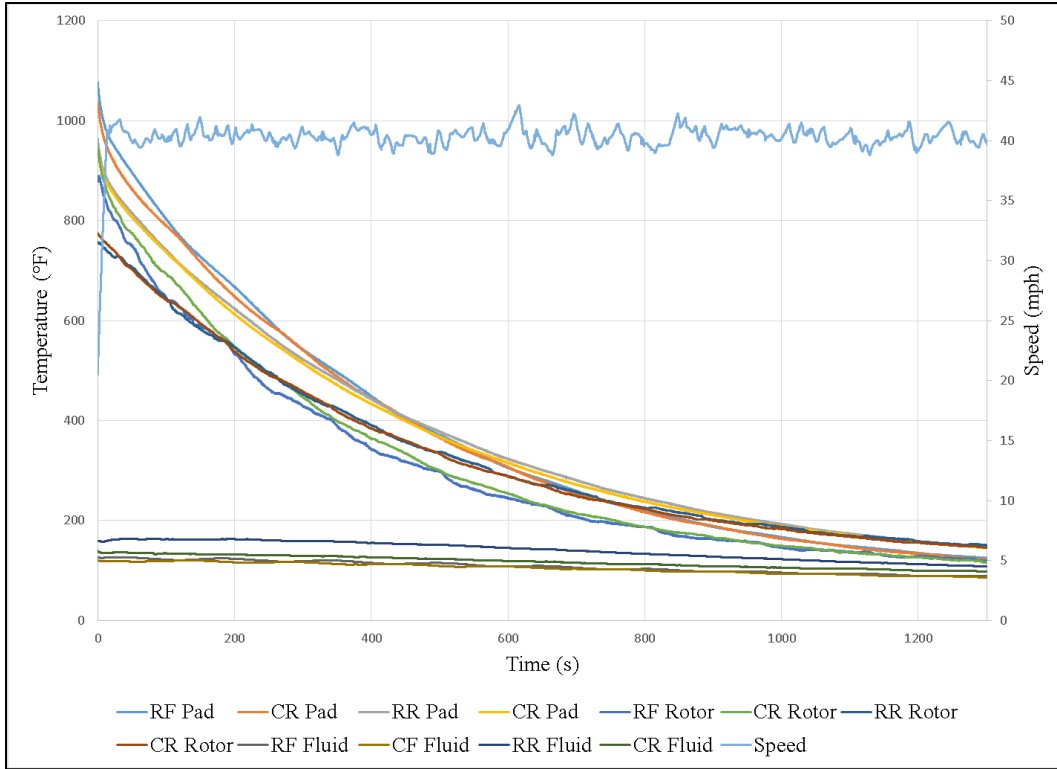


Figure 4
Representative Brake Cooling Data at Nominal 40 mph

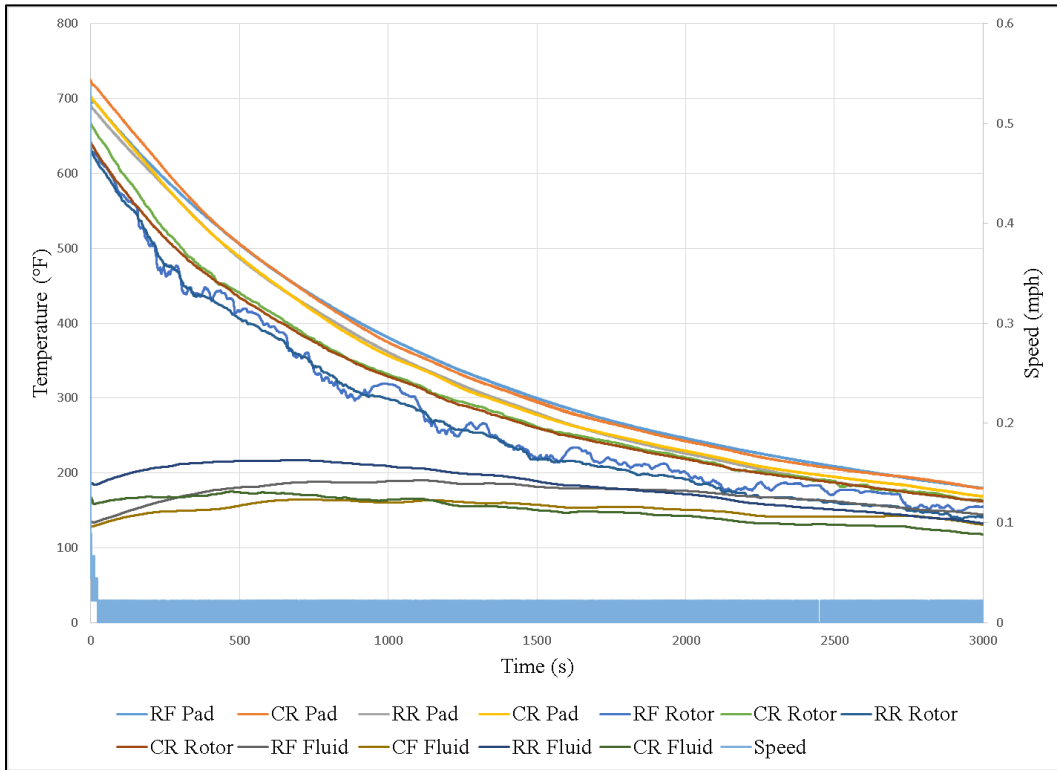


Figure 5
Representative Brake Cooling Data at 0 mph

7.0 BRAKE PERFORMANCE EVALUATION

A brake performance evaluation was performed using the procedures in the National Highway Traffic Safety Administration’s (NHTSA) Federal Motor Vehicle Safety Standard (FMVSS) 105, Hydraulic and Electric Brake Systems.

7.1 Brake Performance Evaluation Instrumentation and Equipment

The instrumentation included two digital data acquisition devices sampling at 100 s/s. The description of the data collected is listed in Table 7.

**Table 7
Brake Performance Evaluation Instrumentation**

Instrument	Parameter	Location
GPS Antenna	Speed	Roof
GPS Antenna	Distance	Roof
GPS Antenna	Longitudinal Acceleration	Roof
Thermocouple	Ambient Temperature	Roof
Thermocouple	Brake Pad Temperature	RF Brake Pad .040-inch Depth
Thermocouple	Brake Pad Temperature	CF Brake Pad .040-inch Depth
Thermocouple	Brake Pad Temperature	RR Brake Pad .040-inch Depth
Thermocouple	Brake Pad Temperature	CR Brake Pad .040-inch Depth
Thermocouple	Brake Pad Temperature	RF Brake Pad .080-inch Depth
Thermocouple	Brake Pad Temperature	CF Brake Pad .080-inch Depth
Thermocouple	Brake Pad Temperature	RR Brake Pad .080-inch Depth
Thermocouple	Brake Pad Temperature	CR Brake Pad .080-inch Depth
Thermocouple	Brake Rotor Temperature	RF Brake Rotor
Thermocouple	Brake Rotor Temperature	CF Brake Rotor
Thermocouple	Brake Rotor Temperature	RR Brake Rotor
Thermocouple	Brake Rotor Temperature	CR Brake Rotor
Thermocouple	Brake Fluid Temperature	RF Brake Caliper
Thermocouple	Brake Fluid Temperature	CF Brake Caliper
Thermocouple	Brake Fluid Temperature	RR Brake Caliper
Thermocouple	Brake Fluid Temperature	CR Brake Caliper
Pressure Transducer	Brake Pressure	Front Circuit Master Cylinder
Pressure Transducer	Brake Pressure	Rear Circuit Master Cylinder
Pressure Transducer	Brake Pressure	RF Brake Caliper
Pressure Transducer	Brake Pressure	CF Brake Caliper
Pressure Transducer	Brake Pressure	RR Brake Caliper
Pressure Transducer	Brake Pressure	CR Brake Caliper
IMU	Lateral Acceleration	Approximate CG
IMU	Longitudinal Acceleration	Approximate CG
IMU	Vertical Acceleration	Approximate CG

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Instrument	Parameter	Location
IMU	Roll Rate	Approximate CG
IMU	Pitch Rate	Approximate CG
IMU	Yaw Rate	Approximate CG
Load Cell	Pedal Force	Brake Pedal
Displacement Transducer	Brake Pedal Position	Brake Pedal
Encoder	Wheel Speed	RF Wheel Encoder
Encoder	Wheel Speed	CF Wheel Encoder
Encoder	Wheel Speed	RR Wheel Encoder
Encoder	Wheel Speed	CR Wheel Encoder

The equipment used for this evaluation includes:

- Tire pressure gauge
- Digital video camera
- Digital photographic camera

7.2 Brake Performance Evaluation Courses and Facilities

NATC's WesTrack paved oval course was used for this evaluation. The section that was used is flat (with less than 2% grade in all directions). Prior to the start of testing, the course was inspected to ensure that it was dry and free of debris or damage that would influence test results.

7.3 Brake Performance Evaluation Conduct

The brake performance evaluation consisted of 14 individual tests that were performed in the order listed below. The following procedures outline how each of the individual test are performed.

7.3.1 Brake Warming Conduct

Prior to test conduct for each day of testing or any time the brakes have cooled below the target initial brake temperature (IBT), brake warming is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range.
3. Check fuel level to ensure the fuel tank is full.
4. Accelerate the test article to 40 (+ 0, - 2) mph.
5. Use the brakes to decelerate to 10 mph while limiting the deceleration rate to no more than 10 fpsps.
6. Repeat steps 4 and 5 until the brake temperatures reach the required level, or you have performed 10 snubs, whichever occurs first.

7.3.2 Instrumentation Check Conduct

The instrumentation check is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range.
3. Check fuel level to ensure the fuel tank is full.
4. Accelerate the test article to 30 (+ 0, - 2) mph.
5. Use the brakes to decelerate to a stop while limiting the deceleration rate to no more than 10 fpsps.
6. Repeat steps 4 and 5 once.
7. Download and review the data for accuracy and consistency.
8. If issues are discovered, resolve the issues and repeat steps 4 through 7. Do not perform more than 10 events for the purpose of an instrumentation check.

7.3.3 Service Brake System First Effectiveness Test Conduct

The service brake system first effectiveness test is performed at HTL using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
3. Check fuel level to ensure the fuel tank is full.
4. Accelerate the test article to over 30 mph.
5. Shift the transmission to Neutral and coast to 30 (+ 0, - 2) mph.
6. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
7. Repeat steps 4 through 6 for a total of six stops from 30 mph.
8. Accelerate the test article to over 60 mph.
9. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
10. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
11. Repeat steps 8 through 10 for a total of six stops from 60 mph.

7.3.4 Service Brake System Burnish Conduct

The service brake system burnish is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
3. Check fuel level to ensure the fuel tank is full.

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4. Accelerate the vehicle to 40 (+ 0, - 2) mph.
5. Use the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
6. Accelerate the vehicle to 40 mph.
7. Repeat steps 5 and 6 at 1-mile intervals between initiations of the snubs until 125 snubs have been completed.
8. Stop the vehicle and visually inspect the brakes.
9. Repeat steps 4 through 8 until 500 snubs have been completed.

7.3.5 Service Brake System Second Effectiveness Conduct

The service brake system second effectiveness test is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
3. Check fuel level to ensure the fuel tank is full.
4. Accelerate the test article to over 30 mph.
5. Shift the transmission to Neutral and coast to 30 (+ 0, - 2) mph.
6. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
7. Repeat steps 4 through 6 for a total of six stops from 30 mph.
8. Accelerate the test article to over 60 mph.
9. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
10. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
11. Repeat steps 8 through 10 for a total of six stops from 60 mph.

7.3.6 Service Brake System First Reburnish Conduct

The service brake system first reburnish is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
3. Check fuel level to ensure the fuel tank is full.
4. Accelerate the vehicle to 40 (+ 0, - 2) mph.
5. Use the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
6. Accelerate the vehicle to 40 mph.
7. Repeat steps 5 and 6 at 1-mile intervals between initiations of the snubs until 35 snubs have been completed.

7.3.7 Service Brake System Third Effectiveness Test Conduct

The service brake system third effectiveness test is performed at LTL using the following procedure.

1. Reduce the payload in the test article to achieve the LTL.
2. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
3. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
4. Check fuel level to ensure the fuel tank is full.
5. Accelerate the test article to over 60 mph.
6. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
7. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
8. Repeat steps 5 through 7 for a total of six stops from 60 mph.

7.3.8 Service Brake System Partial Failure Test Conduct

The service brake system partial failure test is performed at LTL and HTL using the following procedure.

1. Reduce payload from the test article as necessary to achieve the LTL.
2. Modify the brake system to allow a failure in each of the following circuits: front brakes, rear brakes, and ABS.
3. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
4. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
5. Check fuel level to ensure the fuel tank is full.
6. Disable the front brake circuit with an open failure.
7. Accelerate the test article to over 60 mph.
8. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
9. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
10. Repeat steps 7 through 9 for a total of four stops from 60 mph with the front brake circuit disabled.
11. Bring the test article to a stop, restore operation of the front brake circuit, and bleed entrained air from the system.
12. Disable the rear brake circuit with an open failure.
13. Accelerate the test article to over 60 mph.
14. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
15. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
16. Repeat steps 13 through 15 for a total of four stops from 60 mph with the rear brake circuit disabled.

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17. Bring the test article to a stop, restore operation of the rear brake circuit, and bleed entrained air from the system.
18. Increase the payload to achieve the HTL.
19. Disable the front brake circuit with an open failure.
20. Accelerate the test article to over 60 mph.
21. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
22. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
23. Repeat steps 20 through 22 for a total of four stops from 60 mph with the front brake circuit disabled.
24. Bring the test article to a stop, restore operation of the front brake circuit, and bleed entrained air from the system.
25. Disable the rear brake circuit with an open failure.
26. Accelerate the test article to over 60 mph.
27. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
28. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
29. Repeat steps 26 through 28 for a total of four stops from 60 mph with the rear brake circuit disabled.
30. Bring the test article to a stop, restore operation of the rear brake circuit, and bleed entrained air from the system.
31. Disable the ABS by removing the fuse.
32. Accelerate the test article to over 60 mph.
33. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
34. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
35. Repeat steps 32 through 34 for a total of four stops from 60 mph with the ABS disabled.
36. Bring the test article to a stop, restore operation of the ABS, and bleed entrained air from the system.

7.3.9 Service Brake System Inoperative Power Assist Test Conduct

The service brake system inoperative power assist test is performed using the following procedure.

1. Modify the brake system to allow a failure of the power brake assist.
2. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
3. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
4. Check fuel level to ensure the fuel tank is full.
5. Disable the power brake assist.
6. Accelerate the test article to over 60 mph.
7. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
8. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.

9. Repeat steps 5 through 8 for a total of four stops from 60 mph with the power brake assist disabled.
10. Bring the test article to a stop and restore the service brake system to normal.

7.3.10 Service Brake System First Fade and Recovery Test Conduct

The service brake system first fade and recovery test is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
3. Check fuel level to ensure the fuel tank is full.
4. Conduct baseline snubs.
 - a. Accelerate the vehicle to 42 mph.
 - b. Place the transmission in Neutral.
 - c. Once the vehicle decelerates to 40 (+ 0, - 2) mph, apply the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
 - d. Accelerate the vehicle to and maintain 40 mph until IBT is between 150 °F and 200 °F.
 - e. Repeat steps a through d until three snubs have been completed.
5. Calculate the average of the maximum control force from each snub.
6. Conduct fade snubs.
 - a. Establish the IBT between 130 °F and 150 °F.
 - b. Accelerate the vehicle to 42 mph.
 - c. Place the transmission in Neutral.
 - d. Once the vehicle decelerates to 40 (+ 0, - 2) mph, apply the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
 - e. Accelerate the vehicle to and maintain 40 mph.
 - f. Repeat steps b through e with 30-second intervals between the start of each snub until 10 snubs have been completed.
7. Accelerate to 40 mph and drive for 1.5 miles.
8. Conduct recovery snubs.
 - a. Accelerate the vehicle to 42 mph.
 - b. Place the transmission in Neutral.
 - c. Once the vehicle decelerates to 40 (+ 0, - 2) mph, apply the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
 - d. Accelerate the vehicle to and maintain 40 mph.
 - e. Repeat steps a through d with 1.5-mile intervals between the start of each snub until five snubs have been completed.

7.3.11 Service Brake System Second Reburnish Conduct

The service brake system second reburnish is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.

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2. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
3. Check fuel level to ensure the fuel tank is full.
4. Accelerate the vehicle to 40 (+ 0, - 2) mph.
5. Use the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
6. Accelerate the vehicle to 40 mph and hold for approximately 1 mile.
7. Repeat steps 5 and 6 until 35 snubs have been completed.

7.3.12 Service Brake System Second Fade and Recovery Test Conduct

The service brake system second fade and recovery test is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
3. Check fuel level to ensure the fuel tank is full.
4. Conduct baseline snubs.
 - a. Accelerate the vehicle to 42 mph.
 - b. Place the transmission in Neutral.
 - c. Once the vehicle decelerates to 40 (+ 0, - 2) mph, apply the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
 - d. Accelerate the vehicle to and maintain 40 mph until IBT is between 150 °F and 200 °F.
 - e. Repeat steps a through d until three snubs have been completed.
5. Calculate the average of the maximum control force from each snub.
6. Conduct fade snubs.
 - a. Establish the IBT between 130 °F and 150 °F.
 - b. Accelerate the vehicle to 42 mph.
 - c. Place the transmission in Neutral.
 - d. Once the vehicle decelerates to 40 (+ 0, - 2) mph, apply the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
 - e. Accelerate the vehicle to and maintain 40 mph.
 - f. Repeat steps b through e with 30-second intervals between the start of each snub until 20 snubs have been completed.
7. Accelerate to 40 mph and drive for 1.5 miles.
8. Conduct recovery snubs.
 - a. Accelerate the vehicle to 42 mph.
 - b. Place the transmission in Neutral.
 - c. Once the vehicle decelerates to 40 (+ 0, - 2) mph, apply the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
 - d. Accelerate the vehicle to and maintain 40 mph.
 - e. Repeat steps a through d with 1.5-mile intervals between the start of each snub until five snubs have been completed.

7.3.13 Service Brake System Third Reburnish Conduct

The service brake system third reburnish is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
3. Check fuel level to ensure the fuel tank is full.
4. Accelerate the vehicle to 40 (+ 0, - 2) mph.
5. Use the brakes to decelerate to 20 mph while limiting the deceleration rate to no more than 10 fpsps.
6. Accelerate the vehicle to 40 mph and hold for approximately 1 mile.
7. Repeat steps 5 and 6 until 35 snubs have been completed.

7.3.14 Service Brake System Fourth Effectiveness Test Conduct

The service brake system fourth effectiveness test is performed using the following procedure.

1. Visually inspect the test article; if any unusual conditions are noted, they should be remedied before conducting the evaluation.
2. Check tire pressures to verify that they are within the manufacturer's recommended range; do not decrease tire pressures if the tires are warm from operation.
3. Check fuel level to ensure the fuel tank is full.
4. Accelerate the test article to over 30 mph.
5. Shift the transmission to Neutral and coast to 30 (+ 0, - 2) mph.
6. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
7. Repeat steps 4 through 6 for a total of six stops from 30 mph.
8. Accelerate the test article to over 60 mph.
9. Shift the transmission to Neutral and coast to 60 (+ 0, - 2) mph.
10. Use the brakes to decelerate to a stop while limiting the pedal force to no more than 150 lb.
11. Repeat steps 8 through 10 for a total of six stops from 60 mph.

7.3.15 Final Inspection

The final inspection is performed using the following procedure.

1. Park the vehicle in a location where the wheels can be removed.
2. Raise each wheel off the ground using a jack in the manufacturer's recommended location and secure its position using a jack stand.
3. Remove each of the four wheels.
4. Inspect the brake system at each location for detachment or fracture of any component, such as brake springs and brake shoes. All mechanical components of the braking system should be intact and functional.
5. Inspect the entire brake system for brake fluid or lubricant leaks.

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6. Remove each of the calipers or drums paying close attention to the torque of all of the brake hardware to ensure none of the securement hardware has come loose during the evaluation.
7. Remove the brake pads from the calipers.
8. Inspect each of the pads or shoes for facing other than minor cracks that do not impair attachment of the friction facings. Any friction facing tear-out (complete detachment of lining) shall not exceed 10 percent of the lining on any single friction element.

7.4 Brake Performance Evaluation Data Processing

Speed at brake application and distance to stop were measured and adjusted for speed correction using SAE J299, Stopping Distance Procedure, as a guide. The shortest stopping distance is reported in the results. The stopping distance correction formula from SAE J299 is shown in Equation 1.

$$S_c = S_m \frac{V_d^2}{V_a^2} \quad (\text{Eq. 1})$$

Where:

- V_d = desired initial vehicle stopping speed, (mph)
- V_a = actual initial vehicle stopping speed, (mph)
- S_m = measured stopping distance, (ft)
- S_c = calculated stopping distance from V_d , (ft)

Maximum brake pedal force was measured for each stop to verify compliance with FMVSS 105 test criteria.

Pedal force for the fade and recovery data was calculated and compared to the baseline in accordance with FMVSS 105 procedures. The raw data for the fade and recovery tests were provided in CSV format to the customer for further analysis.

7.5 Brake Performance Evaluation Results

The following FMVSS 105 procedures were performed in the following order based on the requirements for a vehicle with a GVWR greater than 10,000 lb. The list corresponds to the 14 procedures described in sections 7.3.1 through 7.3.14, above, and includes the final inspection. Procedures marked with an asterisk (*) are not required for vehicles with GVWR greater than 10,000 pounds but were performed based on the inclusion of the fade and recovery tests requested by the customer. The results of the evaluations are listed in Table 8 through Table 10.

1. Brake Warming: completed at the beginning of each shift (FMVSS 105 S7.1)
2. Instrumentation Check: completed at the beginning of each shift (FMVSS 105 S 7.2)
3. Service Brake System First Effectiveness Test*: 6 stops from 30 mph and 6 stops from 60 mph (FMVSS 105 S 7.3)
4. Service Brake System Burnish Procedure: 500 snubs from 40 to 20 mph at 1.0-mile intervals (FMVSS 105 S 7.4.2)

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5. Service Brake System Second Effectiveness Test: 6 stops from 30 mph and 6 stops from 60 mph (FMVSS 105 S 7.5)
6. Service Brake System First Reburnish: 35 snubs from 40 to 20 mph at 1.0-mile intervals (FMVSS 105 S 7.6)
7. Service Brake System Third Effectiveness Test (LTL): 6 stops from 60 mph (FMVSS 105 S 7.8)
8. Service Brake System Partial Failure Tests: 4 stops each from 60 mph at LTL and at HTL for each failure (FMVSS 105 S 7.9)
9. Service Brake System Inoperative Power Assist Test: 4 stops from 60 mph (FMVSS 105 S 7.10.1)
10. Service Brake System First Fade and Recovery Test* (FMVSS 105 S 7.11.1.2, 7.11.2.2, 7.11.3.2)
11. Service Brake System Second Reburnish* (FMVSS 105 S 7.12)
12. Service Brake System Second Fade and Recovery Test* (S 7.13)
13. Service Brake System Third Reburnish* (FMVSS 105 S 7.14)
14. Service Brake System Fourth Effectiveness Test* (FMVSS 105 S 7.15)
15. Final Inspection (FMVSS 105 S 7.18)

Table 8
First, Second, and Third Effectiveness, and Partial Failure Results

Evaluation	FMVSS 105 Requirement > 8,000 lb & < 10,000 lb (ft)	FMVSS 105 Requirement > 10,000 lb (ft)	Measured Stopping Distance (ft)	Measured Pedal Force (lb)
First Effectiveness 30 mph	72	88	84.2	135.5
First Effectiveness 60 mph	267	388	337.4	142.6
Second Effectiveness 30 mph	57	78	64.2	142.7
Second Effectiveness 60 mph	216	310	268.8	137.5
Third Effectiveness 60 mph	242	335	208.5	134.0
Part Fail Front LTL 60 mph	517	613	445.2	144.6
Part Fail Rear LTL 60 mph	517	613	361.7	140.9
Part Fail Front HTL 60 mph	517	613	594.1	146.5
Part Fail Rear HTL 60 mph	517	613	466.9	124.8
ABS Failure HTL 60 mph	517	613	269.7	128.7
Inop. Power Assist HTL 60 mph	517	613	718.5	151.7

Table 9
First and Second Fade and Recovery Results

Evaluation	Minimum Pedal Force Requirement (lb)	Maximum Pedal Force Requirement (lb)	Measured Pedal Force (lb)	Measured Deceleration Rate (fpsps)
First Fade and Recovery Baseline Snubs	10.0	90.0	30.1	9.2
First Recovery Snub 1	18.1	150.0	30.6	8.2
First Recovery Snub 2	18.1	150.0	27.3	9.2
First Recovery Snub 3	18.1	150.0	27.9	9.2
First Recovery Snub 4	18.1	150.0	28.5	9.3
First Recovery Snub 5	18.1	50.1	29.6	8.4
Second Fade and Recovery Baseline Snubs	10.0	90.0	35.9	9.1
Second Recovery Snub 1	21.6	150.0	30.1	8.5
Second Recovery Snub 2	21.6	150.0	28.4	8.7
Second Recovery Snub 3	21.6	150.0	34.2	10.0
Second Recovery Snub 4	21.6	150.0	30.8	9.6
Second Recovery Snub 5	21.6	55.9	40.1	11.5

Table 10
Fourth Effectiveness Results

Evaluation	FMVSS 105 Requirement > 8,000 lb & < 10,000 lb (ft)	FMVSS 105 Requirement > 10,000 lb (ft)	Measured Stopping Distance (ft)	Measured Pedal Force (lb)
Fourth Effectiveness 30 mph	72	88	70.8	130.6
Fourth Effectiveness 60 mph	267	388	260.7	129.7

REFERENCES

Society of Automotive Engineers (SAE), Surface Vehicle Recommended Practice J1247
Simulated Mountain-Brake Performance Test Procedure, section 5.5 First Simulated
Mountain Descent Procedure, May 2014

National Highway Traffic Safety Administration's (NHTSA) Federal Motor Vehicle Safety
Standard (FMVSS) 105, Hydraulic and Electric Brake Systems

ABBREVIATIONS AND ACRONYMS

°F	Degrees Fahrenheit
ABS	Anti-lock Braking System
CF	Curbside Front
CG	Center of Gravity
CR	Curbside Rear
CTL	Cooling Test Load
FMVSS	Federal Motor Vehicle Safety Standards
FPSPS	Feet per Second per Second
FT	Feet
GTL	Greening Testing Laboratories
GVWR	Gross Vehicle Weight Rating
HTL	Heavy Test Load
IBT	Initial Brake Temperature
IMU	Inertial Measurement Unit
LB	Pounds
LTL	Light Test Load
MPH	Miles per Hour
NATC	Nevada Automotive Test Center
NHTSA	National Highway Traffic Safety Administration
RF	Roadside Front
RR	Roadside Rear
S/S	Samples per Second
SAE	Society of Automotive Engineers
VIN	Vehicle Identification Number

APPENDIX A
PHOTOGRAPHIC SUPPLEMENT

NTSB Performance Study



**NATC Photograph Number 22330-0001
Test Article Front View**



**NATC Photograph Number 22330-0002
Test Article Roadside Front Three-Quarter View**

NTSB Performance Study



NATC Photograph Number 22330-0003
Test Article Roadside View



NATC Photograph Number 22330-0004
Test Article Roadside Rear Three-Quarter View

NTSB Performance Study



**NATC Photograph Number 22330-0005
Test Article Rear View**



**NATC Photograph Number 22330-0006
Test Article Curbside Rear Three-Quarter View**

NTSB Performance Study



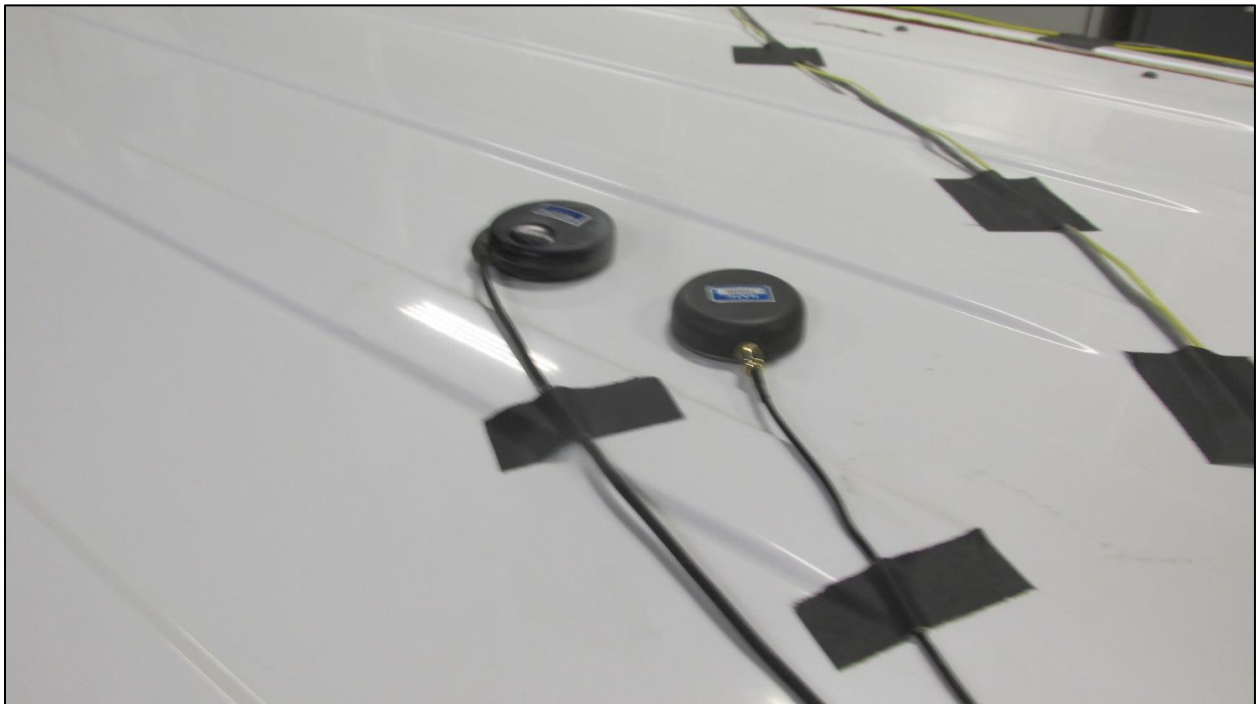
NATC Photograph Number 22330-0007
Test Article Curbside View



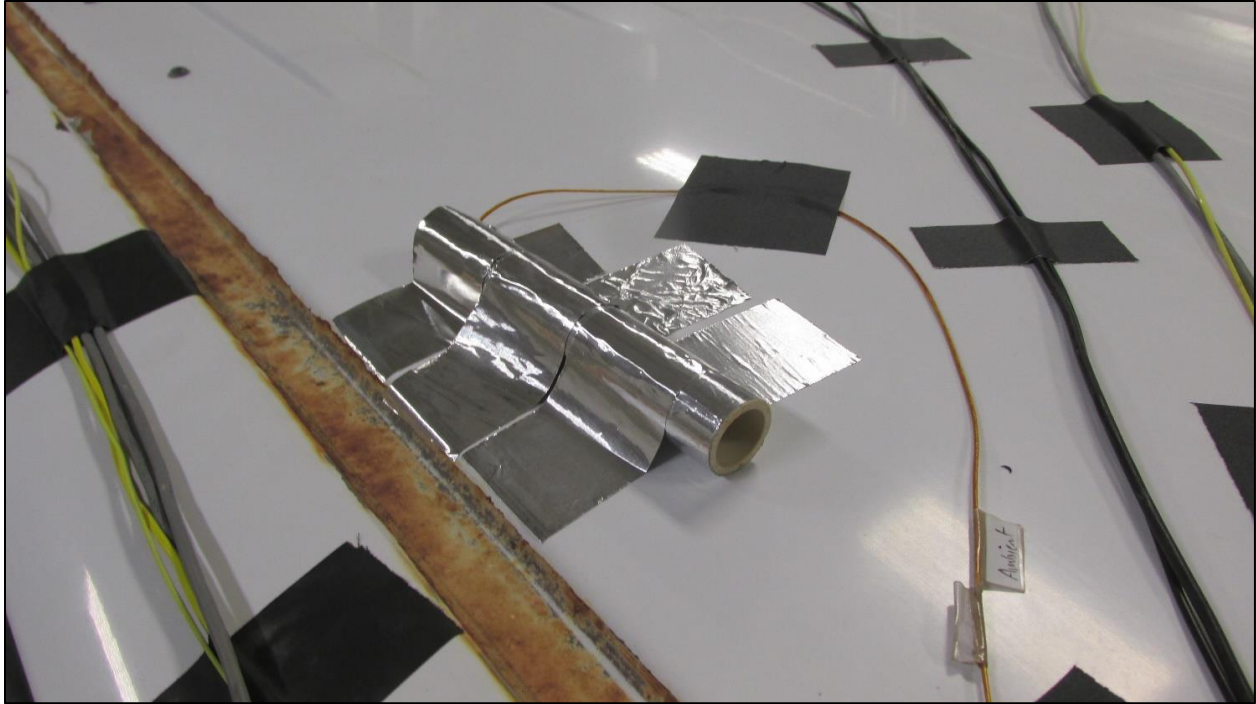
NATC Photograph Number 22330-0008
Instrumentation – Roadside Wheel Encoders



**NATC Photograph Number 22330-0009
Instrumentation – Curbside Wheel Encoders**



**NATC Photograph Number 22330-0010
Instrumentation – GPS Antenna**



**NATC Photograph Number 22330-0011
Instrumentation – Ambient Temperature Sensor**



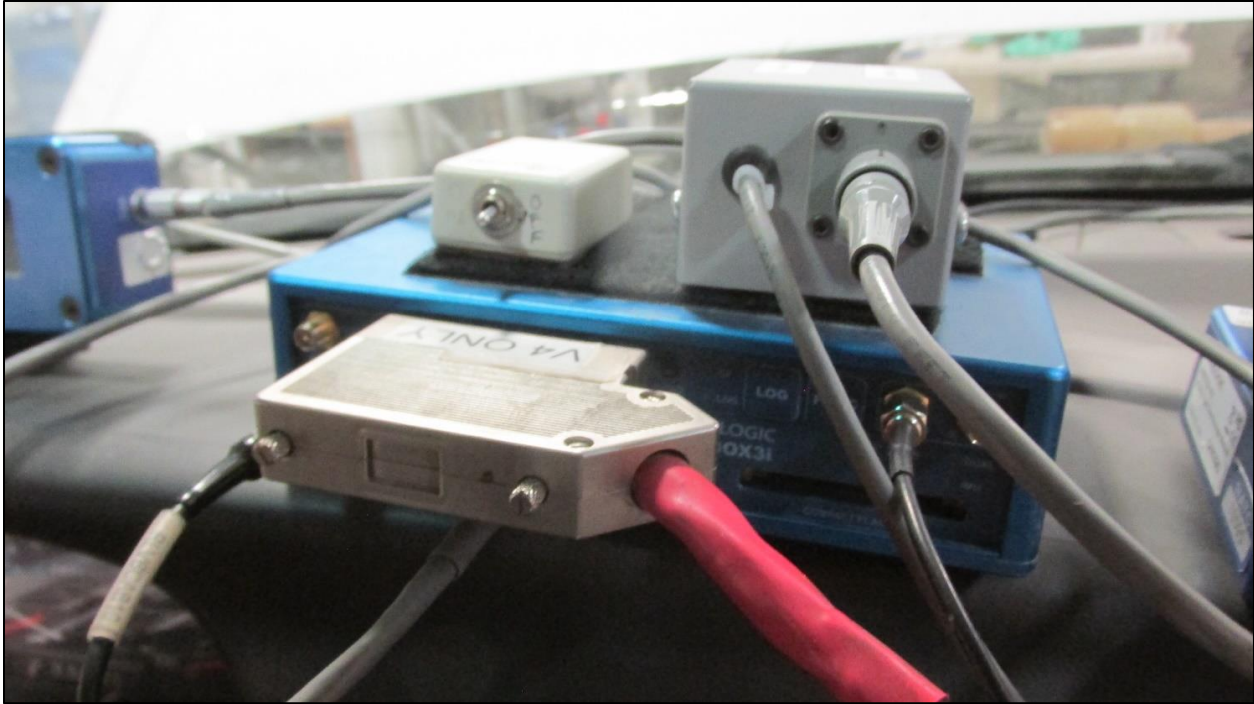
**NATC Photograph Number 22330-0012
Instrumentation – Decelerometer**



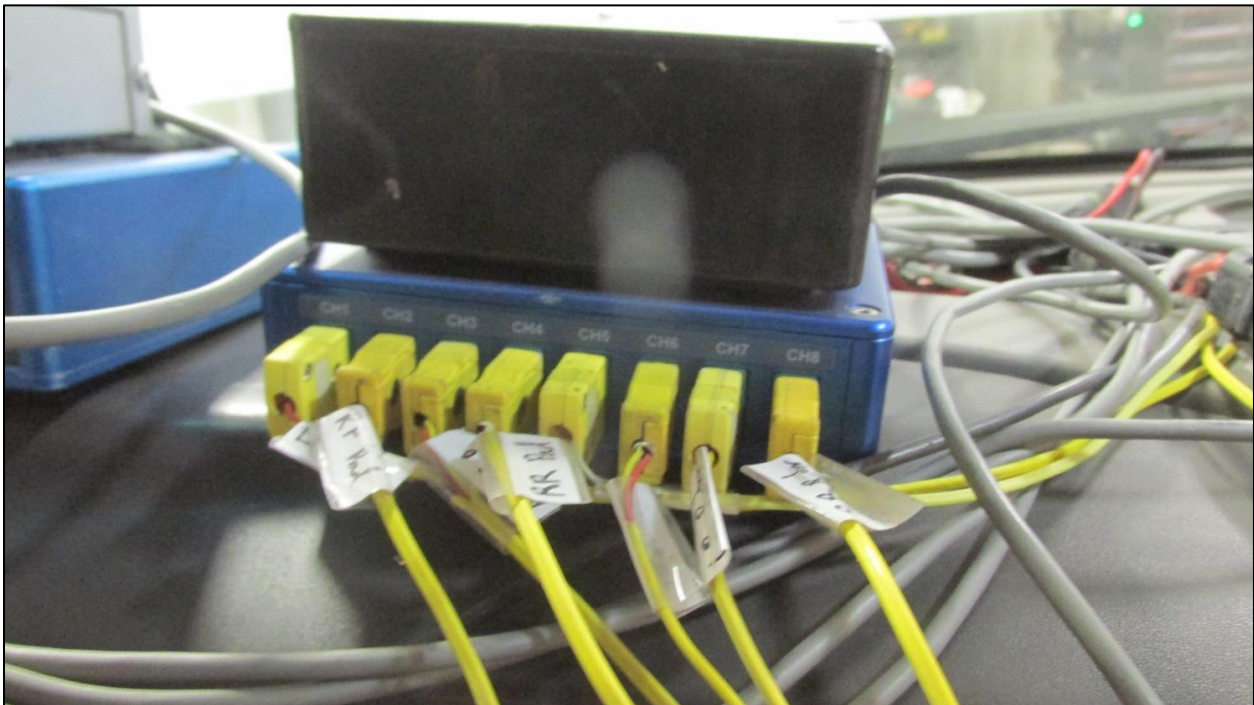
**NATC Photograph Number 22330-0013
Instrumentation – Brake Pedal Load Cell**



**NATC Photograph Number 22330-0014
Instrumentation – VBOX Display**



**NATC Photograph Number 22330-0015
Instrumentation – Data Acquisition VBOX**

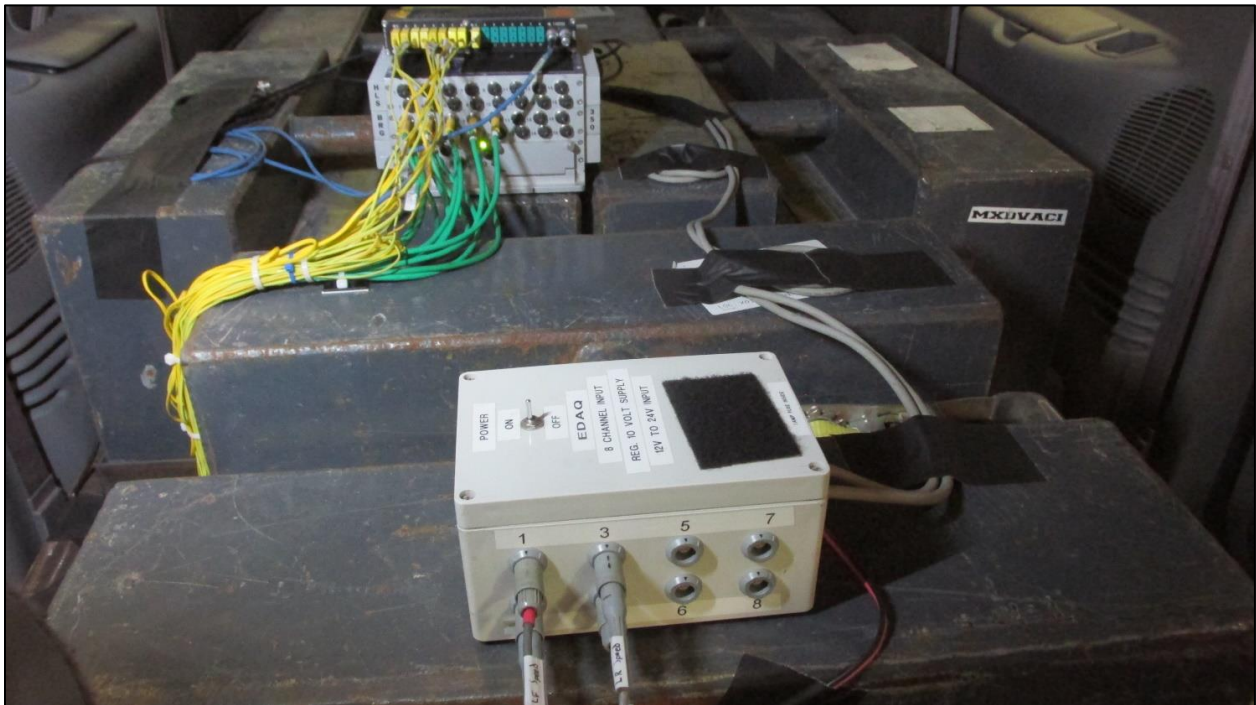


**NATC Photograph Number 22330-0016
Instrumentation – Data Acquisition VBOX Thermocouple Breakout Box**

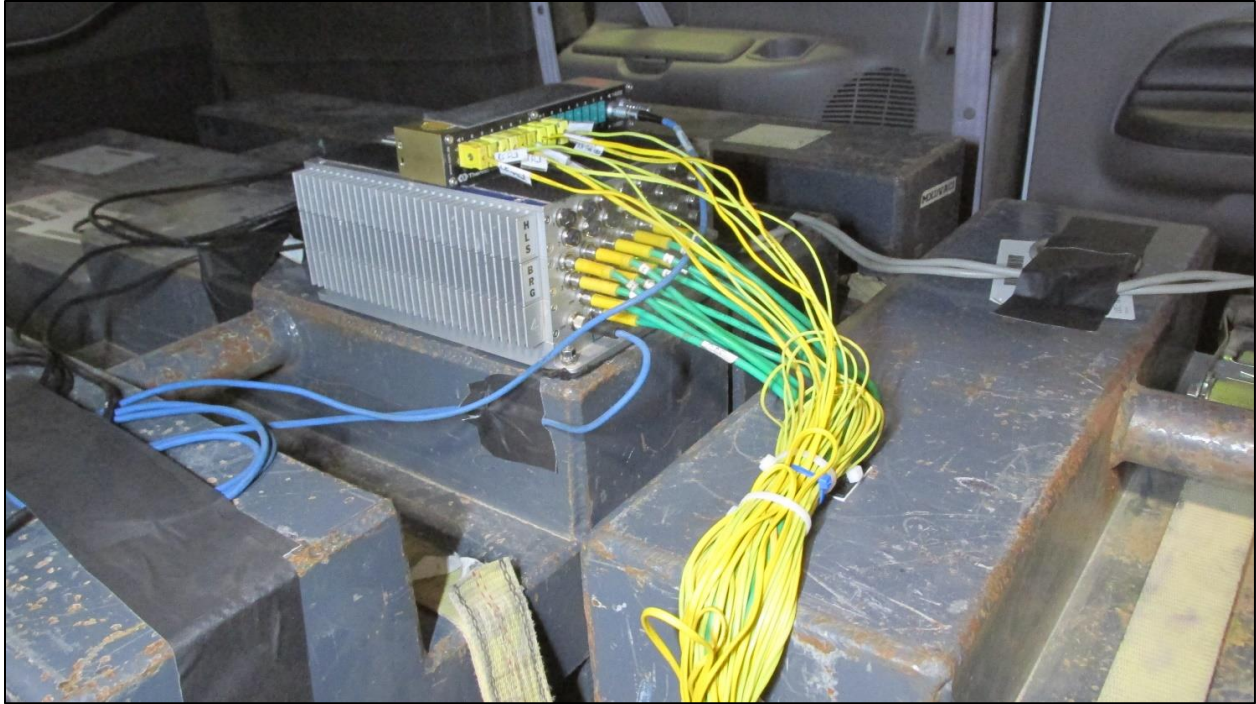
NTSB Performance Study



**NATC Photograph Number 22330-0017
Instrumentation – Data Acquisition VBOX**



**NATC Photograph Number 22330-0018
Instrumentation – Data Acquisition eDAQ and Pulse Counter**



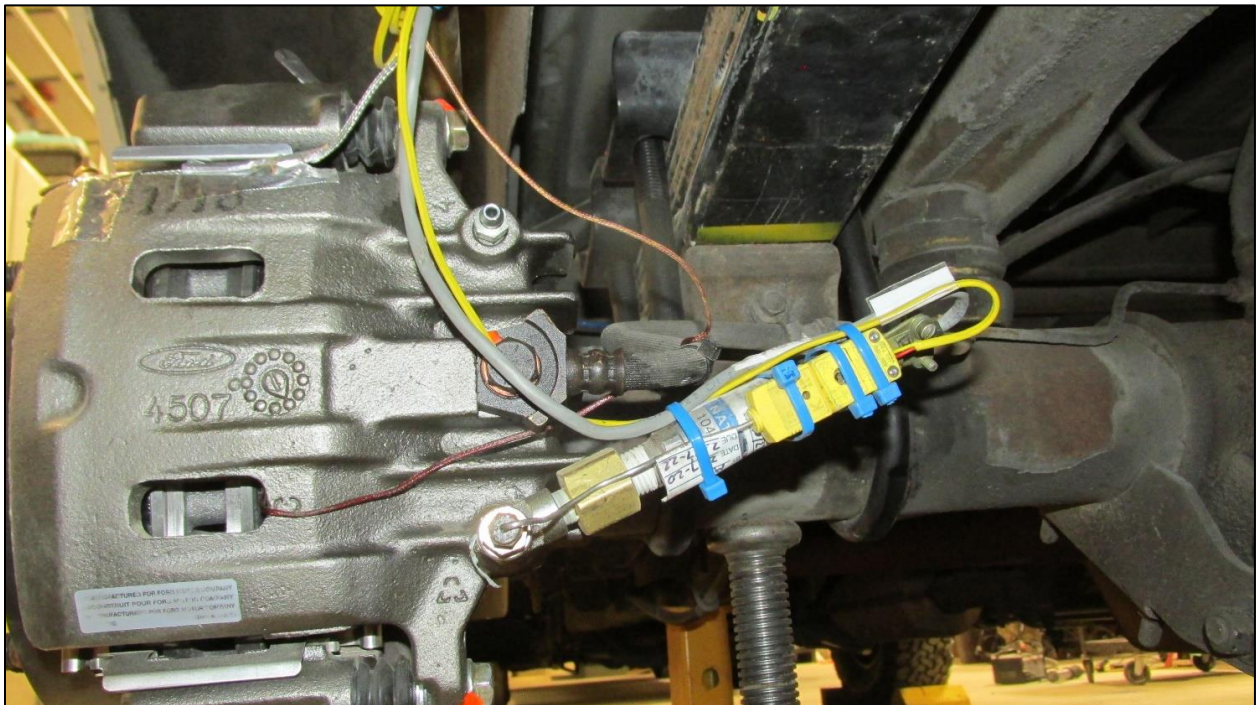
**NATC Photograph Number 22330-0019
Instrumentation – Data Acquisition eDAQ**



**NATC Photograph Number 22330-0020
Instrumentation – Curbside Rear Brake Pressure Transducer**



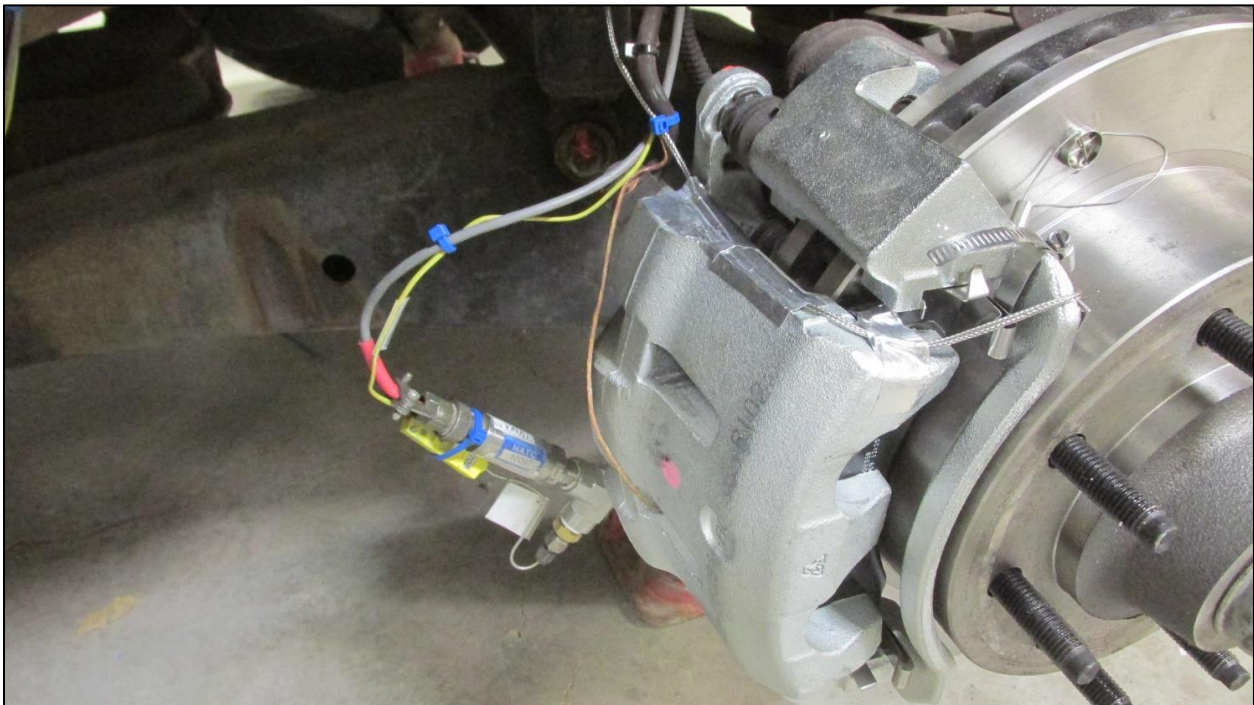
**NATC Photograph Number 22330-0021
Instrumentation – Curbside Rear Rotor Thermocouple**



**NATC Photograph Number 22330-0022
Instrumentation – Roadside Rear Brake Pressure Transducer**



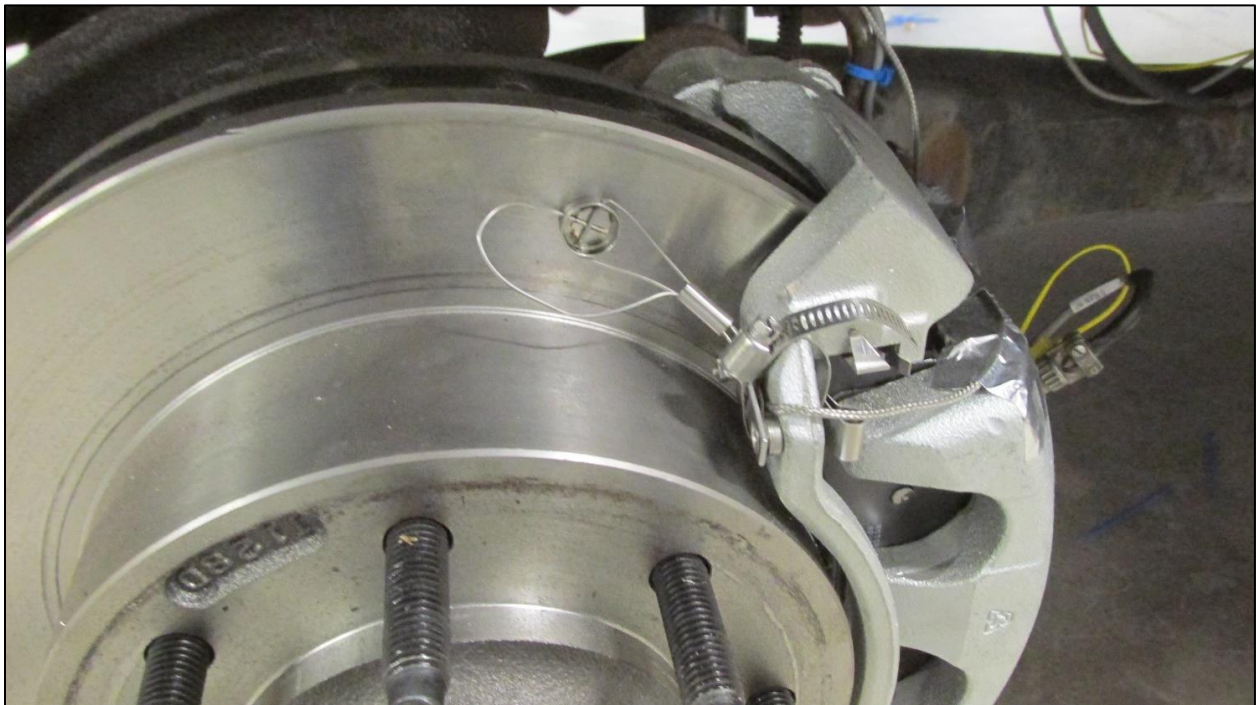
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Instrumentation – Roadside Rear Rotor Thermocouple**



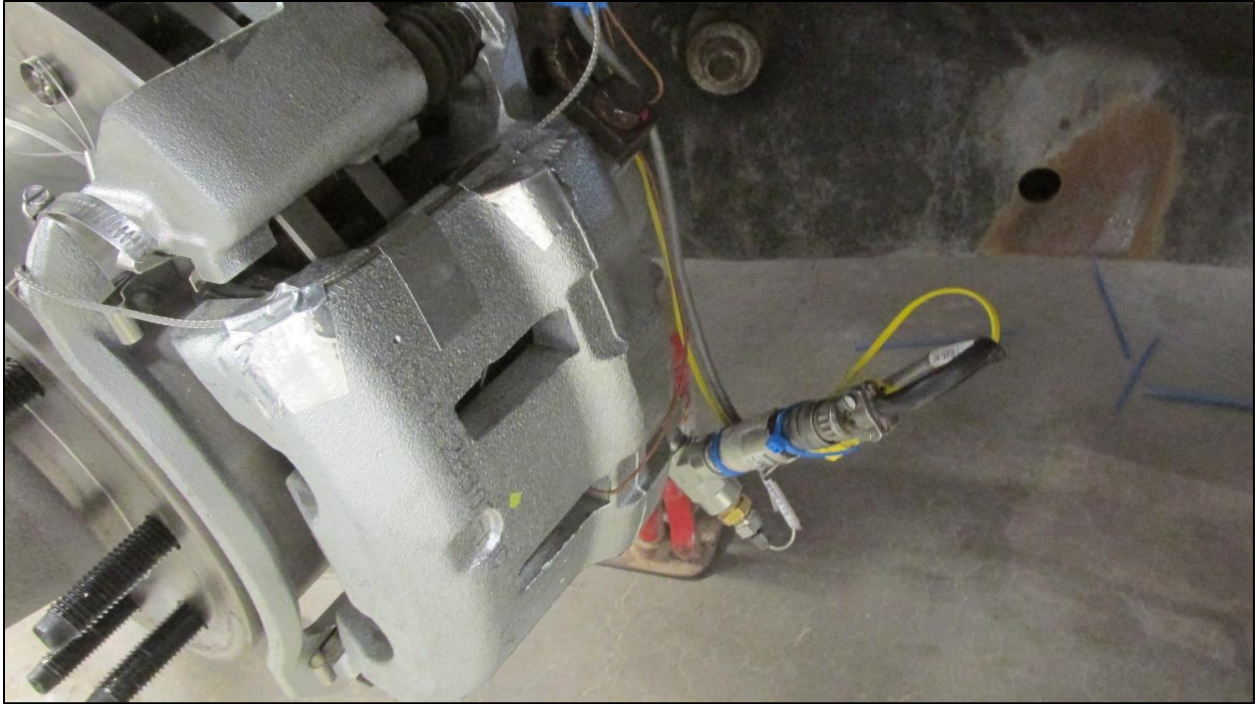
**NATC Photograph Number 22330-0024
Instrumentation – Curbside Front Brake Pressure Transducer**



**NATC Photograph Number 22330-0025
Instrumentation – Curbside Front Rotor Thermocouple**



**NATC Photograph Number 22330-0026
Instrumentation – Roadside Front Rotor Thermocouple**



**NATC Photograph Number 22330-0027
Instrumentation – Roadside Front Brake Pressure Transducer**



**NATC Photograph Number 22330-0028
Instrumentation – Master Cylinder Front Brake Pressure**



**NATC Photograph Number 22330-0029
Instrumentation – Master Cylinder Rear Brake Pressure**

**APPENDIX B
CERTIFICATES OF TRACEABILITY**



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email: info@nadc-ht.com

CERTIFICATE OF TRACEABILITY

Nevada Automotive Test Center (NATC) certifies that the test and measurement equipment listed below has been calibrated using measurement standards and reference instruments whose accuracy is traceable to the National Institute of Standards and Technology (NIST) or nationally accepted measurement systems.

The measurement and reference standards which support the NATC calibration system meet or exceed the requirements set forth in MIL-STD 45662A, and are calibrated on a schedule which is adjusted to ensure traceability at the required accuracy level.

NATC Project / Task No. 22330 - 1211

Job No. 4771 & 4774

Test Description: Braking Evaluations

Test Start Date: 2/25/2020

Test Completion Date: 3/11/2020

Project 22330 Jobs 4771, 4774

Certificate of Traceability
Instrumentation List

<u>Device</u>	<u>Manufacturer</u>	<u>Model #</u>	<u>Asset #</u>	<u>Date Calibrated</u>	<u>Date on Test</u>	<u>Date off Test</u>	<u>Calibration Due Date</u>
VBOX 3i SL	Racelogic	VB3iSL-V4	10594	2/21/2019	2/25/2020	3/11/2020	2/21/2021
Thermocouple Input Module	Racelogic	RLVBTC8-V2	10595	2/24/2020	2/25/2020	3/11/2020	CBU
Inertial Measurement Unit	Racelogic	RLVBMU04	10175	9/17/2018	2/25/2020	3/11/2020	9/17/2020
Multifunction Display	Racelogic	RLVBDSP03	9031	CNR	2/25/2020	3/11/2020	CNR
Bridge Amplifier	Analog Devices	5B38-05	1985	4/19/2019	2/25/2020	3/11/2020	4/19/2021
GPS Antenna	Racelogic	RLACS156	10596	CNR	2/25/2020	3/11/2020	CNR
Pedal Force Cell	Key Transducers	1515-03	7048	7/3/2019	2/25/2020	3/11/2020	7/3/2021
Type K Thermocouples, qty 4.	Temprel	B520B18K2F	K918B	9/11/2018	2/25/2020	3/11/2020	9/11/2020
Brake Disc Thermocouples, qty 4.	TC Direct	201-138	SN 1 to 4	1/23/2020	2/25/2020	3/11/2020	1/23/2022
EDAQ CPU	Somat	ECPU-PLUS	9703	CNR	2/25/2020	3/11/2020	CNR
EDAQ Bridge Layer	Somat	MSBRG	10009	10/18/2019	2/25/2020	3/11/2020	10/18/2020
Thermocouple Input Module	CSM	THMM 16 Pro	9861	2/24/2020	2/25/2020	3/11/2020	CBU
GPS Antenna	Garmin	GPS18x-5Hz	10024	CNR	2/25/2020	3/11/2020	CNR
String Potentiometer	TE Connectivity	SM2-12	10769	2/24/2020	2/25/2020	3/11/2020	CBU
Pressure Transducer	APG	PT-L9-5000	9614	10/24/2019	2/25/2020	3/11/2020	10/24/2020
Pressure Transducer	APG	PT-L9-5000	10097	2/12/2020	2/25/2020	3/11/2020	2/12/2021
Pressure Transducer	APG	PT-L9-5000	10489	10/23/2019	2/25/2020	3/11/2020	10/23/2020
Pressure Transducer	APG	PT-L9-5000	10487	10/24/2019	2/25/2020	3/11/2020	10/24/2020
Pressure Transducer	Transducers Direct	TD1004CCG5000	10616	2/12/2020	2/25/2020	3/11/2020	2/12/2021
Pressure Transducer	APG	PT-L9-5000	9857	2/12/2020	2/25/2020	3/11/2020	2/12/2021
Optical Encoder	BEI	XH20DB	9291	3/2/2020	2/25/2020	3/11/2020	CBU
Optical Encoder	BEI	XH20DB	10234	3/2/2020	2/25/2020	3/11/2020	CBU
Optical Encoder	BEI	XH20DB	10618	3/2/2020	2/25/2020	3/11/2020	CBU
Optical Encoder	BEI	XH20DB	9296	3/2/2020	2/25/2020	3/11/2020	CBU
Type K Thermocouple Probe	Omega	KMQSS-062U-6	10612	2/17/2020	2/25/2020	3/11/2020	2/17/2022
Type K Thermocouple Probe	Omega	KMQSS-062U-6	10702	2/17/2020	2/25/2020	3/11/2020	2/17/2022
Type K Thermocouple Probe	Omega	KMQSS-062U-6	10252	2/17/2020	2/25/2020	3/11/2020	2/17/2022
Type K Thermocouple Probe	Omega	KMQSS-062U-6	9648	2/17/2020	2/25/2020	3/11/2020	2/17/2022
Type K Thermocouples, qty 4.	Temprel	B520B18K2F	K918B	9/11/2018	2/29/2020	3/11/2020	9/11/2020

CNR: Calibration Not Required.

CBU: Calibrate Before Use. A through system calibration is performed on these items for the specific test application.



**Brake Performance Study Attachment 2: Dynamometer Testing Report - Performance
Matrix O.E. Brake Parts – 2001 Ford Excursion with Limousine Conversion**

Schoharie, NY

HWY19H001

NATIONAL TRANSPORTATION SAFETY BOARD PERFORMANCE MATRIX

Client NTSB Acquisition and Lease Management Division
490 L'Enfant Plaza East SW
Washington, DC 20594-0003

Report Number 203145-1

Vehicle Simulated 2001 Ford Excursion with Limousine Conversion

Front Lining Edge Code MPV 2000-EE

Rear Lining Edge Code MPV 2000-EE

Test Completion Date 06 March 2020

Signature

Kevin C. Machus, Test Engineer
for Greening Testing Laboratories, Inc.

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NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

Test Numbers	M20-063-23 / M20-064-06
Test Program Number	3946.01.20V01 - 2001 FORD EXCURSION.TST
Vehicle System Simulated	2001 Ford Excursion with Limousine Conversion
Reference	Contract No. 9531BM20P0015
Test Date(s)	20 - 21 February, 06 March 2020
Date Test Report Prepared	10 March 2020
Test Report Prepared By	K. Machus
Gross Vehicle Weight	13,565 lbs (per NTSB)
Static Rolling Radius	16.1 inches (based on revolutions per mile of LT265/75R16D tires)
Test Inertia	379.2 slug·ft ²
Equivalent 1/2 Vehicle Weight	6,783 lbs

	Front Disc Brake	Rear Disc Brake
Lining Edge Code	MPV 2000-EE	MPV 2000-EE
Brake Pad Part Number	Motorcraft BR1266	Motorcraft BR1275
Brake Pad FMSI® Number	7625-D756	7626-D757
Brake Configuration	dual piston, separate function caliper disc brake	dual piston, separate function caliper disc brake
Piston Diameter(s)	2 x 54 mm	2 x 46 mm
Rotor Part Number	Ford 1G3Z-1V102-AB	Ford YC3Z-2C026-BB
Brake Size (nominal) Rotor Diameter x Thickness	13.0 x 1.5 inches	12.8 x 1.2 inches
Rotor Mass (nominal)	#REF!	#REF!
Rotor Effective Radius	5.599 inches	5.529 inches
Wheel Rotation	right hand	left hand
Test Fixture	096622	190316
Date Parts Received	16 January 2020	16 January 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

FRONT BRAKE PAD MEASUREMENTS

Instrument Check - 2nd Effectiveness Matrix				3rd Effectiveness Matrix			4th Effectiveness Matrix					
	Pre	Post	Loss	Pre	Post	Loss	Pre	Post	Loss			
Inboard Pad												
Thickness (inch)	A	0.717	0.633	0.084	0.633	0.618	0.015	0.618	0.613	0.005		
	B	0.720	0.625	0.095	0.625	0.607	0.018	0.607	0.603	0.004		
	C	0.725	0.632	0.093	0.632	0.610	0.022	0.610	0.602	0.008		
	D	0.725	0.644	0.081	0.644	0.628	0.016	0.628	0.609	0.019		
	E	0.725	0.652	0.073	0.652	0.632	0.020	0.632	0.608	0.024		
	F	0.718	0.640	0.078	0.640	0.612	0.028	0.612	0.594	0.018		
	G	0.718	0.628	0.090	0.628	0.605	0.023	0.605	0.594	0.011		
	H	0.714	0.638	0.076	0.638	0.620	0.018	0.620	0.605	0.015		
			Average Loss	Average Loss			Average Loss					
			Cumulative Total	Cumulative Total			Cumulative Total					
Mass (kg)	0.667		0.628	0.628		0.619	0.619		0.570			
			Loss			Loss			Loss			
	Cumulative Total		0.039	Cumulative Total		0.048	Cumulative Total		0.097			
Outboard Pad												
Thickness (inch)	I	0.716	0.621	0.095	0.621	0.599	0.022	0.599	0.573	0.026		
	J	0.712	0.623	0.089	0.623	0.599	0.024	0.599	0.574	0.025		
	K	0.712	0.621	0.091	0.621	0.597	0.024	0.597	0.579	0.018		
	L	0.703	0.624	0.079	0.624	0.607	0.017	0.607	0.587	0.020		
	M	0.703	0.655	0.048	0.655	0.638	0.017	0.638	0.625	0.013		
	N	0.705	0.648	0.057	0.648	0.635	0.013	0.635	0.612	0.023		
	O	0.704	0.649	0.055	0.649	0.632	0.017	0.632	0.613	0.019		
	P	0.711	0.648	0.063	0.648	0.630	0.018	0.630	0.618	0.012		
			Average Loss	Average Loss			Average Loss					
			Cumulative Total	Cumulative Total			Cumulative Total					
Mass (kg)	0.659		0.627	0.627		0.619	0.619		0.570			
			Loss			Loss			Loss			
	Cumulative Total		0.032	Cumulative Total		0.040	Cumulative Total		0.089			
Total (Inboard Pad + Outboard Pad)												
Thickness Loss				0.156	Thickness Loss				0.039	Thickness Loss		0.033
Cumulative				0.156	Cumulative				0.195	Cumulative		0.228
Mass Loss				0.071	Mass Loss				0.017	Mass Loss		0.098
Cumulative				0.071	Cumulative				0.088	Cumulative		0.186

NOTE: Values in parentheses indicate an increase in thickness.



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

FRONT BRAKE PAD MEASUREMENTS

Overall						
	Pre	Post	Loss			
				Inboard Pad		
Thickness (inch)	A	0.717	0.613	0.104		
	B	0.720	0.603	0.117		
	C	0.725	0.602	0.123		
	D	0.725	0.609	0.116		
	E	0.725	0.608	0.117		
	F	0.718	0.594	0.124		
	G	0.718	0.594	0.124		
	H	0.714	0.605	0.109		
			Average Loss	0.117		
Mass (kg)	0.667	0.570				
		Loss	0.097			
				Outboard Pad		
Thickness (inch)	I	0.716	0.573	0.143		
	J	0.712	0.574	0.138		
	K	0.712	0.579	0.133		
	L	0.703	0.587	0.116		
	M	0.703	0.625	0.078		
	N	0.705	0.612	0.093		
	O	0.704	0.613	0.091		
	P	0.711	0.618	0.093		
			Average Loss	0.111		
Mass (kg)	0.659	0.570				
		Loss	0.089			
Total (Inboard Pad + Outboard Pad)						
			Thickness Loss	0.228		
			Mass Loss	0.186		

NOTE: Values in parentheses indicate an increase in thickness.



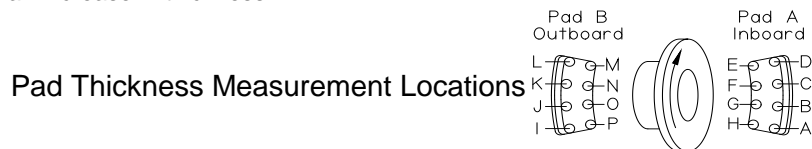
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

REAR BRAKE PAD MEASUREMENTS

Instrument Check - 2nd Effectiveness Matrix			3rd Effectiveness Matrix			4th Effectiveness Matrix					
	Pre	Post	Loss	Pre	Post	Loss	Pre	Post	Loss		
Inboard Pad											
Thickness (inch)	A	0.697	0.628	0.069	0.628	0.614	0.014	0.614	0.594	0.020	
	B	0.692	0.626	0.066	0.626	0.615	0.011	0.615	0.593	0.022	
	C	0.694	0.631	0.063	0.631	0.624	0.007	0.624	0.603	0.021	
	D	0.687	0.660	0.027	0.660	0.652	0.008	0.652	0.638	0.014	
	E	0.684	0.655	0.029	0.655	0.644	0.011	0.644	0.635	0.009	
	F	0.691	0.630	0.061	0.630	0.616	0.014	0.616	0.601	0.015	
	G	0.692	0.622	0.070	0.622	0.607	0.015	0.607	0.593	0.014	
	H	0.692	0.623	0.069	0.623	0.608	0.015	0.608	0.592	0.016	
Average Loss				Average Loss				Average Loss			
Cumulative Total			0.057	Cumulative Total			0.012	Cumulative Total			0.016
Mass (kg)	0.449		0.423	0.423		0.419	0.419		0.411		
			Loss			Loss			Loss		
			Cumulative Total			Cumulative Total			Cumulative Total		
			0.026			0.004			0.008		
Outboard Pad											
Thickness (inch)	I	0.691	0.646	0.045	0.646	0.633	0.013	0.633	0.596	0.037	
	J	0.699	0.644	0.055	0.644	0.638	0.006	0.638	0.589	0.049	
	K	0.699	0.630	0.069	0.630	0.618	0.012	0.618	0.576	0.042	
	L	0.701	0.619	0.082	0.619	0.616	0.003	0.616	0.567	0.049	
	M	0.698	0.639	0.059	0.639	0.634	0.005	0.634	0.582	0.052	
	N	0.698	0.652	0.046	0.652	0.646	0.006	0.646	0.600	0.046	
	O	0.698	0.667	0.031	0.667	0.654	0.013	0.654	0.604	0.050	
	P	0.691	0.664	0.027	0.664	0.650	0.014	0.650	0.615	0.035	
Average Loss				Average Loss				Average Loss			
Cumulative Total			0.052	Cumulative Total			0.009	Cumulative Total			0.045
Mass (kg)	0.459		0.434	0.434		0.427	0.427		0.419		
			Loss			Loss			Loss		
			Cumulative Total			Cumulative Total			Cumulative Total		
			0.025			0.007			0.008		
Total (Inboard Pad + Outboard Pad)											
Thickness Loss			0.109	Thickness Loss			0.021	Thickness Loss			0.061
Cumulative			0.109	Cumulative			0.130	Cumulative			0.191
Mass Loss			0.051	Mass Loss			0.011	Mass Loss			0.016
Cumulative			0.051	Cumulative			0.062	Cumulative			0.078

NOTE: Values in parentheses indicate an increase in thickness.



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

REAR BRAKE PAD MEASUREMENTS

Overall						
	Pre	Post	Loss			
				Inboard Pad		
Thickness (inch)	A	0.697	0.594	0.103		
	B	0.692	0.593	0.099		
	C	0.694	0.603	0.091		
	D	0.687	0.638	0.049		
	E	0.684	0.635	0.049		
	F	0.691	0.601	0.090		
	G	0.692	0.593	0.099		
	H	0.692	0.592	0.100		
Average Loss				0.085		
Mass (kg)	0.449	0.411				
		Loss	0.038			
				Outboard Pad		
Thickness (inch)	I	0.691	0.596	0.095		
	J	0.699	0.589	0.110		
	K	0.699	0.576	0.123		
	L	0.701	0.567	0.134		
	M	0.698	0.582	0.116		
	N	0.698	0.600	0.098		
	O	0.698	0.604	0.094		
	P	0.691	0.615	0.076		
Average Loss				0.106		
Mass (kg)	0.459	0.419				
		Loss	0.040			
Total (Inboard Pad + Outboard Pad)						
Thickness Loss				0.191		
Mass Loss				0.078		

NOTE: Values in parentheses indicate an increase in thickness.



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2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

BRAKE DISC MEASUREMENTS

FRONT THICKNESS, MASS AND RUN-OUT

		Instrument Check - 2nd Effectiveness Matrix			3rd Effectiveness Matrix			4th Effectiveness Matrix		
		Pre	Post	Loss	Pre	Post	Loss	Pre	Post	Loss
Thickness (inch)	0° (A)	1.495	1.495	0.000	1.495	1.494	0.001	1.494	1.495	(0.001)
	90° (B)	1.495	1.495	0.000	1.495	1.494	0.001	1.494	1.495	(0.001)
	180° (C)	1.495	1.494	0.001	1.494	1.494	0.000	1.494	1.495	(0.001)
	270° (D)	1.495	1.494	0.001	1.494	1.494	0.000	1.494	1.495	(0.001)
	Average	1.495	1.495	0.000	1.495	1.494	0.001	1.495	1.494	0.001
		Cumulative Total			Cumulative Total			Cumulative Total		
Mass (kg)		20.692	20.692		20.692	20.684		20.692	20.683	
			Loss	0.000		Loss	0.008		Loss	0.009
		Cumulative Total			Cumulative Total			Cumulative Total		
		0.000			0.008			0.017		
Run-Out (in)		0.009	0.005	---	0.004	0.003	---	0.004	0.003	---

REAR THICKNESS, MASS AND RUN-OUT

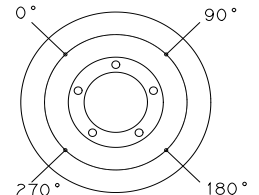
		Instrument Check - 2nd Effectiveness Matrix			3rd Effectiveness Matrix			4th Effectiveness Matrix		
		Pre	Post	Loss	Pre	Post	Loss	Pre	Post	Loss
Thickness (inch)	0° (A)	1.181	1.180	0.001	1.180	1.180	0.000	1.180	1.180	0.000
	90° (B)	1.181	1.180	0.001	1.180	1.180	0.000	1.180	1.180	0.000
	180° (C)	1.181	1.180	0.001	1.180	1.180	0.000	1.180	1.180	0.000
	270° (D)	1.181	1.180	0.001	1.180	1.180	0.000	1.180	1.180	0.000
	Average	1.181	1.180	0.001	1.180	1.180	0.000	1.181	1.180	0.001
		Cumulative Total			Cumulative Total			Cumulative Total		
		0.001			0.001			0.002		
Mass (kg)		10.896	10.882		10.882	10.879		10.896	10.875	
			Loss	0.014		Loss	0.003		Loss	0.021
		Cumulative Total			Cumulative Total			Cumulative Total		
		0.014			0.017			0.038		
Run-Out (in)		0.009	0.005	---	0.004	0.003	---	0.004	0.003	---

NOTE: Values in parentheses indicate an increase in thickness.

Physical Characteristics

	FRONT		Pre Test	
	Pre Test	Post Test	Pre Test	Post Test
Surface Roughness (µin) (0° Inboard Face)	46	56	27	44
Brinell Hardness (0° Inboard Face)	207	207	228	228

Measurement Locations



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

BRAKE DISC MEASUREMENTS

FRONT THICKNESS, MASS AND RUN-OUT

Overall

		Pre	Post	Loss
Thickness (inch)	0° (A)	1.495	1.495	0.000
	90° (B)	1.495	1.495	0.000
	180° (C)	1.495	1.495	0.000
	270° (D)	1.495	1.495	0.000
	Average	1.495	1.495	0.000
Mass (kg)		20.692	20.683	
			Loss	0.009

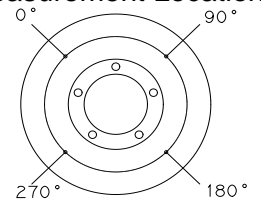
REAR THICKNESS, MASS AND RUN-OUT

Instrument Check - 2nd Effectiveness Matrix

		Pre	Post	Loss
Thickness (inch)	0° (A)	1.181	1.180	0.001
	90° (B)	1.181	1.180	0.001
	180° (C)	1.181	1.180	0.001
	270° (D)	1.181	1.180	0.001
	Average	1.181	1.180	0.001
Mass (kg)		10.896	10.875	
			Loss	0.021

NOTE: Values in parentheses indicate an increase in thickness.

Measurement Locations



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

DATA NOTES

1 All average and sustained values shown in this report are calculated with respect to **DISTANCE**.

2 The data presented in this report has been gathered as follows:

START Threshold = 50 lbf·ft of brake torque during brake apply.

AVERAGE = average value between START and STOP Threshold levels.

INITIAL Data Point = Values are taken at the point where the control level is achieved.

SUSTAINED Data = average value between the INITIAL and END data points.

END Data Point = Values are taken 0.1 seconds prior to the STOP threshold

MAXIMUM = maximum value observed in the SUSTAINED Data Interval.

STOP Threshold = brake release

FINAL temperature is the highest temperature value observed in a 4.0 second "window" beginning 1.0 seconds after brake release.

3 Brake application is initiated when the control temperature (rotor) reaches the desired initial brake temperature.

4 Cooling Air Temperature = 80°F (±5°F)

5 Cooling Air Velocity = 30 mi/h for burnish and 300°F Effectiveness, 5 mi/h all other sections.

6 For all stops which show "zero" (0) or negative values for some of the computed pressure, torque or coefficient values:

These stops achieved final speed but did not achieve the torque level required for the particular stop. Since the START data and STOP data thresholds were satisfied, deceleration rate, distance, time to stop, etc., are accurate values, and can be used for data comparison purposes.

The presence of "zero" values generally is caused by lack of brake performance, resulting in a "clamp" condition. "Clamp" condition is defined by the brake calling for the maximum pressure the test section allows ("clamp" pressure) and the brake being unable to attain the deceleration rate required in the test section at that pressure.

7 Thermocouple locations and depths:

Front Rotor: Center of inboard rubbing track at a depth of 0.040 inches

Front Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches

Front Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches

Rear Rotor: Center of inboard rubbing track at a depth of 0.040 inches

Rear Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches

Rear Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches

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2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

COMPUTED DATA DESCRIPTIONS

SPEED

INIT = Speed start threshold is achieved.

FNL = Brake release speed

TIME

STOP = Time elapsed between start threshold and brake release

REPT = Time elapsed between cycles

DISTANCE

STOP = Distance elapsed between start threshold and brake release

REPT = Distance elapsed between cycles

DECEL

AVG = Average deceleration measured from start threshold to brake release

PRESSURE

AVERAGE = Average pressure from start threshold to brake release

SUSTAINED = Average pressure from point control level is achieved to brake release

MAXIMUM = Maximum pressure from start threshold to brake release

TORQUE

AVERAGE = Average torque from start threshold to brake release

SUSTAINED = Average torque from point control level is achieved to brake release

MAXIMUM = Maximum torque from start threshold to brake release

TEMPERATURE

INT = Temperature at start threshold

MAX = Maximum temperature between start threshold and 0.1 seconds after brake release

FLUID DISPLACEMENT

MAX = Maximum fluid displacement between start threshold and brake release

FRICITION COEFFICIENT

SUST = Friction coefficient (μ) calculated using the following formula:

$$\mu = \frac{\text{Sustained Torque (lbf}\cdot\text{ft)} / \text{Rotor Effective Radius (ft)}}{\text{Sustained Pressure (lbf/in}^2\text{)} * \text{Total Caliper Piston Area (in}^2\text{)}} * 0.5$$

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2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

TEST SYNOPSIS

Step	Description	FMVSS 105 Reference	Braking Speed (mi/h)	Brake Application Control (IBT of Distance)	Deceleration Level (g) or Pressure Level (lbf/in ²)	Number of Stops/Snubs
1	Instrument Check	7.2 Instrumentation Check at GVWR	30-0	<200°F	0.31	10
2	Burnish	7.4 Burnish at GVWR	40-0	IBT = 200°F or 1 mile distance	0.37	200
3	50 mi/h Effectiveness	---	50-40	300°F	400, 600, 800, 1000, 1200, 1400, 1600, 1800 lbf/in ²	8
4	55 mi/h Effectiveness	---	55-45	300°F	400, 600, 800, 1000, 1200, 1400, 1600, 1800 lbf/in ²	8
5	60 mi/h Effectiveness	---	60-50	300°F	400, 600, 800, 1000, 1200, 1400, 1600, 1800 lbf/in ²	8
6	65 mi/h Effectiveness	---	65-55	300°F	400, 600, 800, 1000, 1200, 1400, 1600, 1800 lbf/in ²	8
7	Best Effort	---	55-0	300°F	1800 lbf/in ²	2
8	Warm brake to 450°F at the conditions outlined in Step 2 and repeat sections 3-7 at an initial temperature of 450°F					
9	Warm brake to 600°F at the conditions outlined in Step 2 and repeat sections 3-7 at an initial temperature of 600°F					
10	Warm brake to 750°F at the conditions outlined in Step 2 and repeat sections 3-7 at an initial temperature of 750°F					
11	Reburnish	---	40-0	IBT = 200°F or 1 mile distance	0.37	35
12	Repeat Sections 3 - 10					
13	Inspection					
14	Reburnish	---	40-0	IBT = 200°F or 1 mile distance	0.37	35
15	Repeat Sections 3 - 10					
16	Inspection					
17	Reburnish	---	40-0	IBT = 200°F or 1 mile distance	0.37	35
18	Repeat Sections 3 - 10					
19	Warm brake to 900°F at the conditions outlined in Step 2 and repeat sections 3-7 at an initial temperature of 900°F					
20	End Of Test					

Test Numbers: M20-063-23 / M20-064-06

Report Number: 203145-1

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

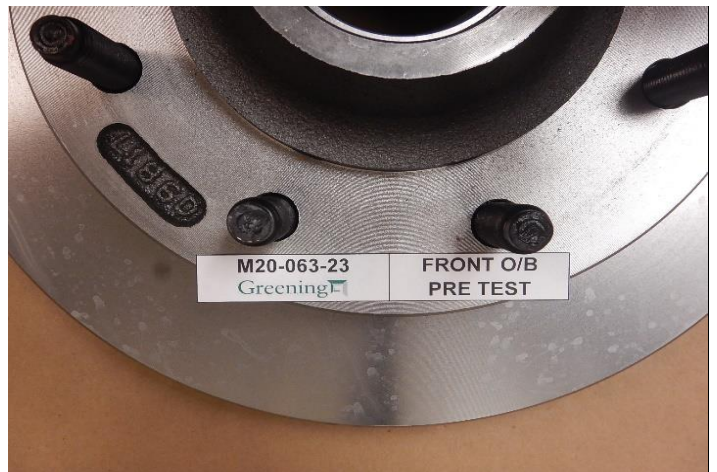
NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

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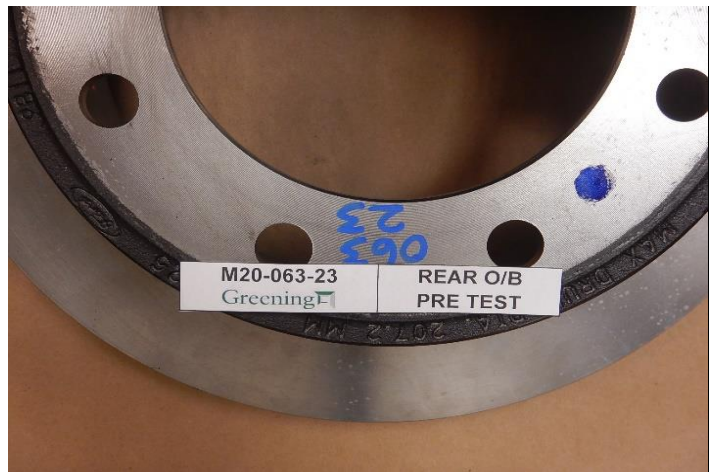
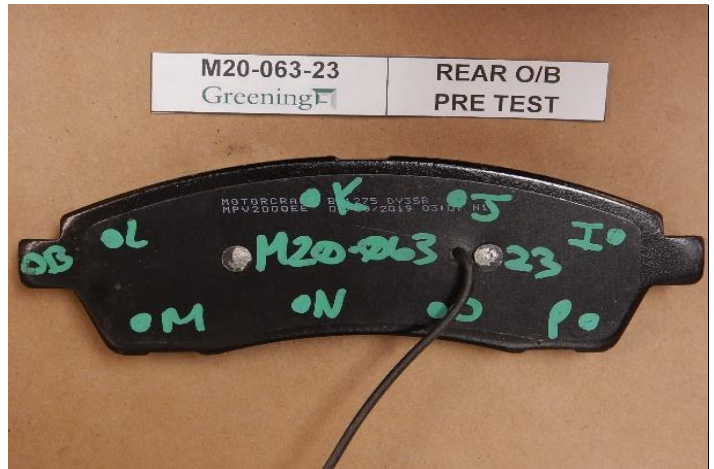
PRE TEST PHOTOGRAPHS - FRONT BRAKE



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2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI@ NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

PRE TEST PHOTOGRAPHS - REAR BRAKE



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

POST SECOND EFFECTIVENESS MATRIX VISUAL INSPECTION - FRONT BRAKE

Inboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is grey/black in color.

All other test hardware appears in good condition.

PHOTOGRAPHS



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

POST SECOND EFFECTIVENESS MATRIX VISUAL INSPECTION - REAR BRAKE

Inboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is grey/black in color.

All other test hardware appears in good condition.

PHOTOGRAPHS



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

POST THIRD EFFECTIVENESS MATRIX VISUAL INSPECTION - FRONT BRAKE

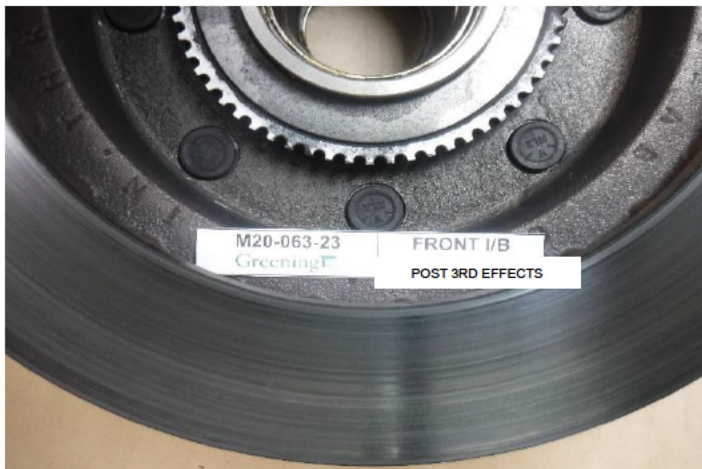
Inboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is blue/grey in color.

All other test hardware appears in good condition.

PHOTOGRAPHS



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

POST THIRD EFFECTIVENESS MATRIX VISUAL INSPECTION - REAR BRAKE

Inboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is blue/grey in color.

All other test hardware appears in good condition.

PHOTOGRAPHS



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

POST TEST VISUAL INSPECTION - FRONT BRAKE

Inboard Pad: The pad has moderate glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has moderate glazing, light grooving, light pitting and light resin bleed.

Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is black/grey in color.

All other test hardware appears in good condition.

PHOTOGRAPHS



NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

POST TEST VISUAL INSPECTION - REAR BRAKE

Inboard Pad: The pad has moderate glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has moderate glazing, light grooving, light pitting and light resin bleed.

Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is black/grey in color.

All other test hardware appears in good condition.

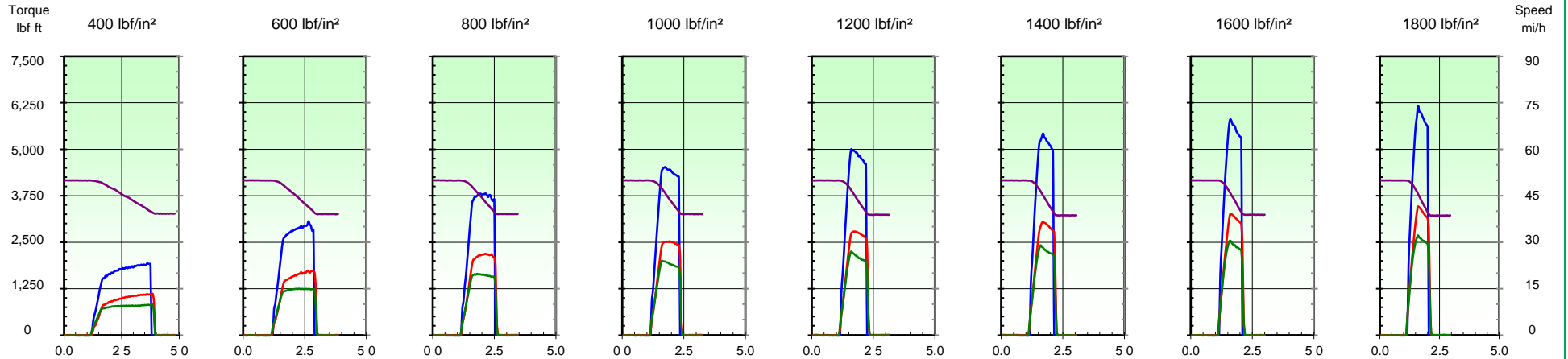
PHOTOGRAPHS



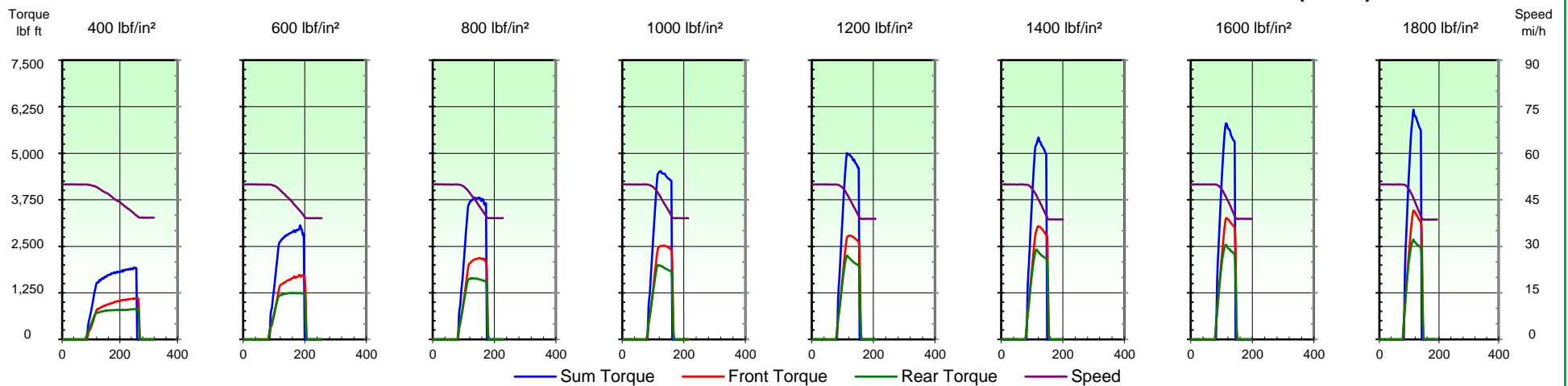
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

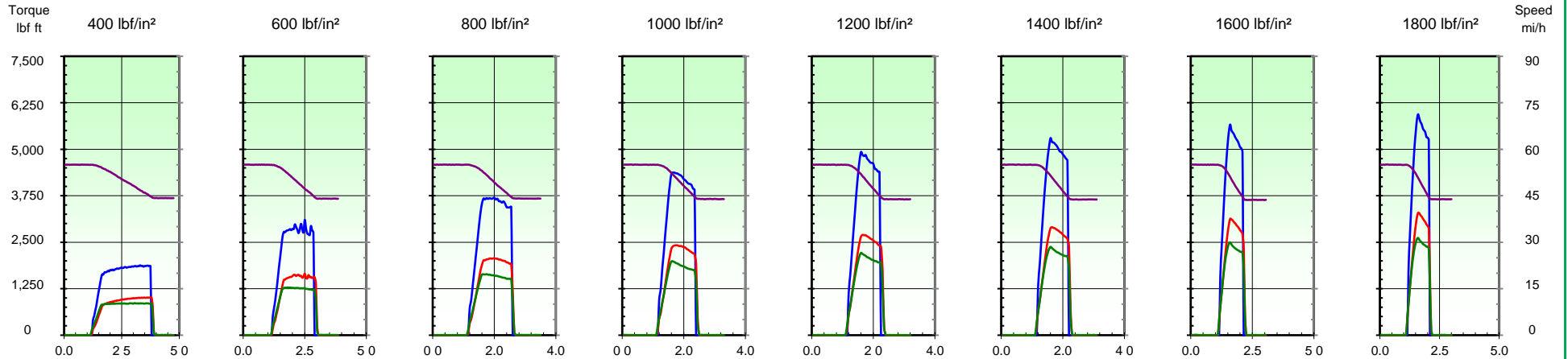
Report Number: 203145-1

Test Report Date: 06 March 2020

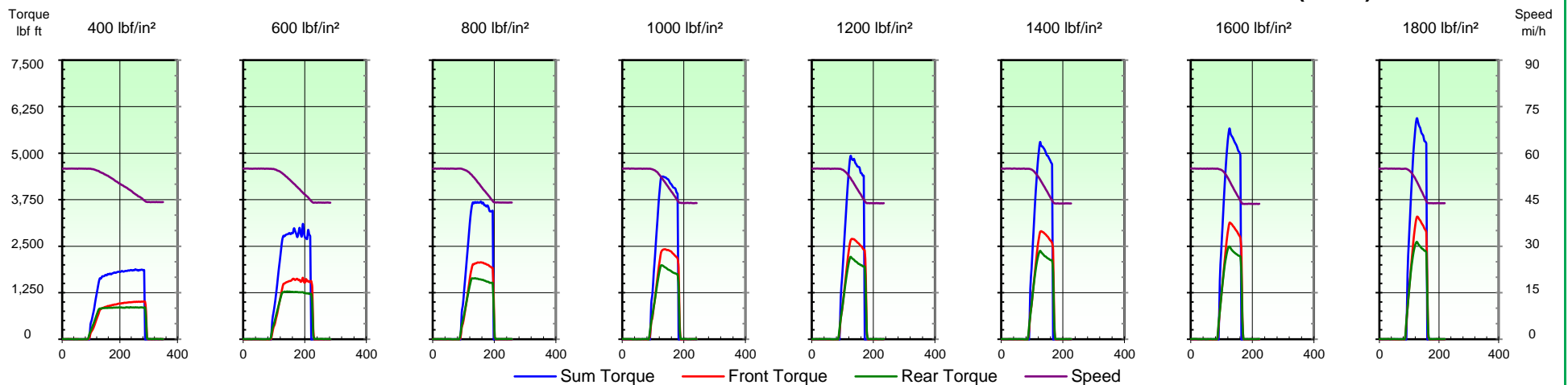
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



— Sum Torque — Front Torque — Rear Torque — Speed

Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

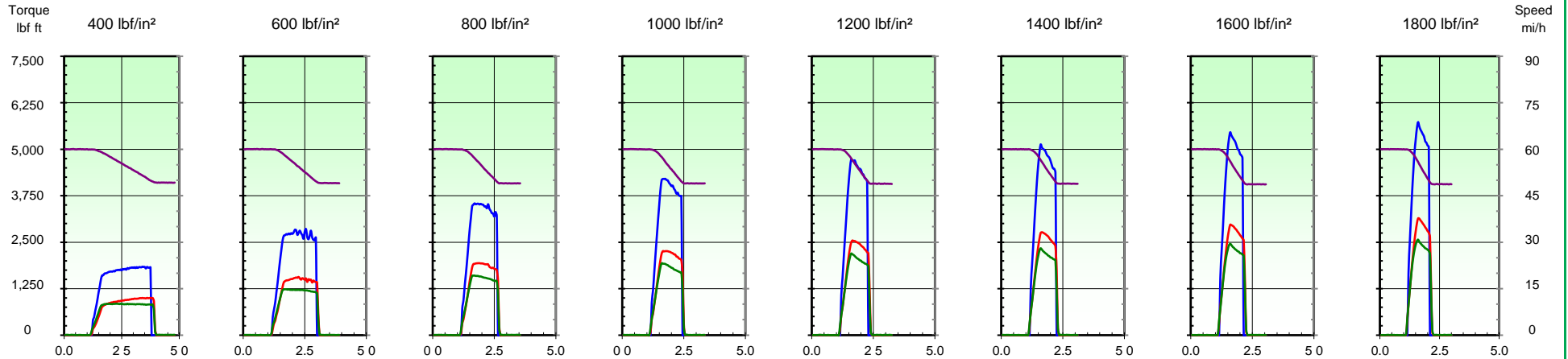
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Test Report Date: 06 March 2020

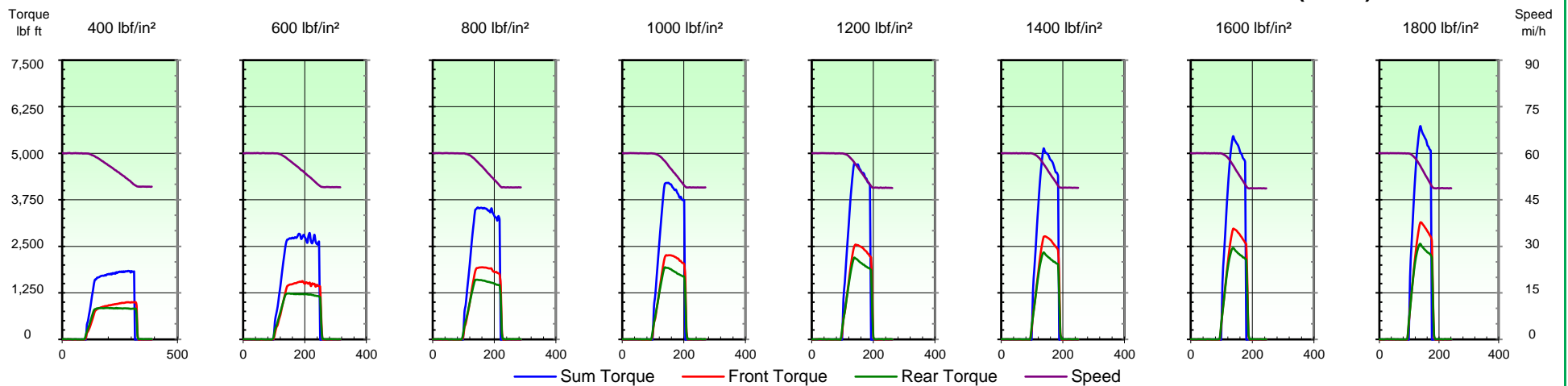
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 60-50 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 60-50 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

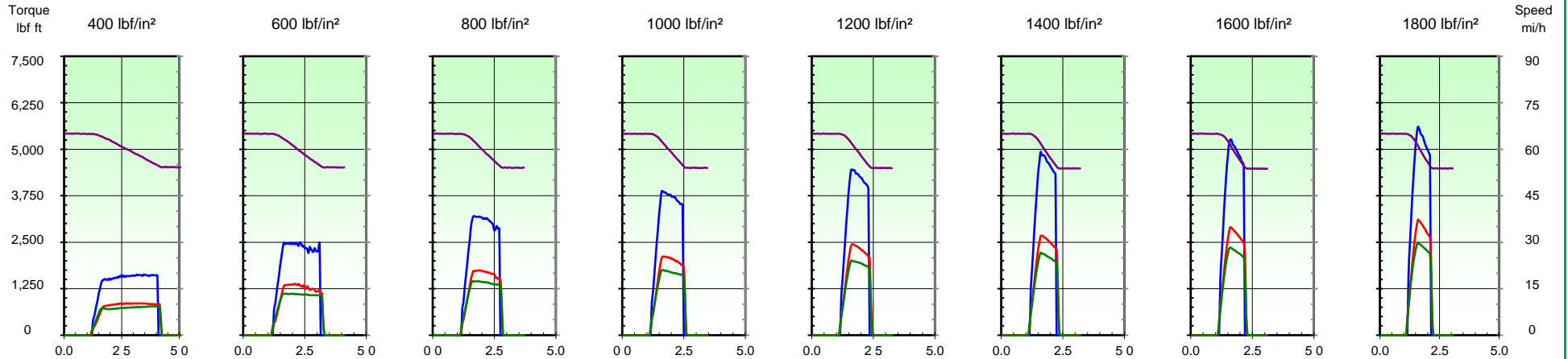
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Test Report Date: 06 March 2020

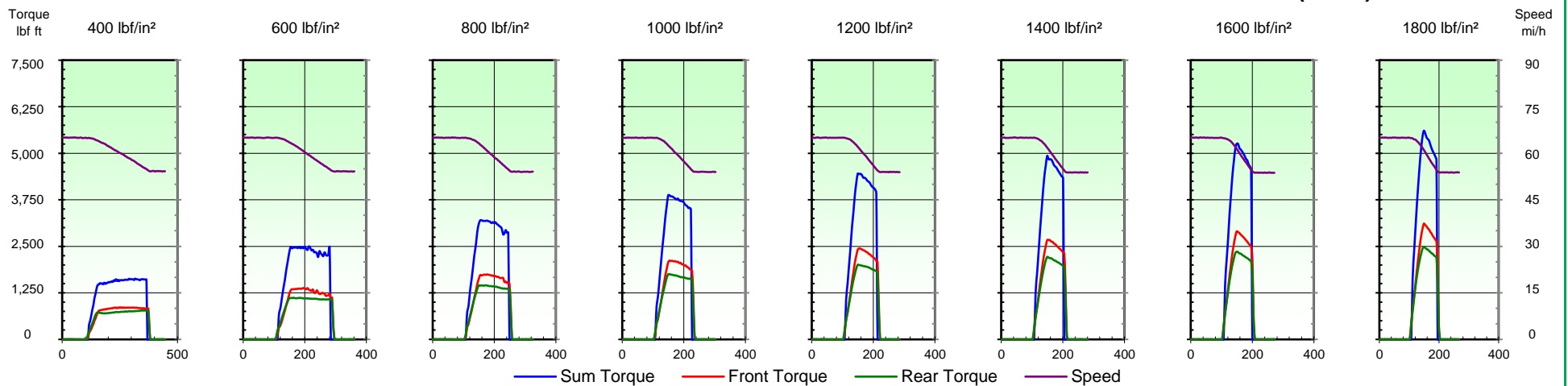
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 65-55 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 65-55 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

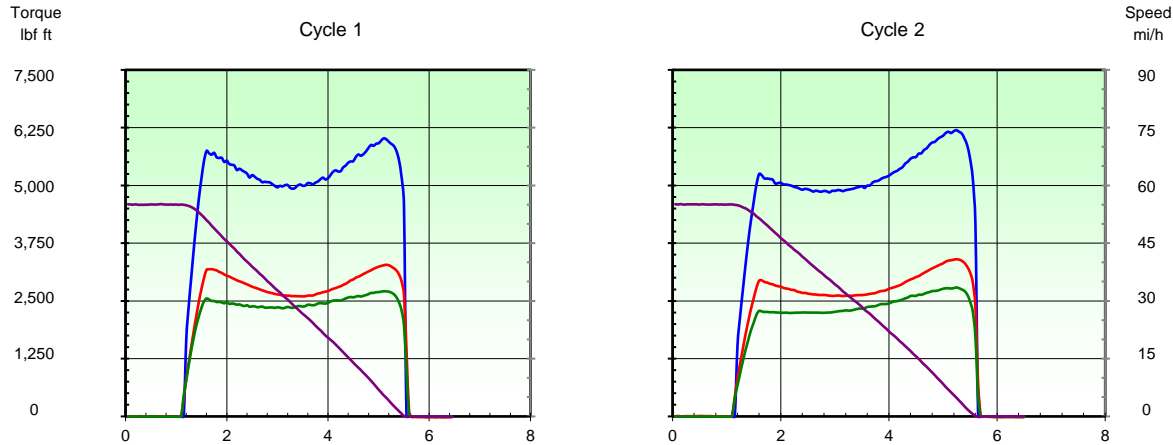
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Test Report Date: 06 March 2020

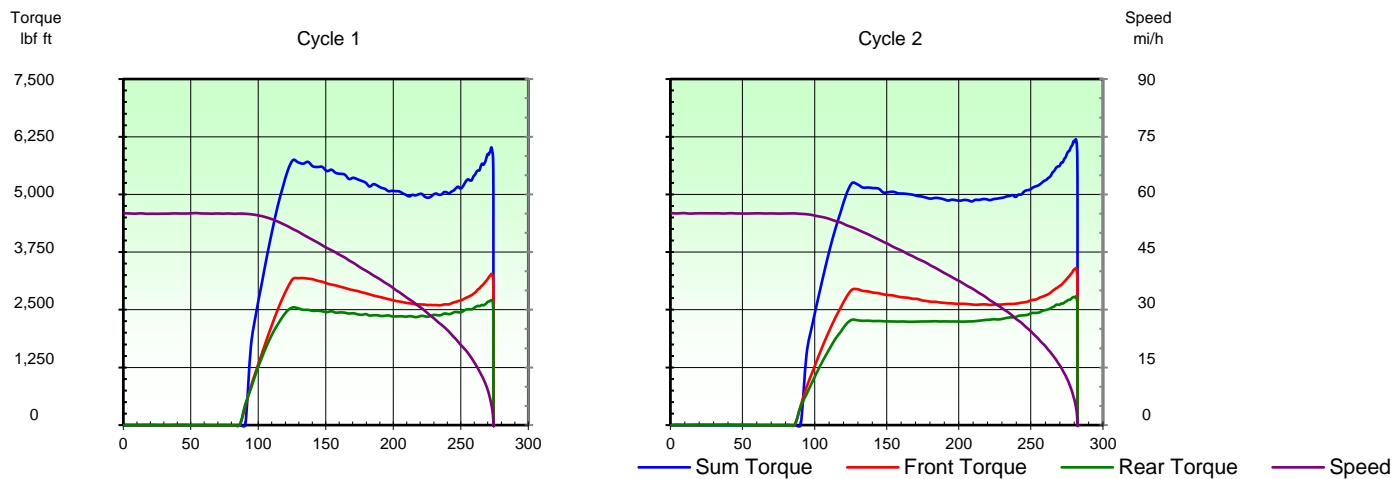
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

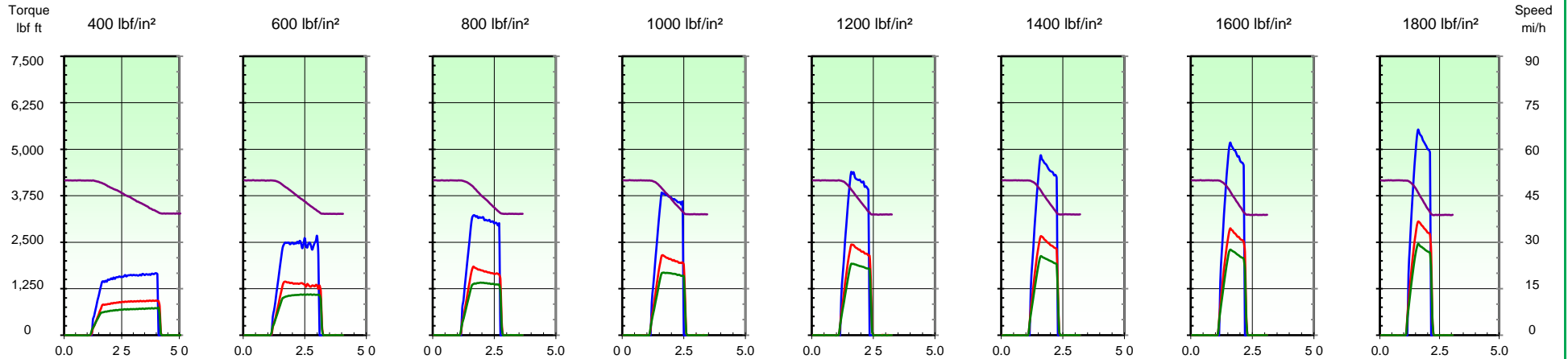
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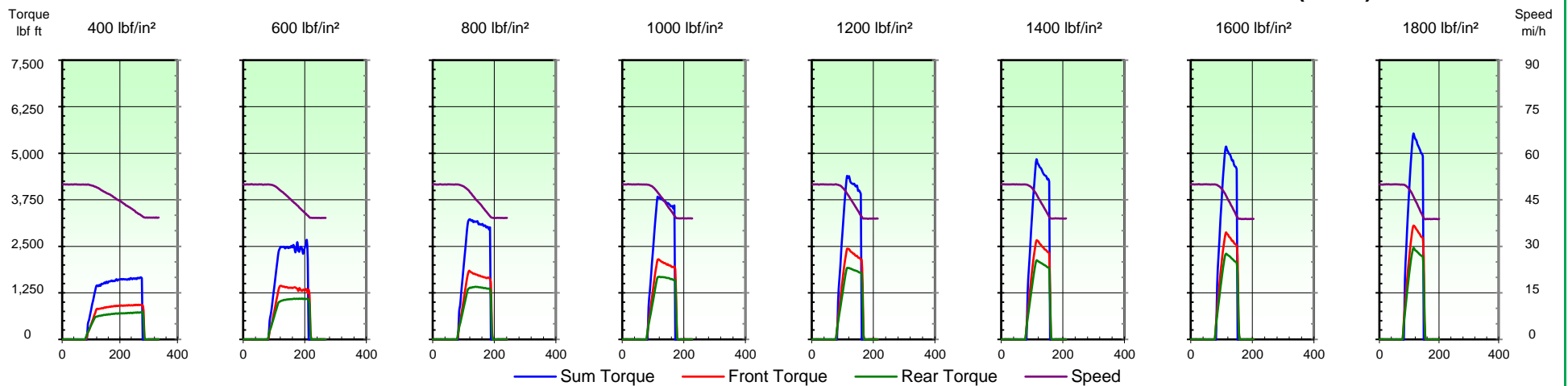
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 50-40 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 50-40 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

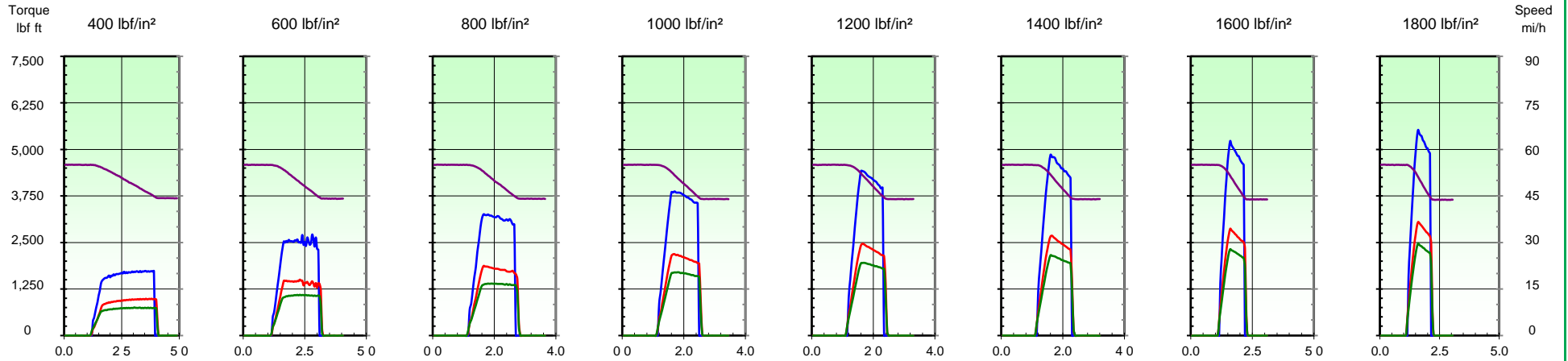
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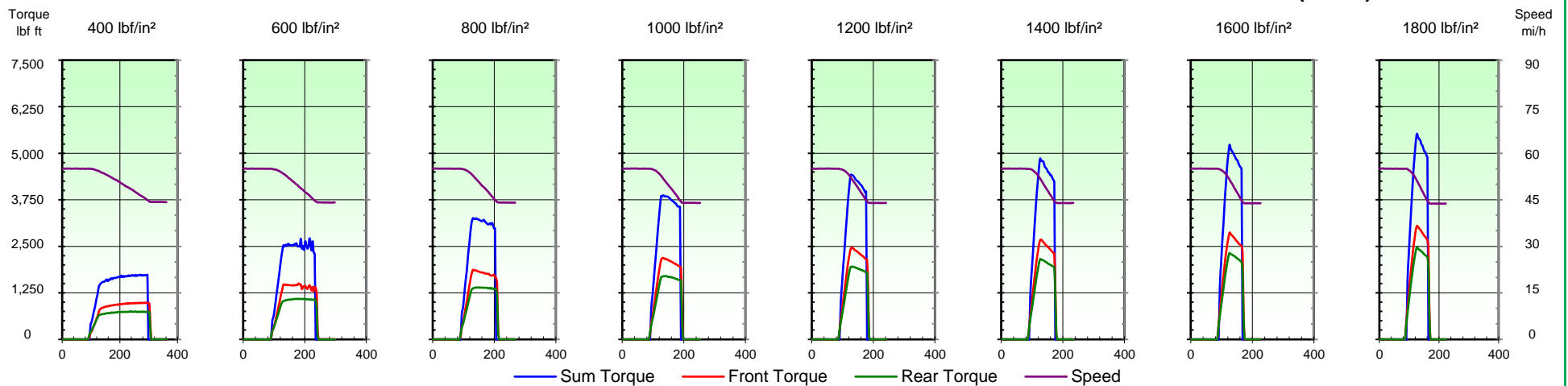
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

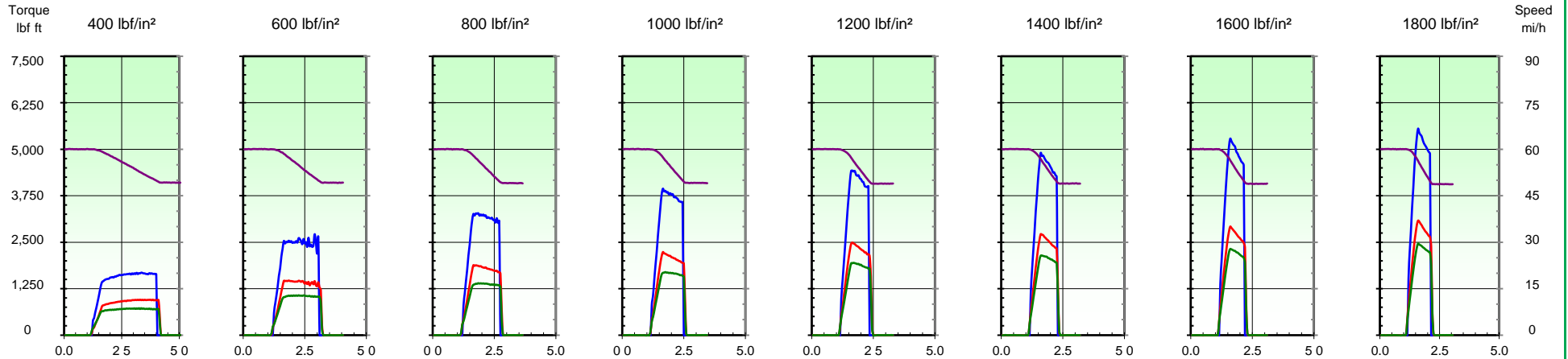
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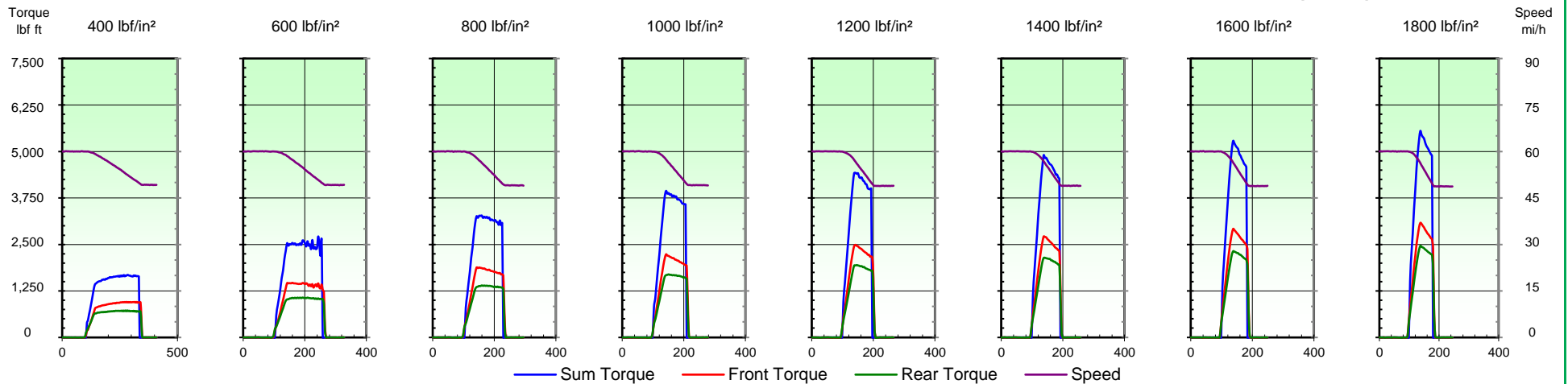
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 60-50 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 60-50 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

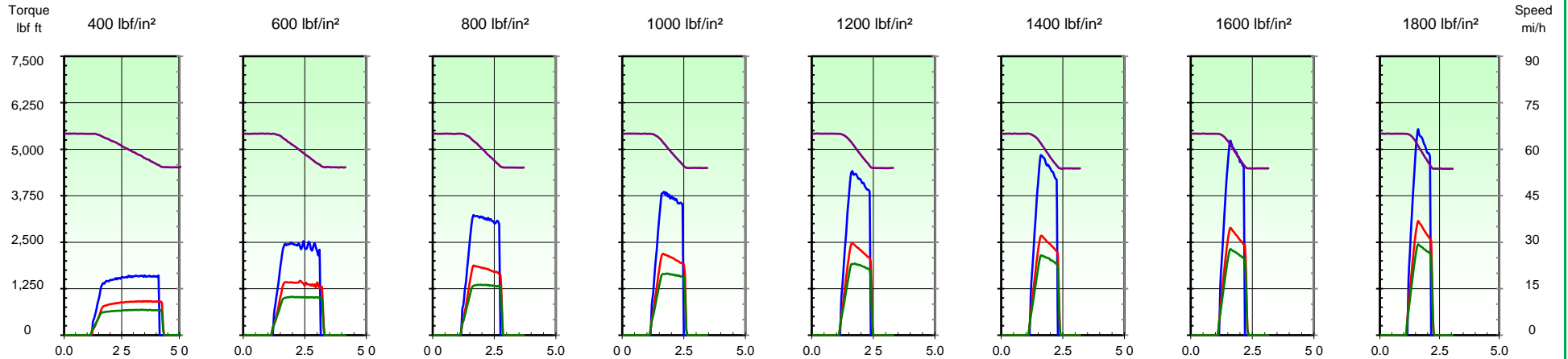
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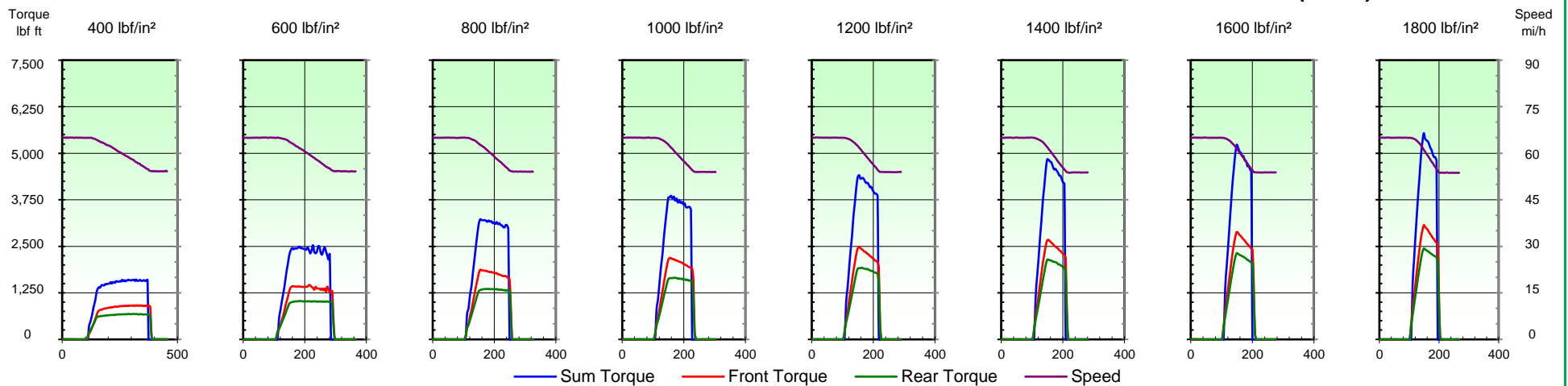
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 65-55 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 65-55 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

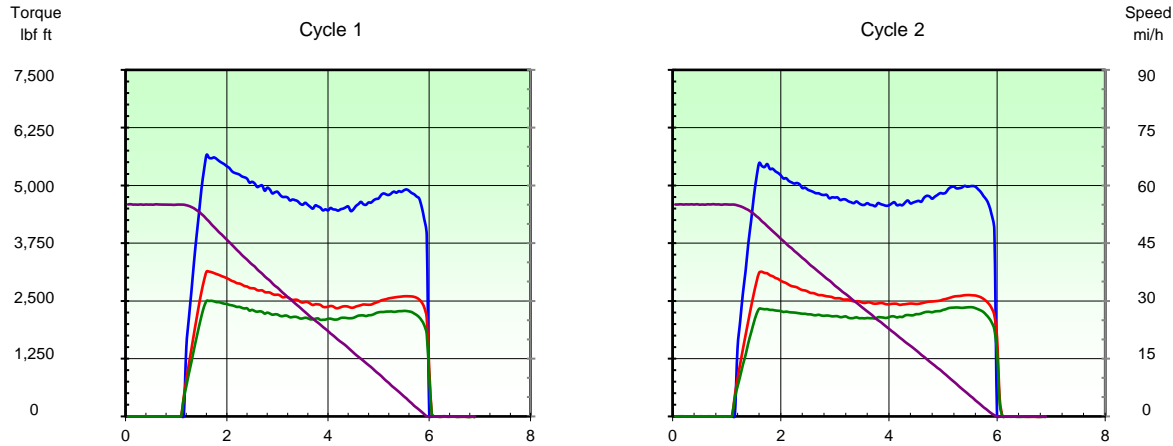
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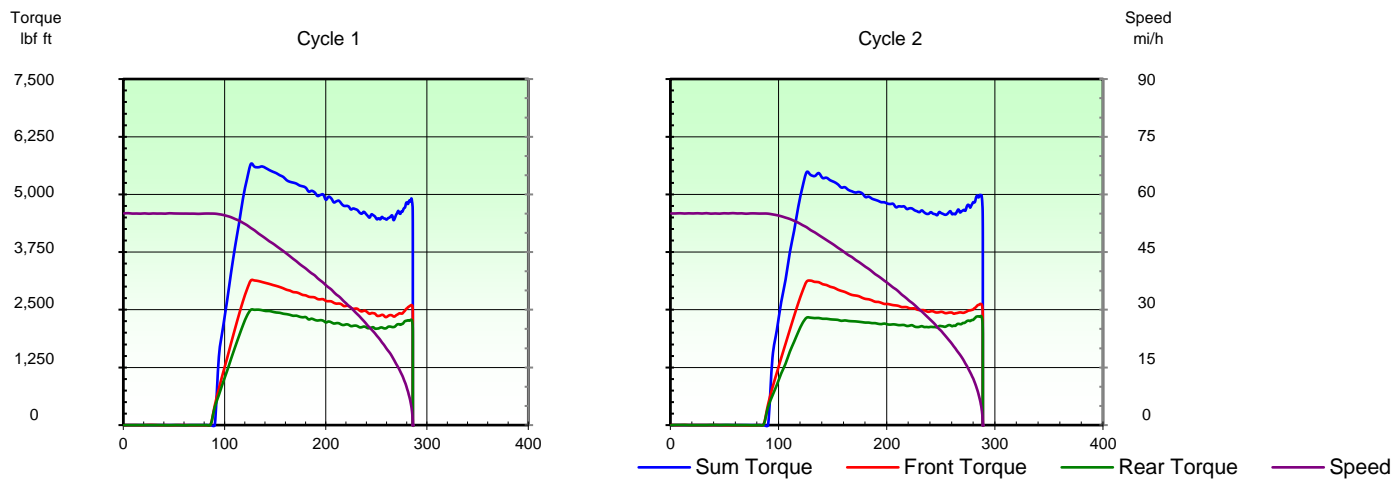
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

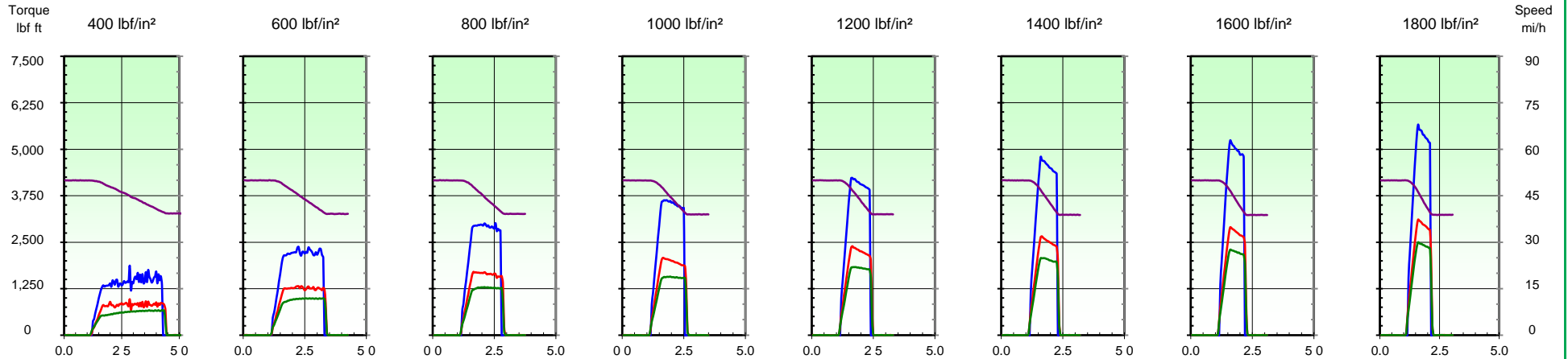
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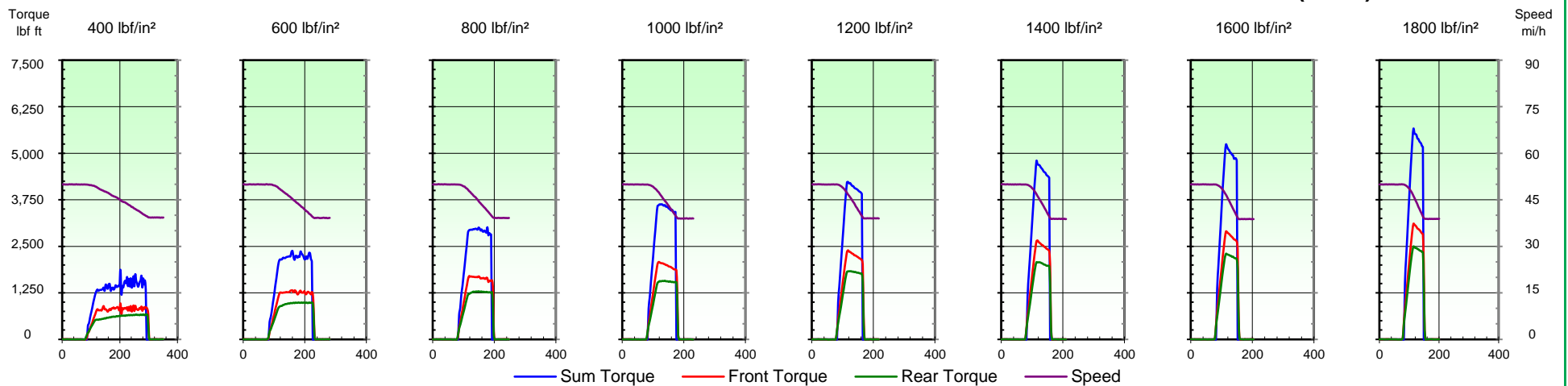
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 50-40 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 50-40 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

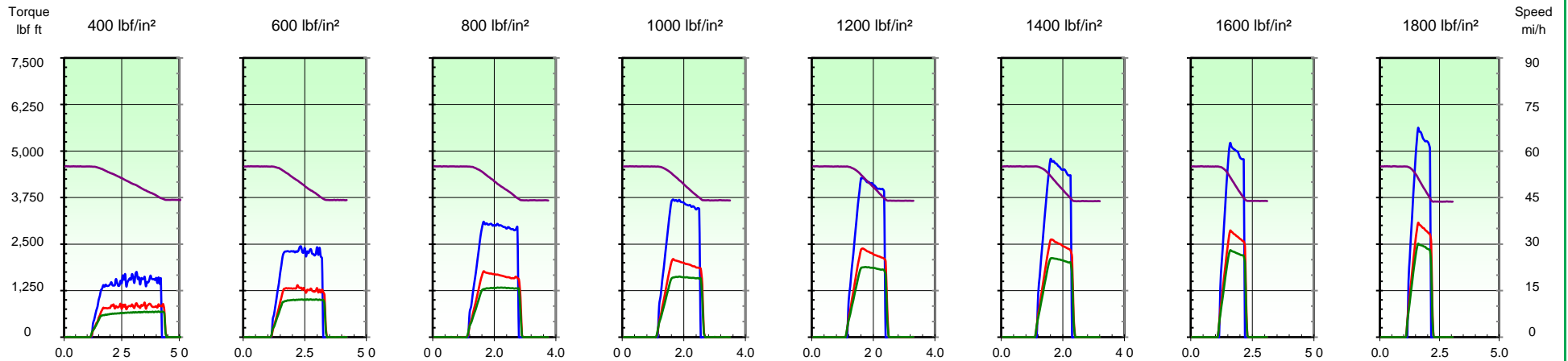
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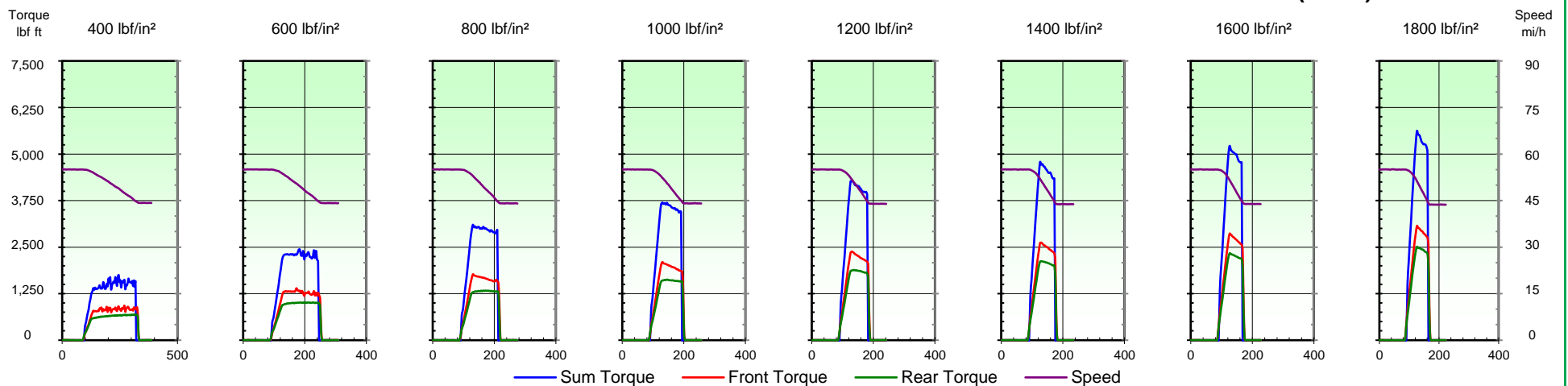
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 55-45 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 55-45 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

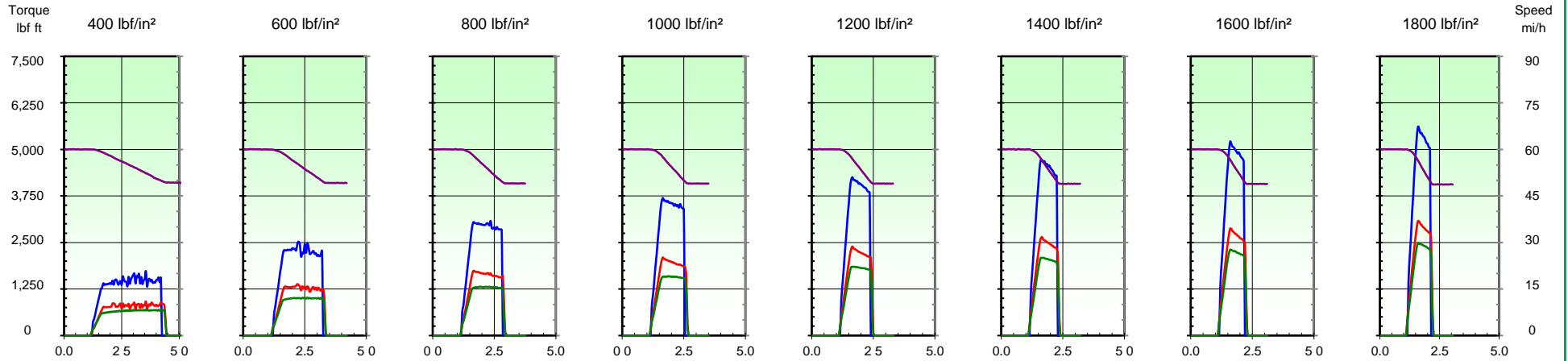
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Test Report Date: 06 March 2020

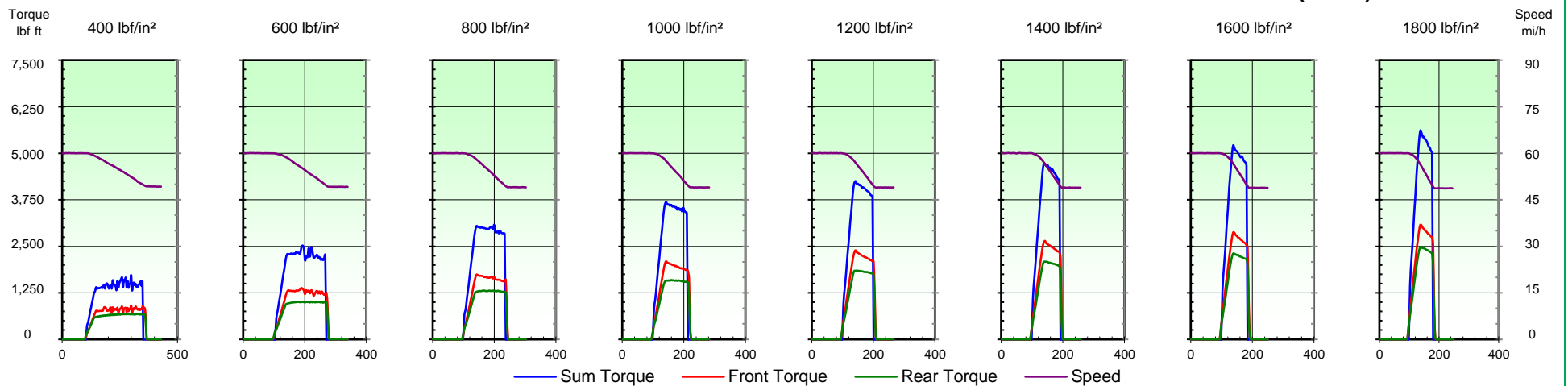
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 60-50 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 60-50 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

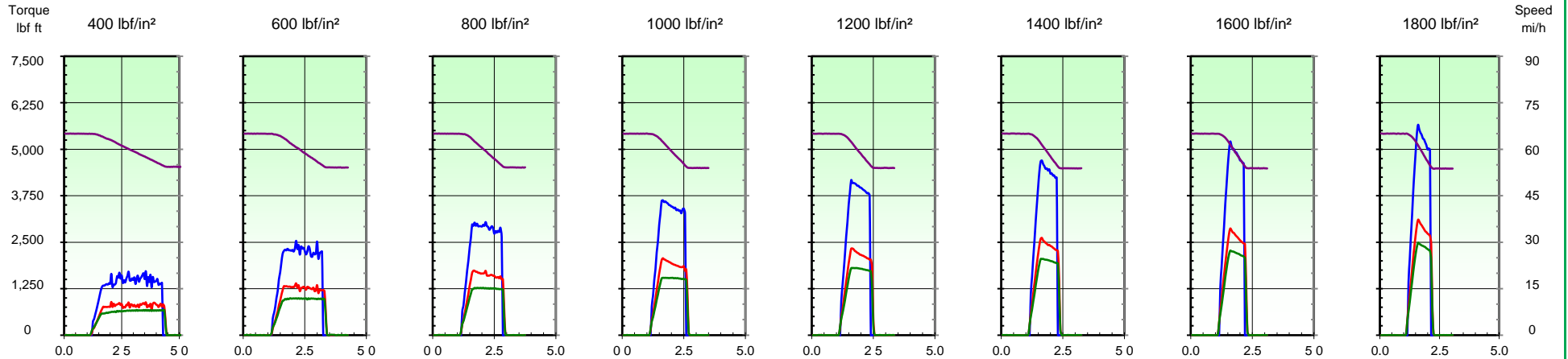
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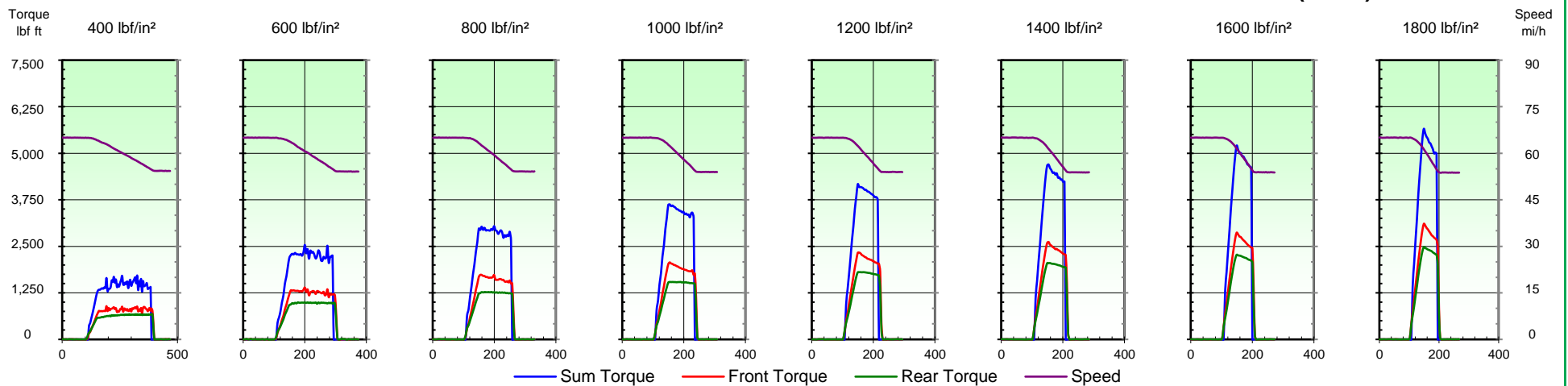
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 65-55 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 65-55 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

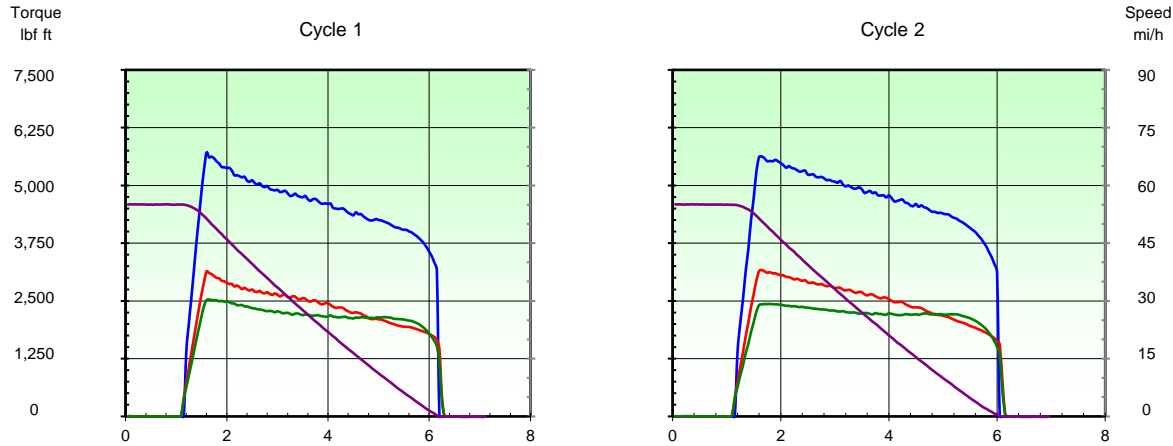
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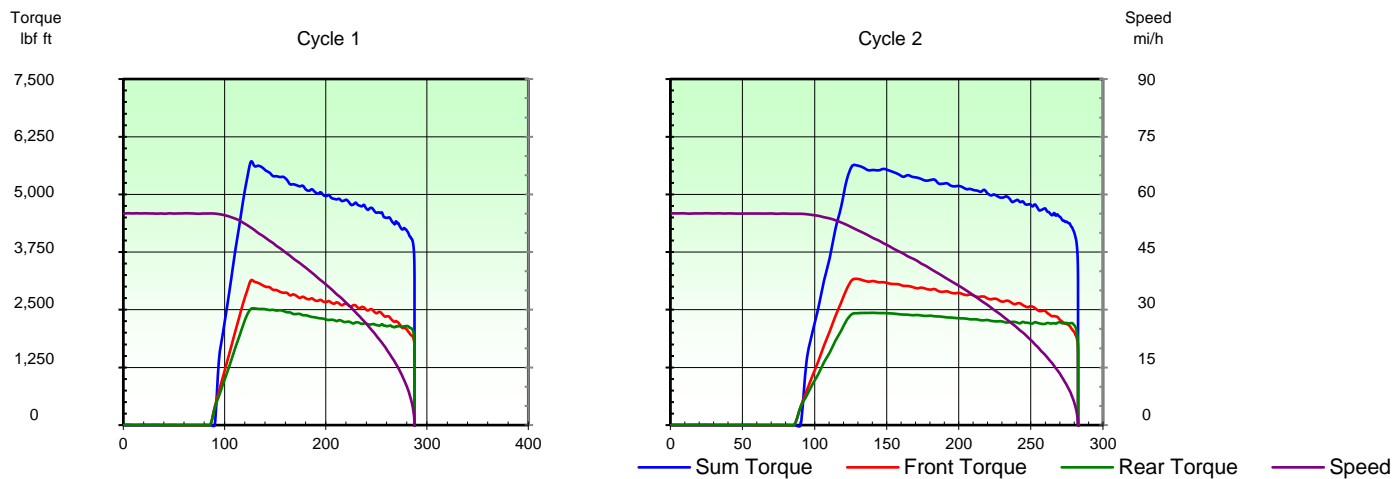
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

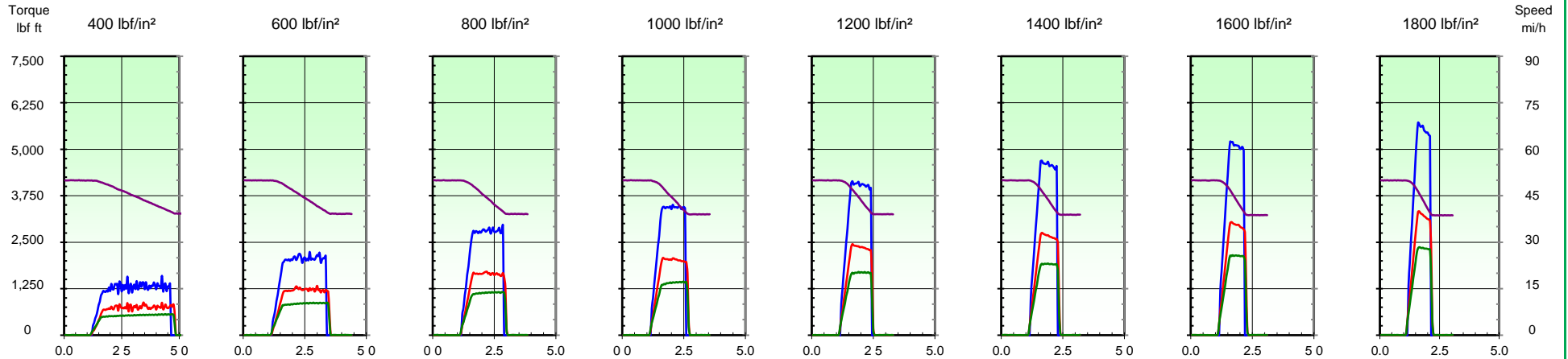
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Test Report Date: 06 March 2020

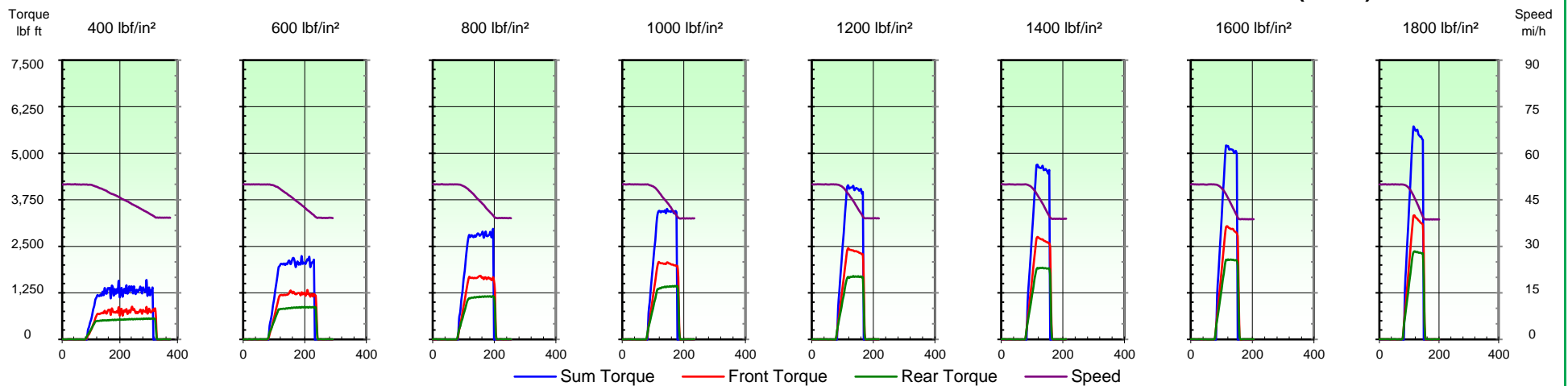
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 50-40 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 50-40 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

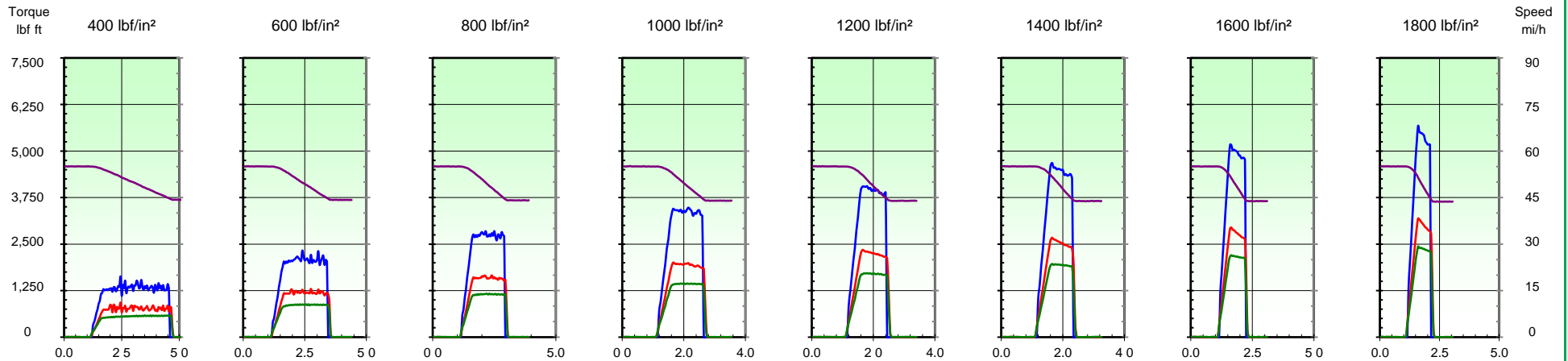
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Test Report Date: 06 March 2020

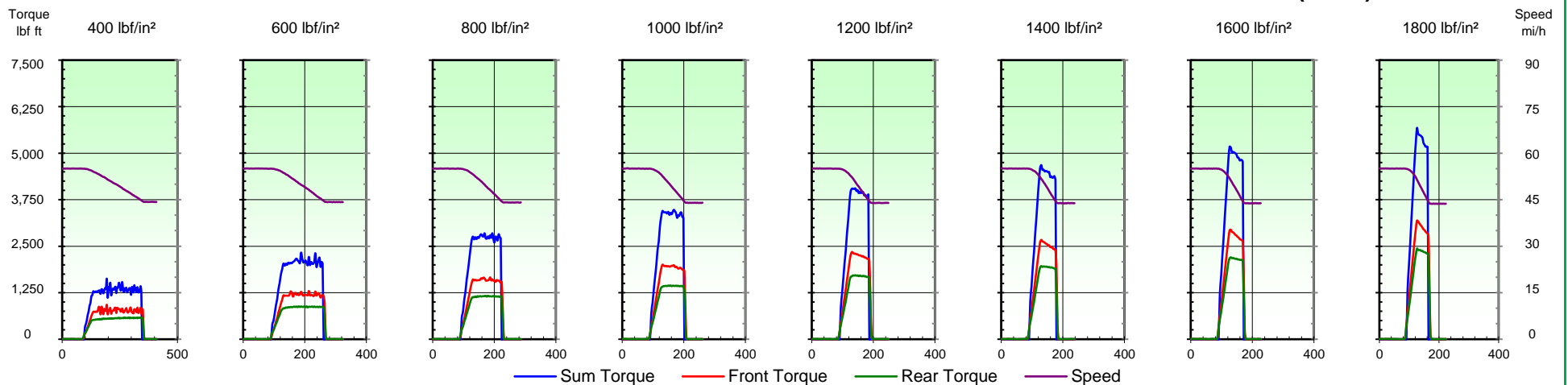
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 55-45 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 55-45 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

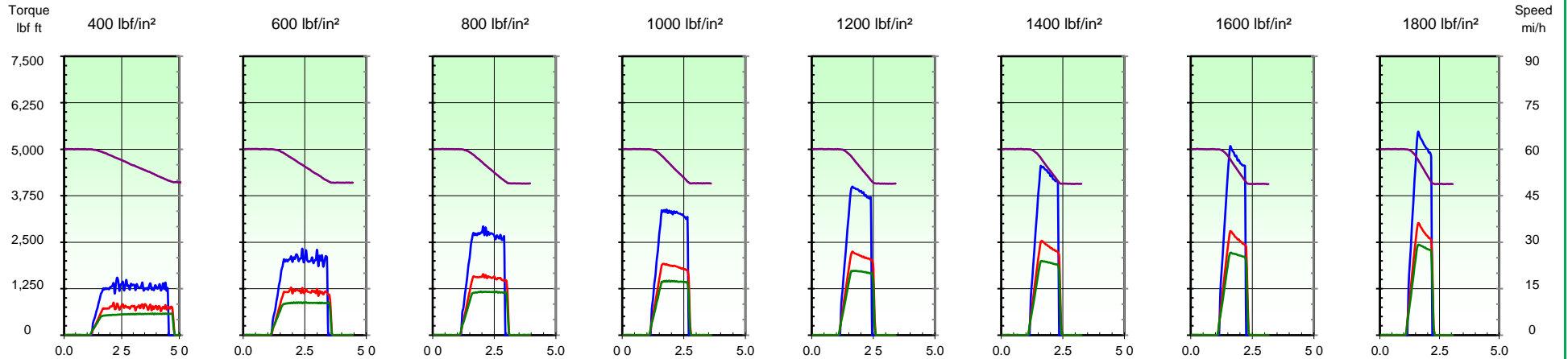
Report Number: 203145-1

Test Report Date: 06 March 2020

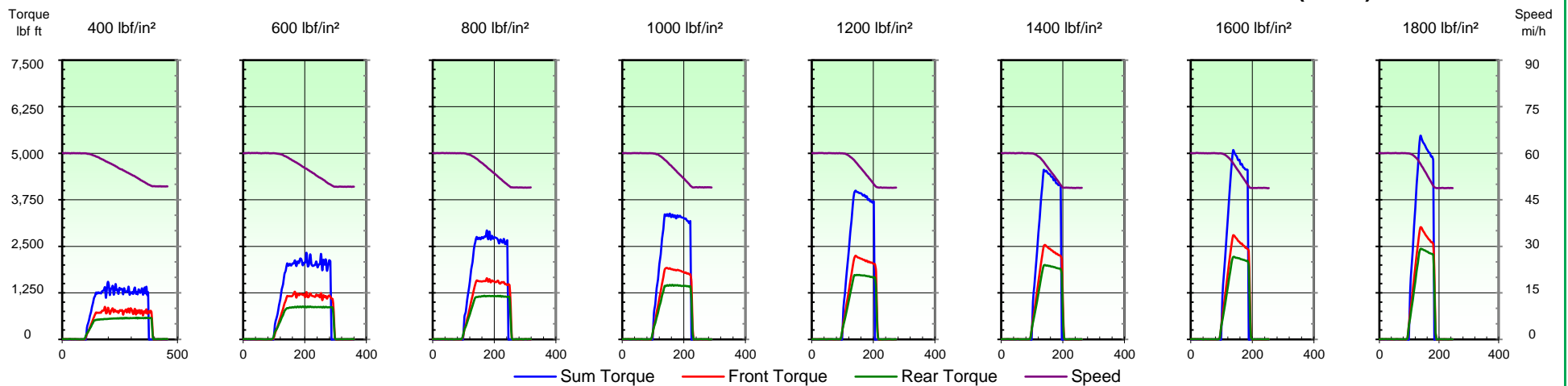
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 60-50 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 60-50 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

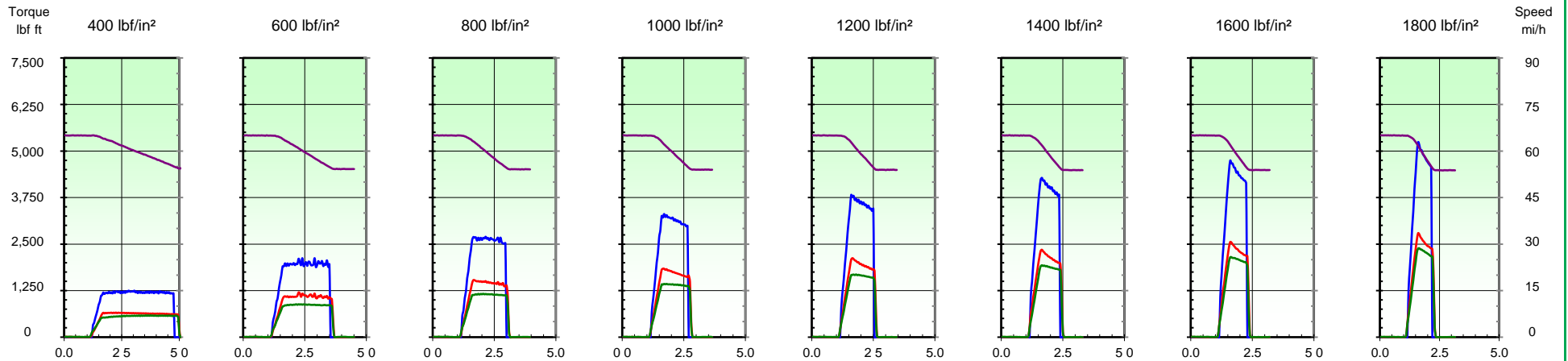
Report Number: 203145-1

Test Report Date: 06 March 2020

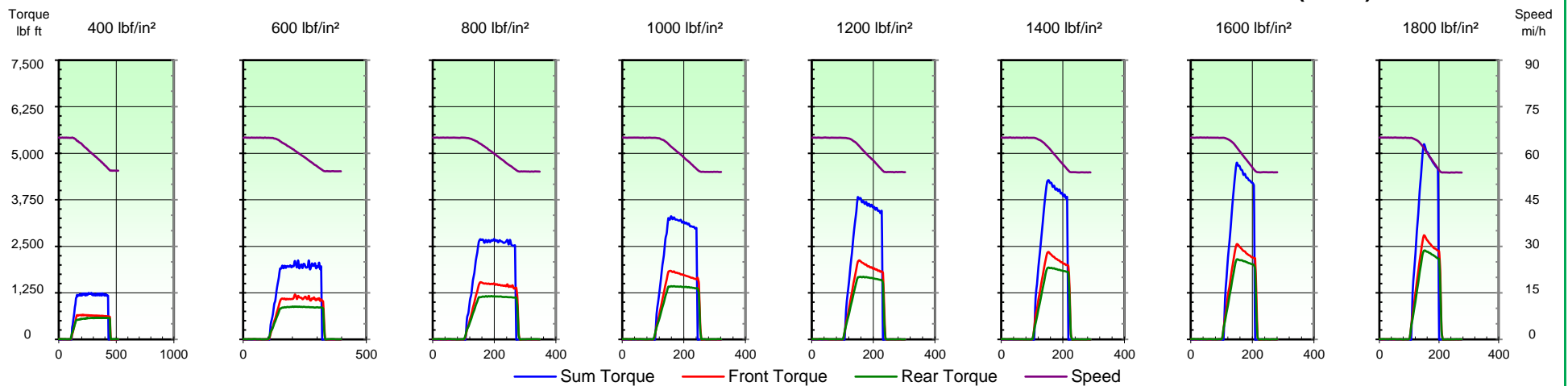
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 65-55 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 65-55 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

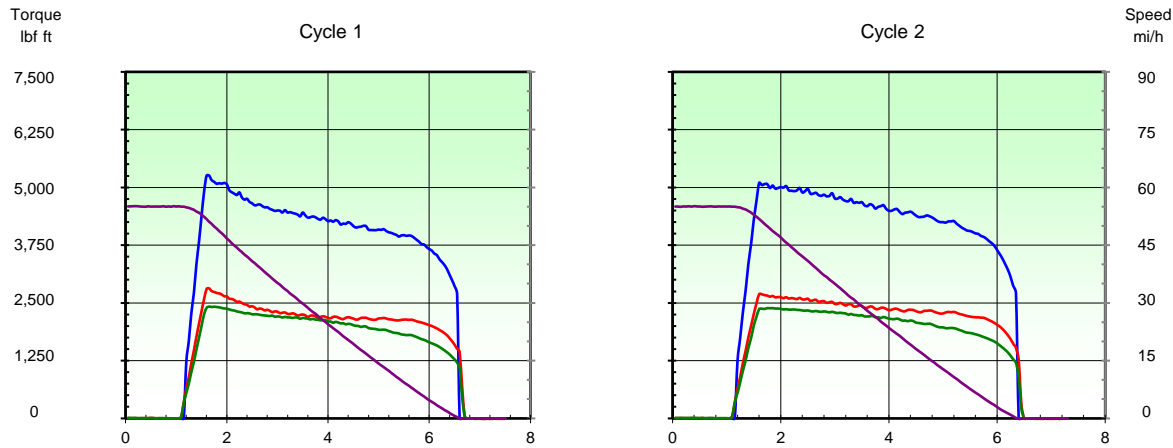
Report Number: 203145-1

Test Report Date: 06 March 2020

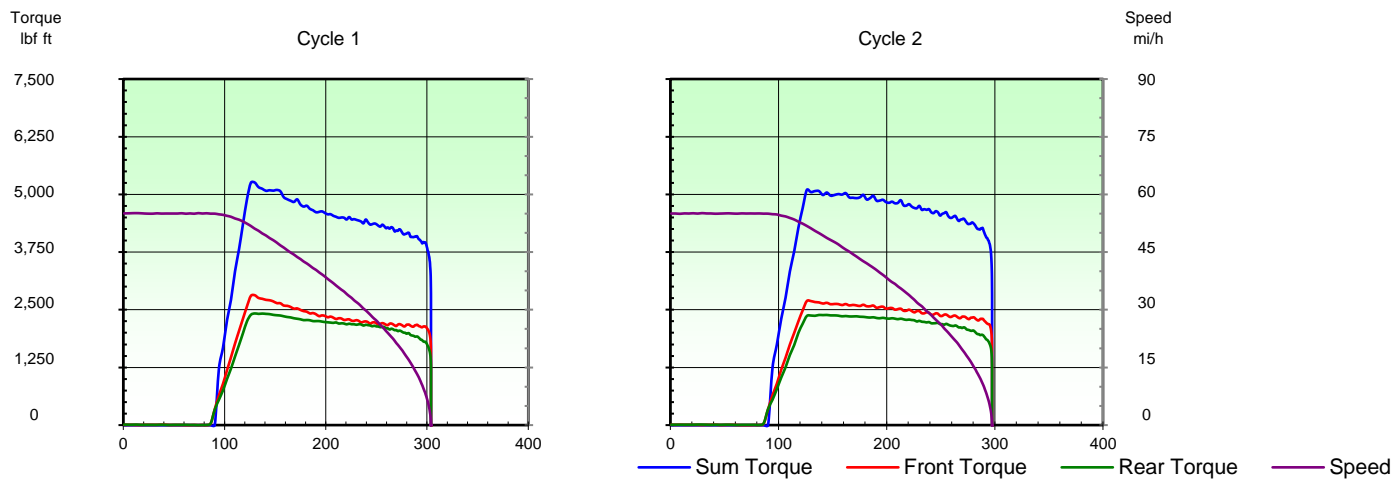
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

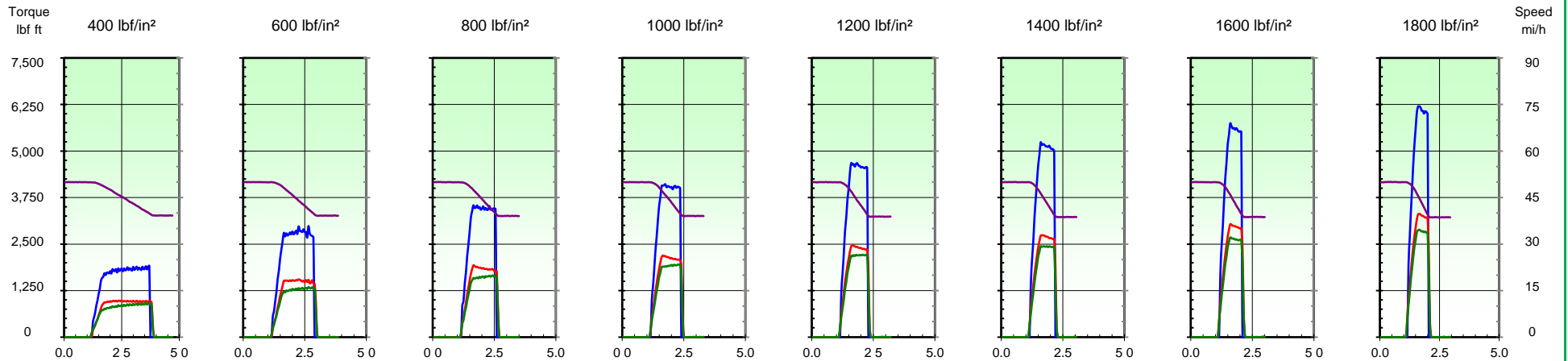
Report Number: 203145-1

Test Report Date: 06 March 2020

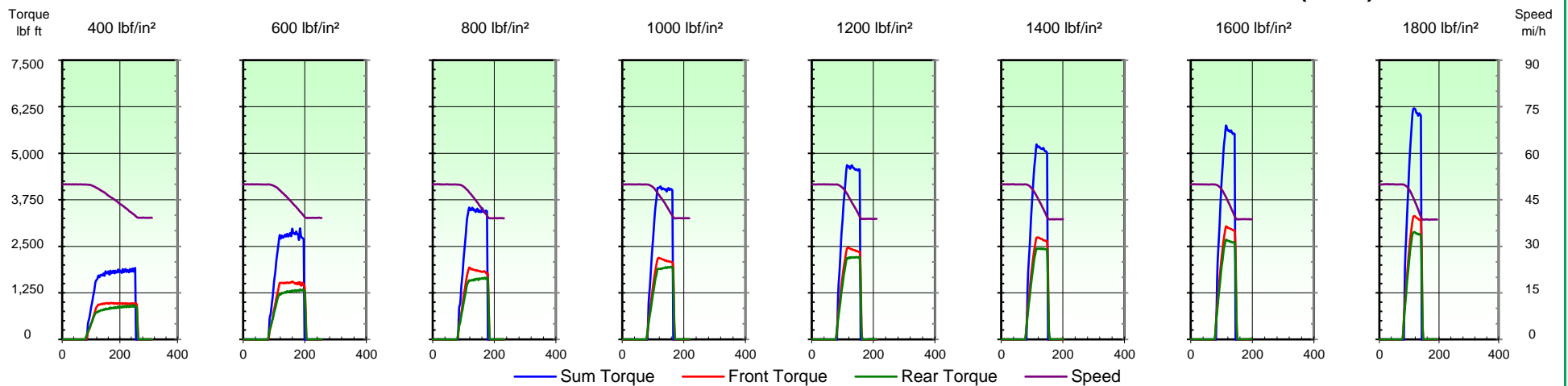
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

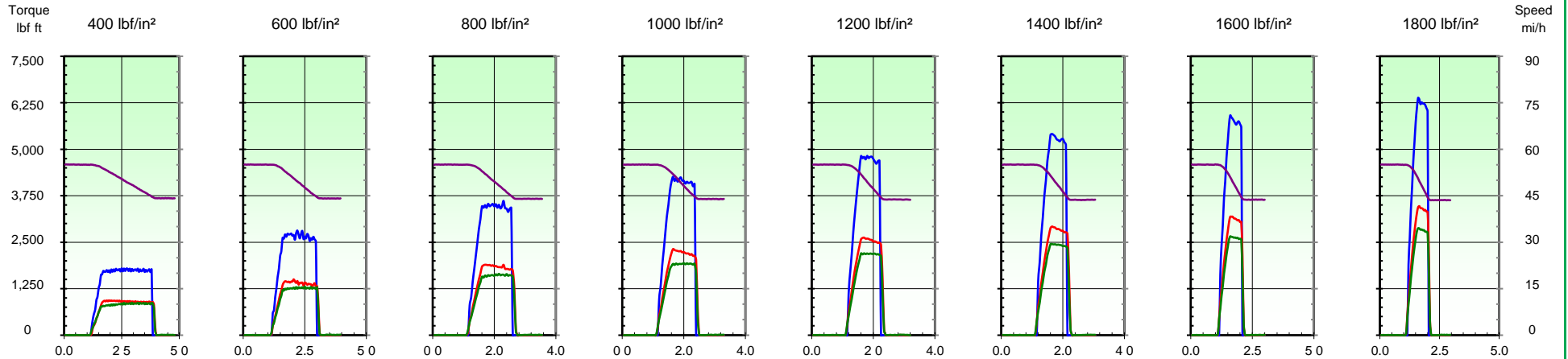
Report Number: 203145-1

Test Report Date: 06 March 2020

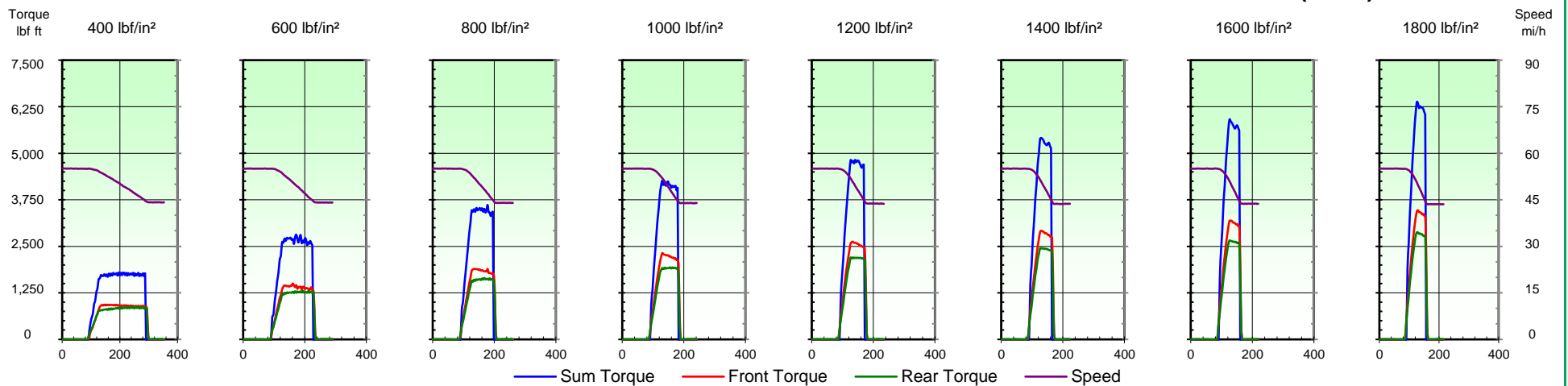
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

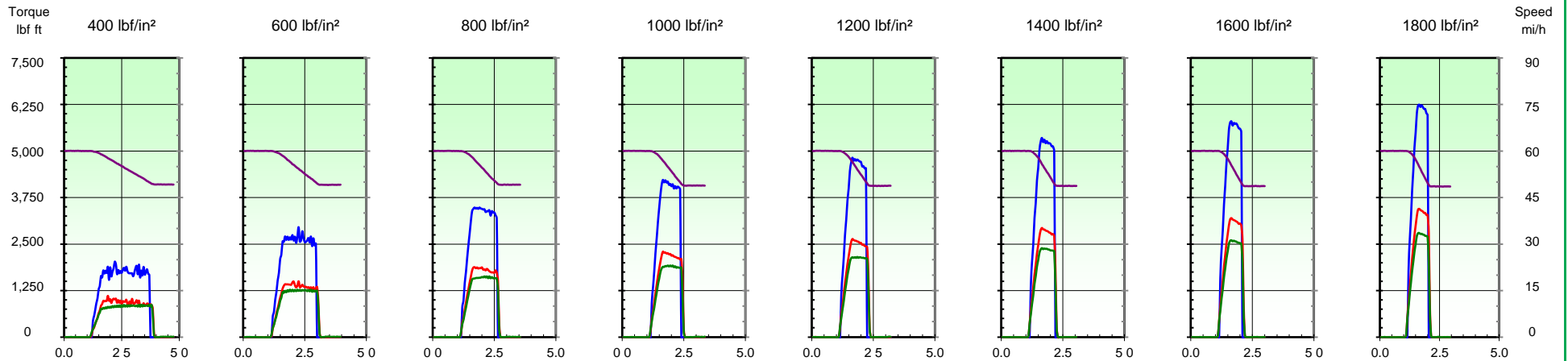
Report Number: 203145-1

Test Report Date: 06 March 2020

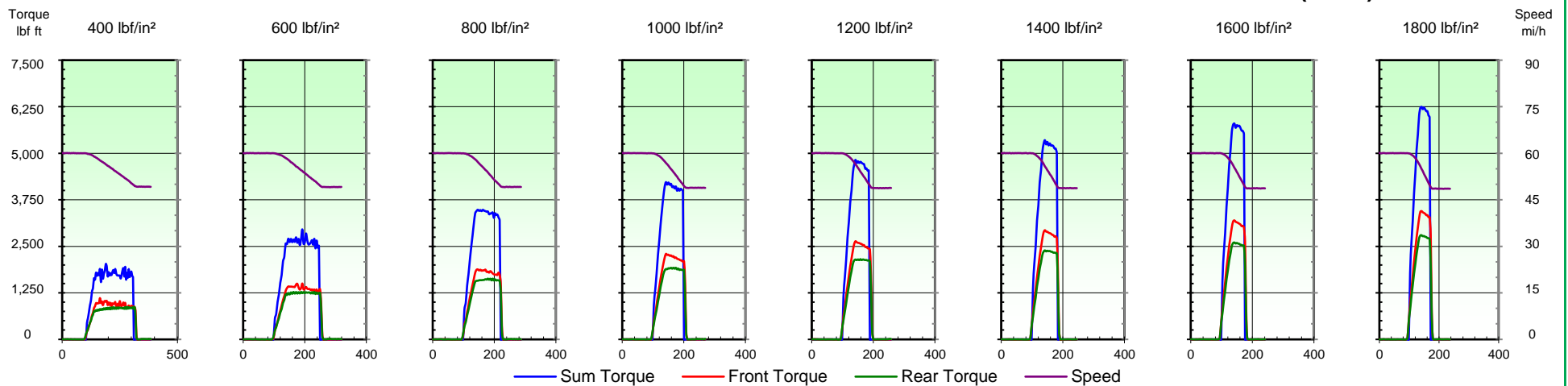
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 60-50 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 60-50 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

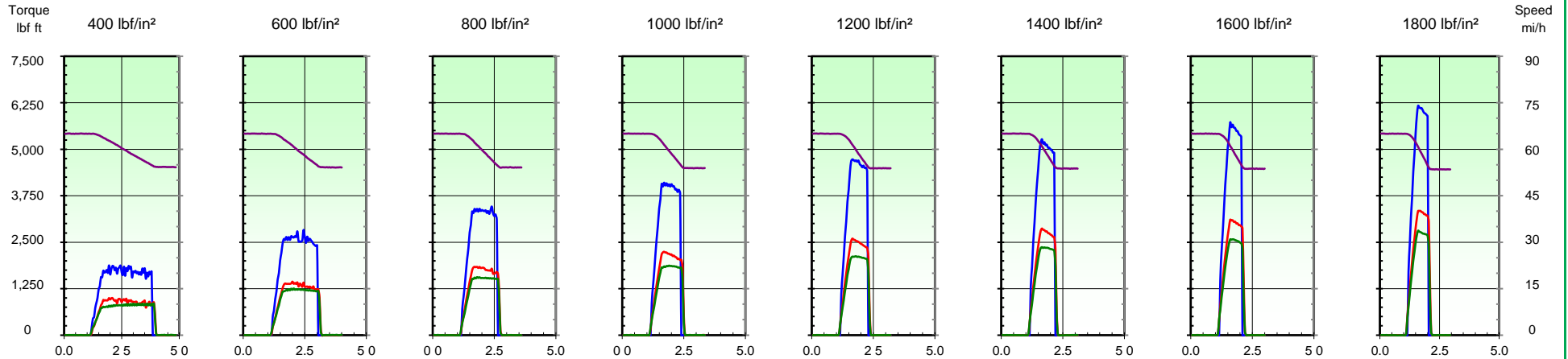
Report Number: 203145-1

Test Report Date: 06 March 2020

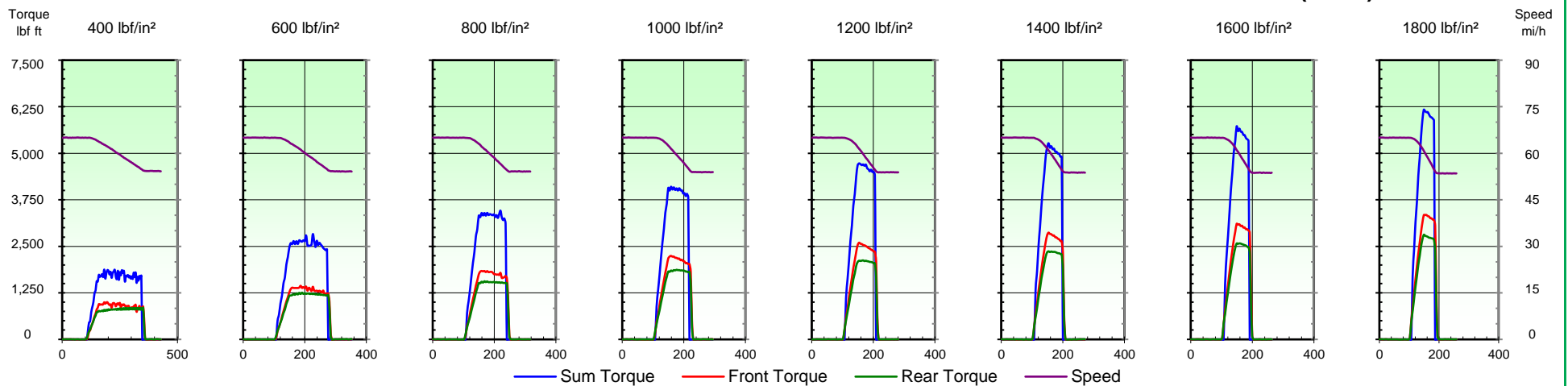
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 65-55 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 65-55 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

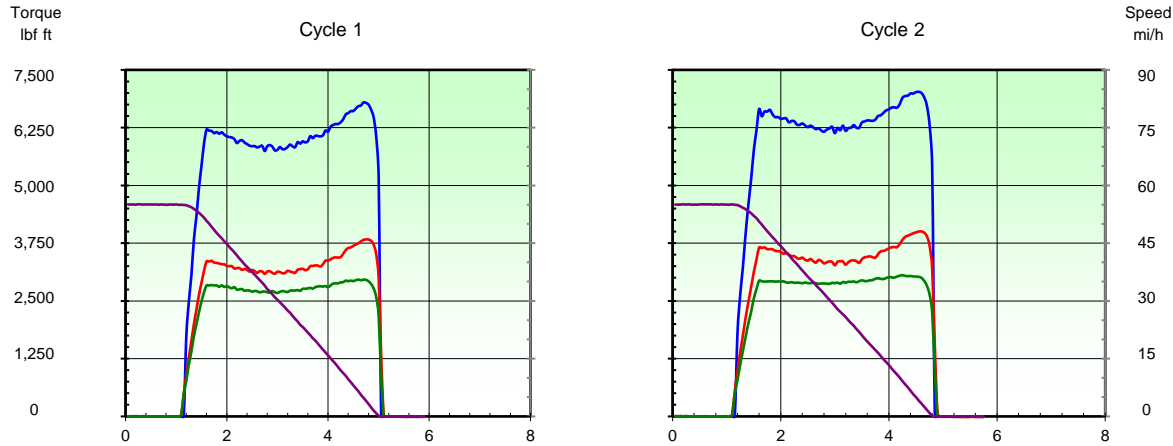
Report Number: 203145-1

Test Report Date: 06 March 2020

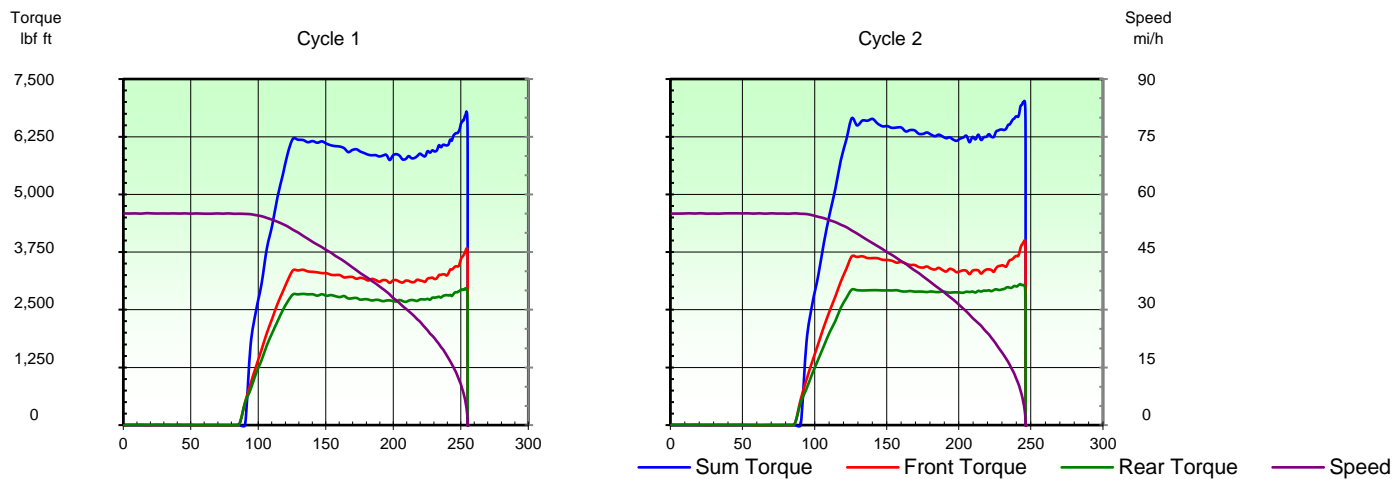
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2nd EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

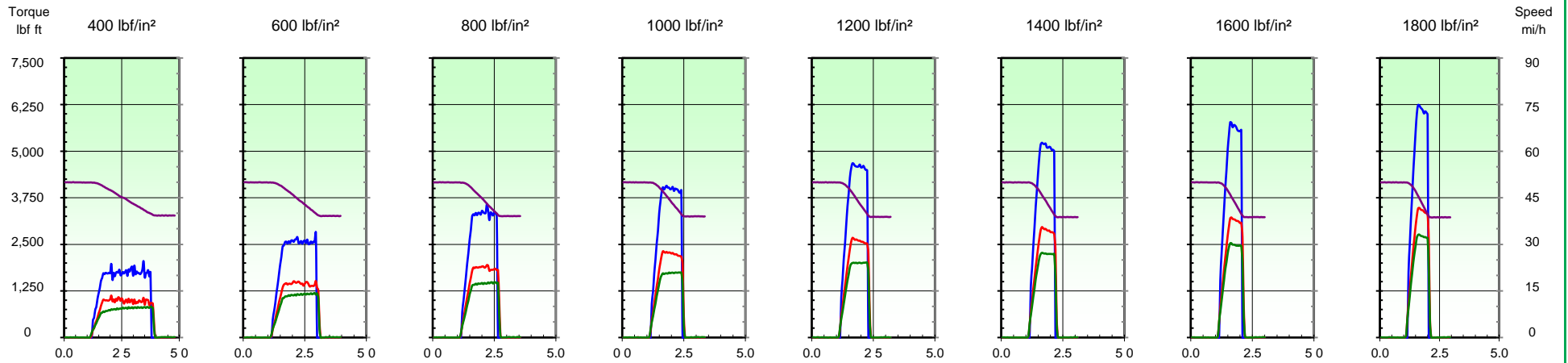
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Test Report Date: 06 March 2020

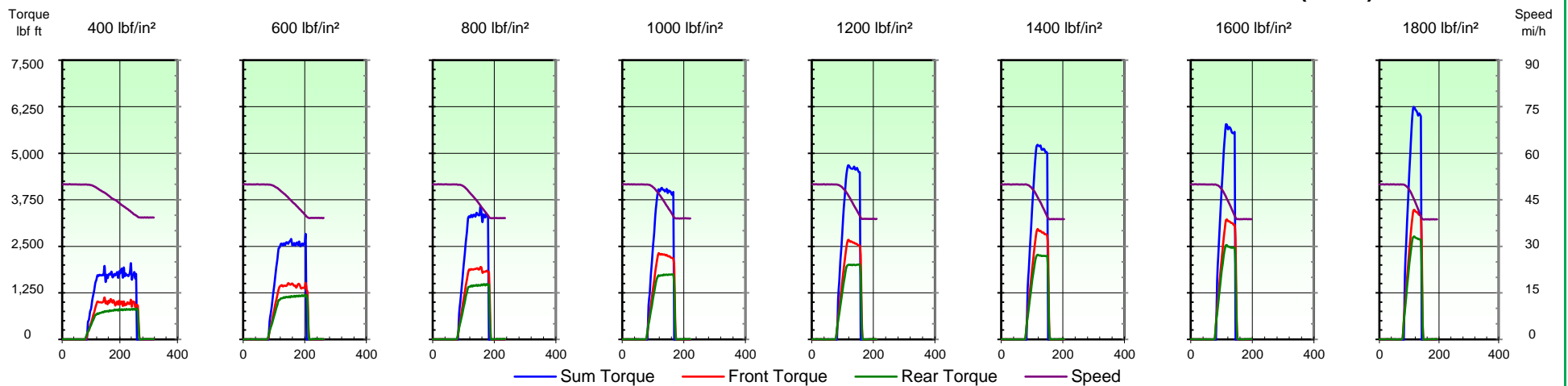
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 50-40 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 50-40 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

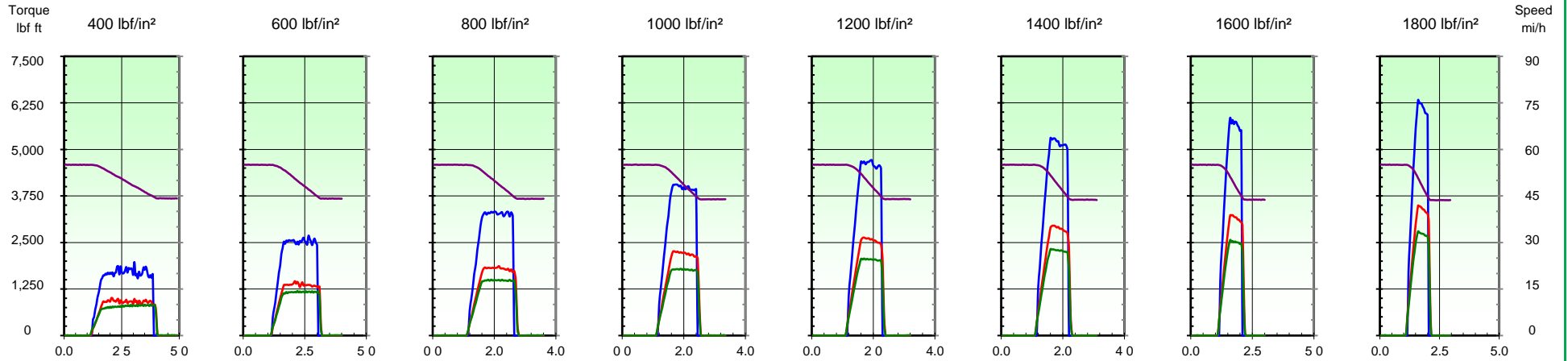
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Test Report Date: 06 March 2020

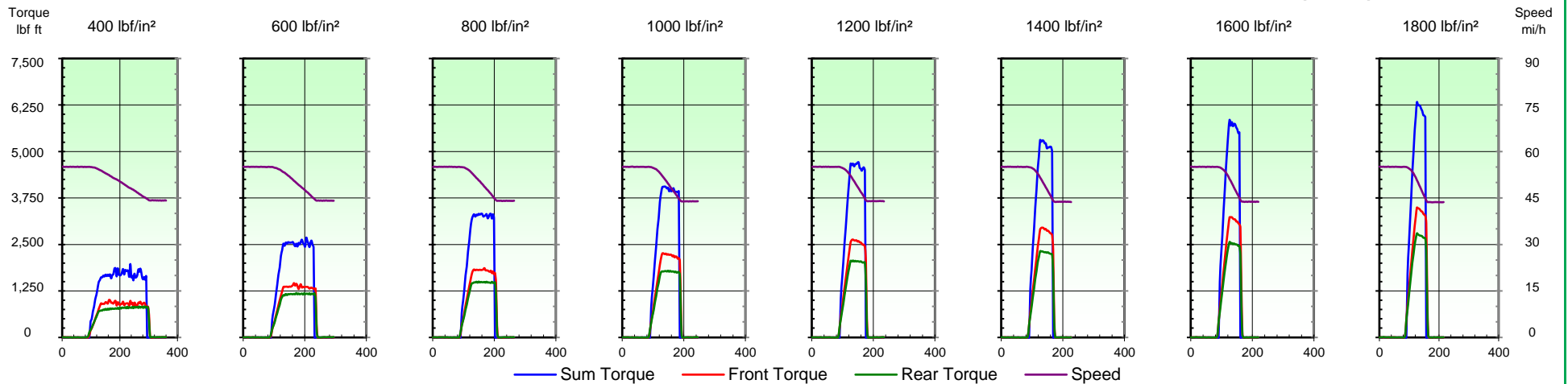
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

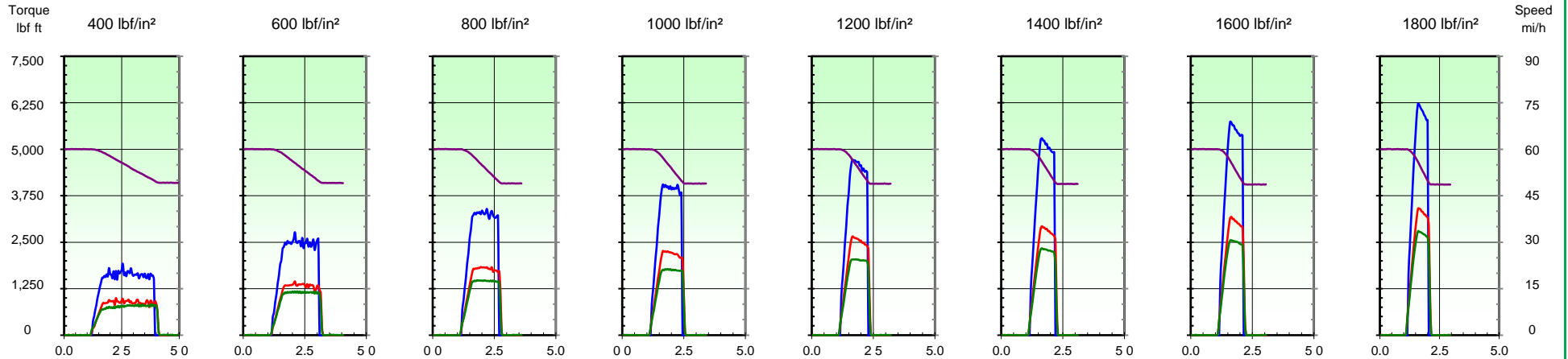
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Test Report Date: 06 March 2020

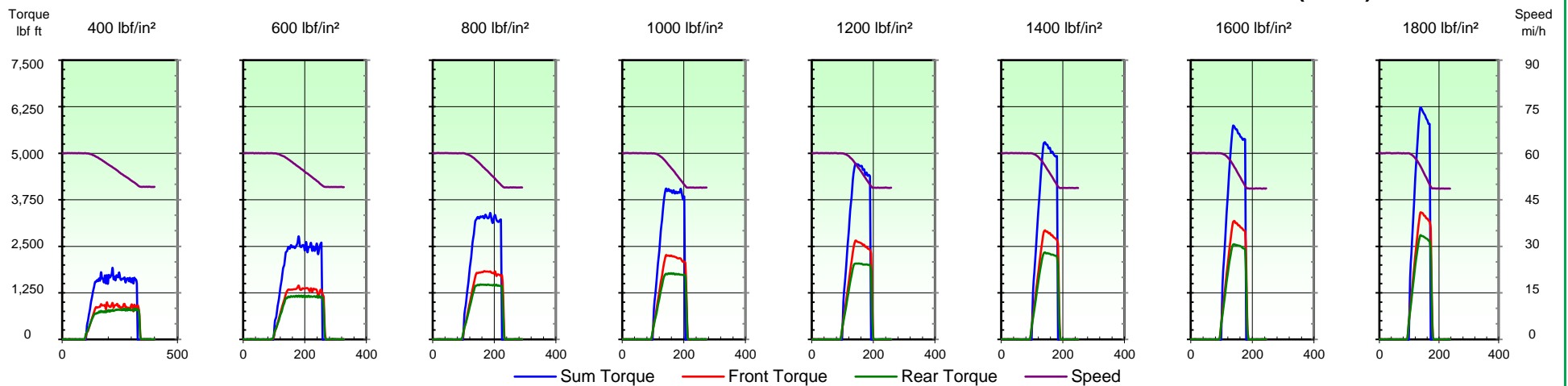
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 60-50 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 60-50 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

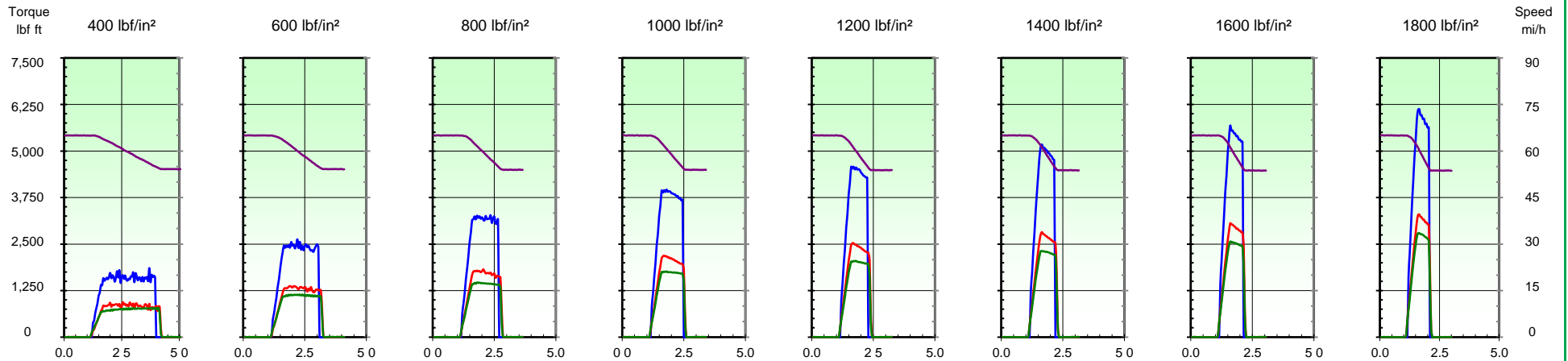
Report Number: 203145-1

Test Report Date: 06 March 2020

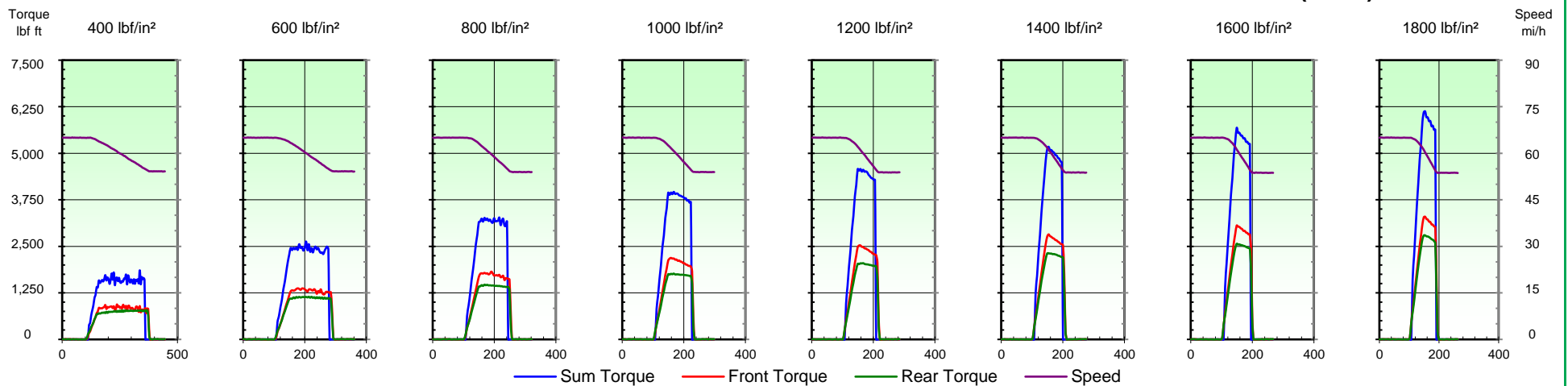
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 65-55 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 65-55 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

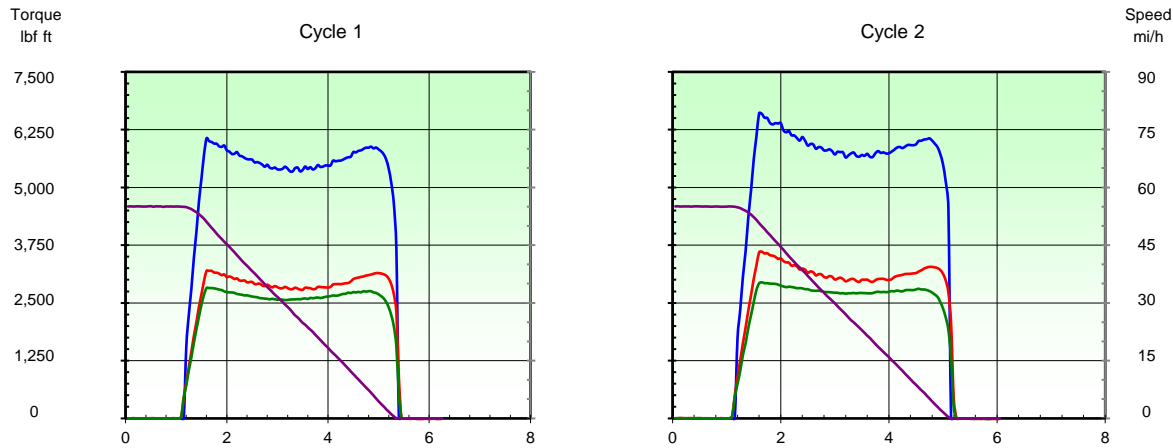
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Test Report Date: 06 March 2020

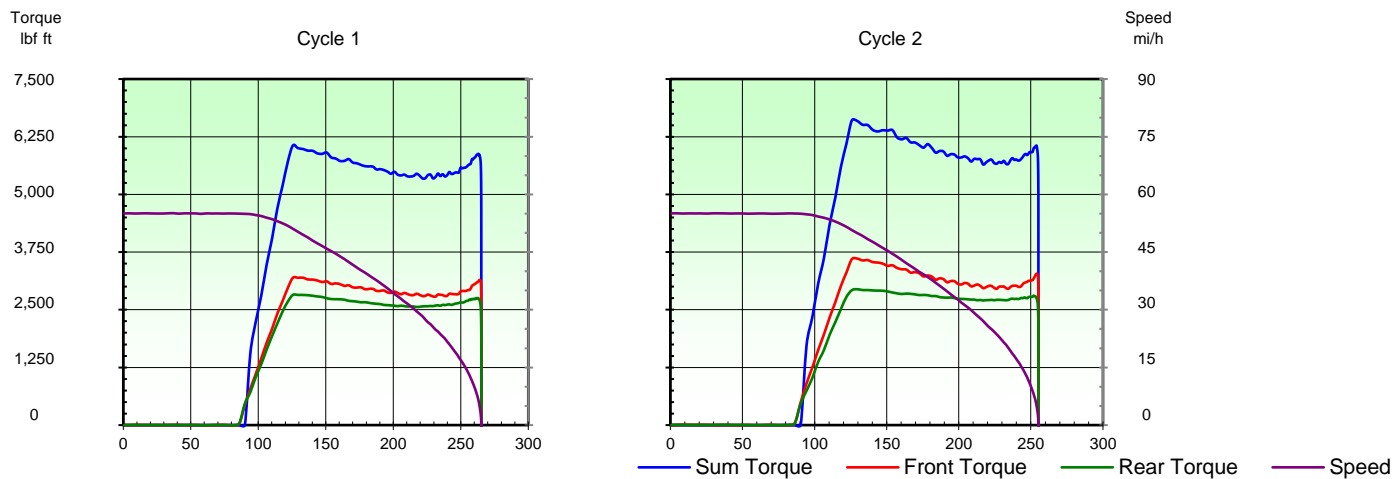
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2nd EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

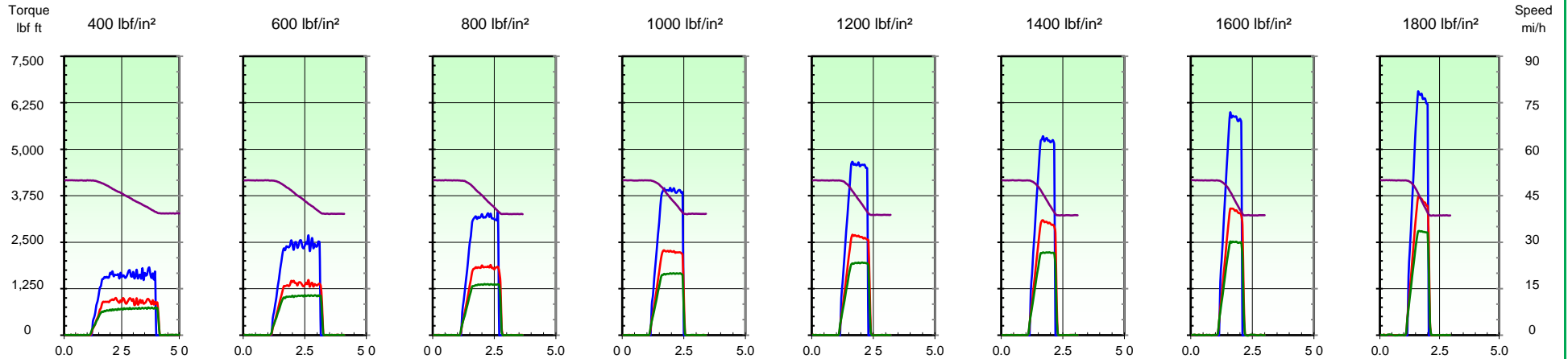
Report Number: 203145-1

Test Report Date: 06 March 2020

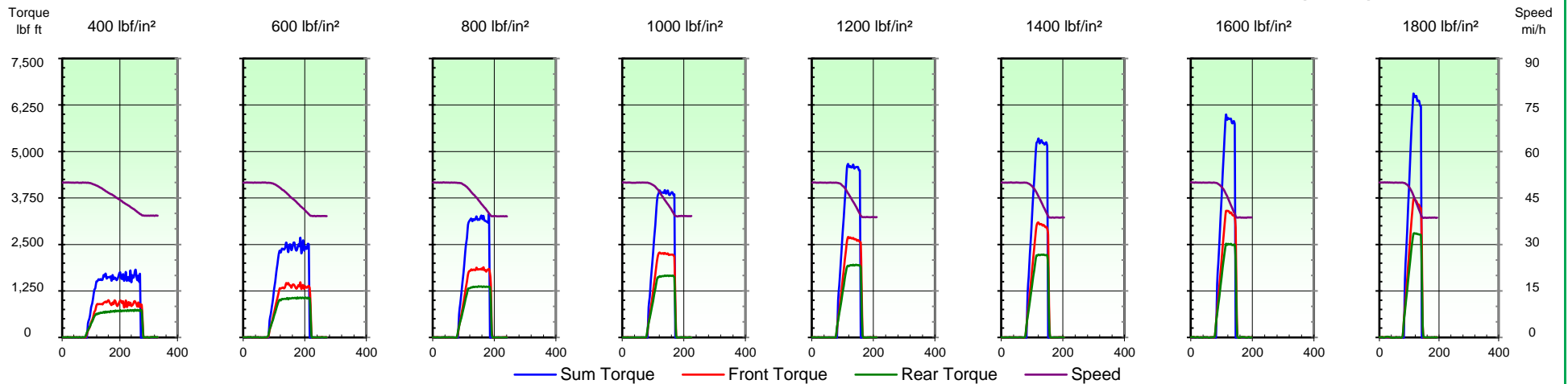
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 50-40 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 50-40 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

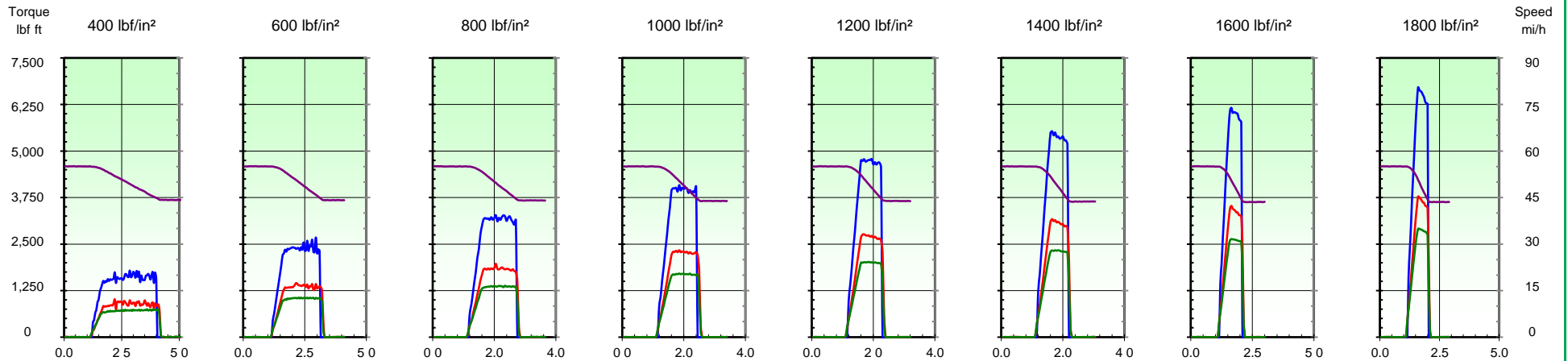
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Test Report Date: 06 March 2020

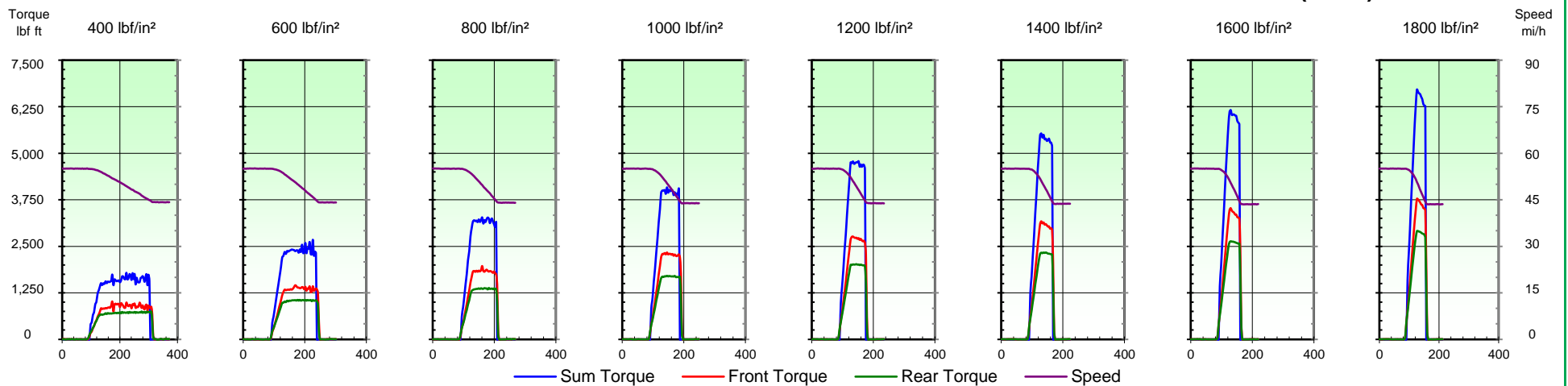
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 55-45 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 55-45 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

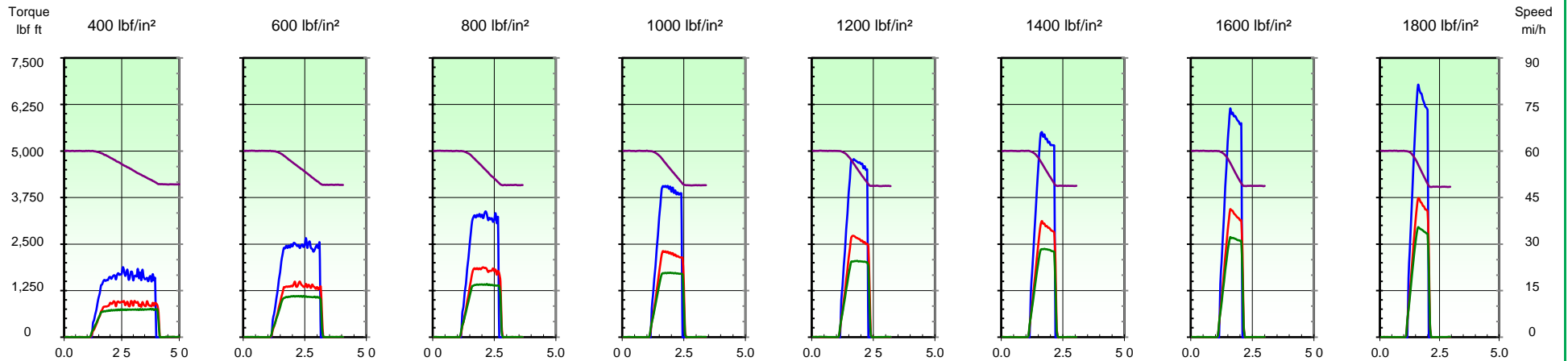
Report Number: 203145-1

Test Report Date: 06 March 2020

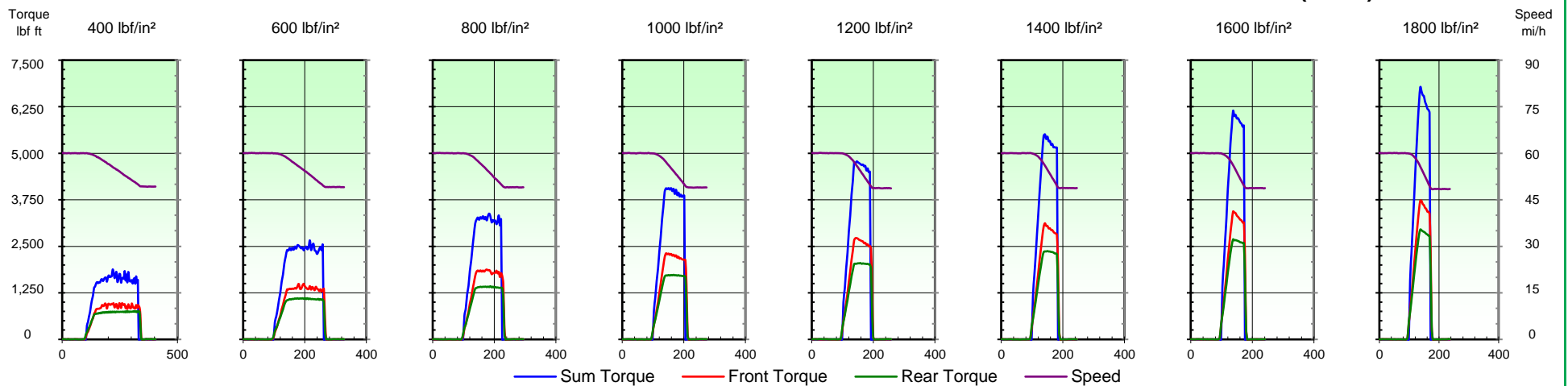
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 60-50 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 60-50 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

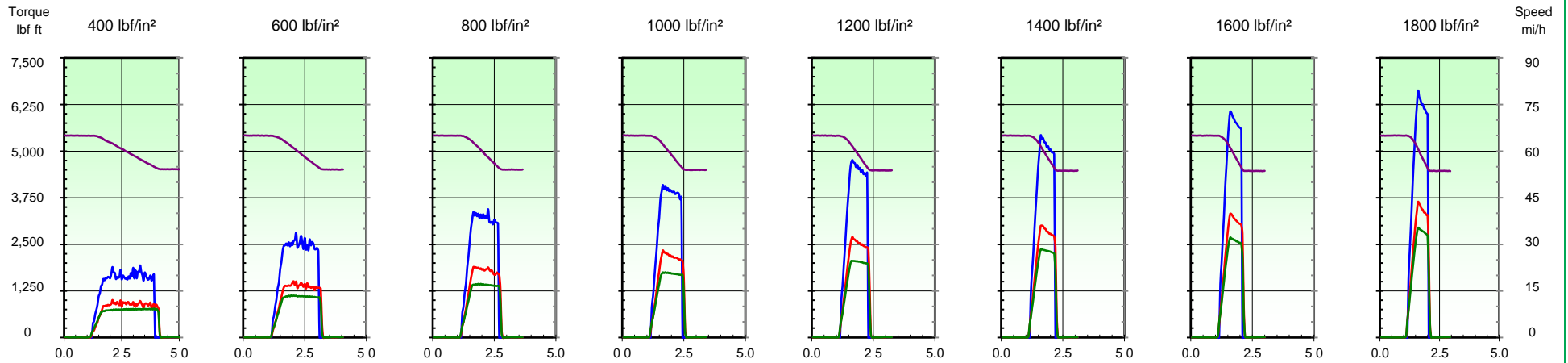
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Test Report Date: 06 March 2020

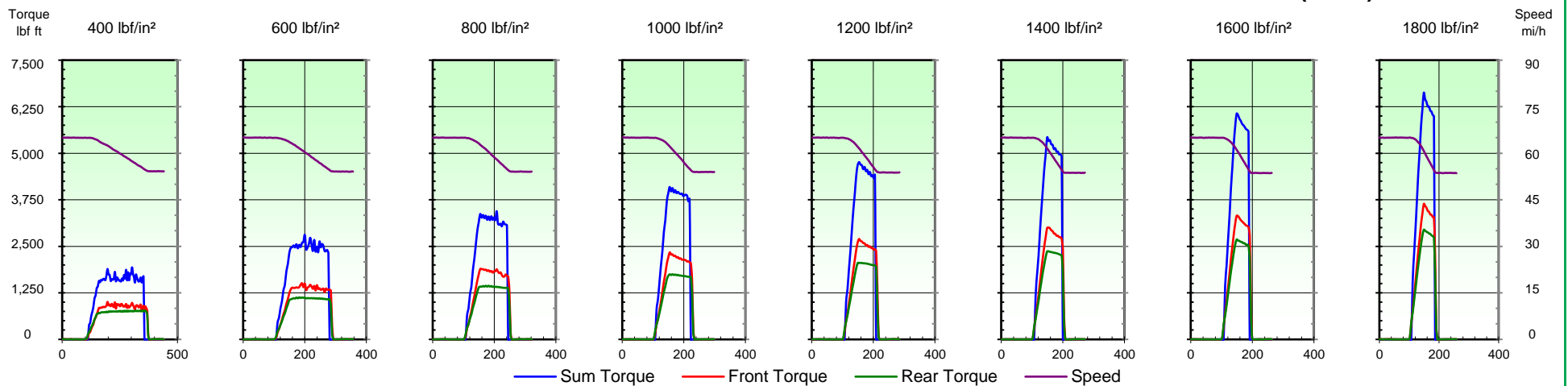
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 65-55 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 65-55 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

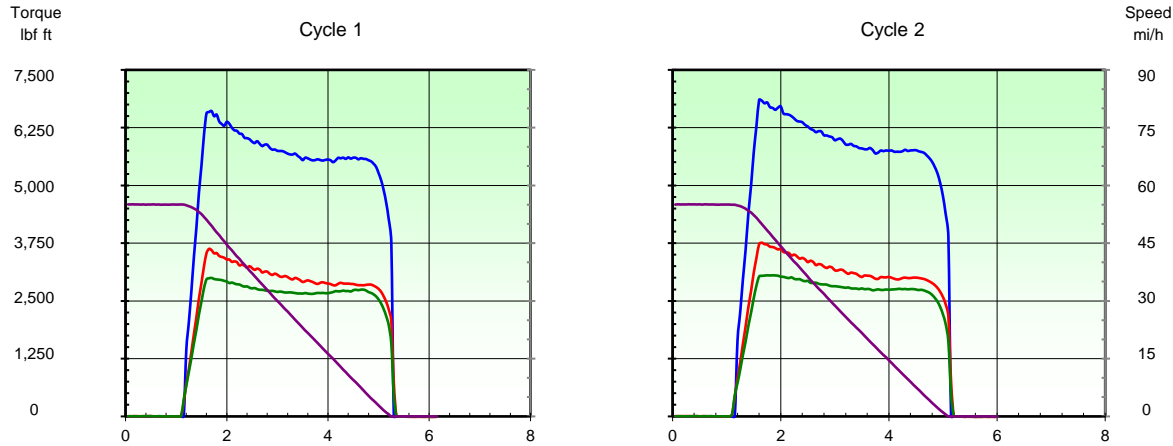
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Test Report Date: 06 March 2020

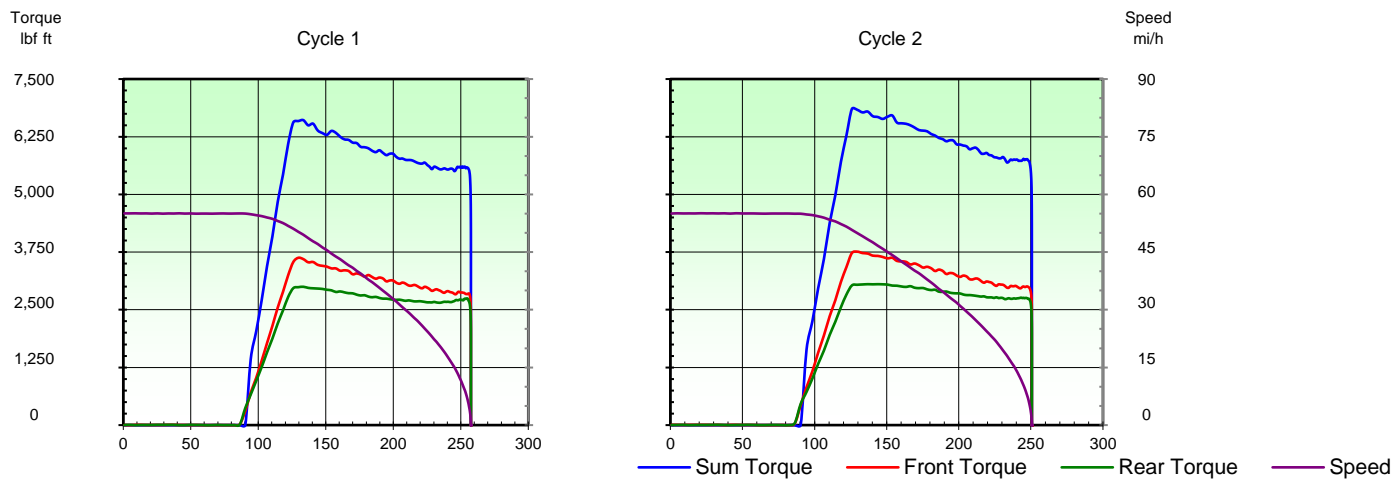
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2nd EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

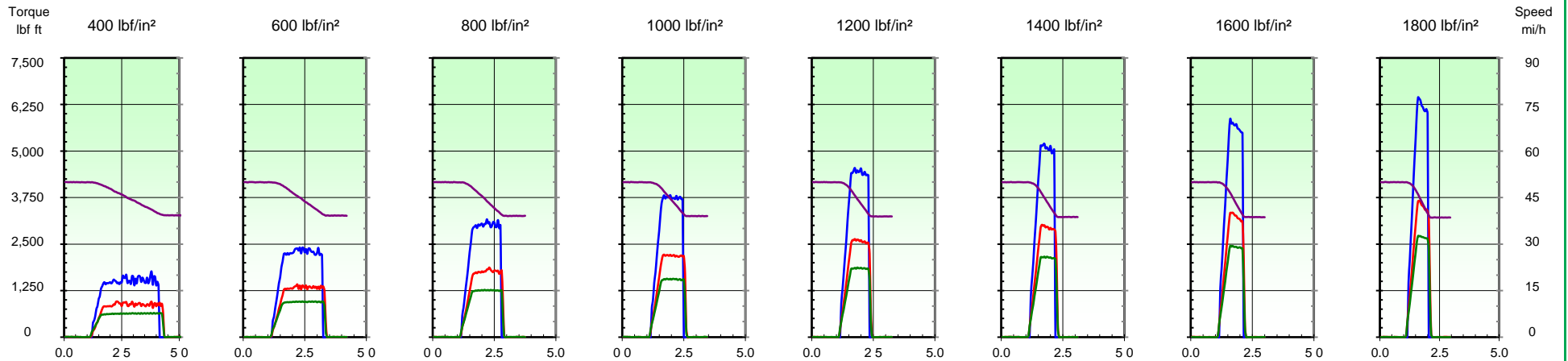
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Test Report Date: 06 March 2020

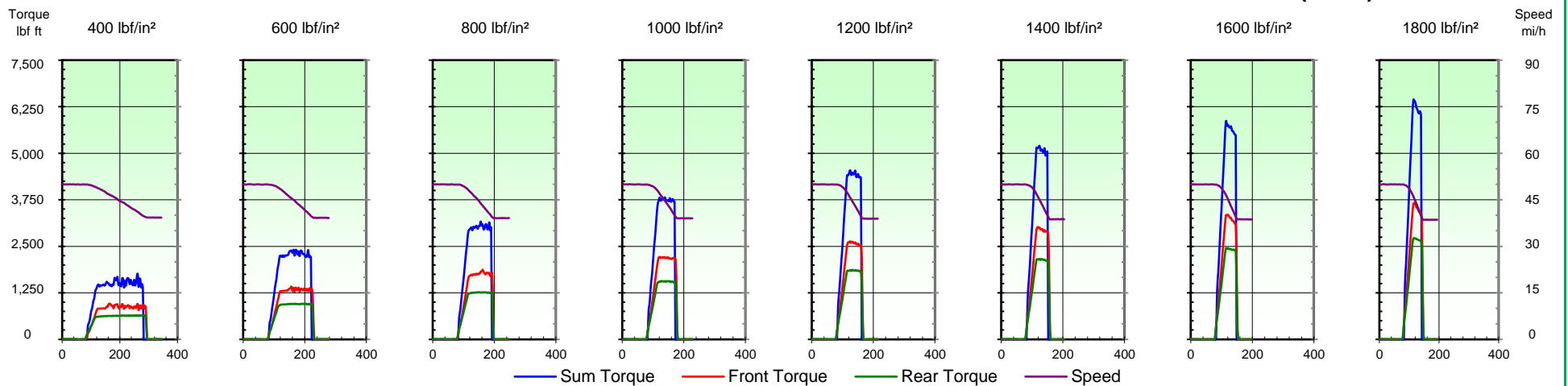
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 50-40 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 50-40 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

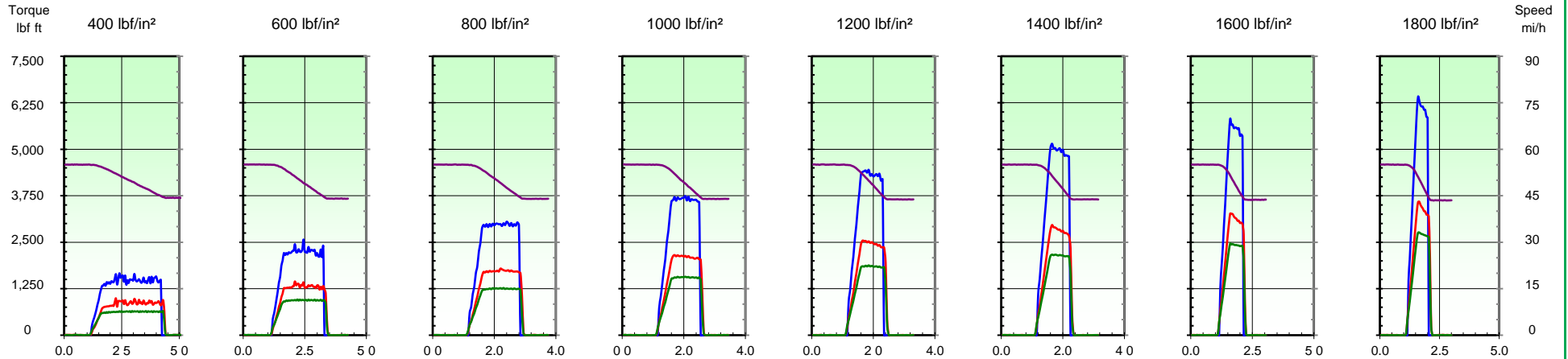
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Test Report Date: 06 March 2020

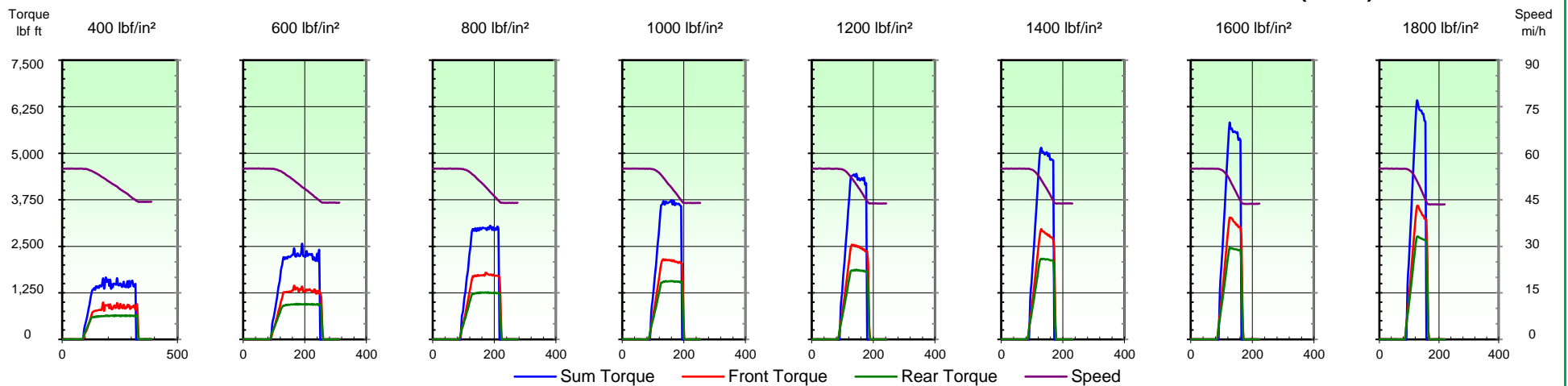
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 55-45 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 55-45 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

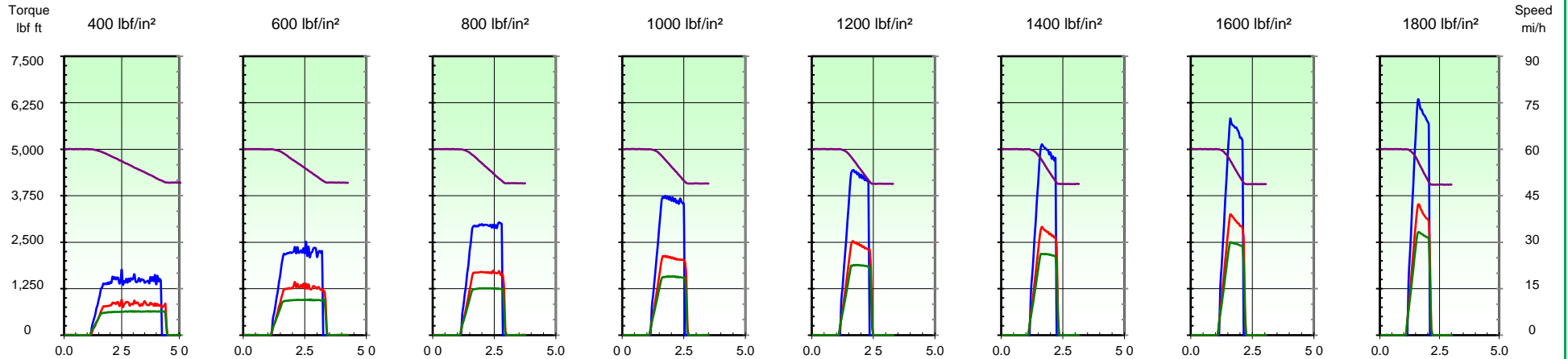
Report Number: 203145-1

Test Report Date: 06 March 2020

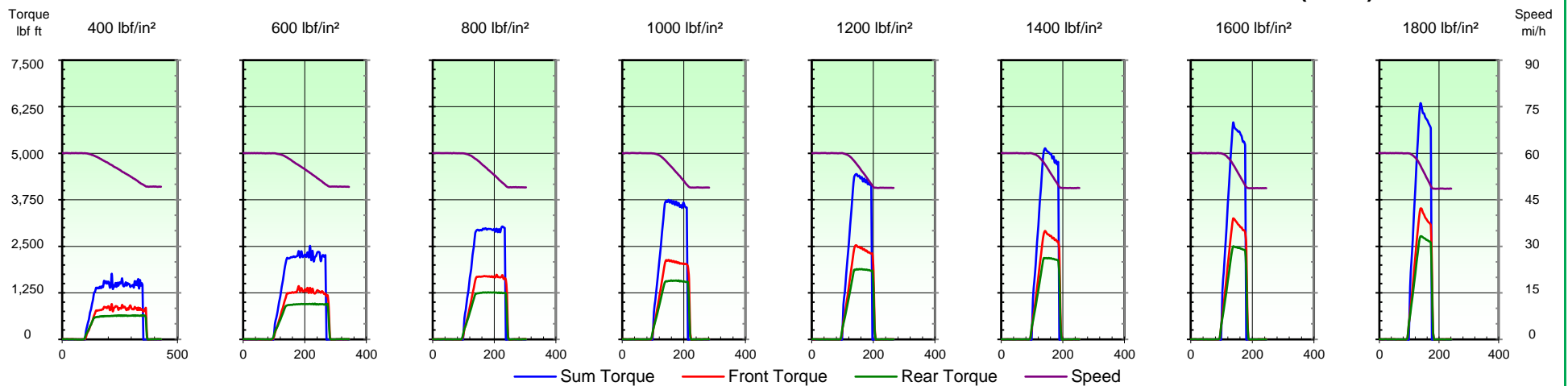
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 60-50 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 60-50 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

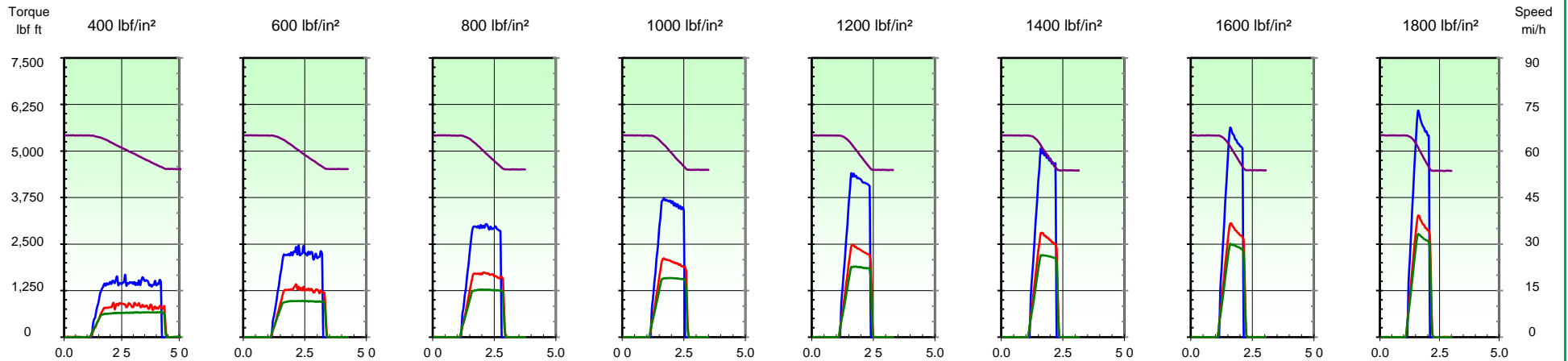
Report Number: 203145-1

Test Report Date: 06 March 2020

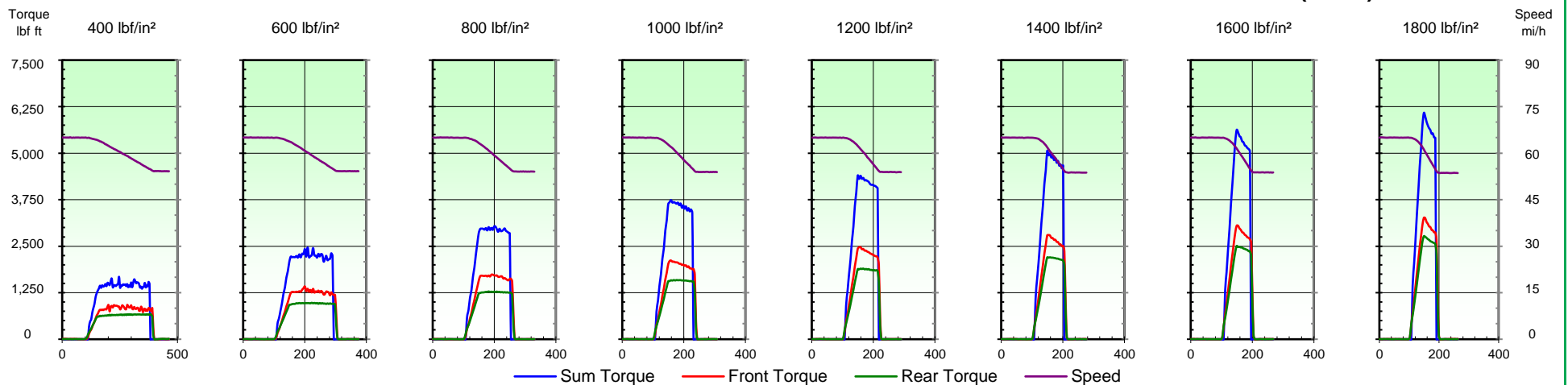
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - 65-55 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - 65-55 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

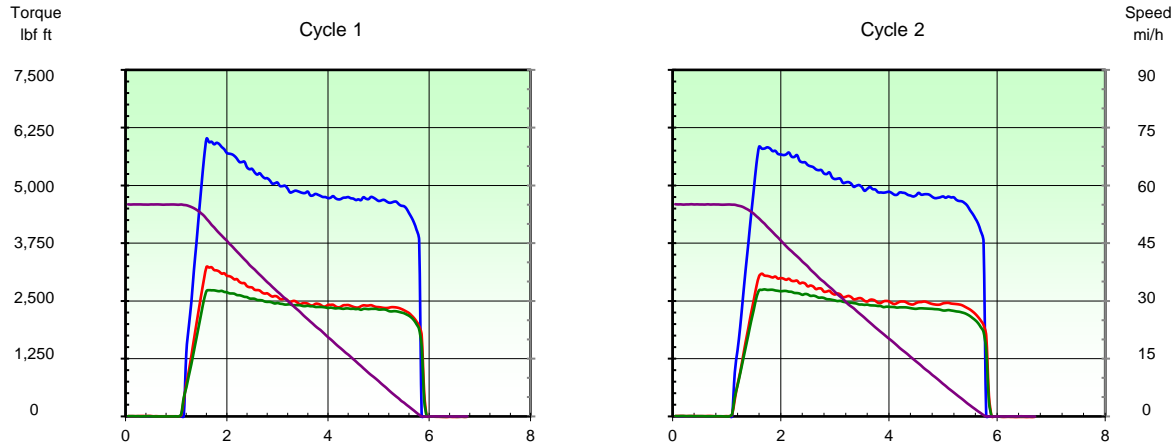
Report Number: 203145-1

Test Report Date: 06 March 2020

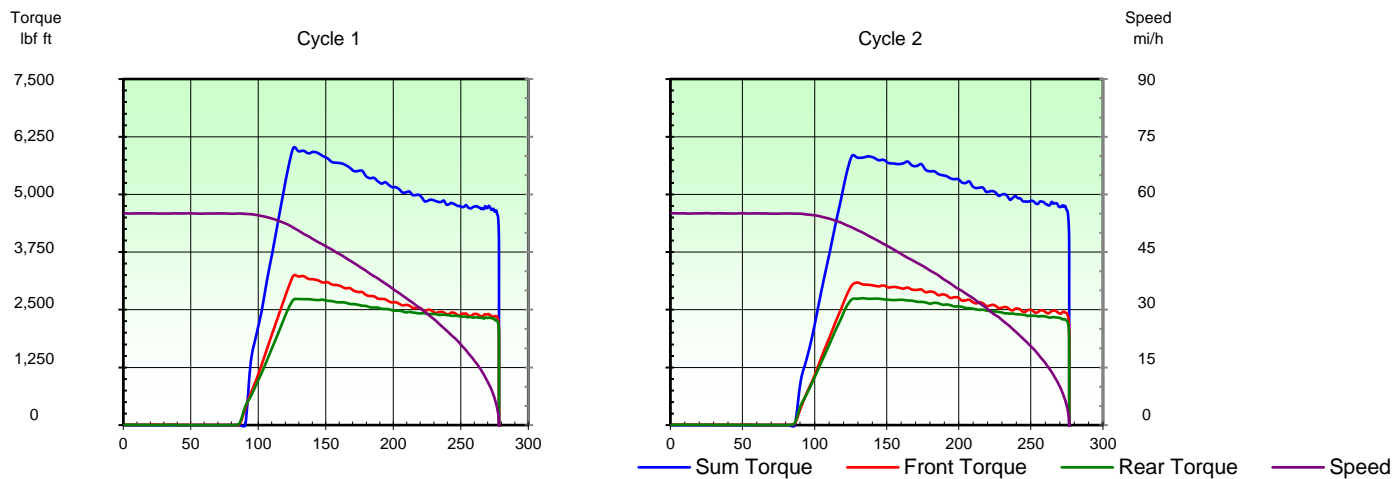
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2nd EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



2ND EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

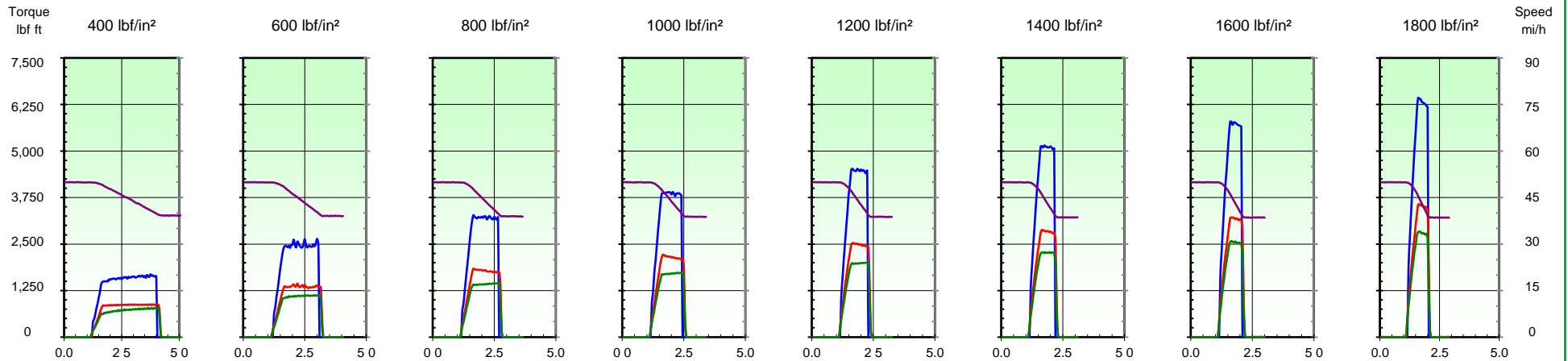
Report Number: 203145-1

Test Report Date: 06 March 2020

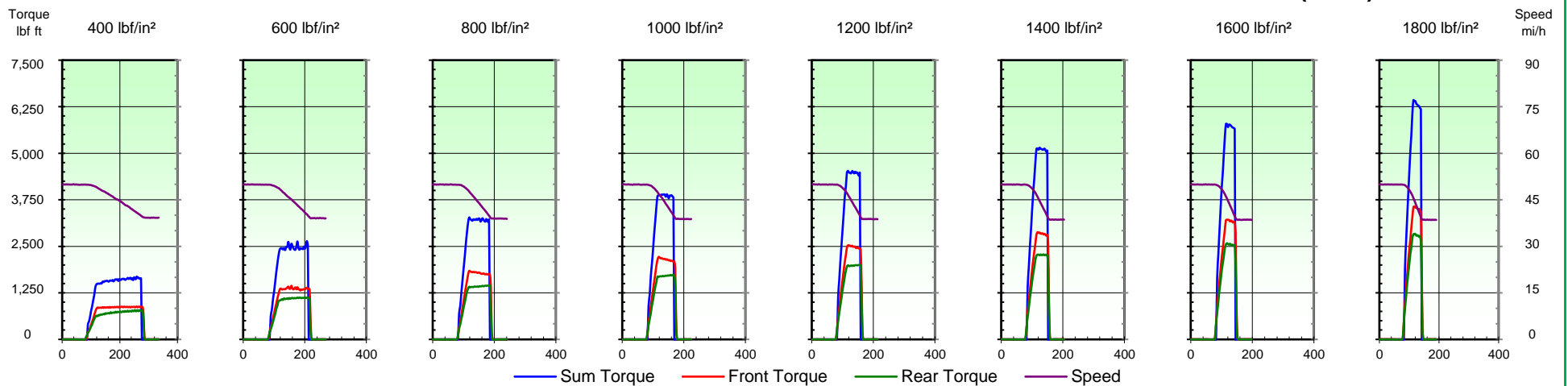
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

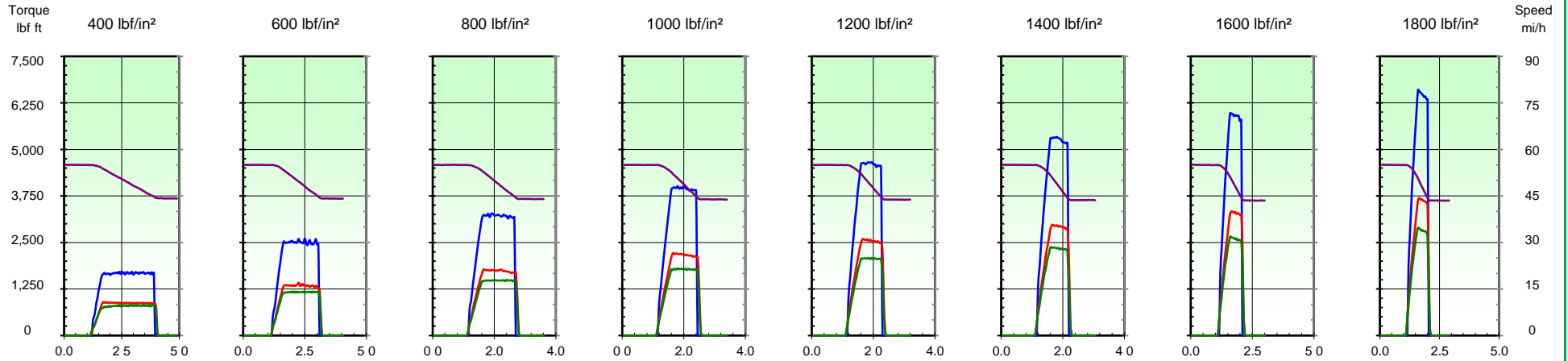
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Test Report Date: 06 March 2020

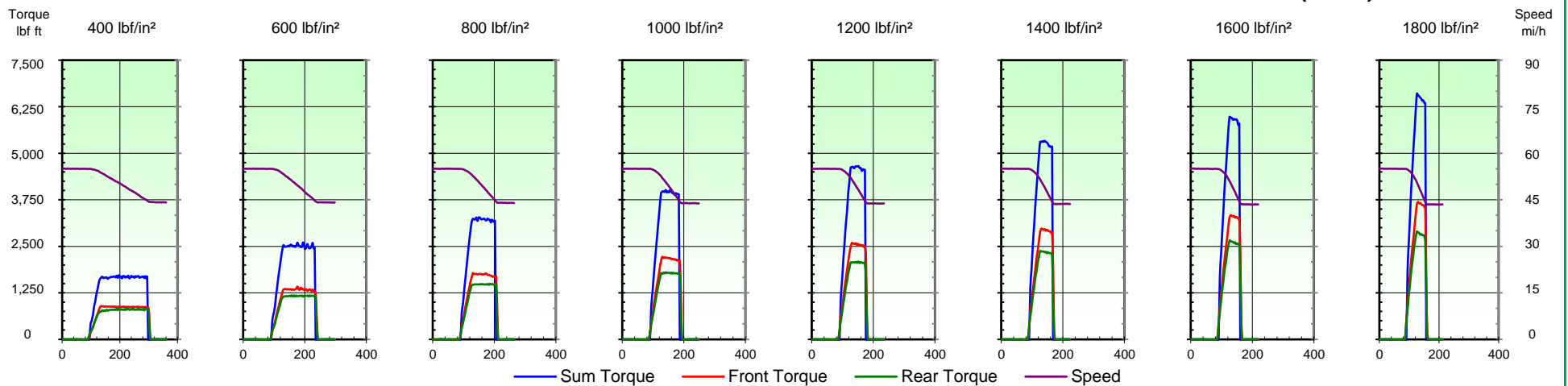
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

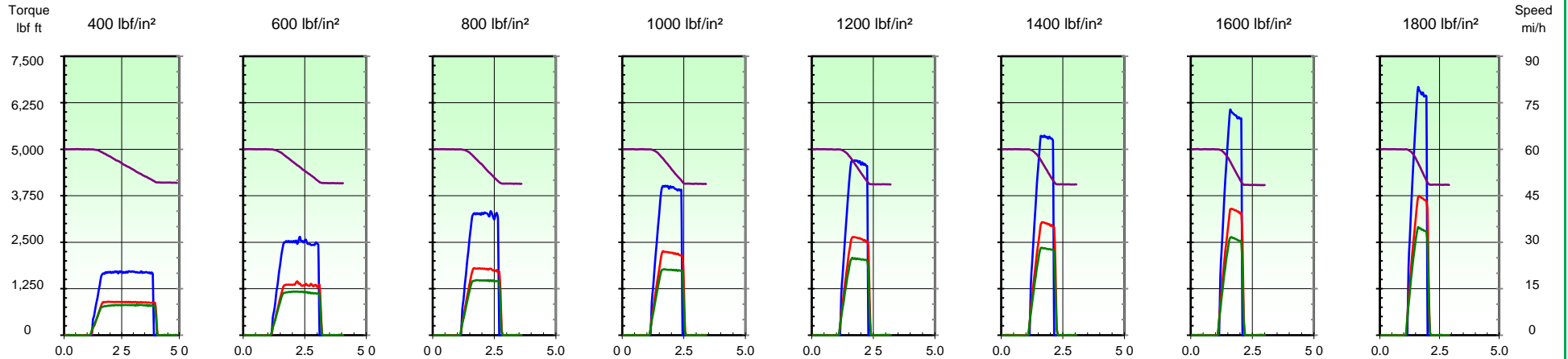
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Test Report Date: 06 March 2020

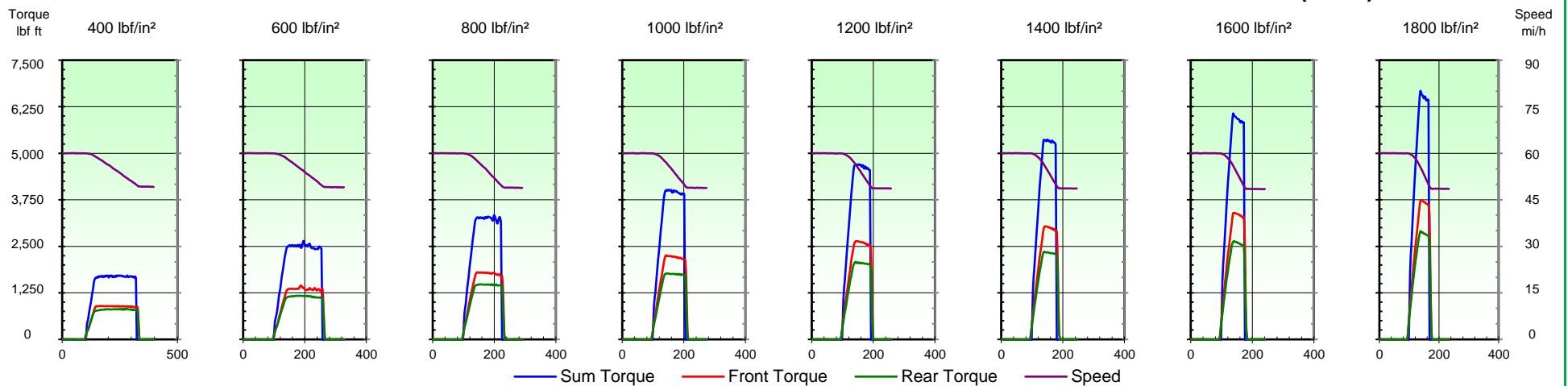
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 60-50 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 60-50 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

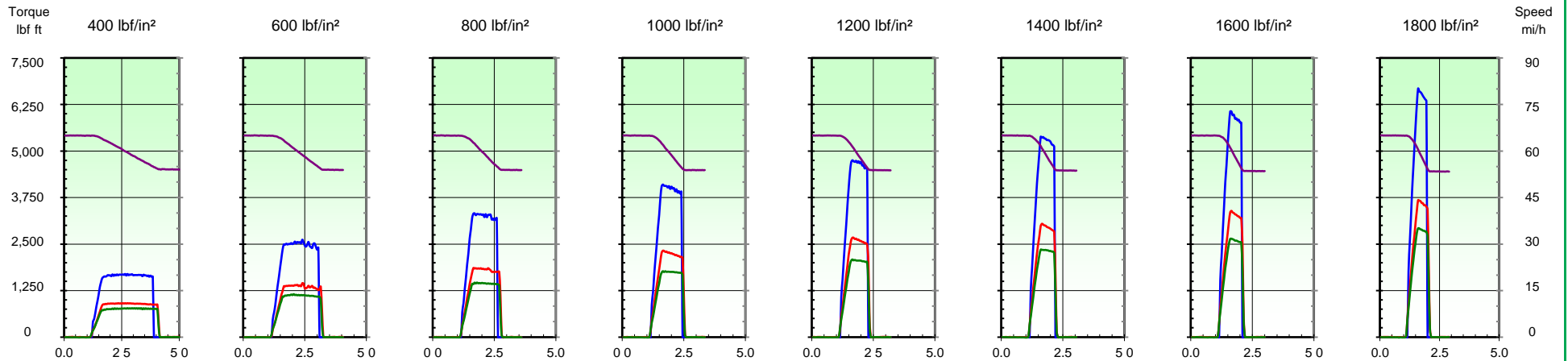
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Test Report Date: 06 March 2020

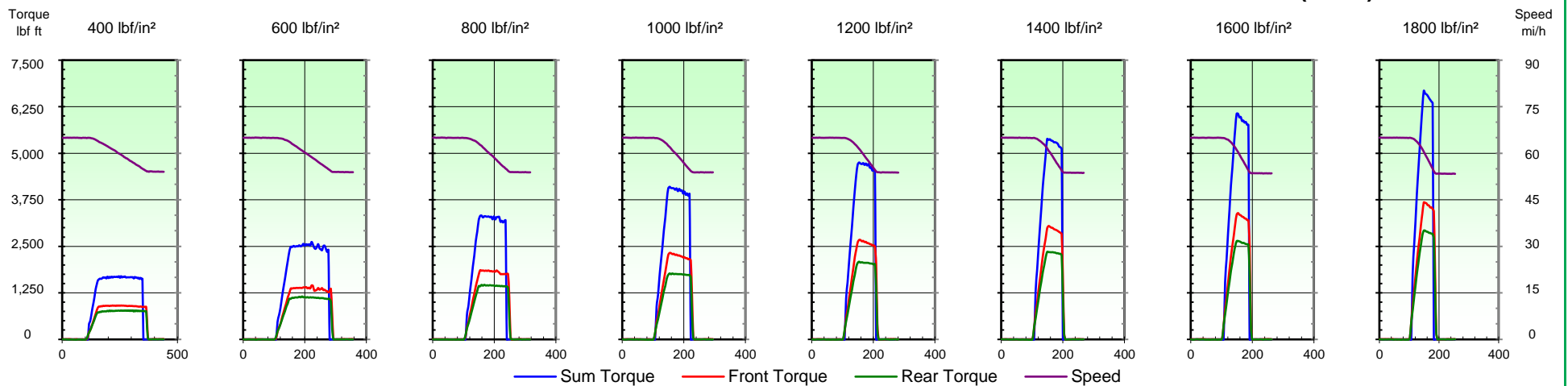
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 65-55 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 65-55 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

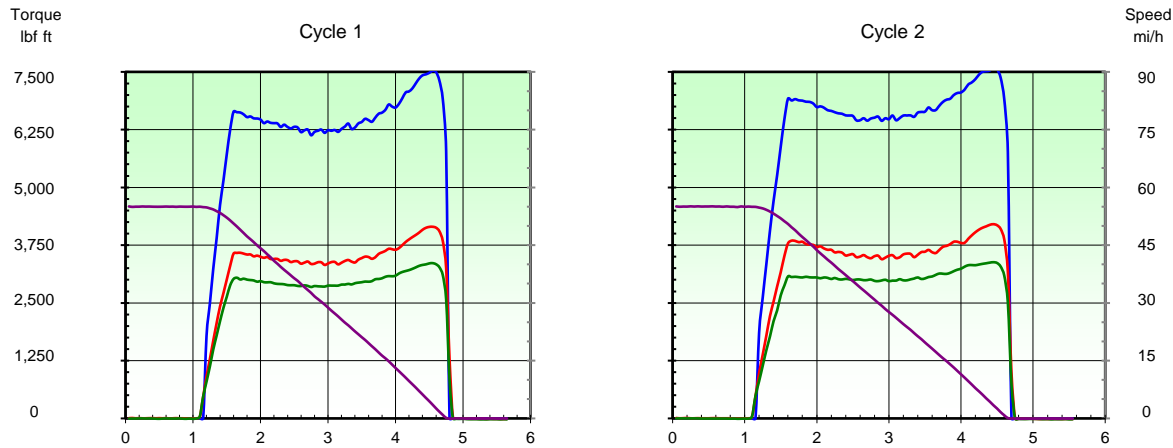
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Test Report Date: 06 March 2020

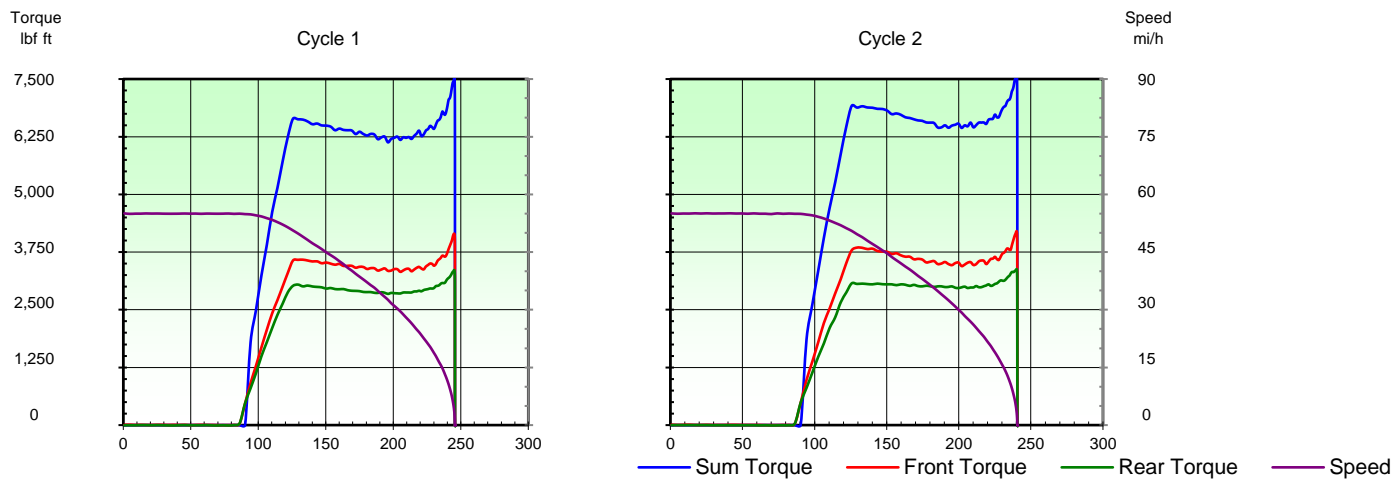
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3rd EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

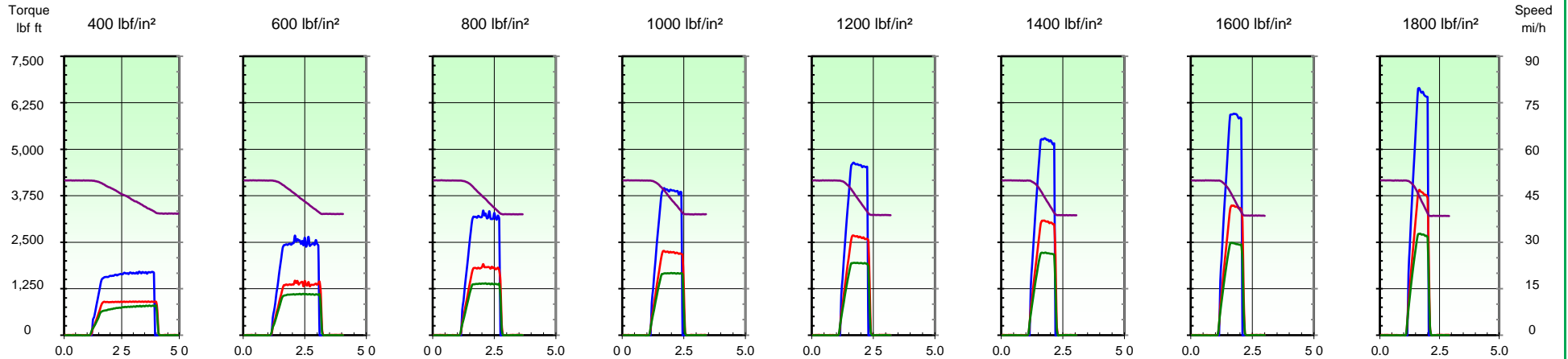
Report Number: 203145-1

Test Report Date: 06 March 2020

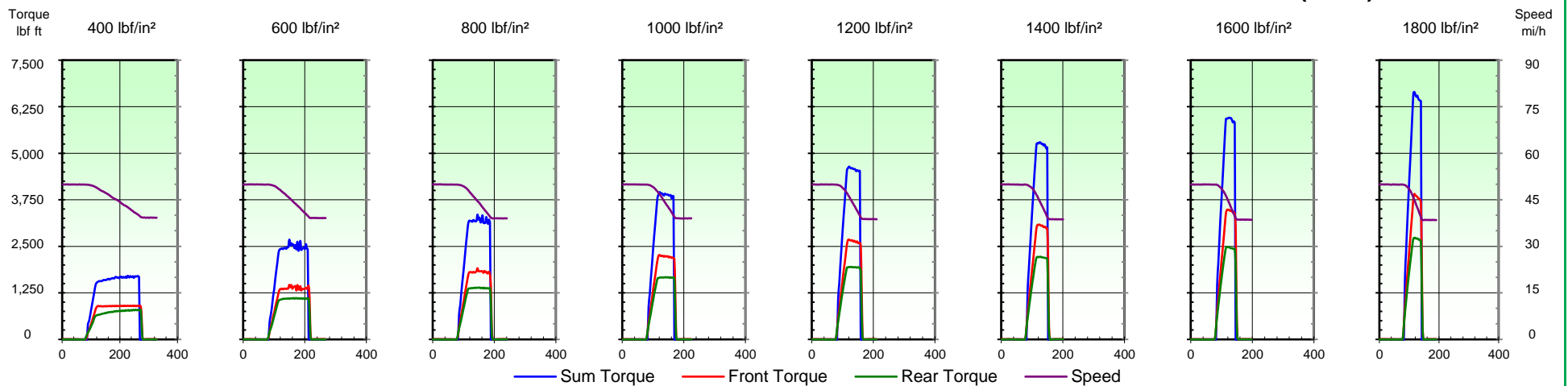
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 50-40 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 50-40 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

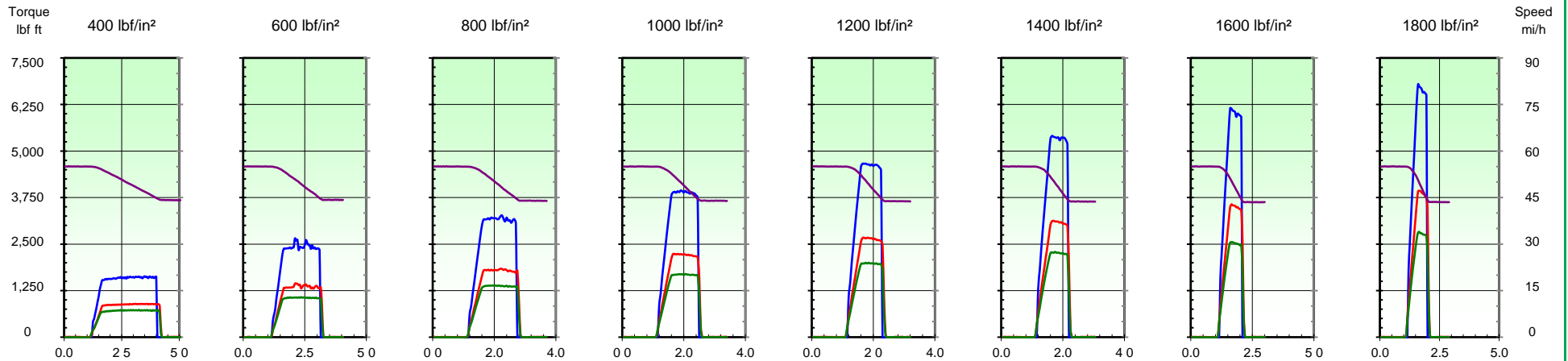
Report Number: 203145-1

Test Report Date: 06 March 2020

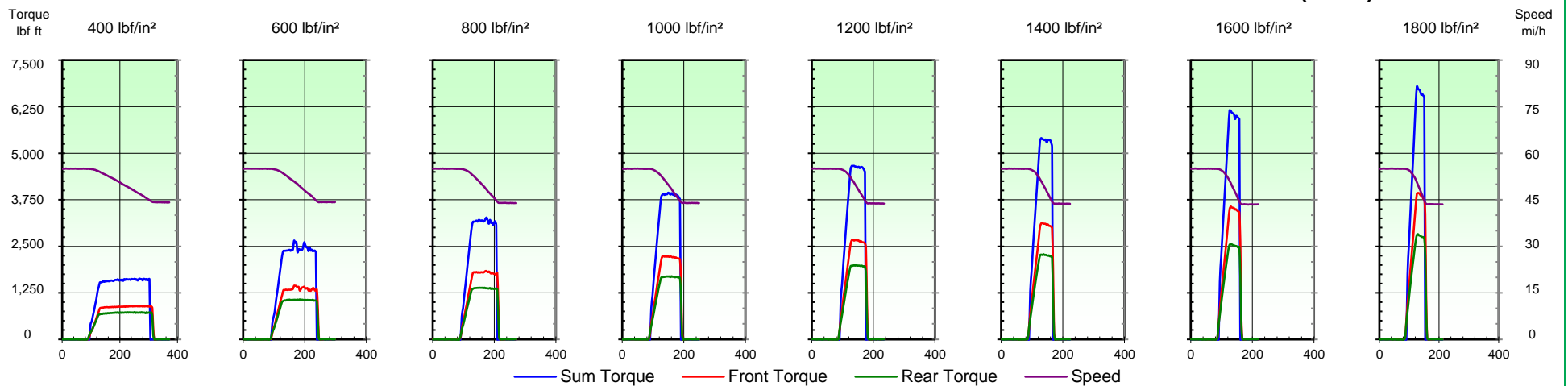
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

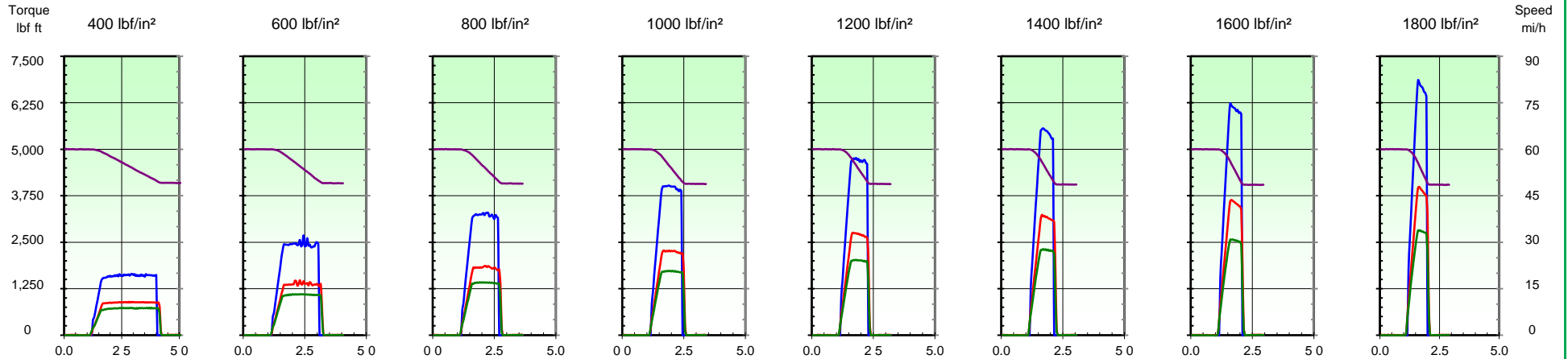
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Test Report Date: 06 March 2020

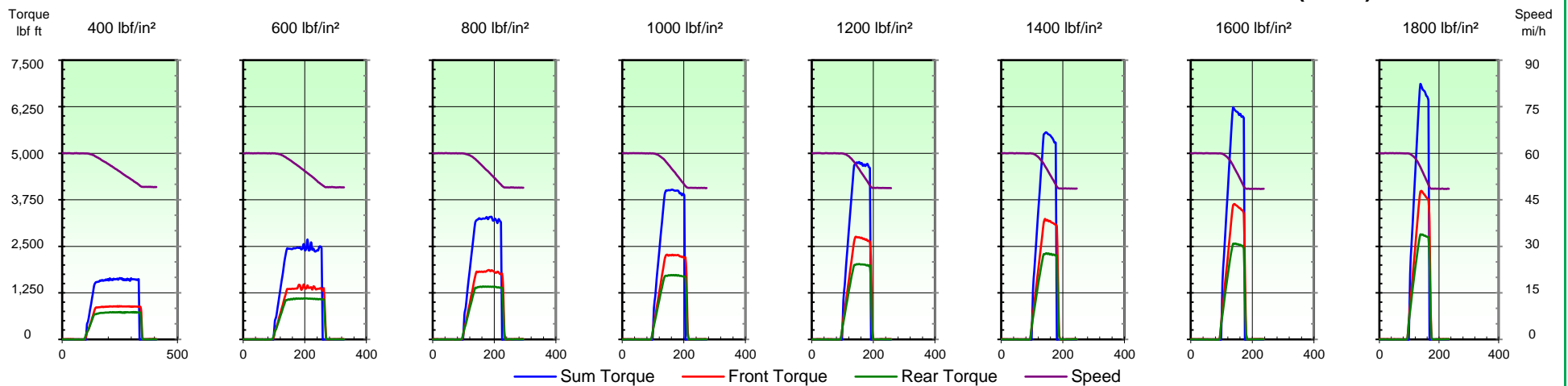
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - 60-50 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 60-50 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

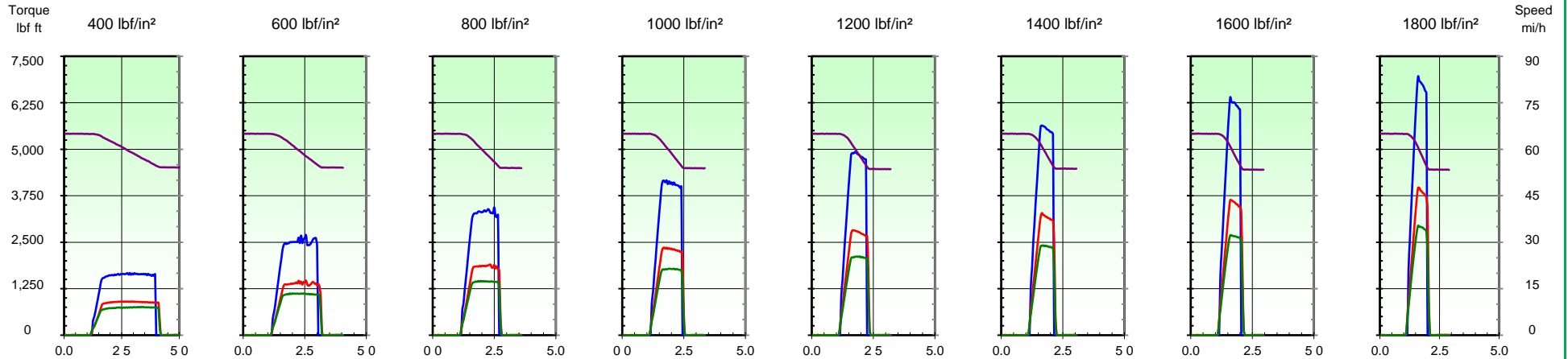
Report Number: 203145-1

Test Report Date: 06 March 2020

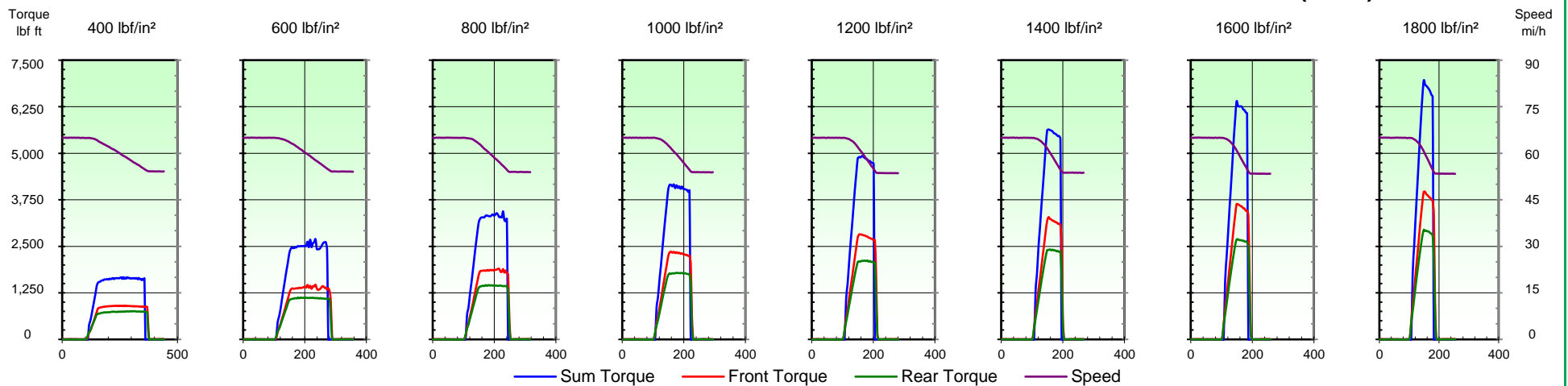
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 65-55 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 65-55 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

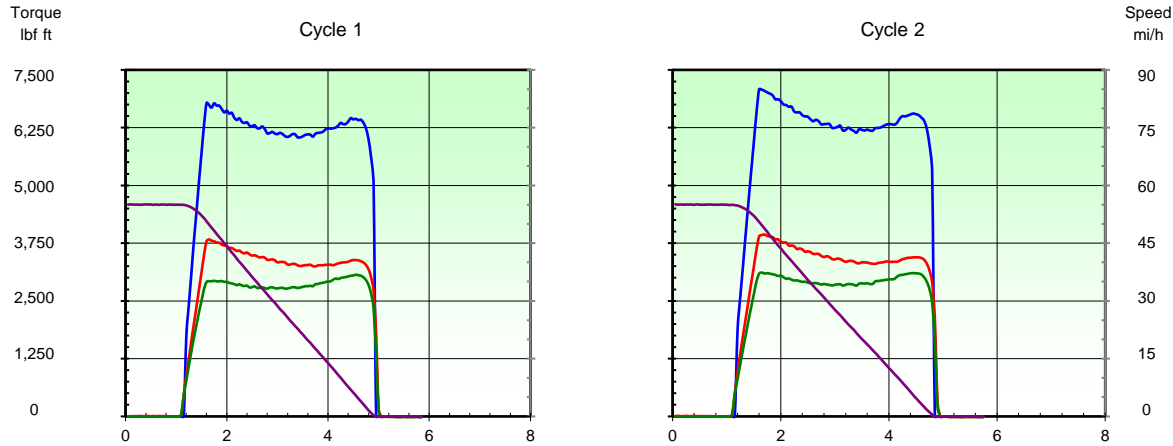
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Test Report Date: 06 March 2020

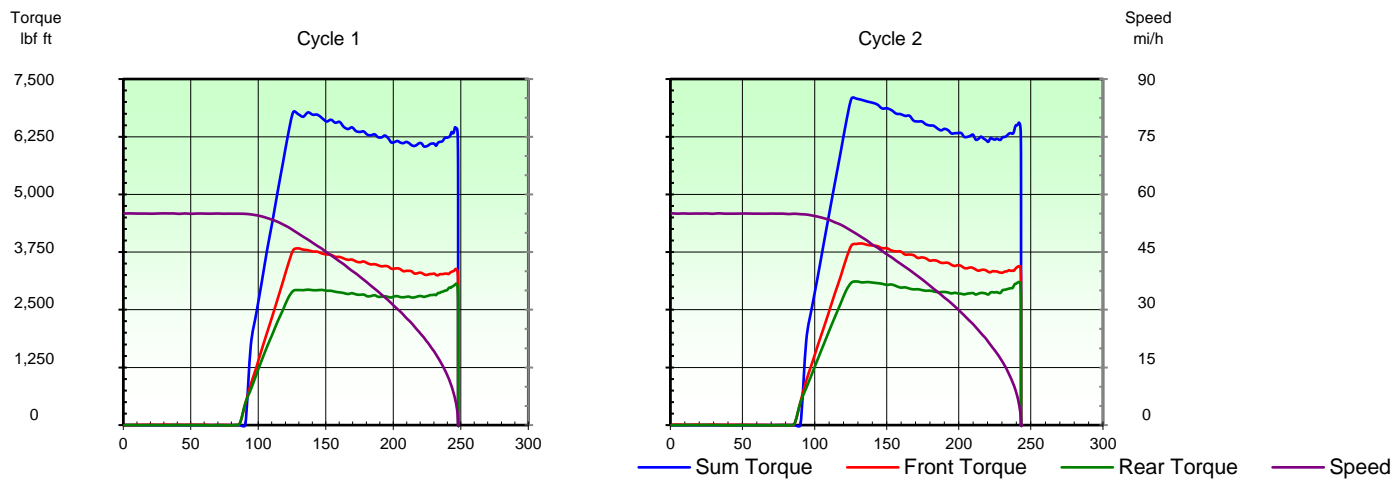
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3rd EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

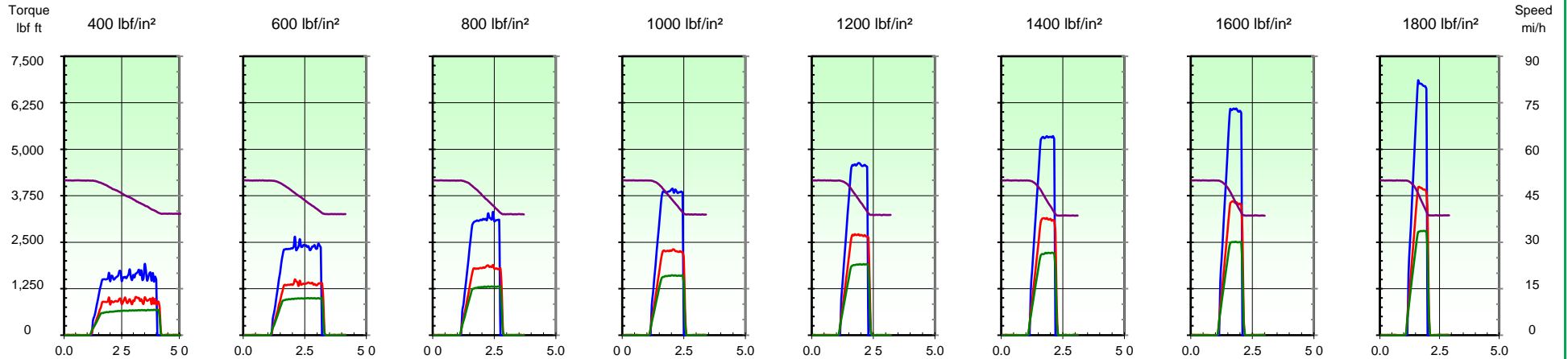
Report Number: 203145-1

Test Report Date: 06 March 2020

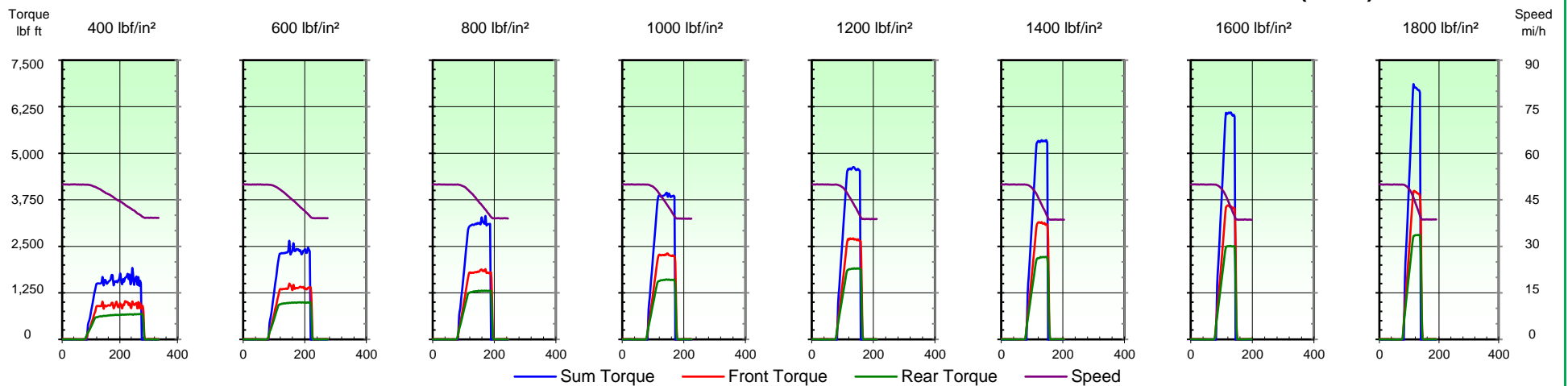
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 50-40 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 50-40 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

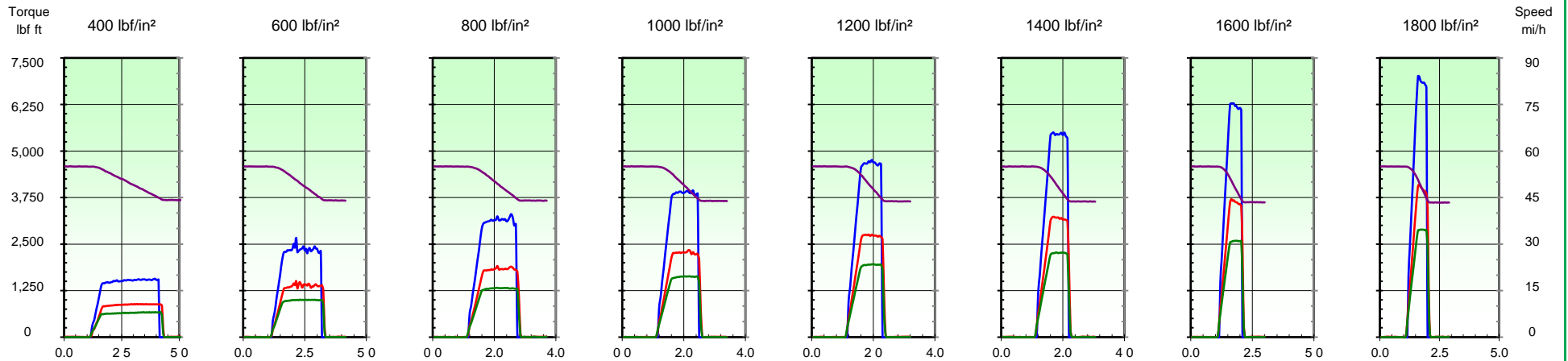
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Test Report Date: 06 March 2020

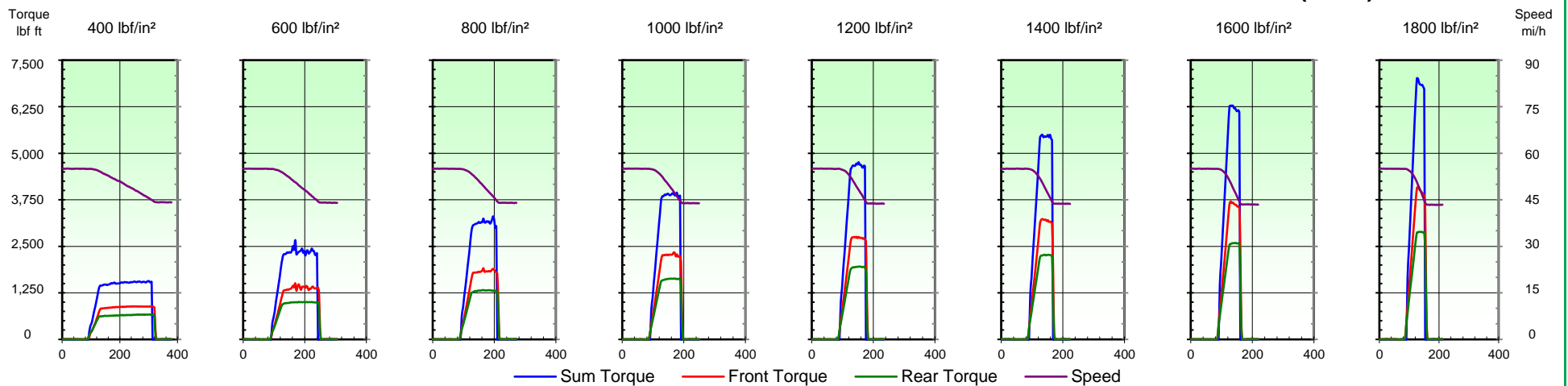
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 55-45 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 55-45 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

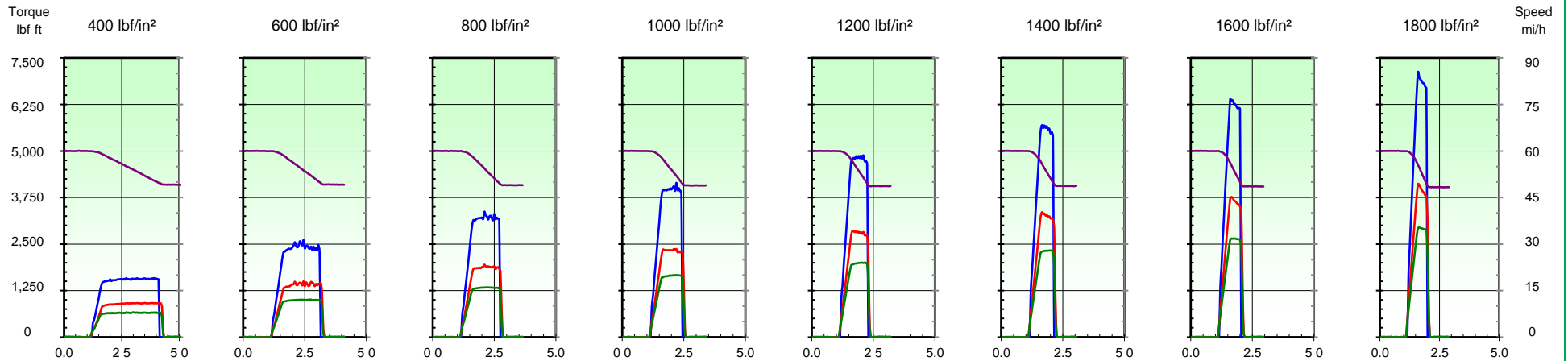
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Test Report Date: 06 March 2020

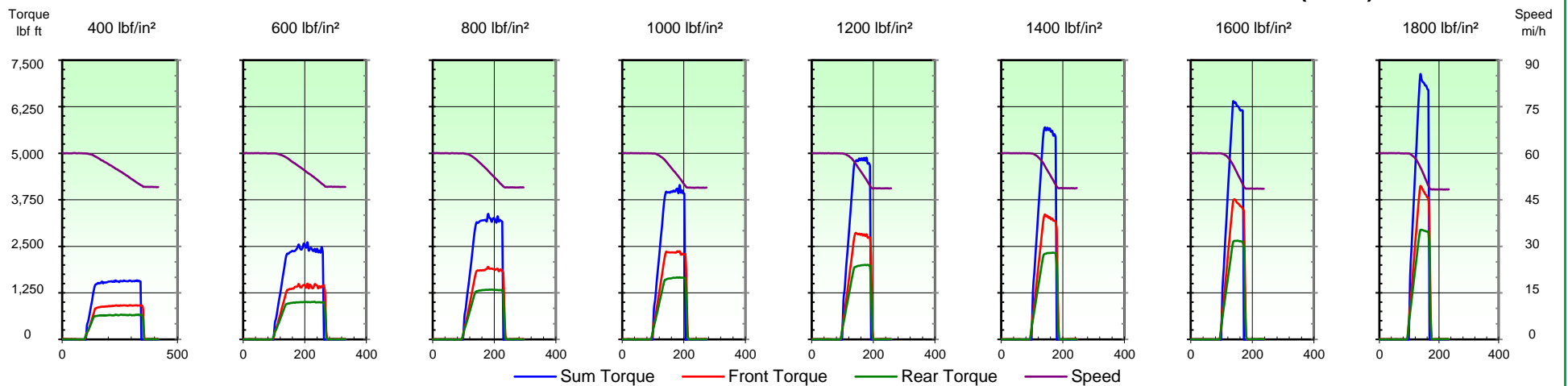
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 60-50 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 60-50 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

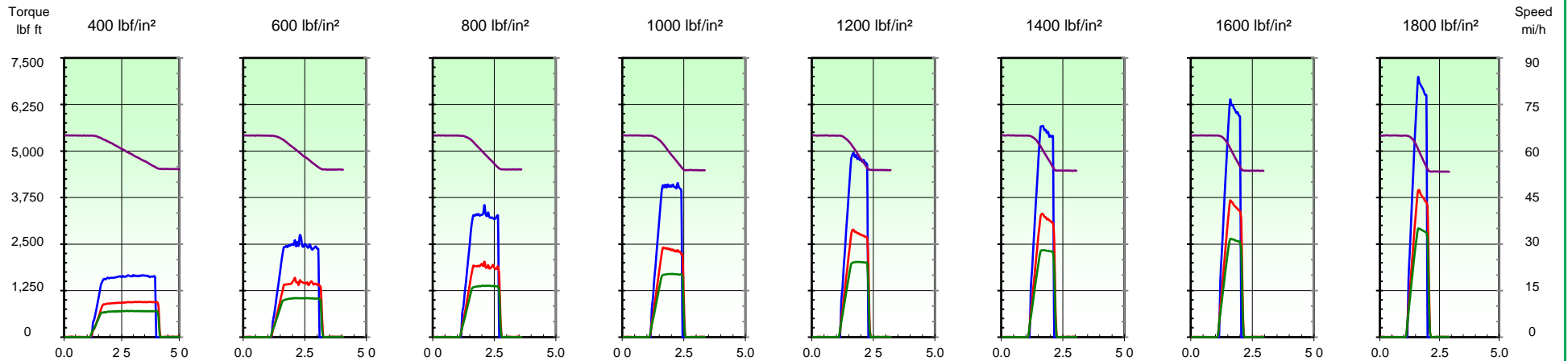
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Test Report Date: 06 March 2020

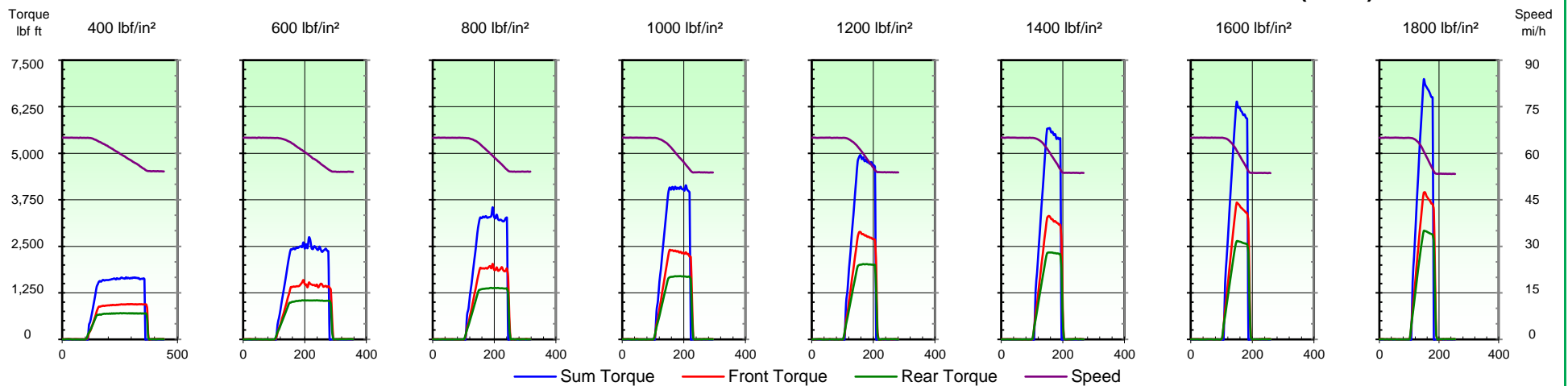
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 65-55 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 65-55 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

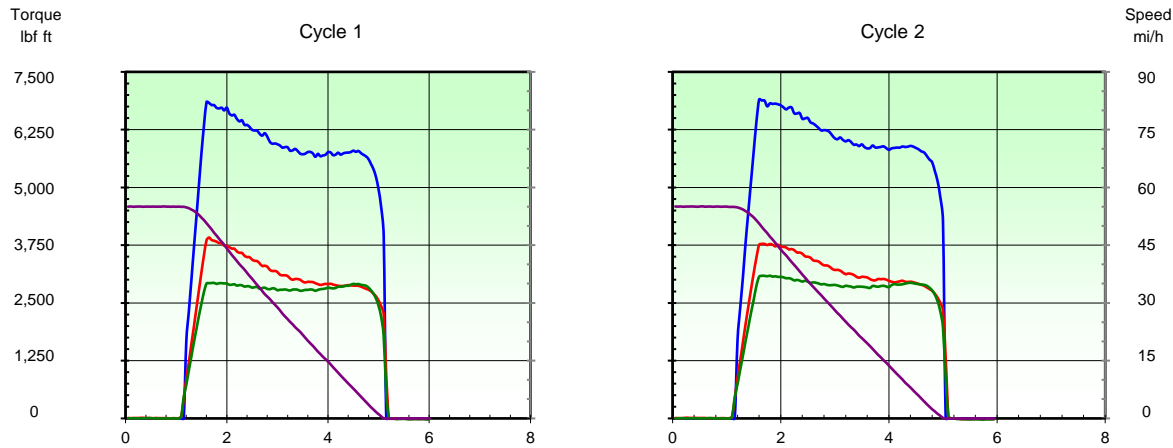
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Test Report Date: 06 March 2020

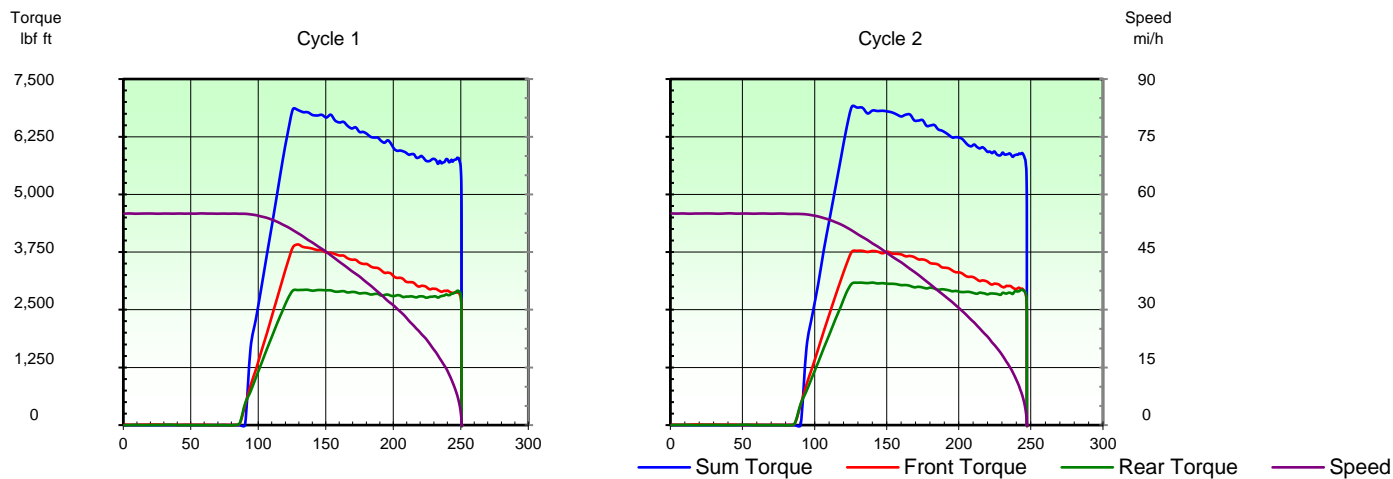
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3rd EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

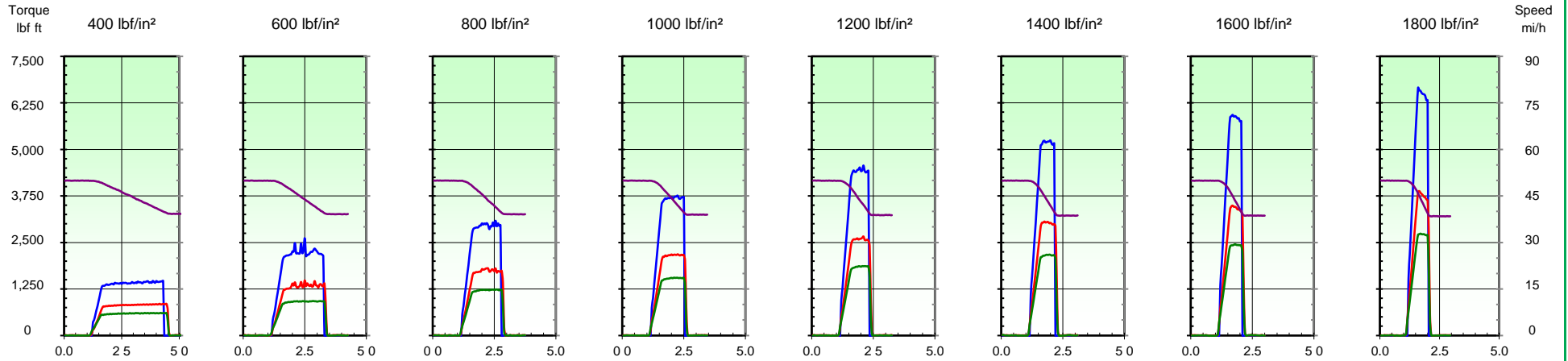
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Test Report Date: 06 March 2020

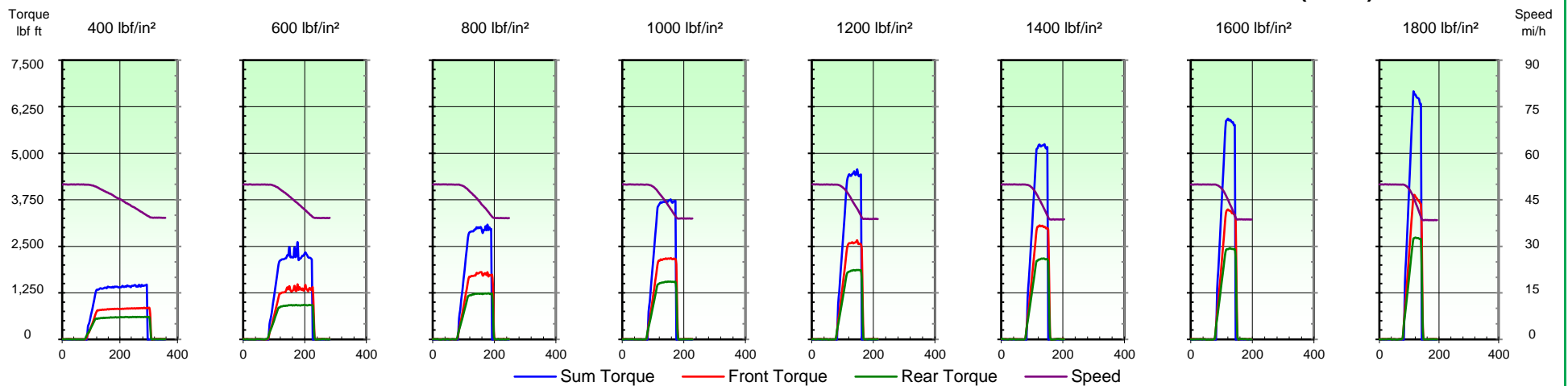
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 50-40 mi/h 75°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 50-40 mi/h 75°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

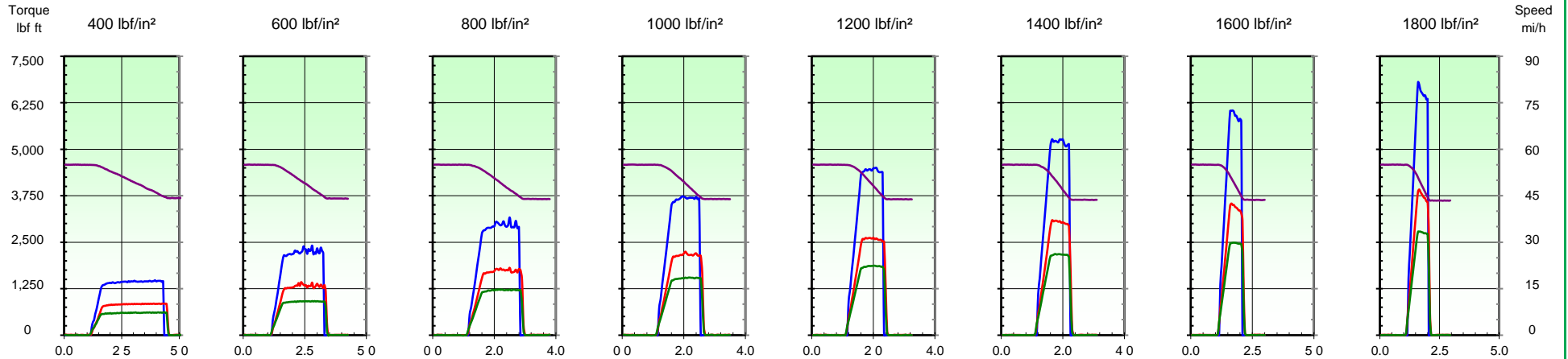
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Test Report Date: 06 March 2020

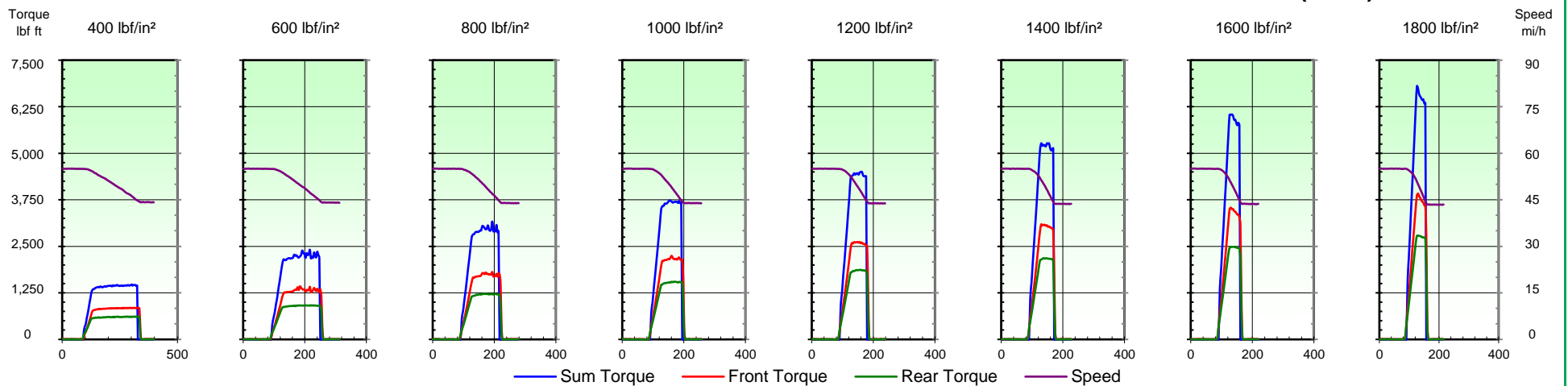
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 55-45 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 55-45 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

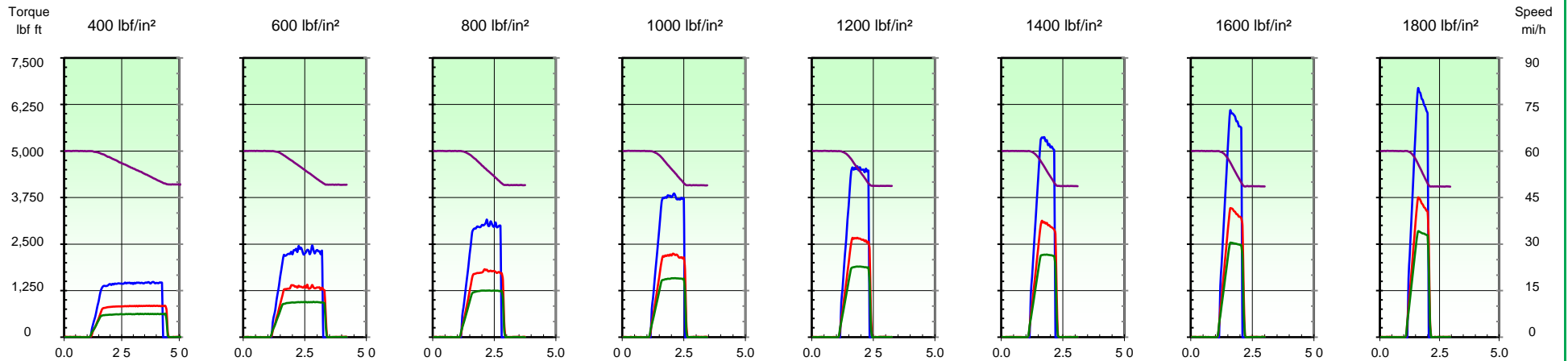
Report Number: 203145-1

Test Report Date: 06 March 2020

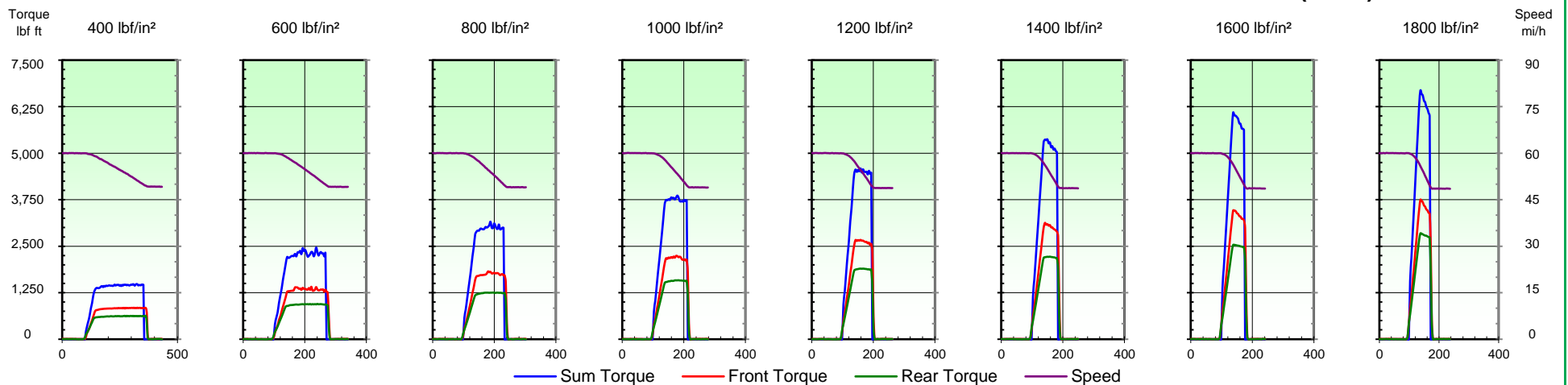
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 60-50 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 60-50 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

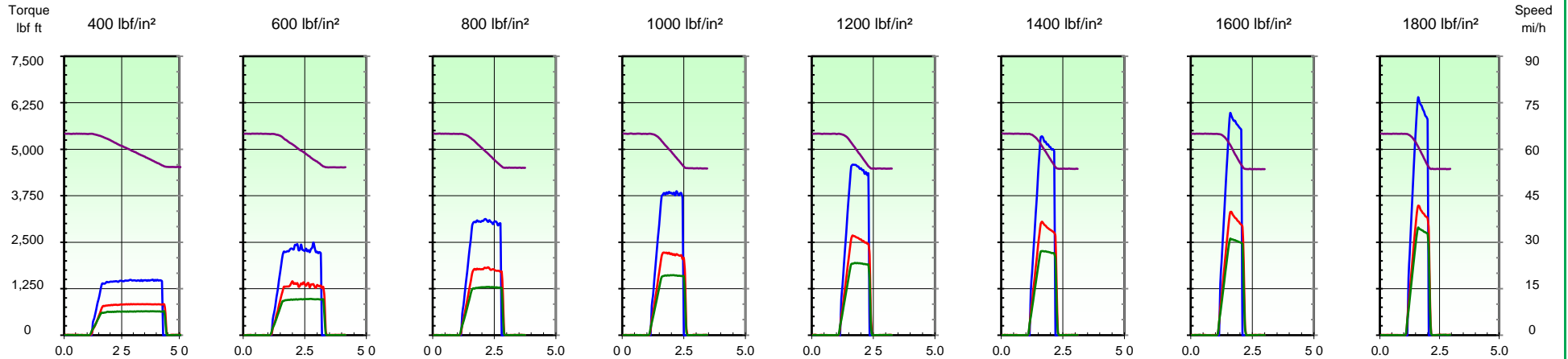
Report Number: 203145-1

Test Report Date: 06 March 2020

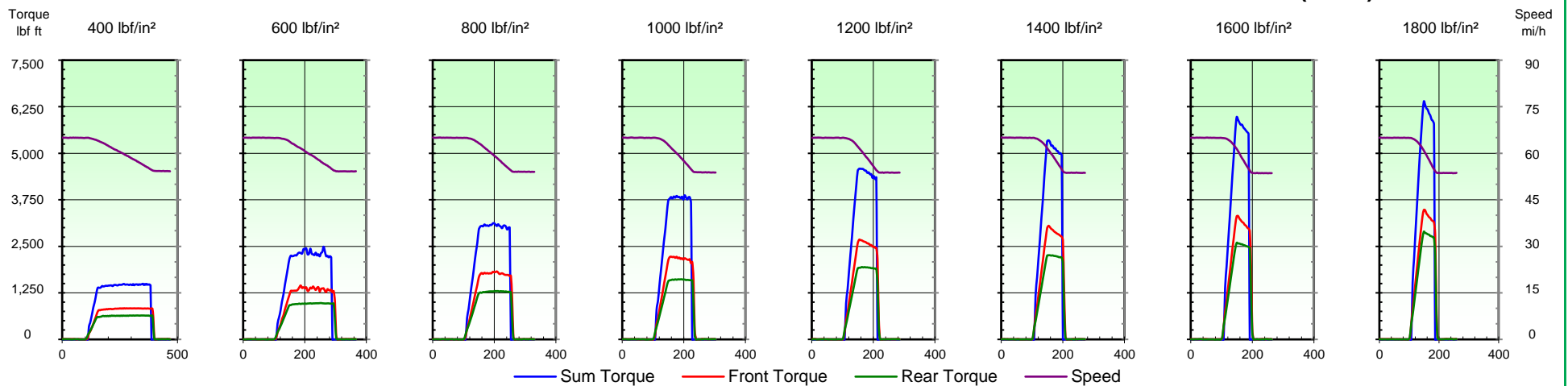
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - 65-55 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - 65-55 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

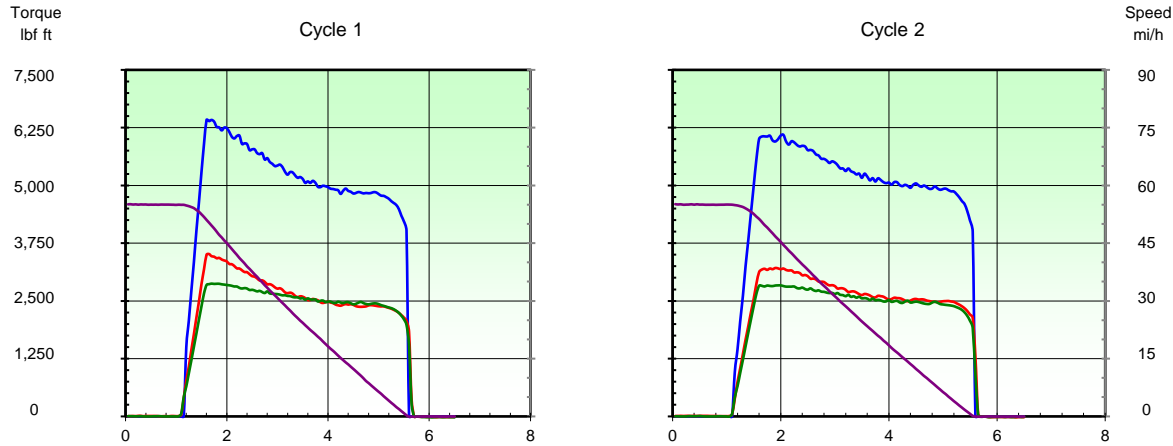
Report Number: 203145-1

Test Report Date: 06 March 2020

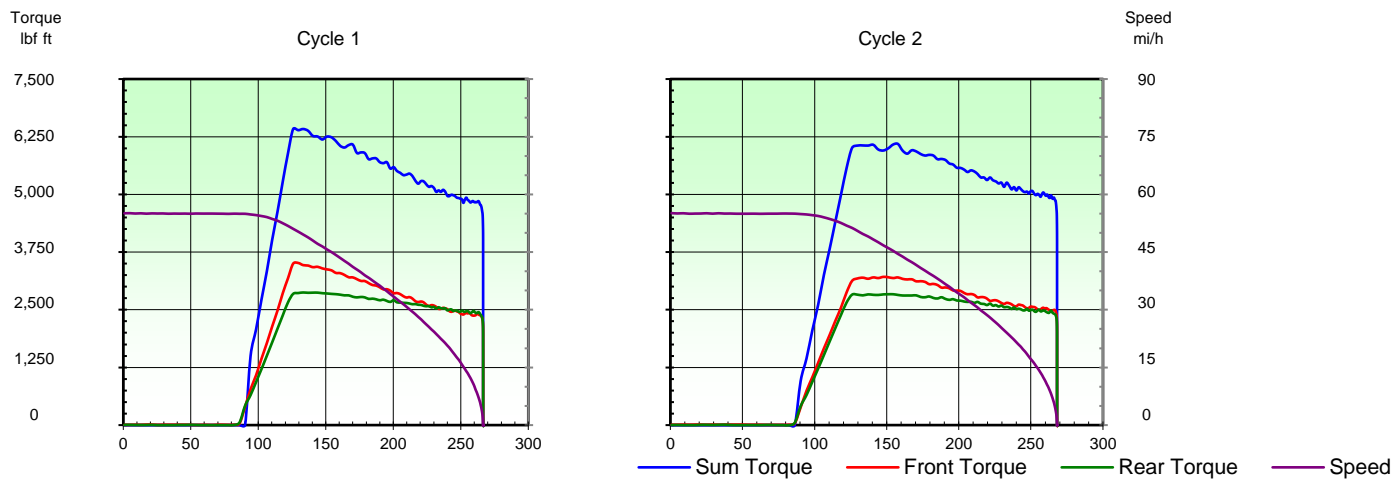
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3rd EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



3RD EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

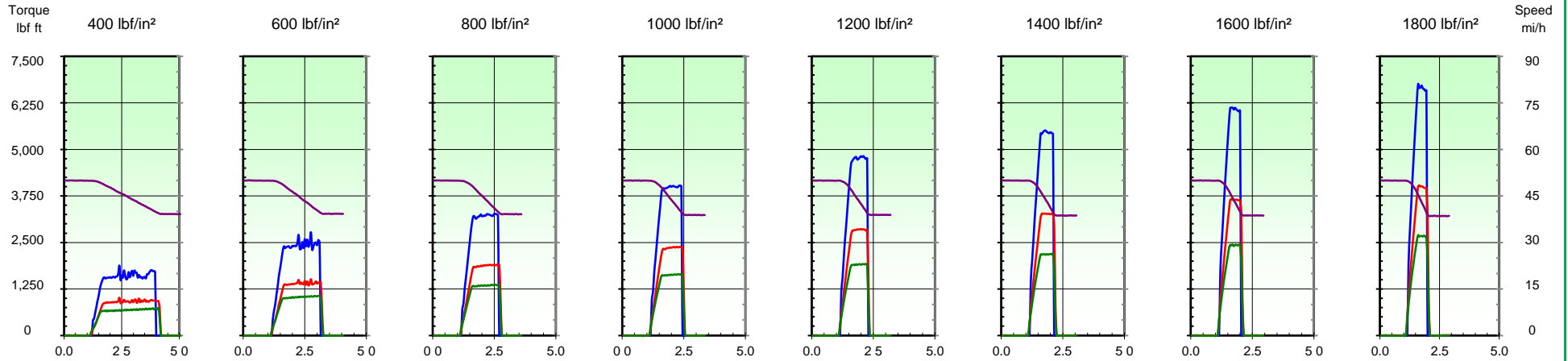
Report Number: 203145-1

Test Report Date: 06 March 2020

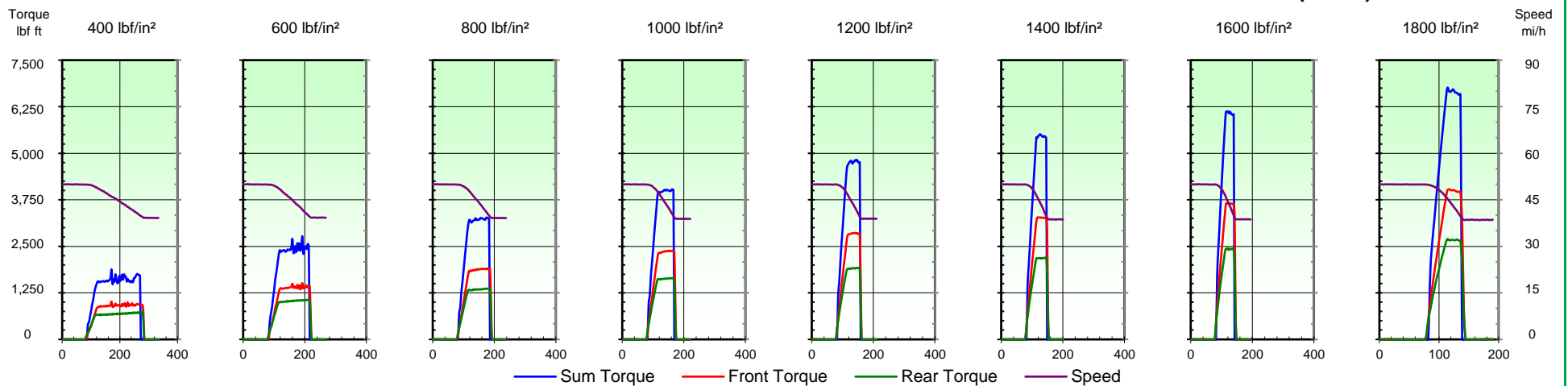
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

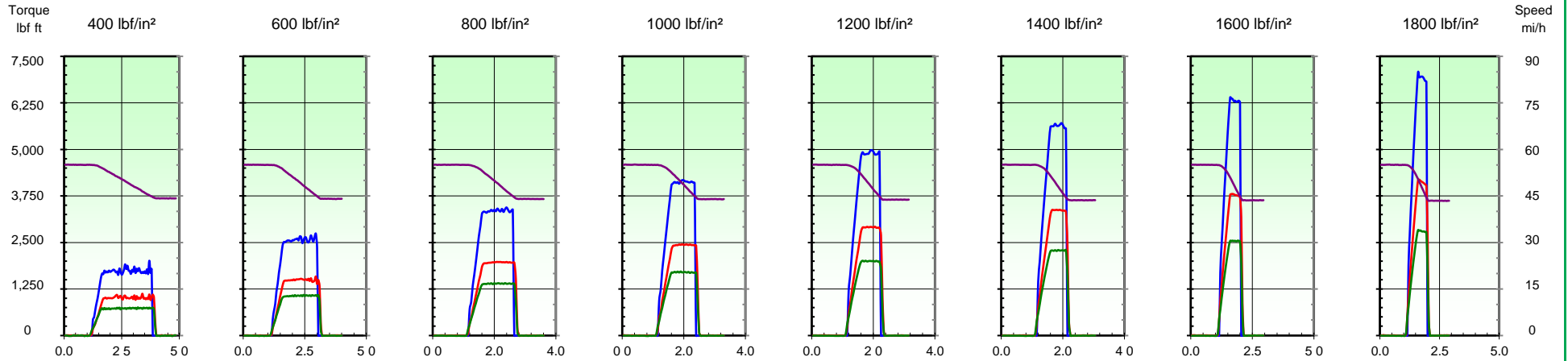
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Test Report Date: 06 March 2020

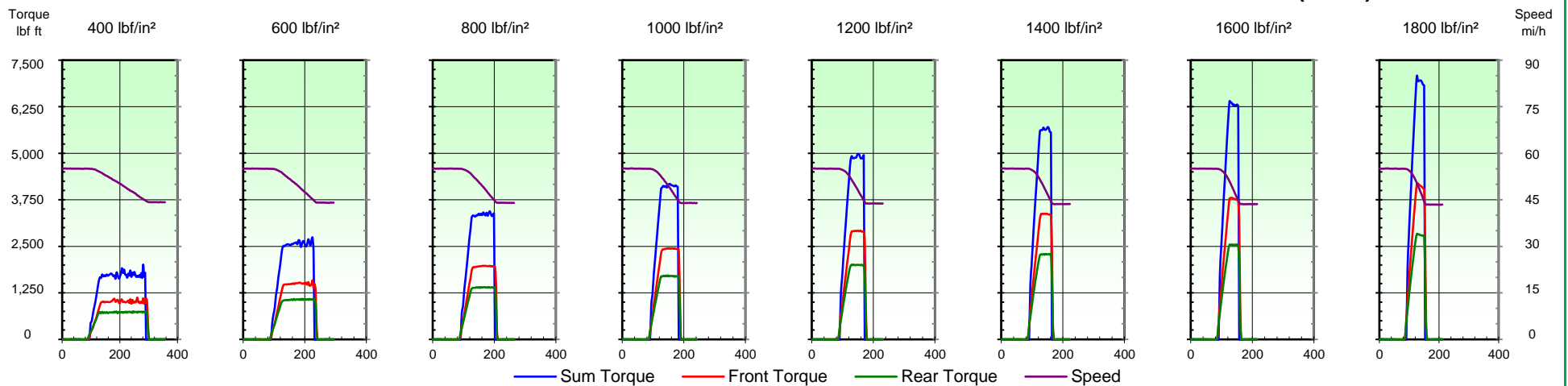
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 55-45 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

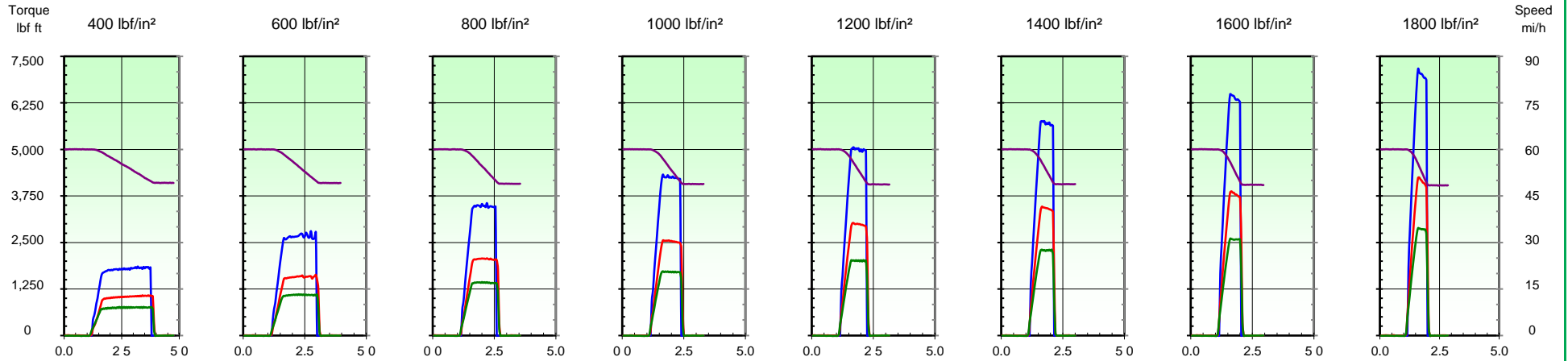
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Test Report Date: 06 March 2020

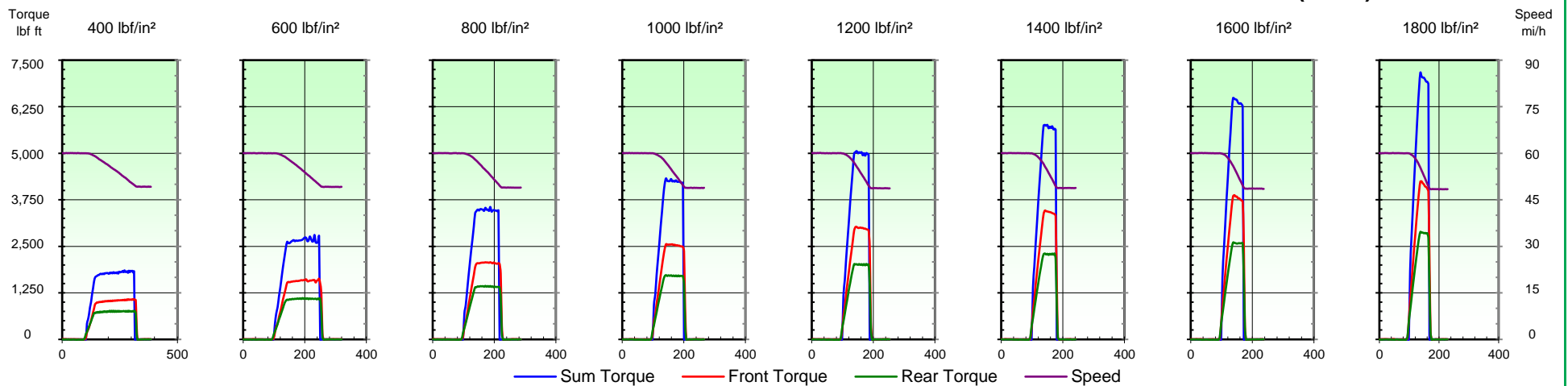
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 60-50 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

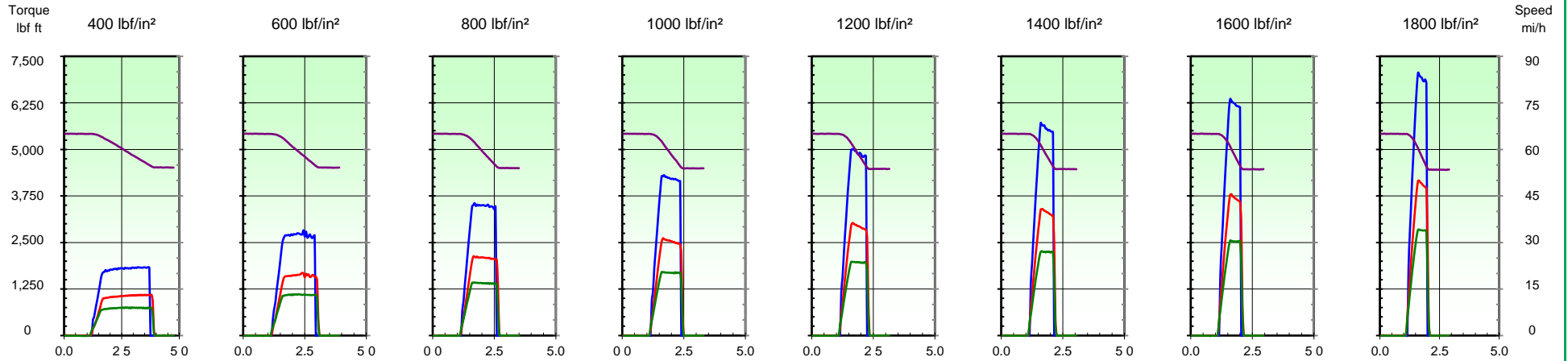
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Test Report Date: 06 March 2020

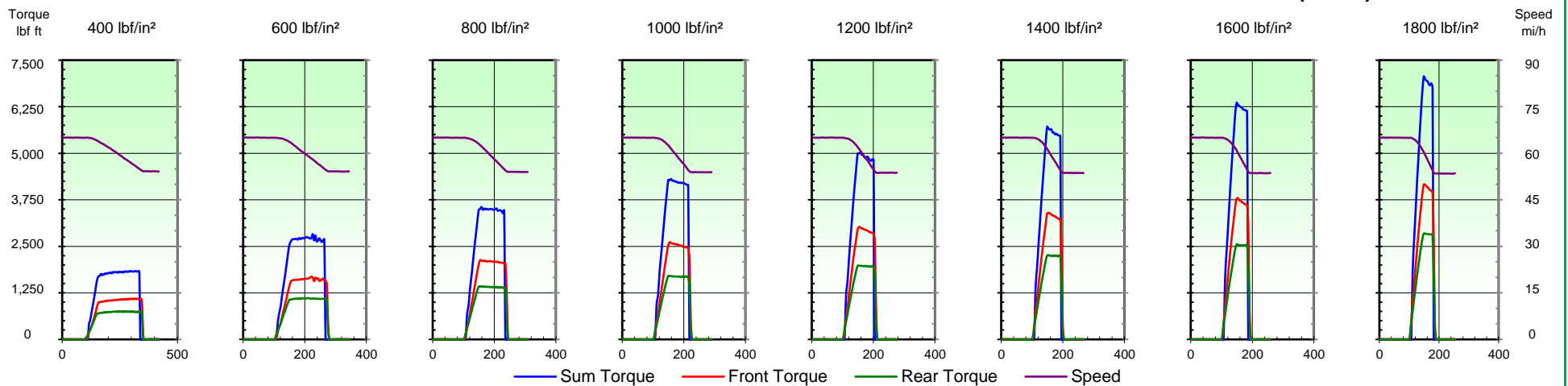
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - 65-55 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

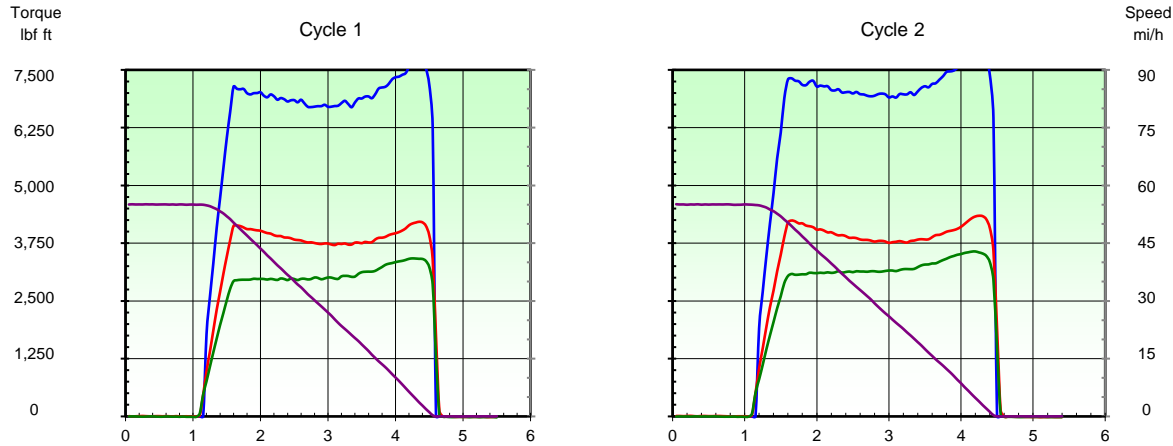
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Test Report Date: 06 March 2020

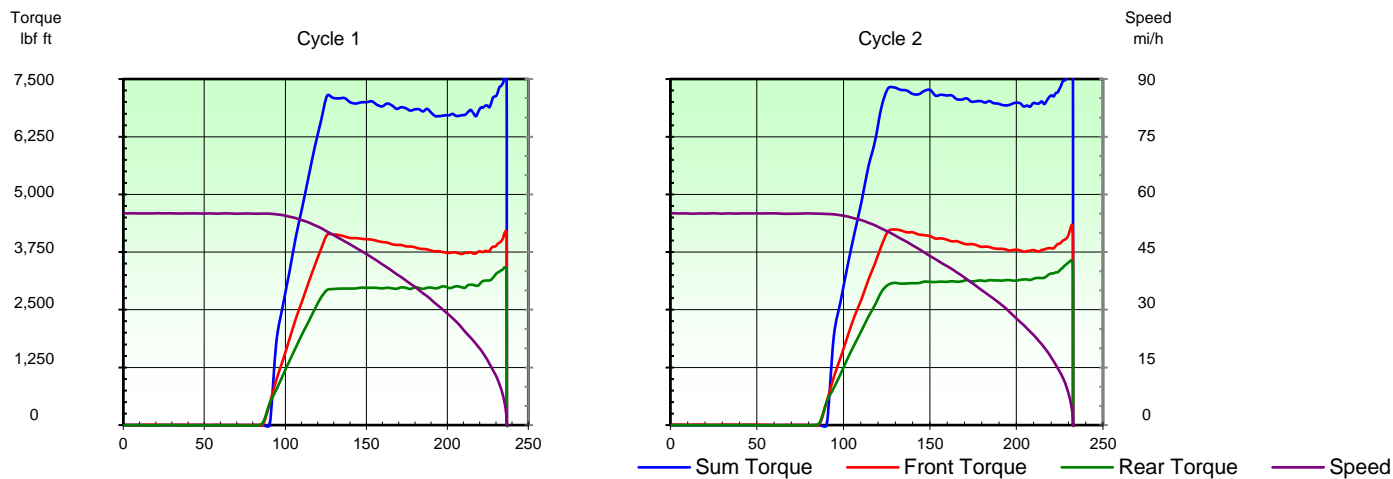
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 50-40 mi/h 300°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



1ST EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 300°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

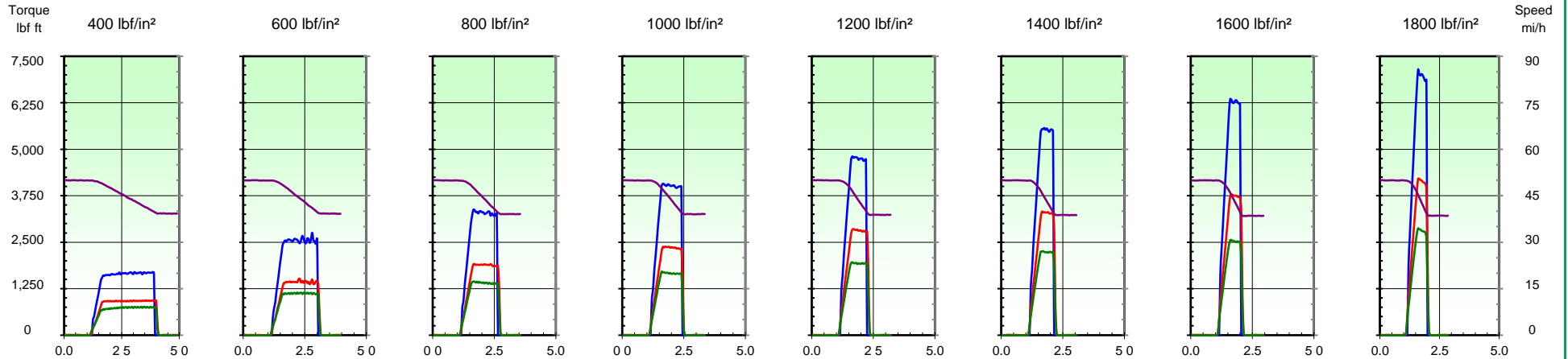
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Test Report Date: 06 March 2020

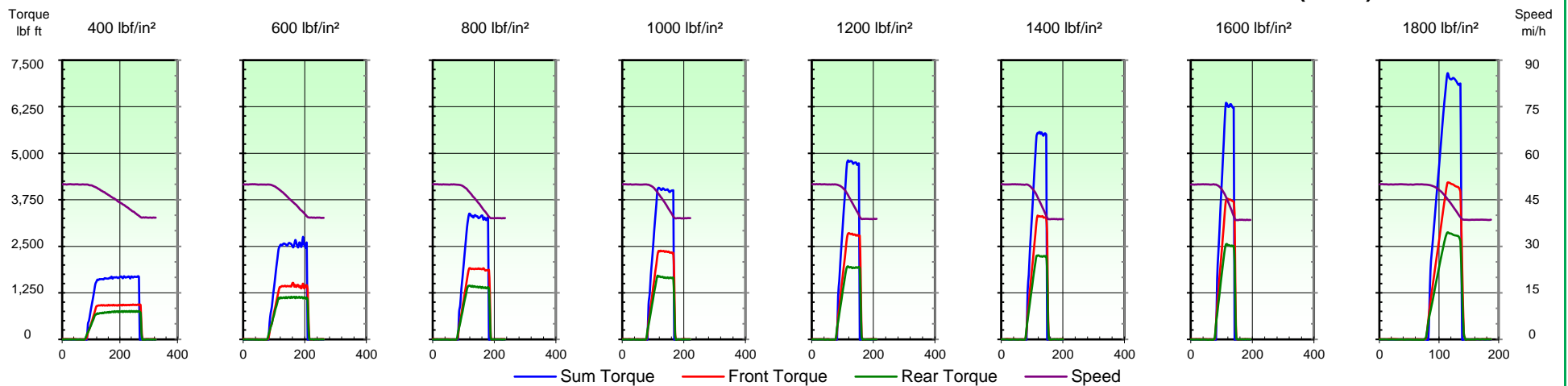
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 50-40 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 50-40 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

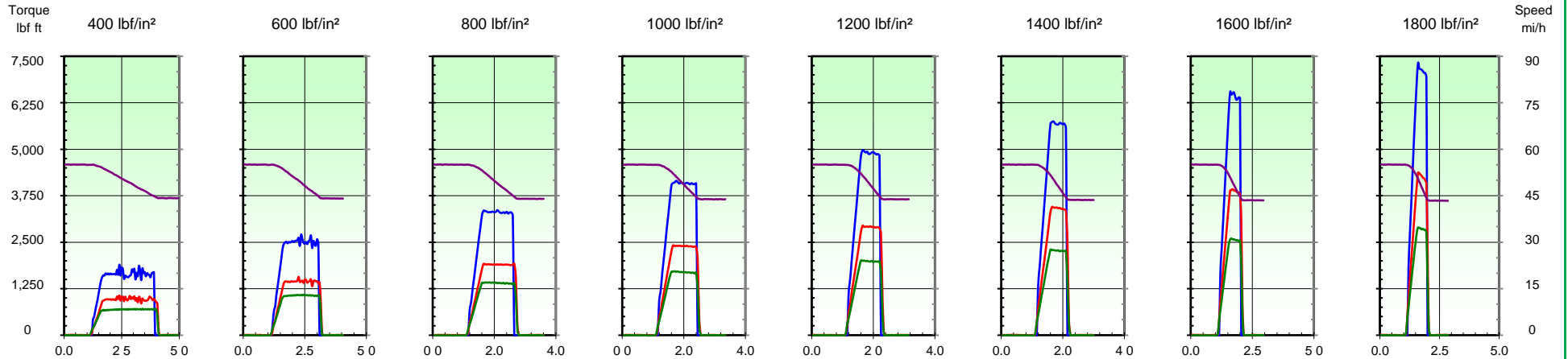
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Test Report Date: 06 March 2020

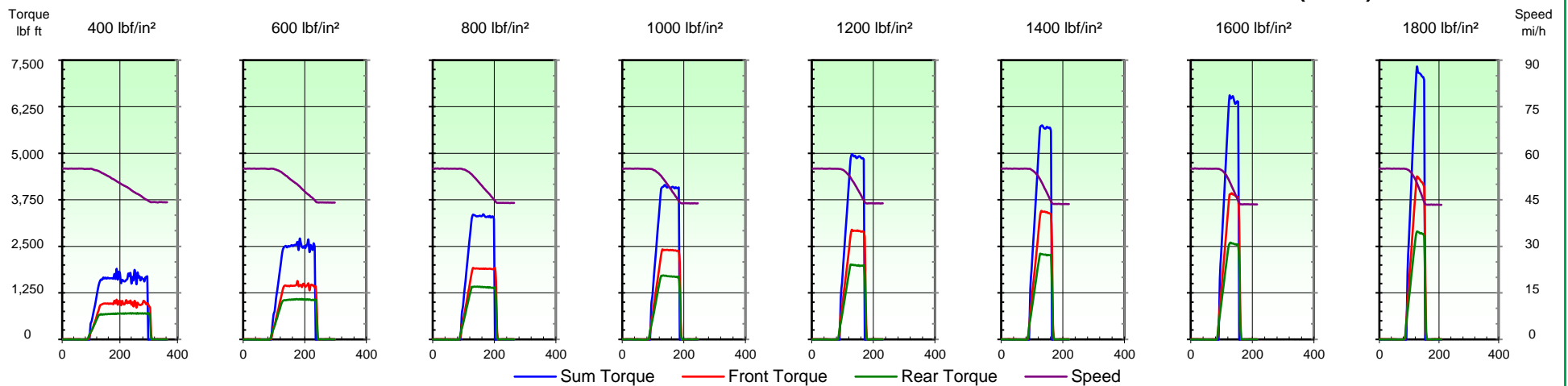
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 55-45 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 55-45 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

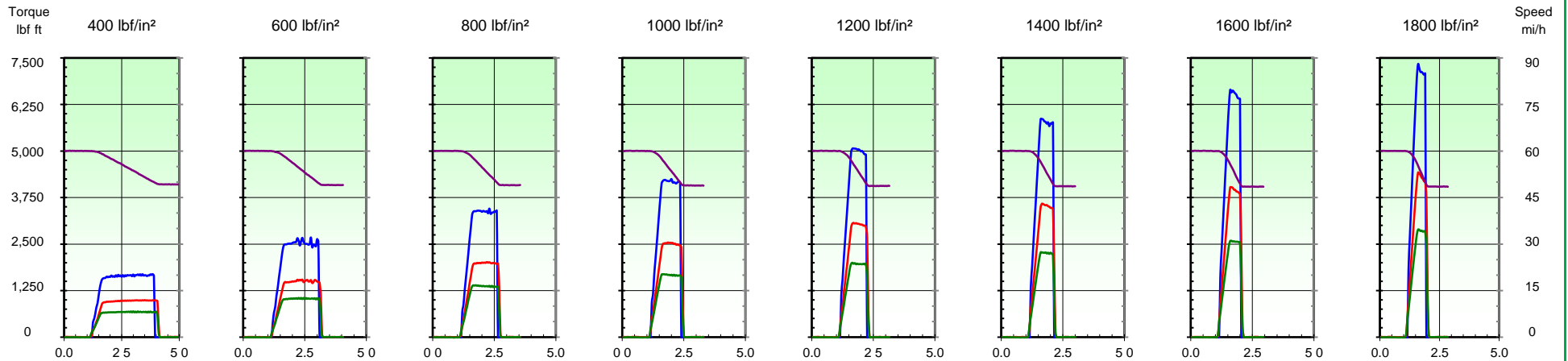
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Test Report Date: 06 March 2020

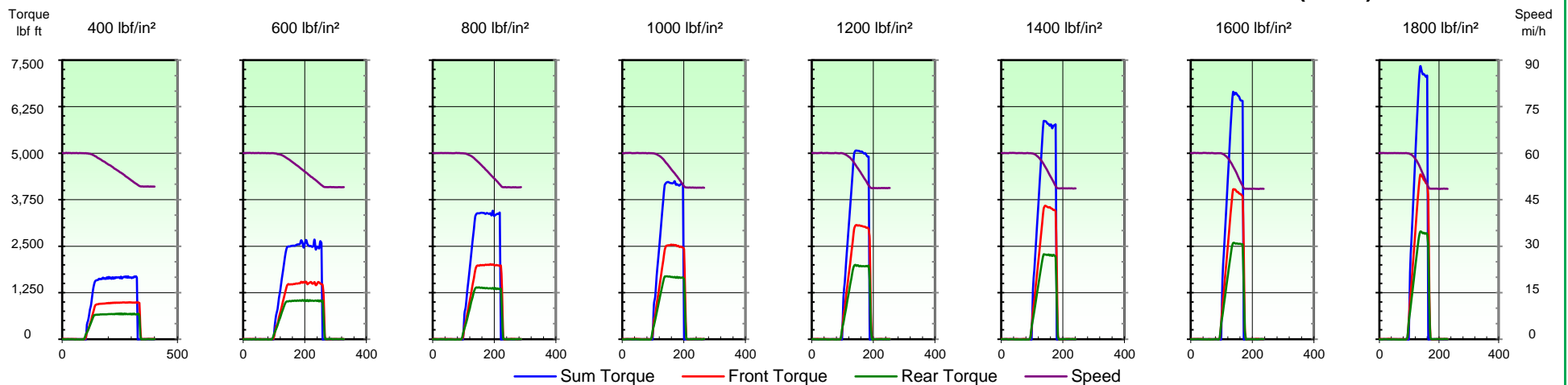
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 60-50 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 60-50 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

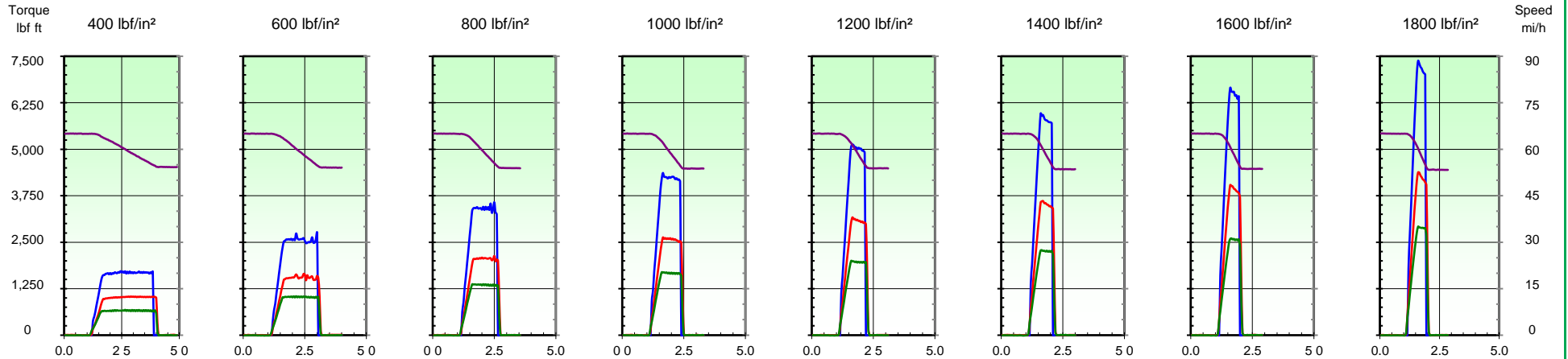
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Test Report Date: 06 March 2020

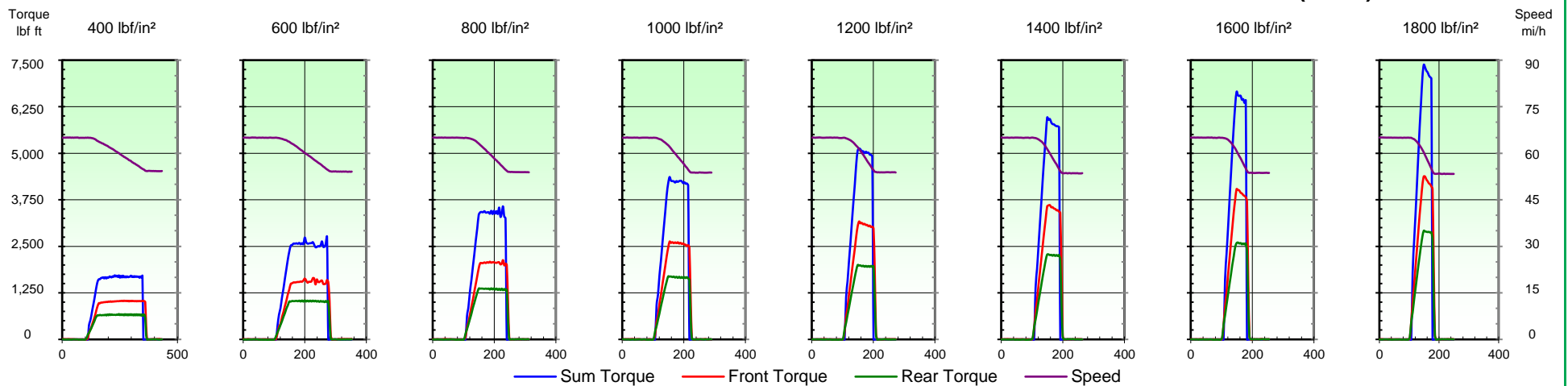
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 65-55 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 65-55 mi/h 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

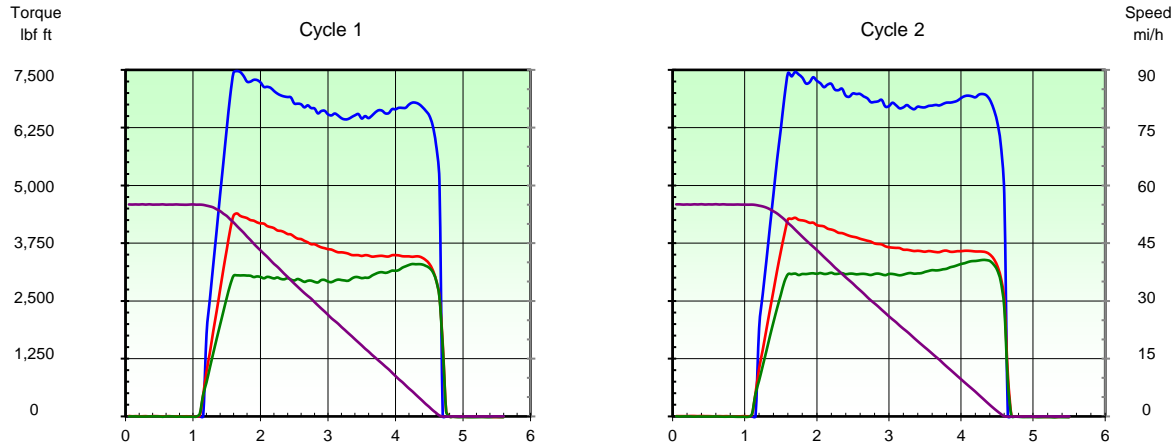
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Test Report Date: 06 March 2020

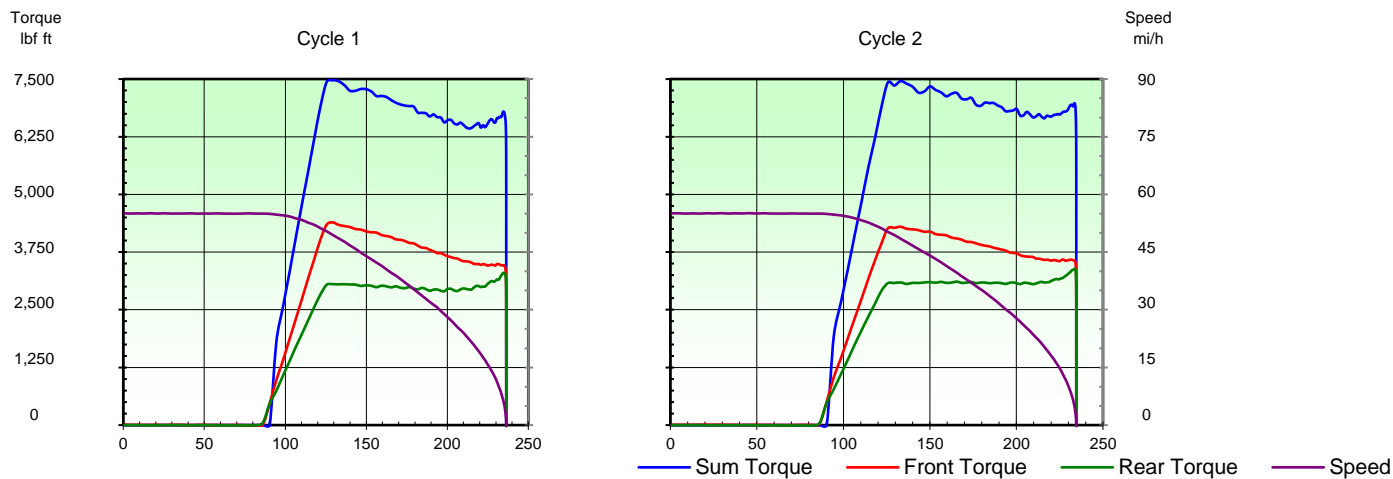
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 450°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 450°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

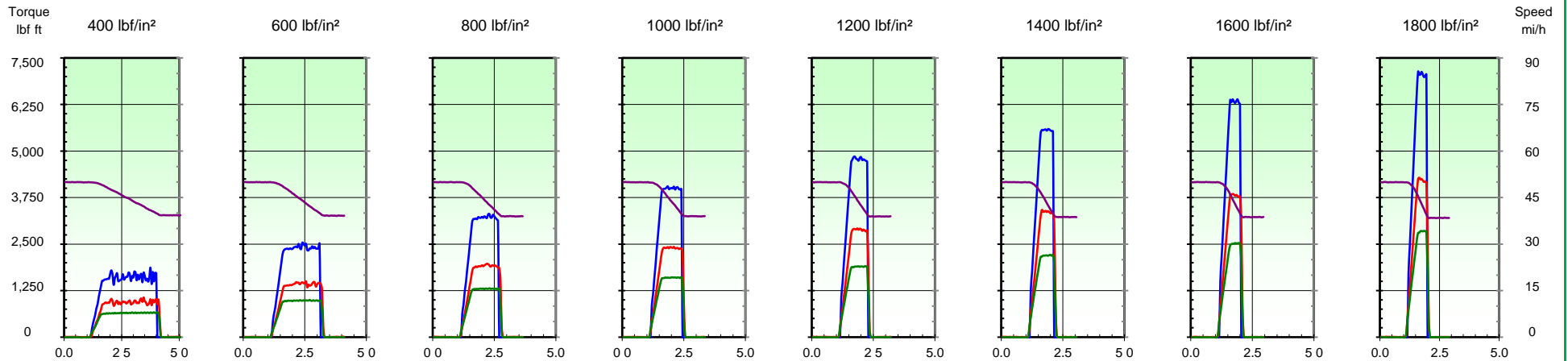
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Test Report Date: 06 March 2020

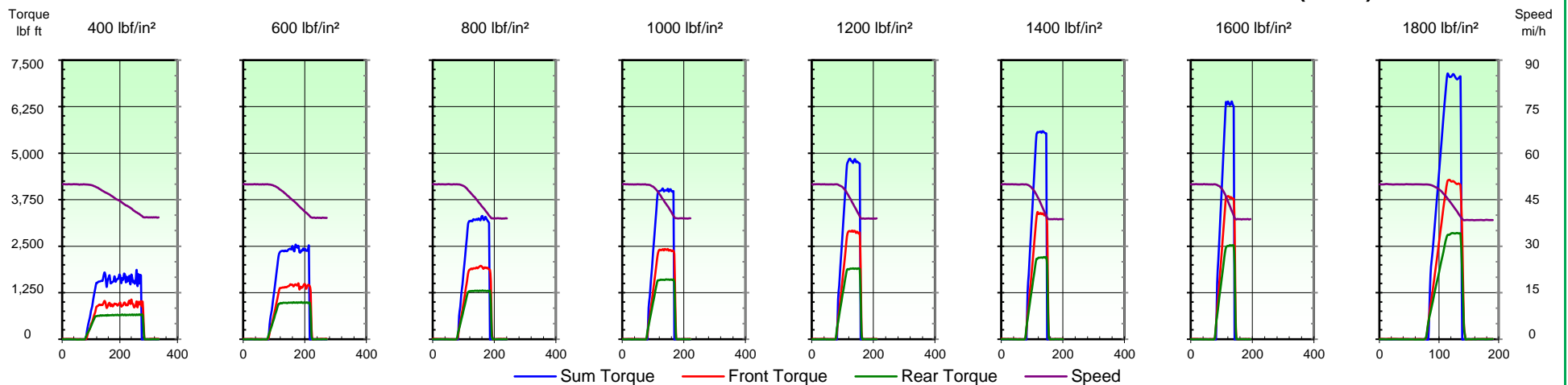
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 50-40 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 50-40 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

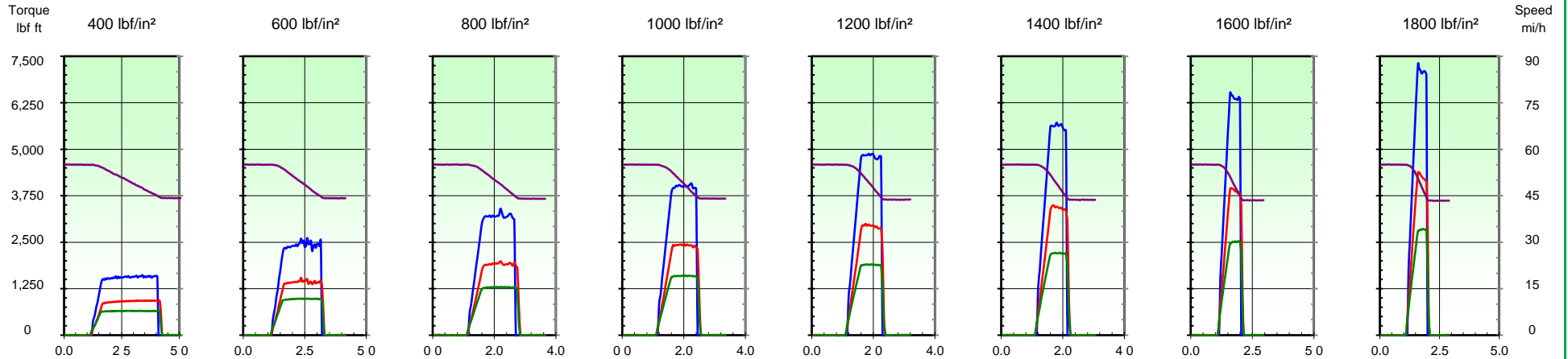
Report Number: 203145-1

Test Report Date: 06 March 2020

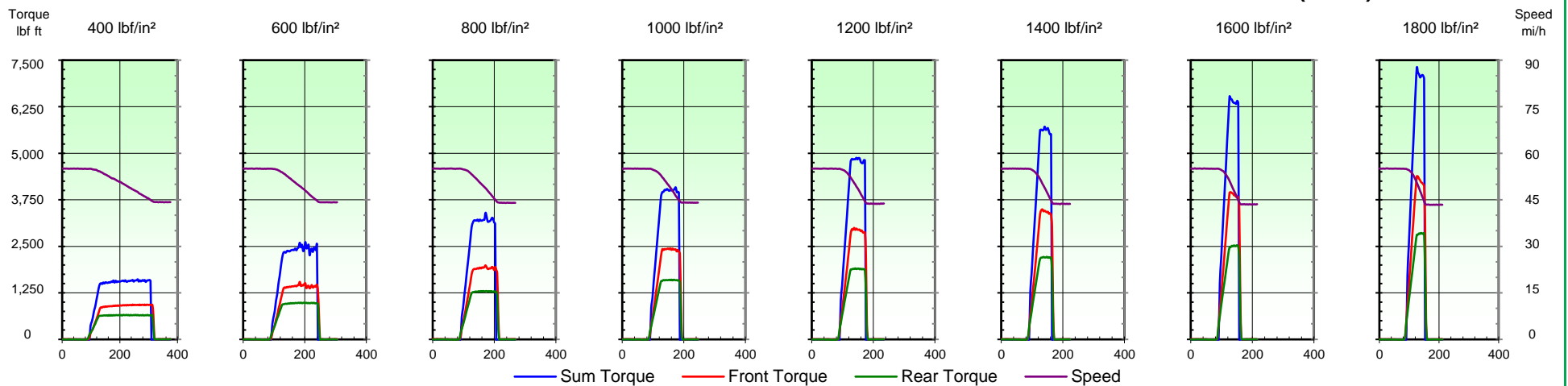
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 55-45 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 55-45 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

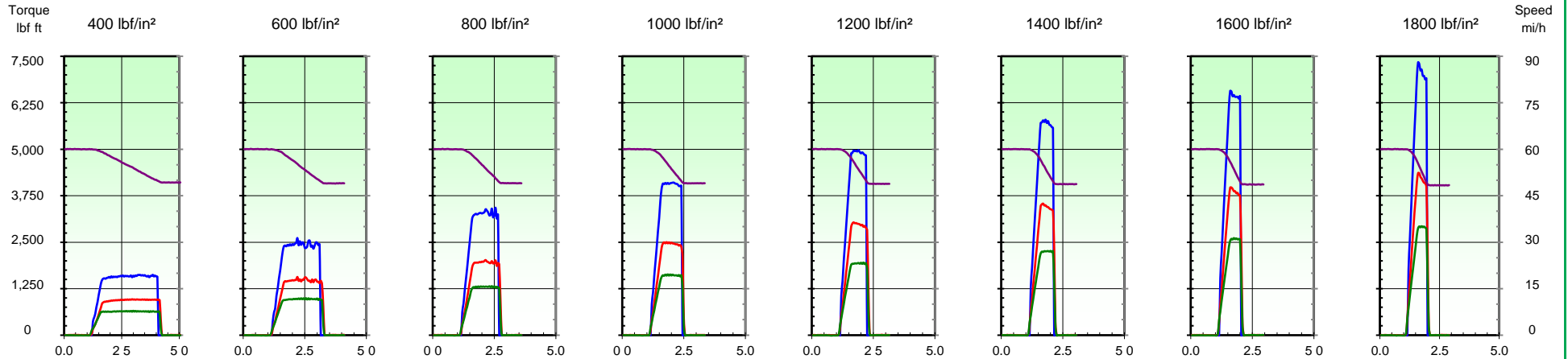
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Test Report Date: 06 March 2020

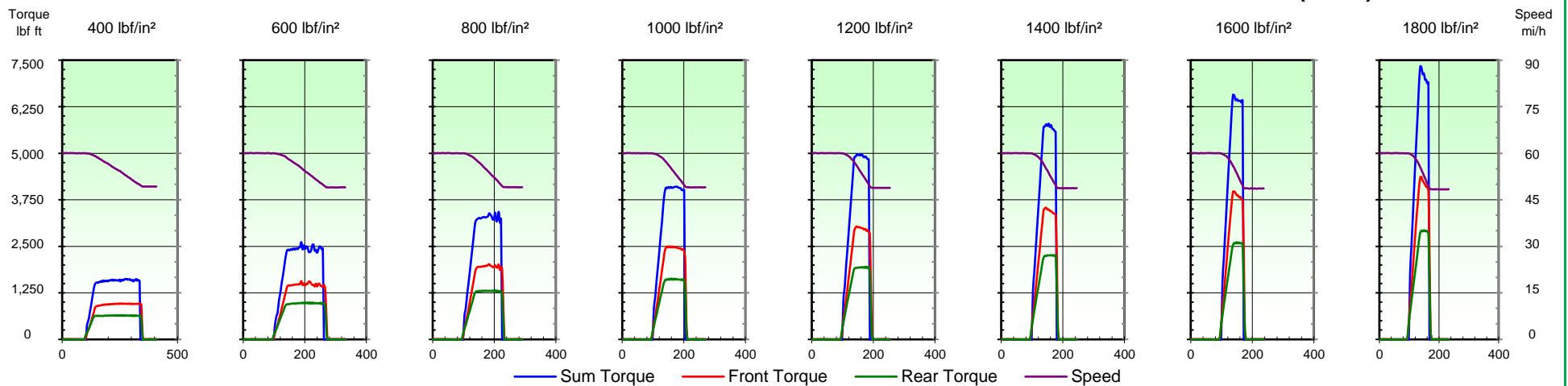
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 60-50 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 60-50 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

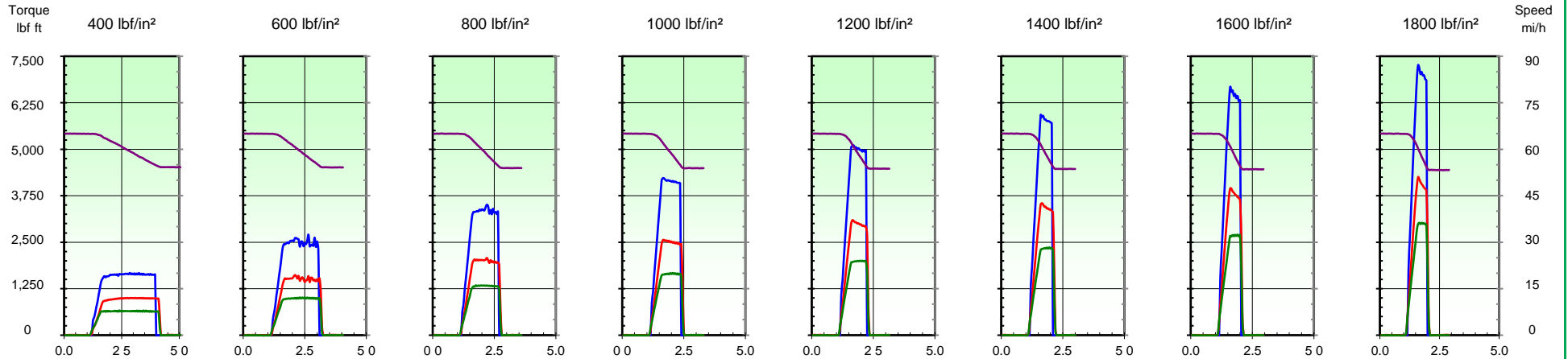
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Test Report Date: 06 March 2020

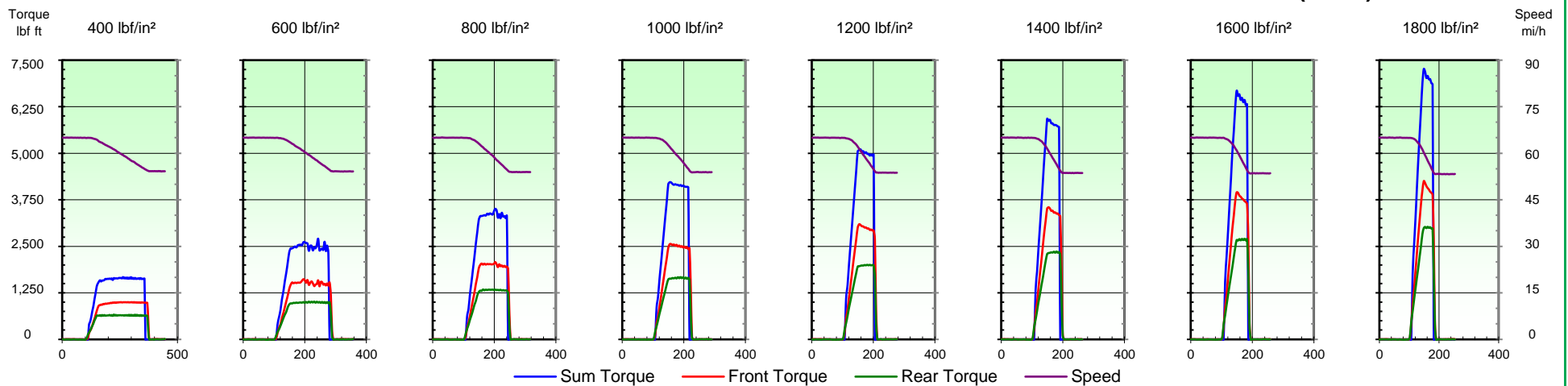
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 65-55 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 65-55 mi/h 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

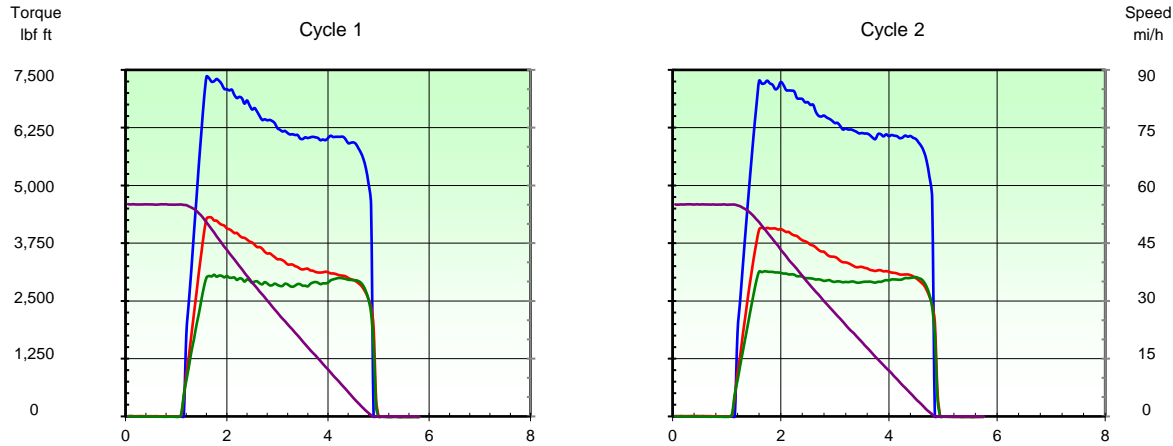
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Test Report Date: 06 March 2020

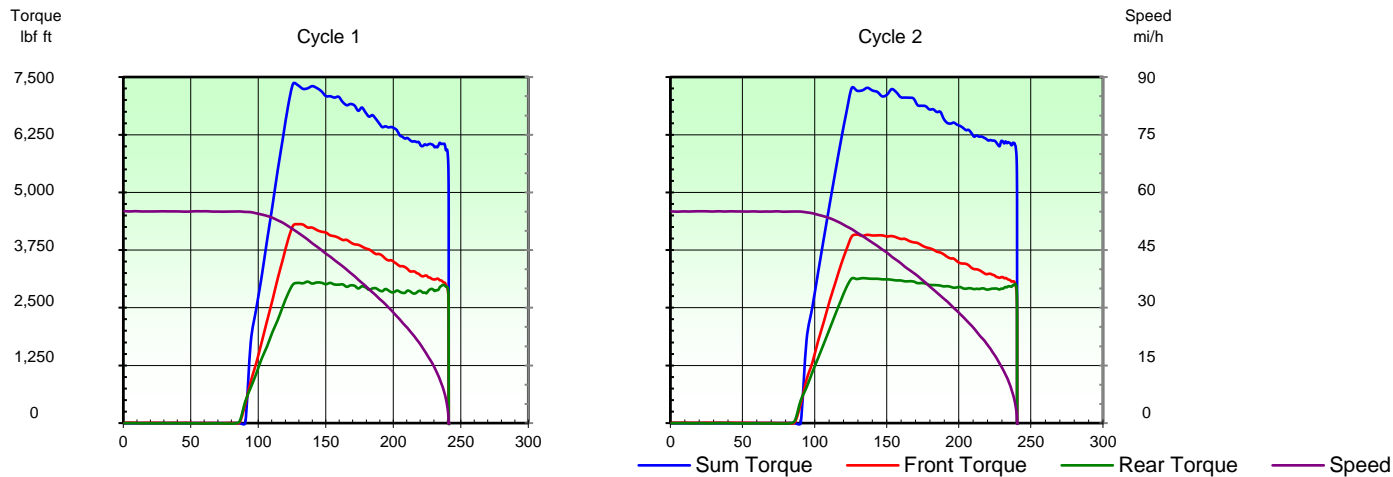
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 600°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 600°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

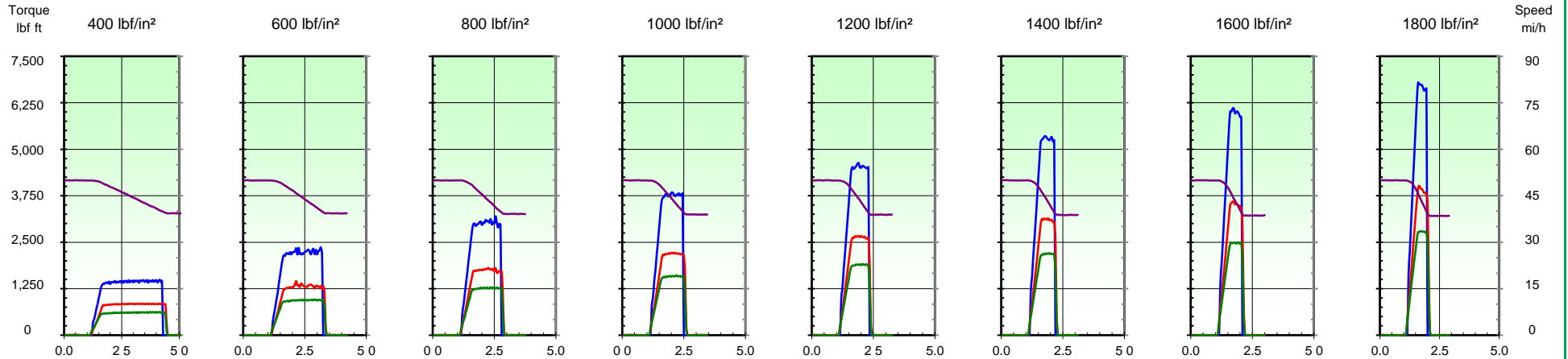
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Test Report Date: 06 March 2020

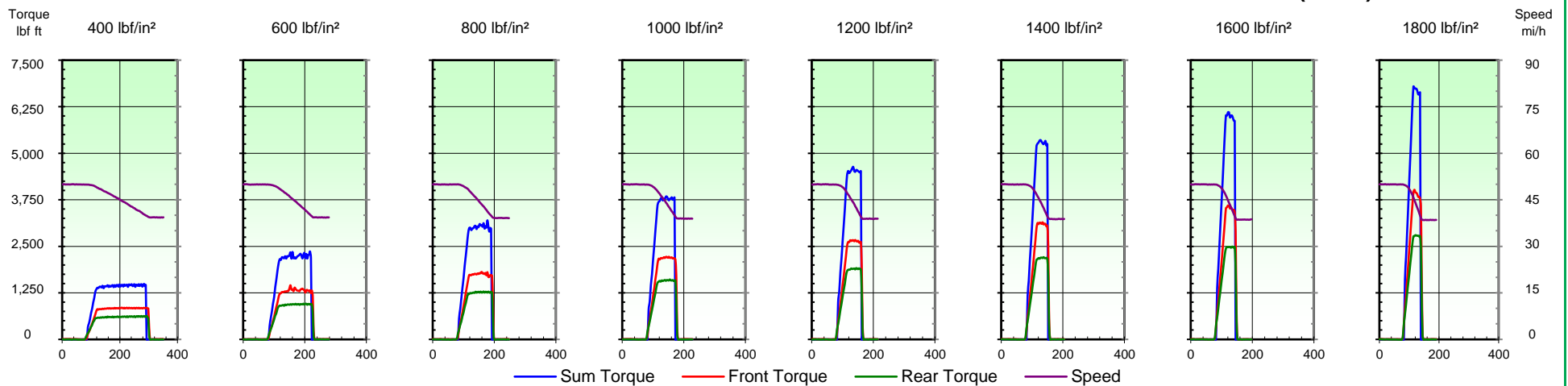
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 50-40 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 50-40 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

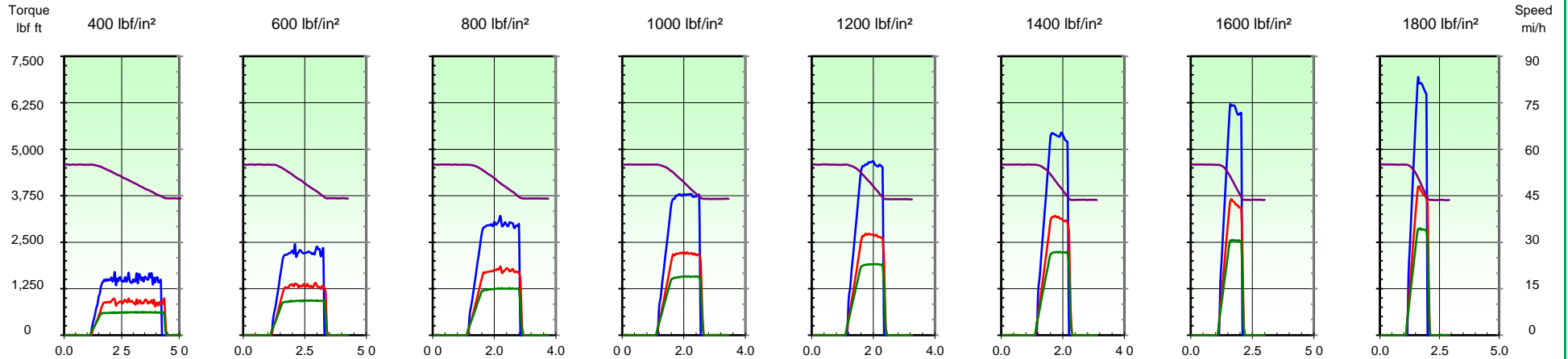
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Test Report Date: 06 March 2020

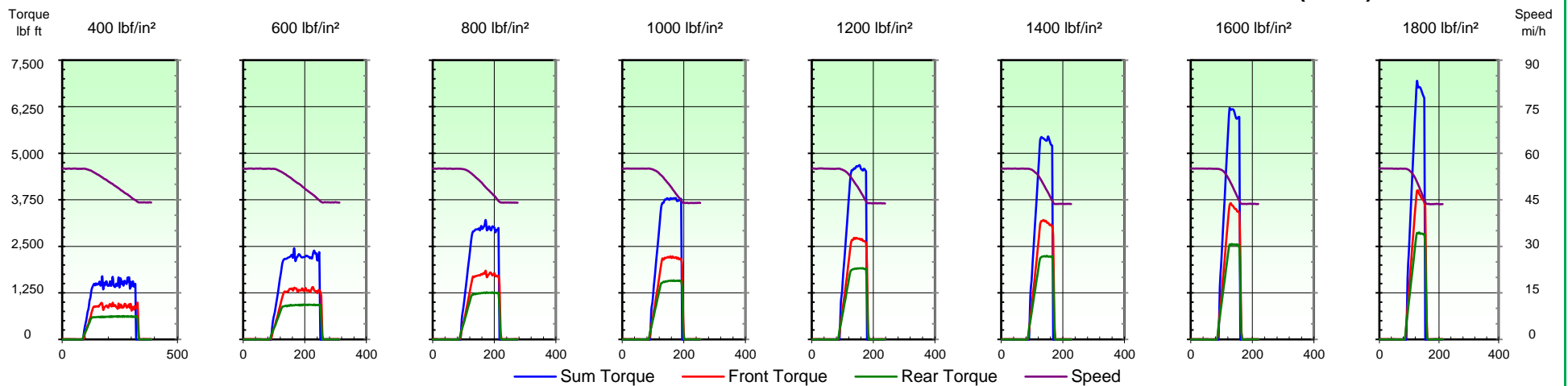
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 55-45 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 55-45 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

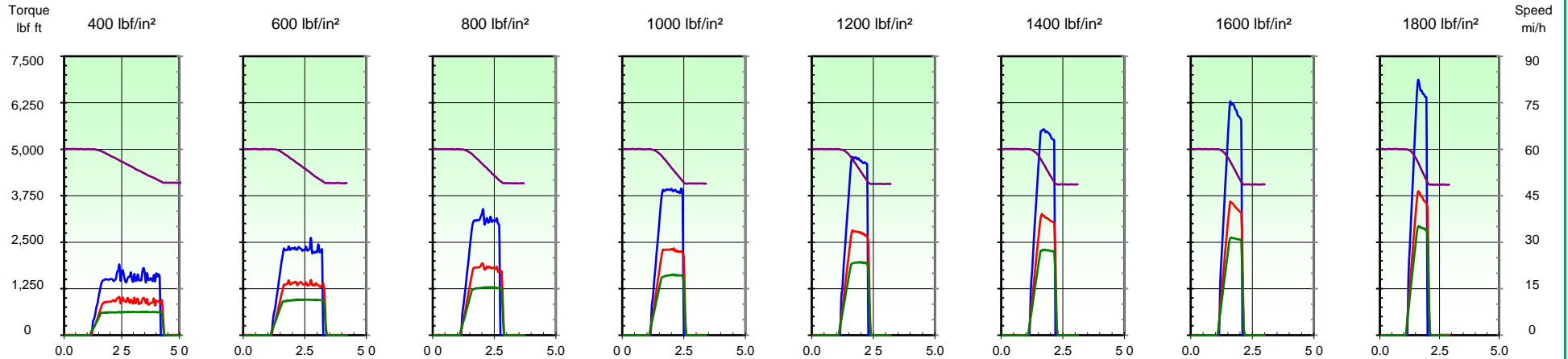
Report Number: 203145-1

Test Report Date: 06 March 2020

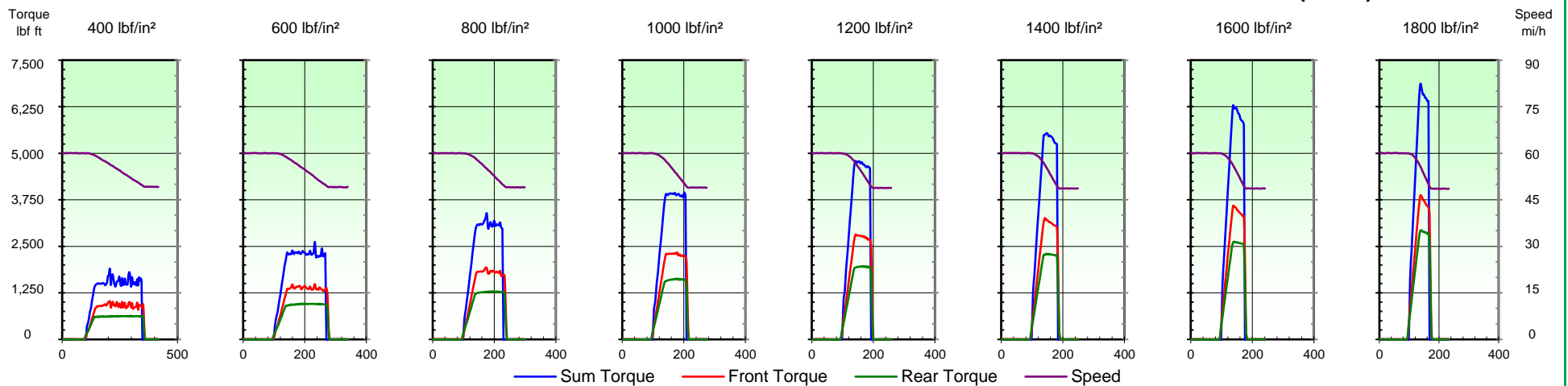
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 60-50 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 60-50 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

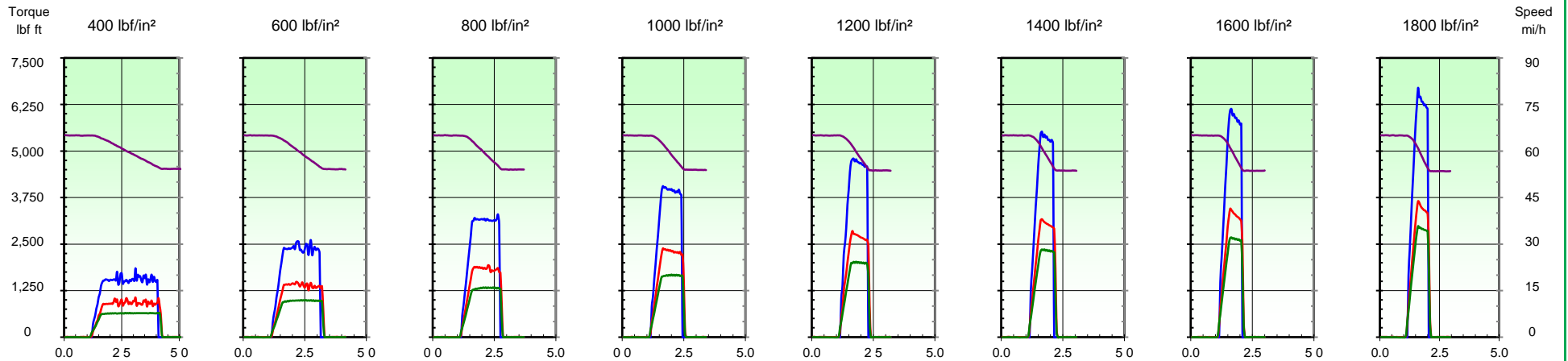
Report Number: 203145-1

Test Report Date: 06 March 2020

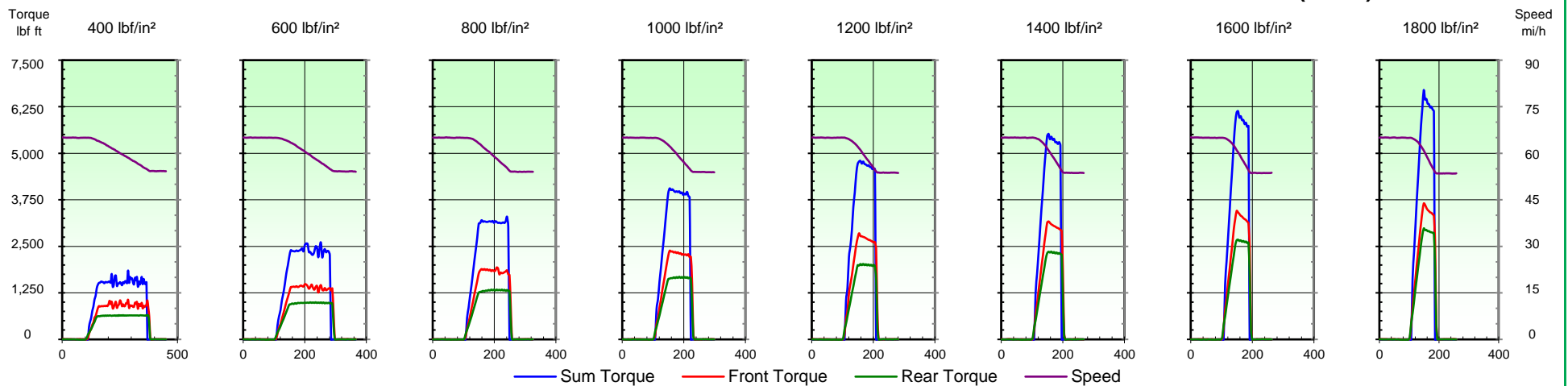
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 65-55 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 65-55 mi/h 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

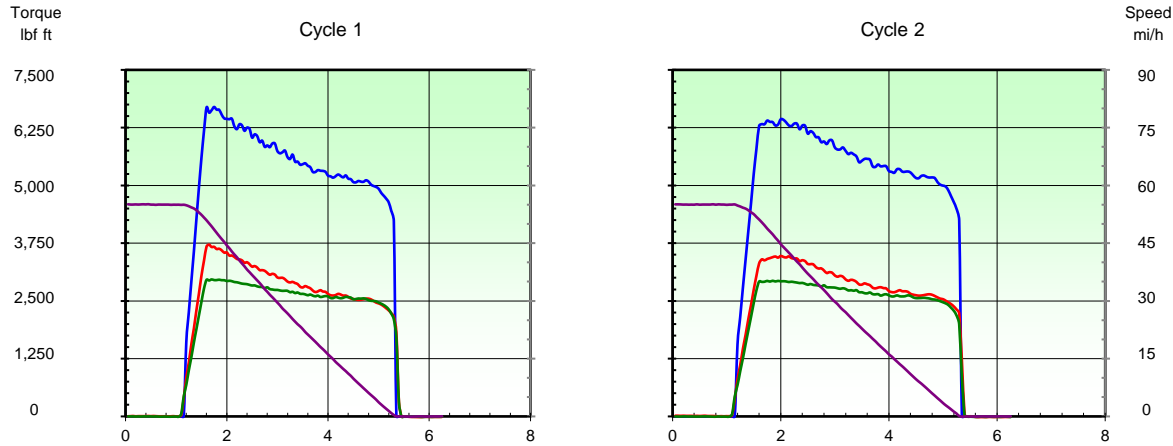
Report Number: 203145-1

Test Report Date: 06 March 2020

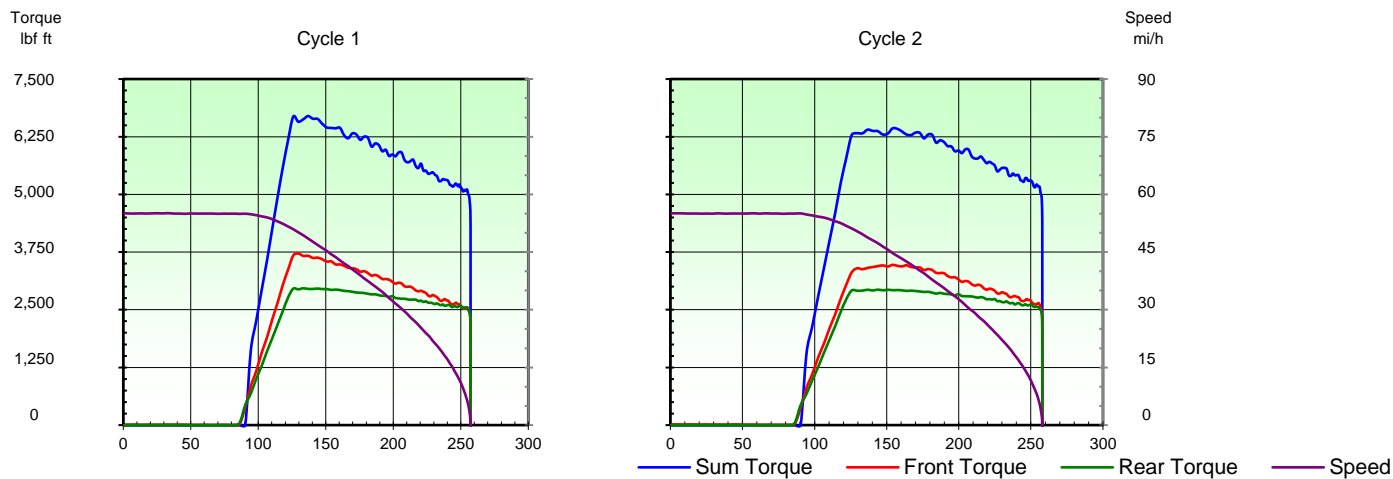
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 750°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 750°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

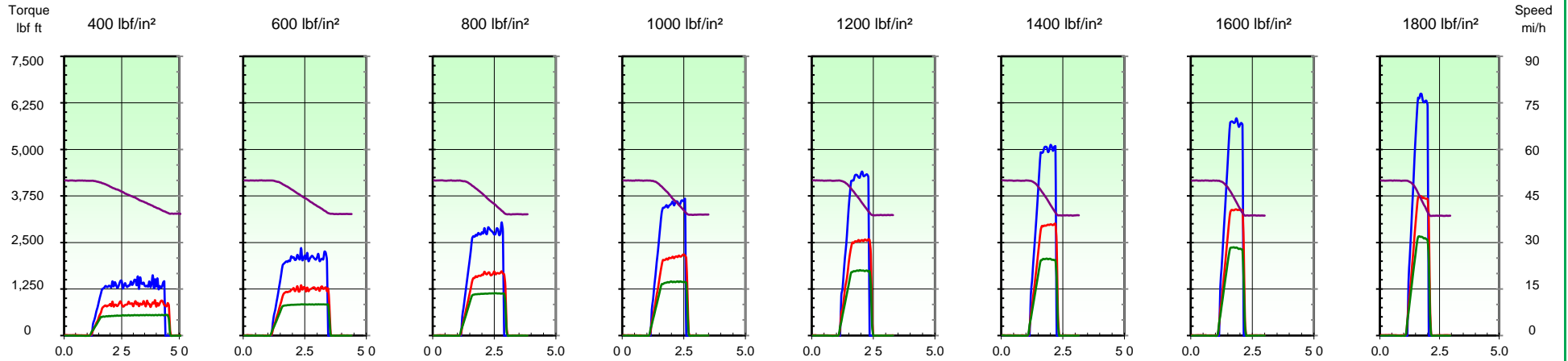
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Test Report Date: 06 March 2020

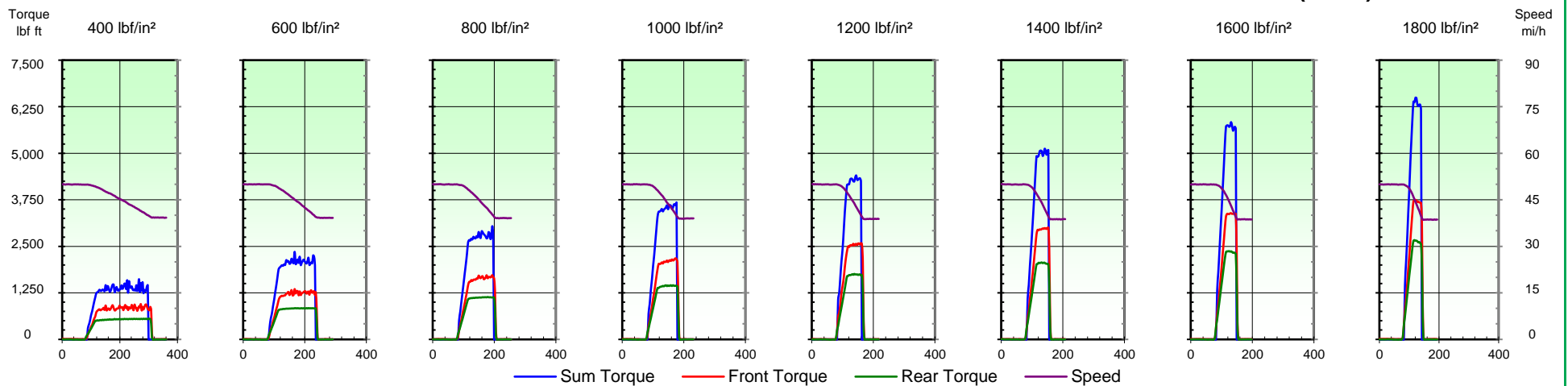
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 50-40 mi/h 900°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 50-40 mi/h 900°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

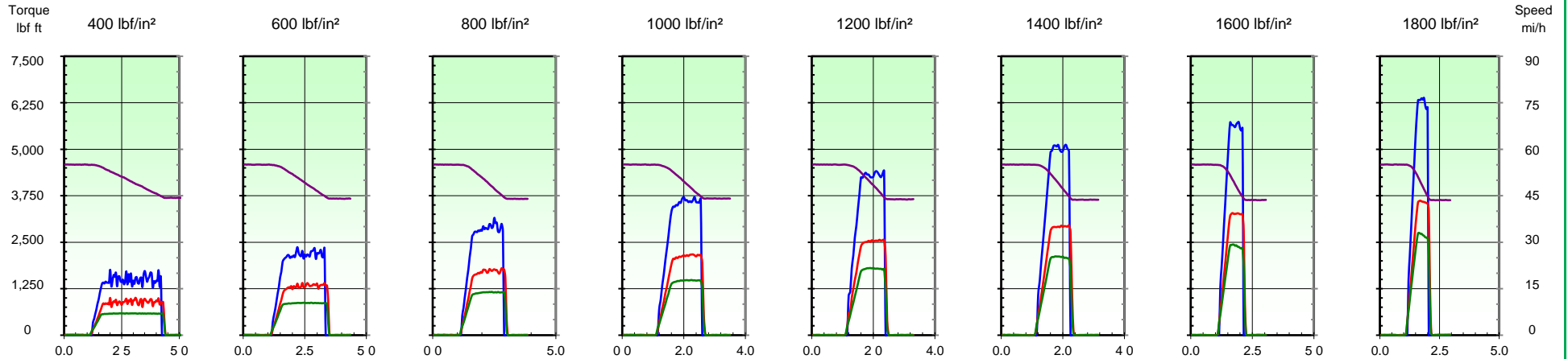
Report Number: 203145-1

Test Report Date: 06 March 2020

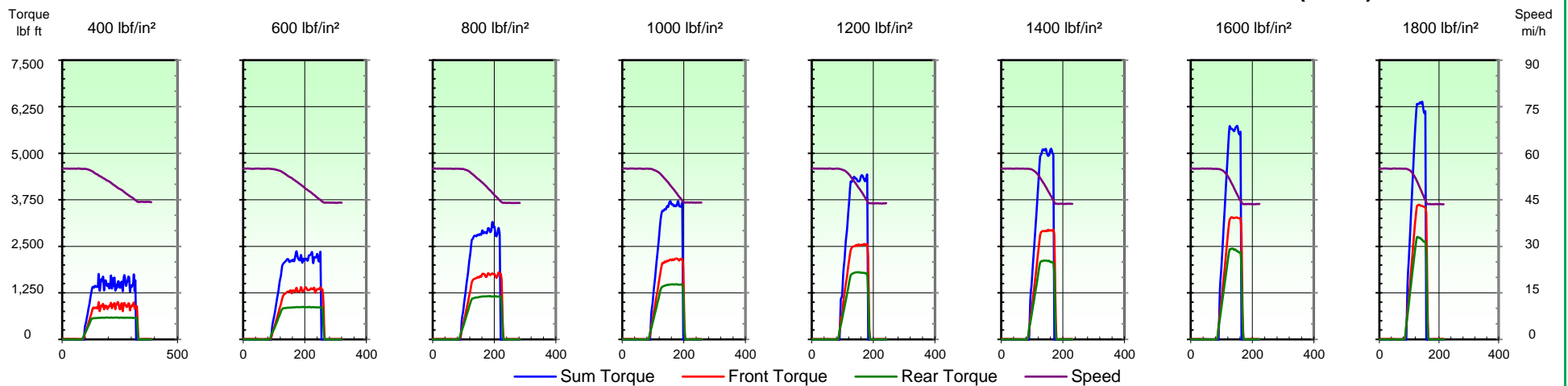
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 55-45 mi/h 900°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 55-45 mi/h 900°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

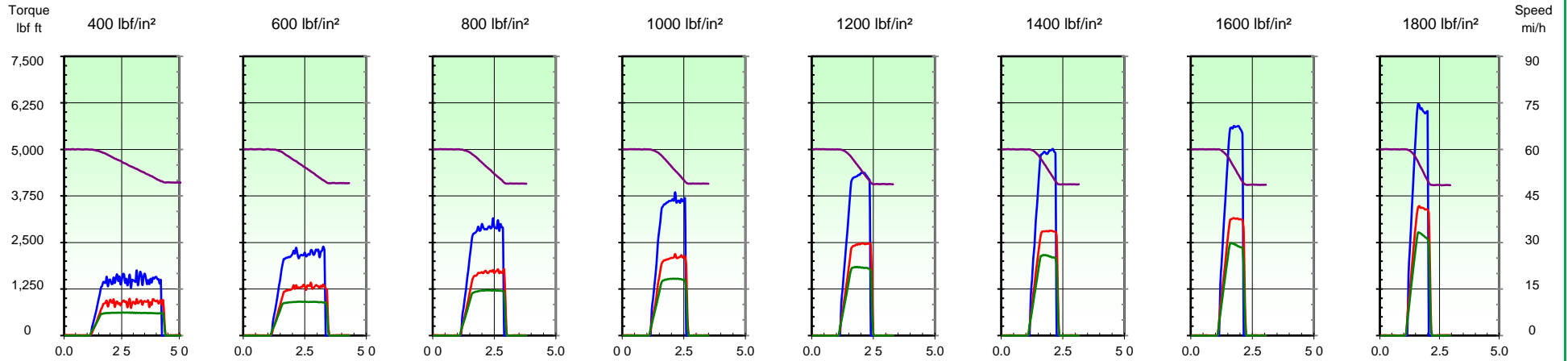
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Test Report Date: 06 March 2020

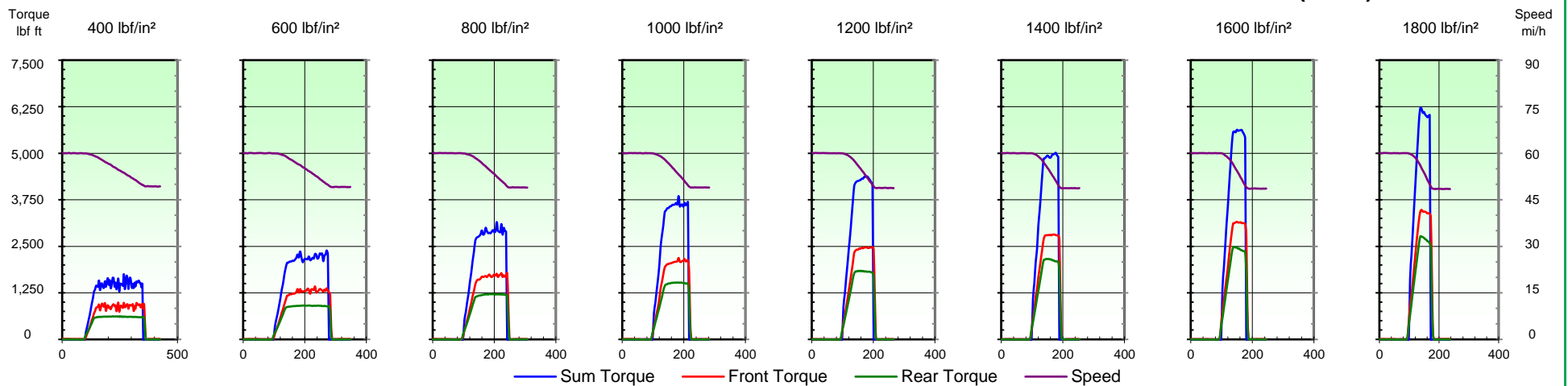
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 60-50 mi/h 900°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 60-50 mi/h 900°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

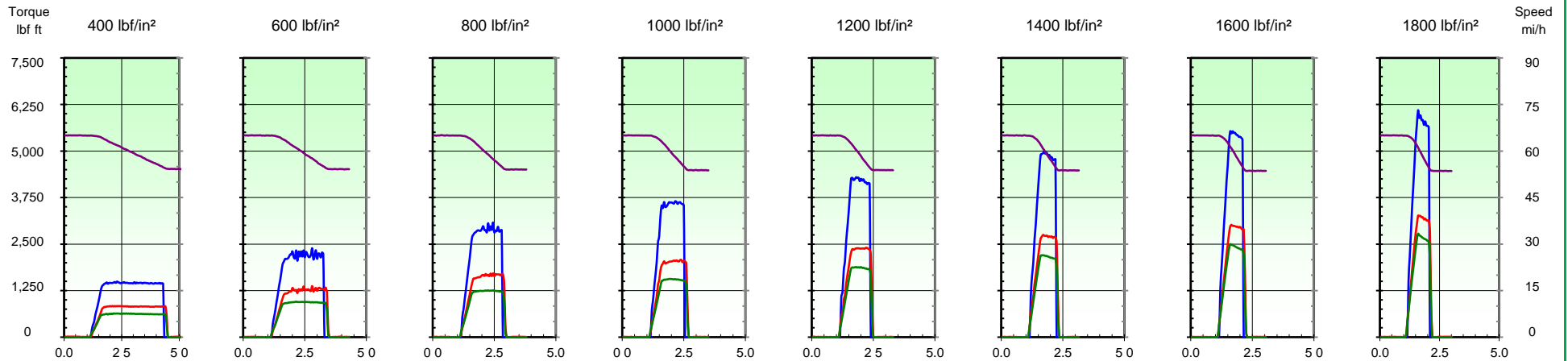
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Test Report Date: 06 March 2020

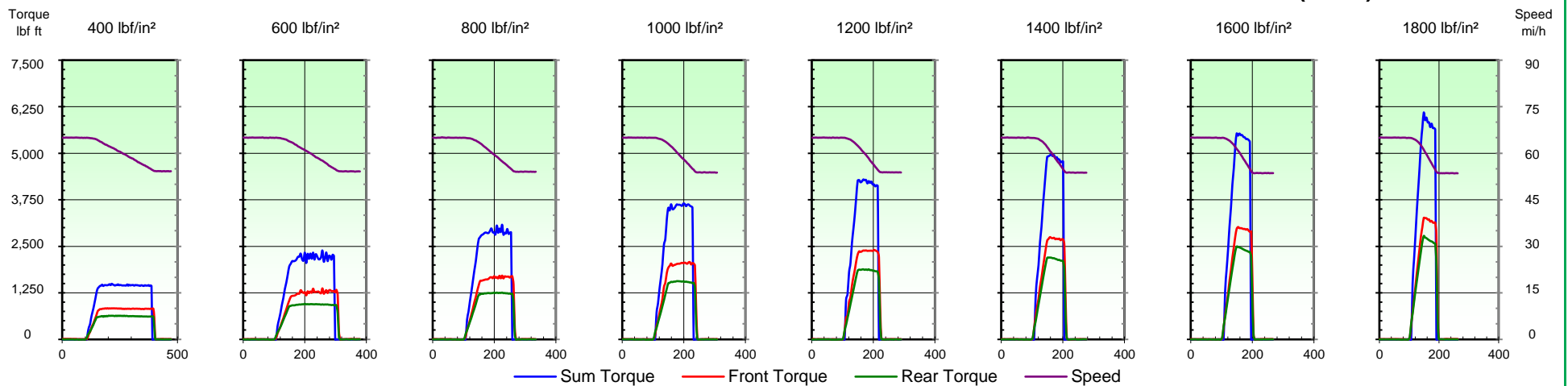
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - 65-55 mi/h 900°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - 65-55 mi/h 900°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

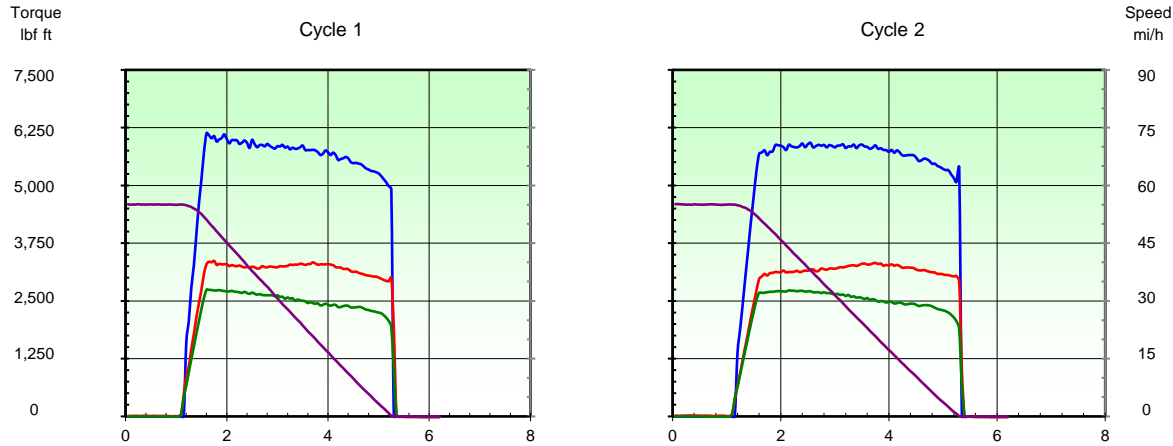
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Test Report Date: 06 March 2020

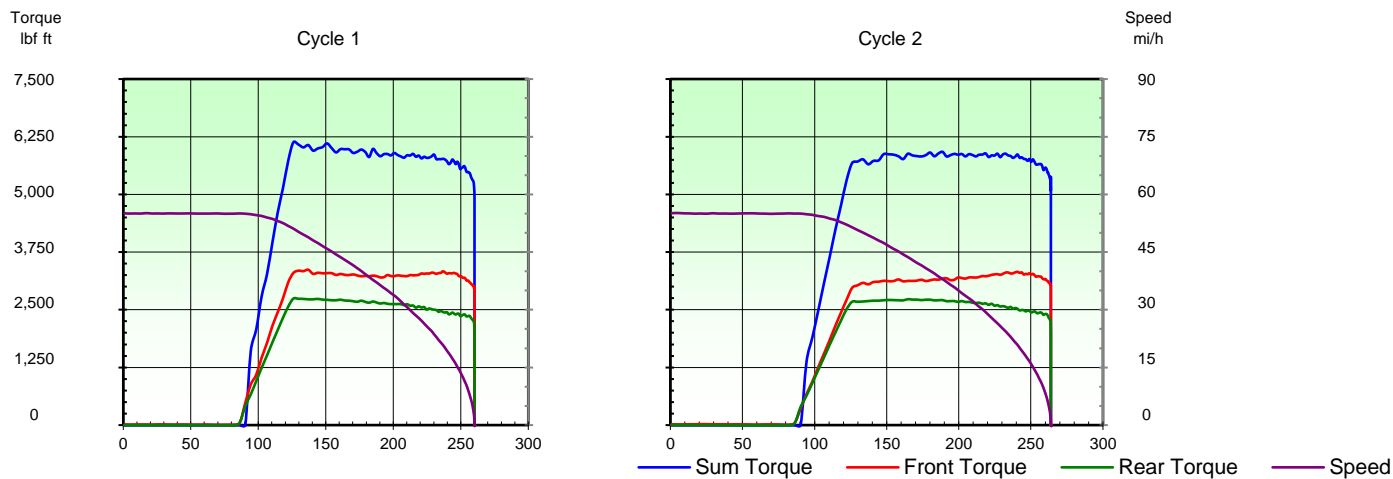
NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 900°F IN-STOP TORQUE & SPEED DATA vs. TIME (SECONDS)



4TH EFFECTIVENESS MATRIX - BEST EFFORT 1800 lbf/in² 900°F IN-STOP TORQUE & SPEED DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

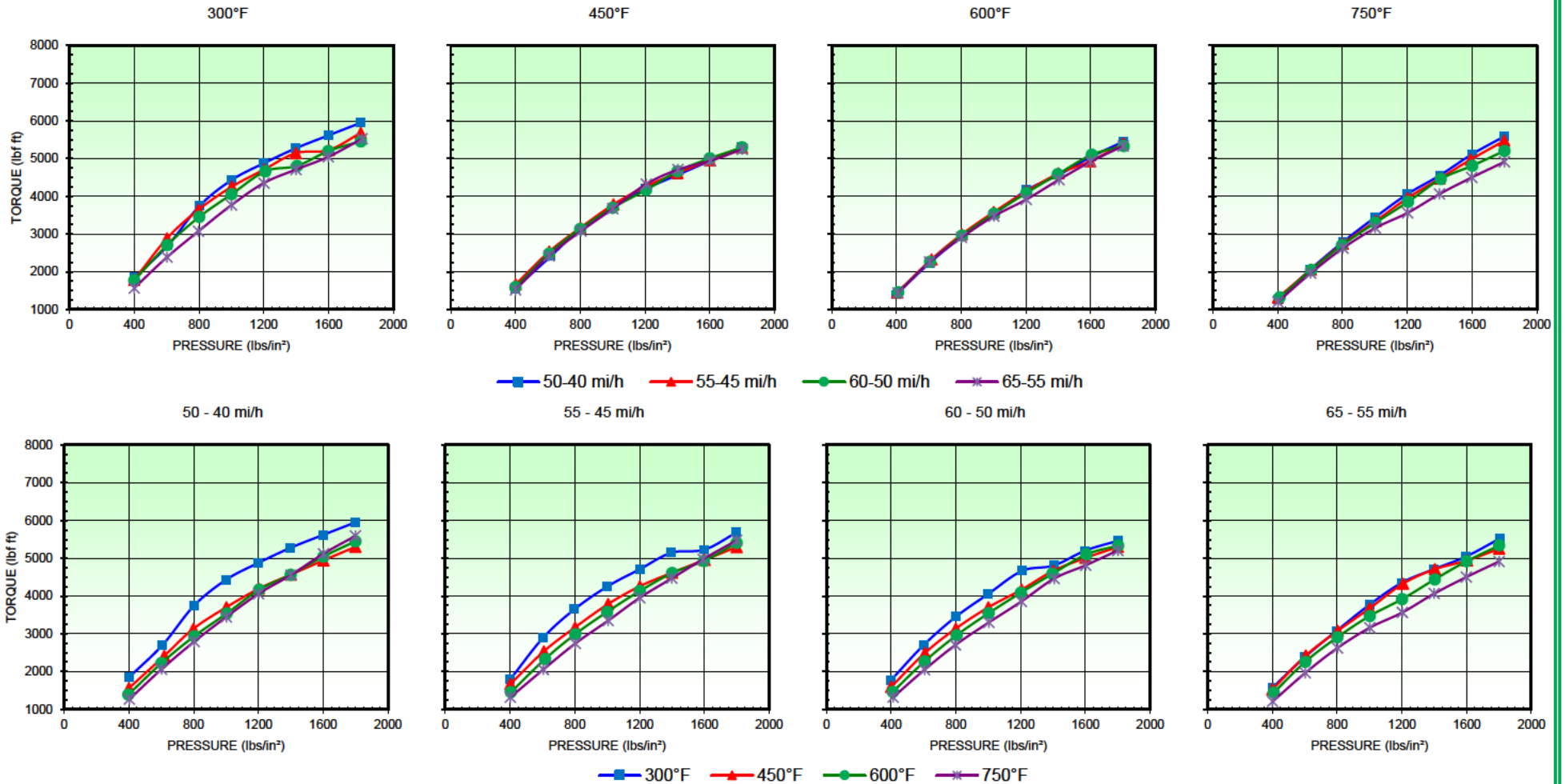
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

1ST EFFECTIVENESS MATRIX - SUSTAINED PRESSURE VS. SUSTAINED SUM TORQUE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

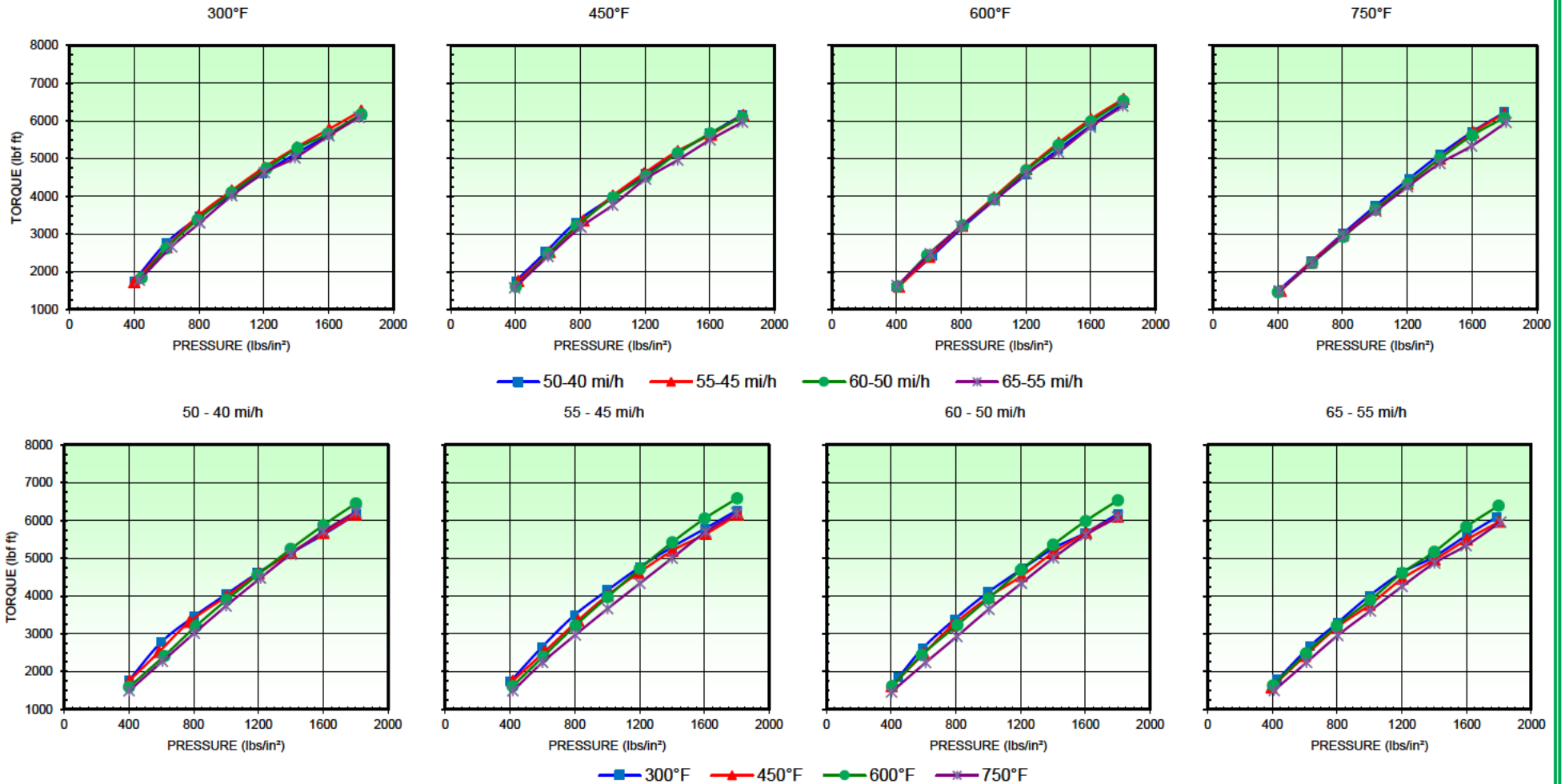
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

2ND EFFECTIVENESS MATRIX - SUSTAINED PRESSURE VS. SUSTAINED SUM TORQUE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

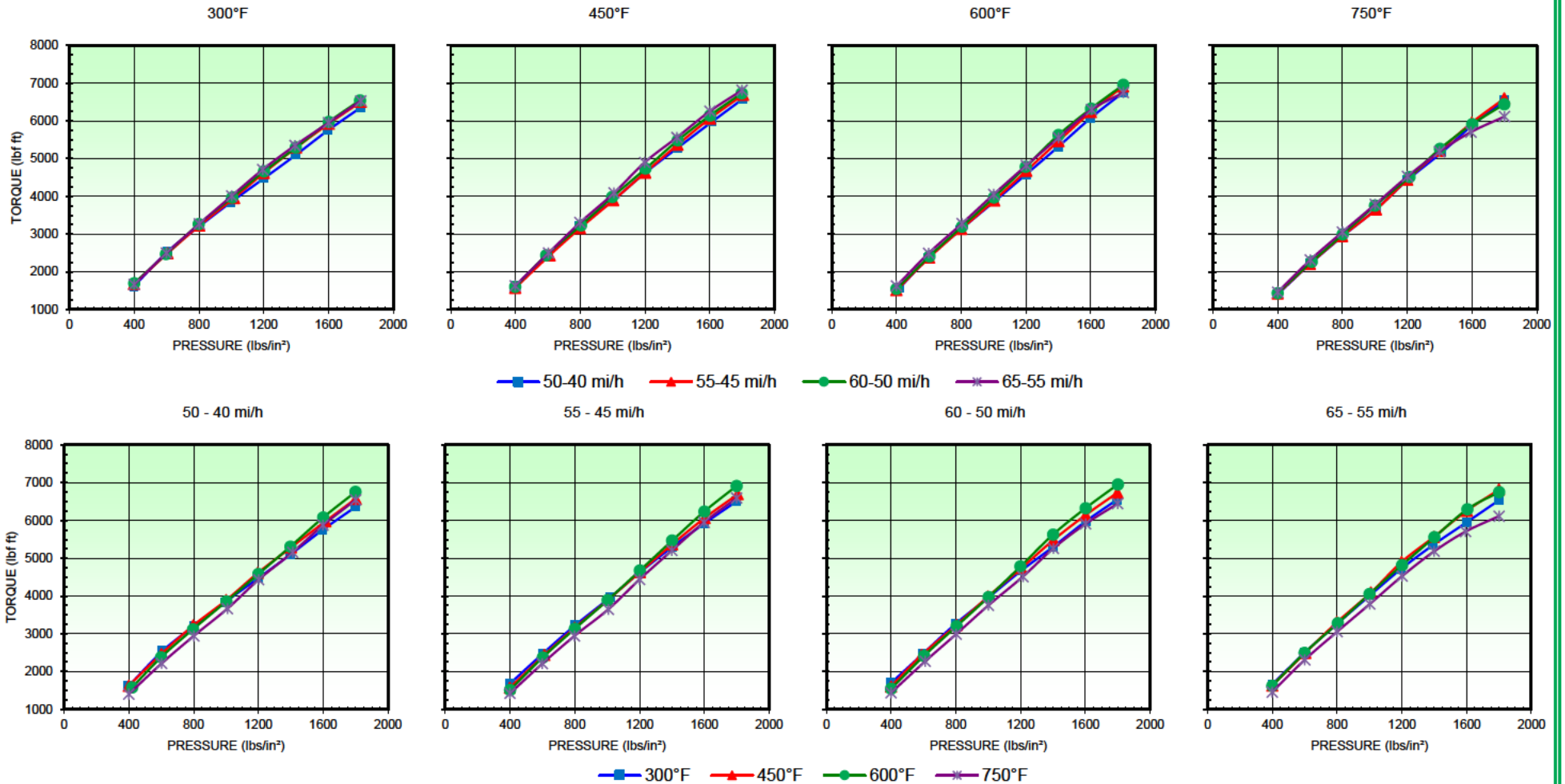
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

3RD EFFECTIVENESS MATRIX - SUSTAINED PRESSURE VS. SUSTAINED SUM TORQUE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

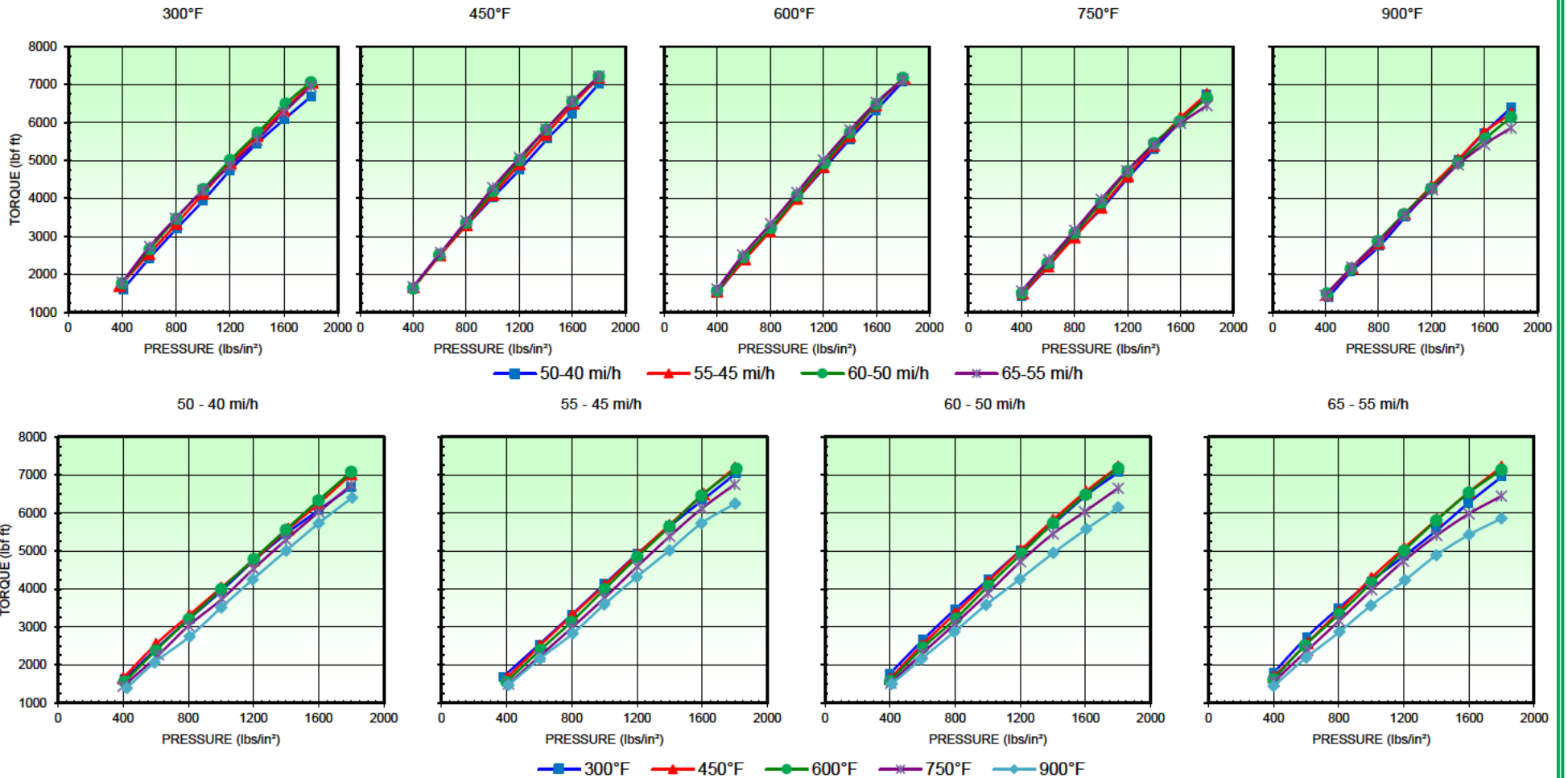
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

4TH EFFECTIVENESS MATRIX - SUSTAINED PRESSURE VS. SUSTAINED SUM TORQUE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

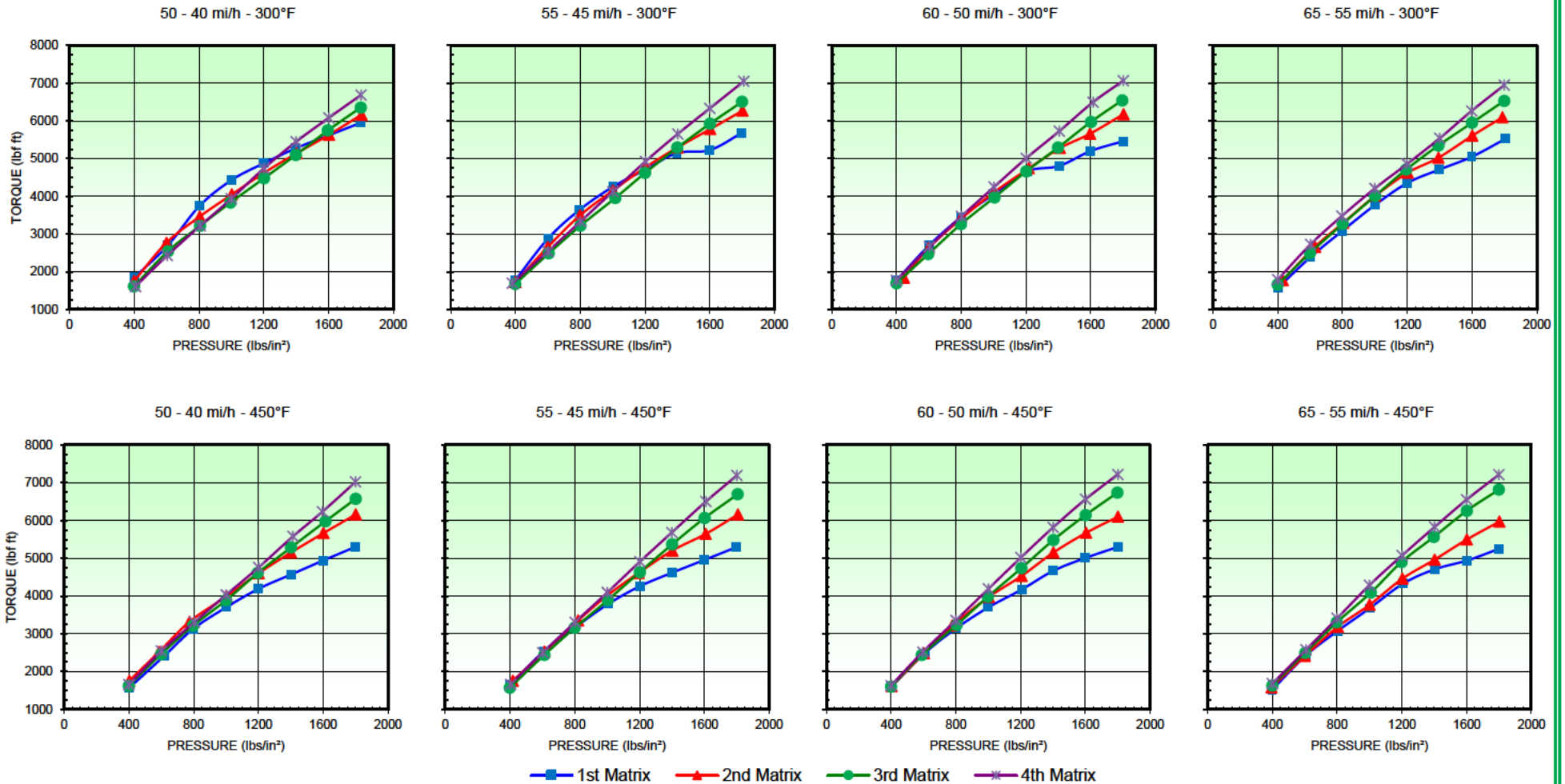
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

EFFECTIVENESS MATRIXES - SUSTAINED PRESSURE VS. SUSTAINED SUM TORQUE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

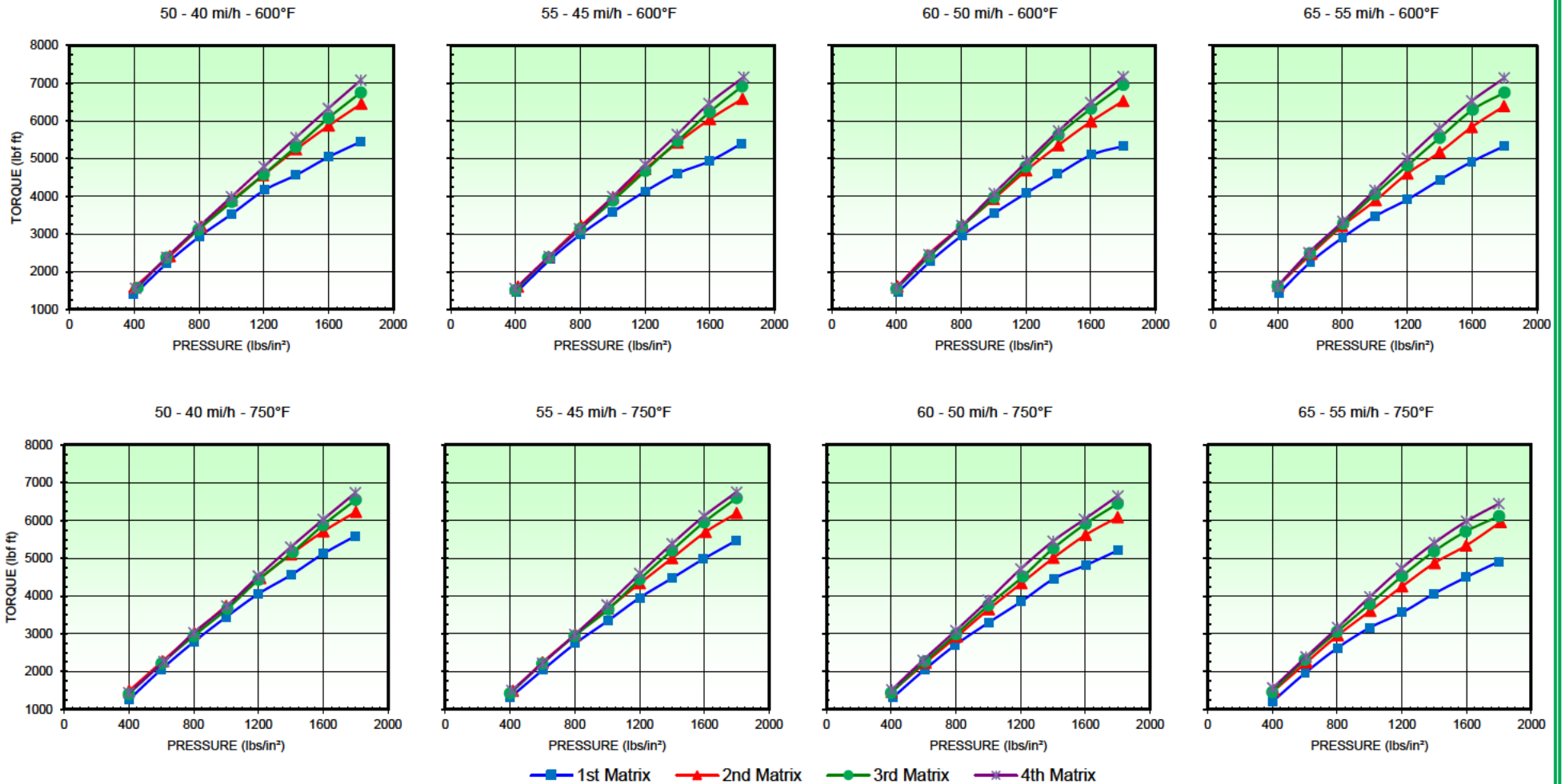
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

EFFECTIVENESS MATRIXES - SUSTAINED PRESSURE VS. SUSTAINED SUM TORQUE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

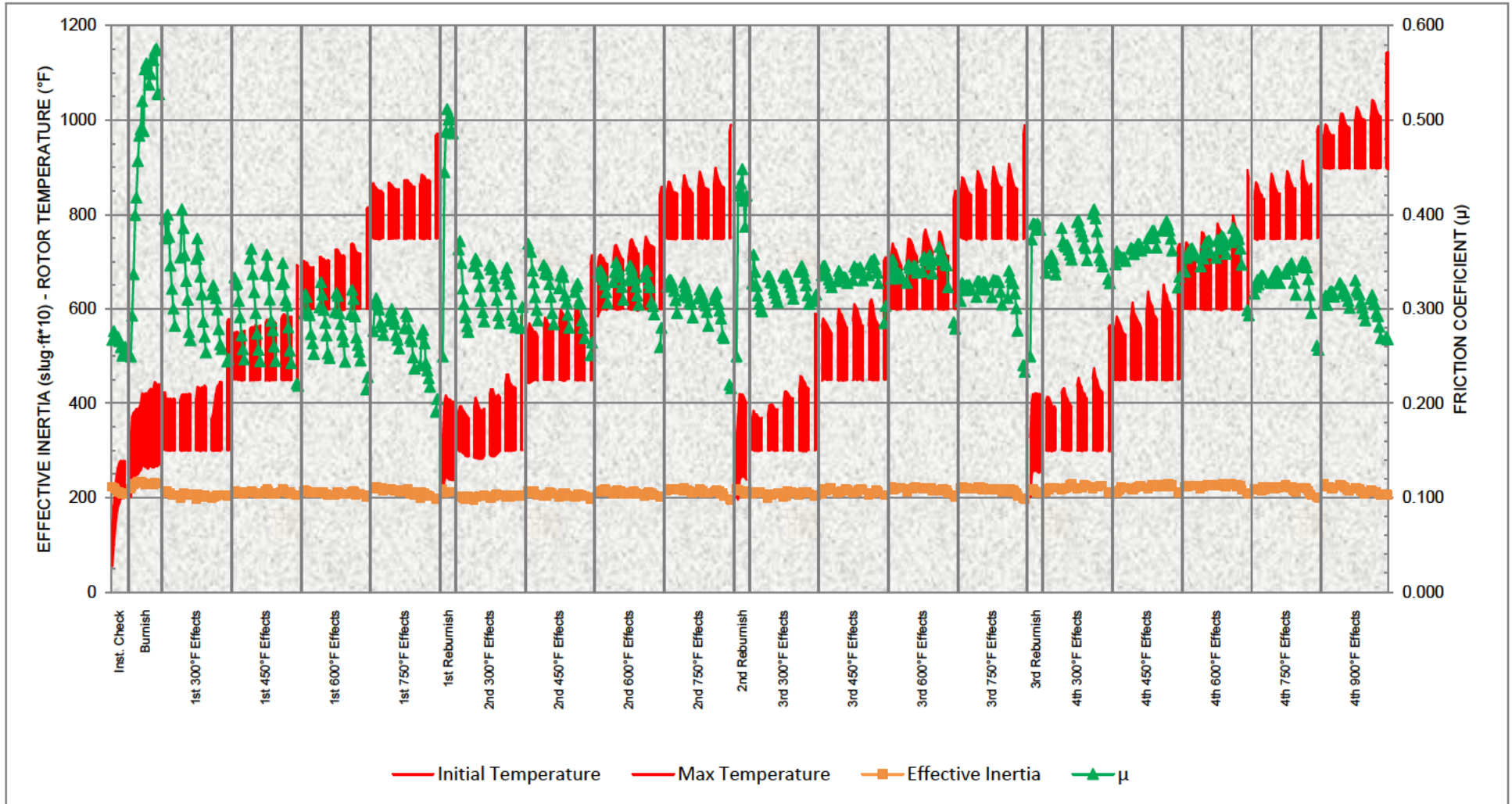
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

TEST PERFORMANCE PROFILE - FRONT BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

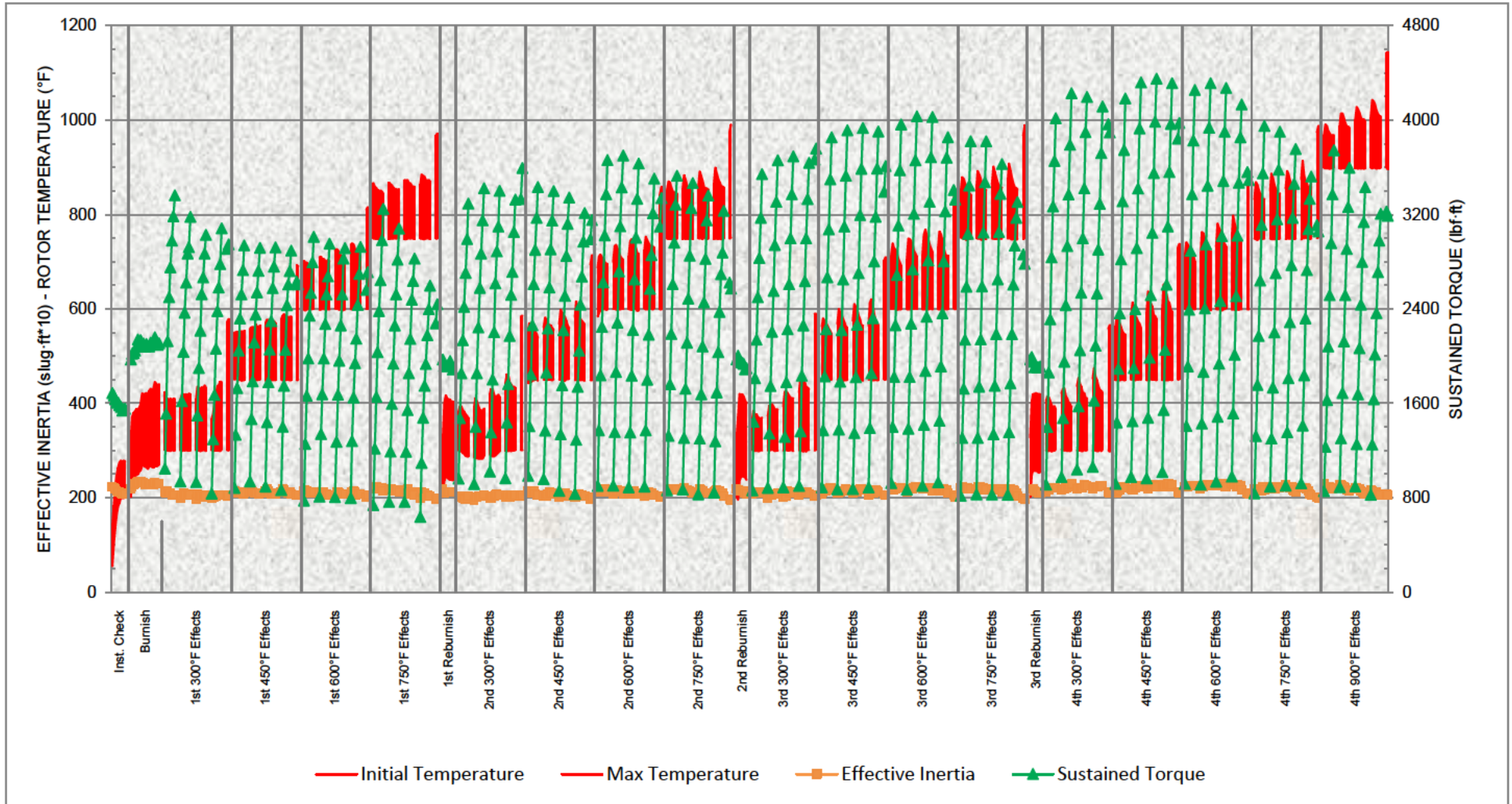
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Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

TEST PERFORMANCE PROFILE - FRONT BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

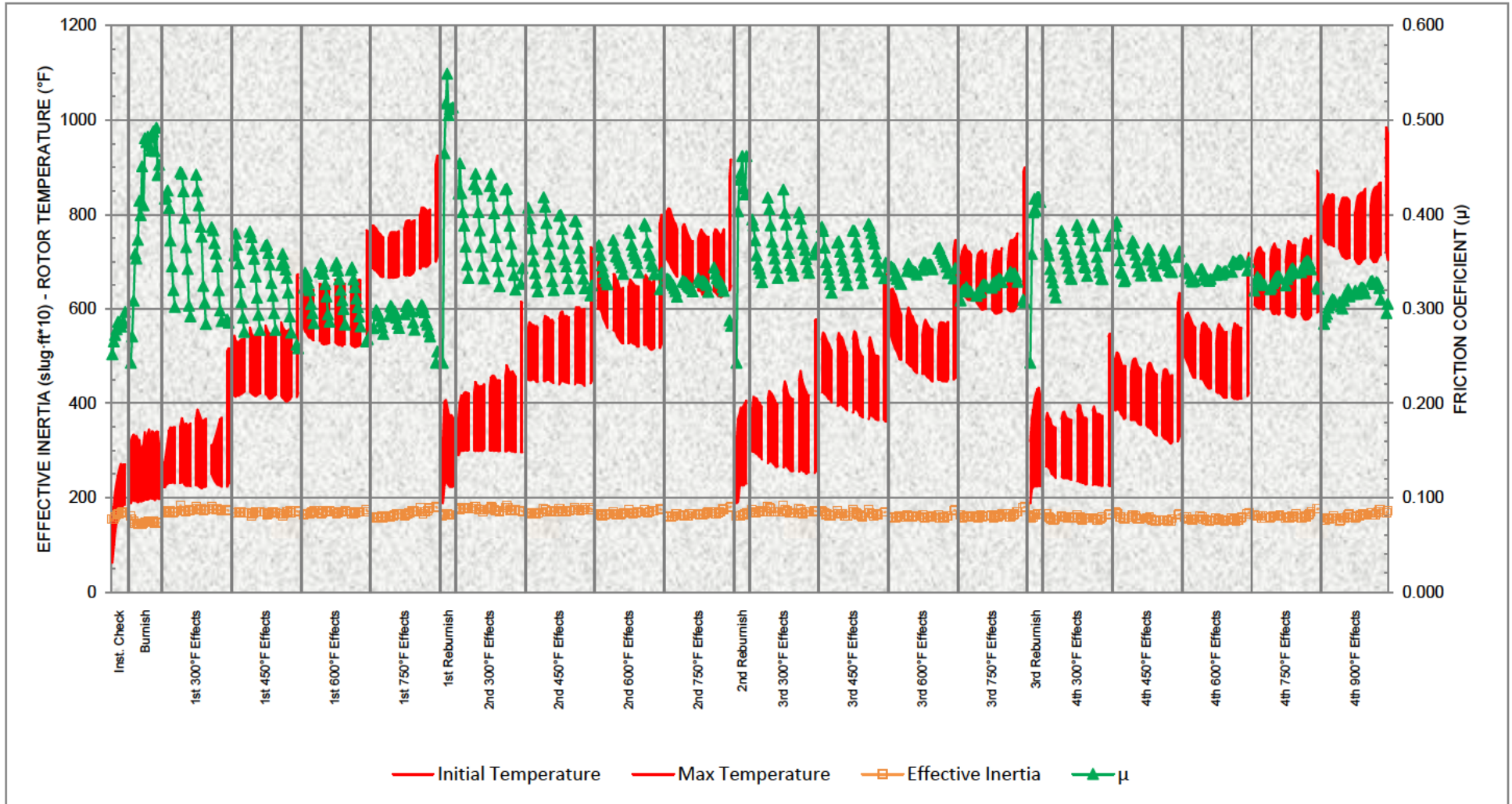
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

TEST PERFORMANCE PROFILE - REAR BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

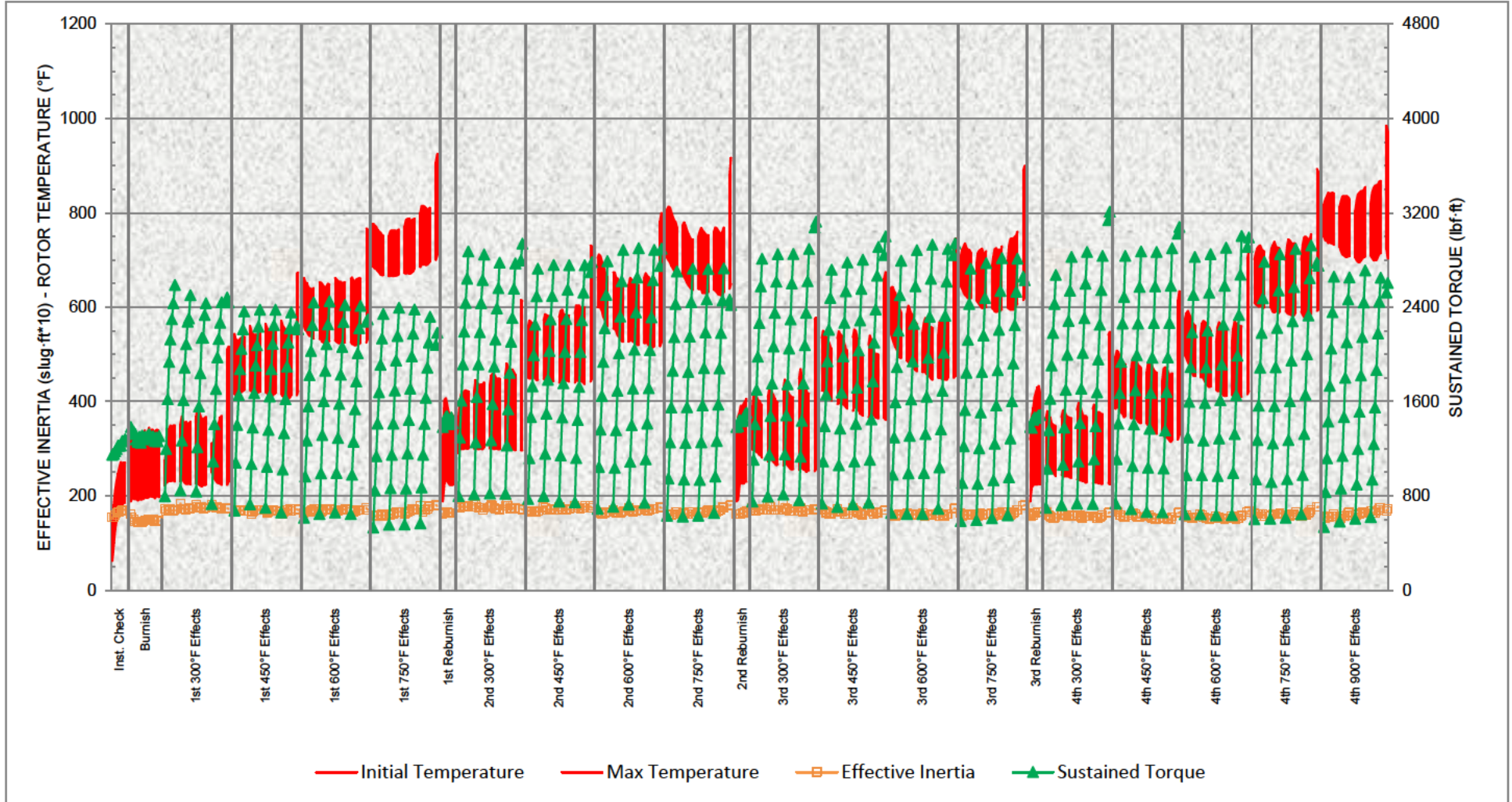
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

TEST PERFORMANCE PROFILE - REAR BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

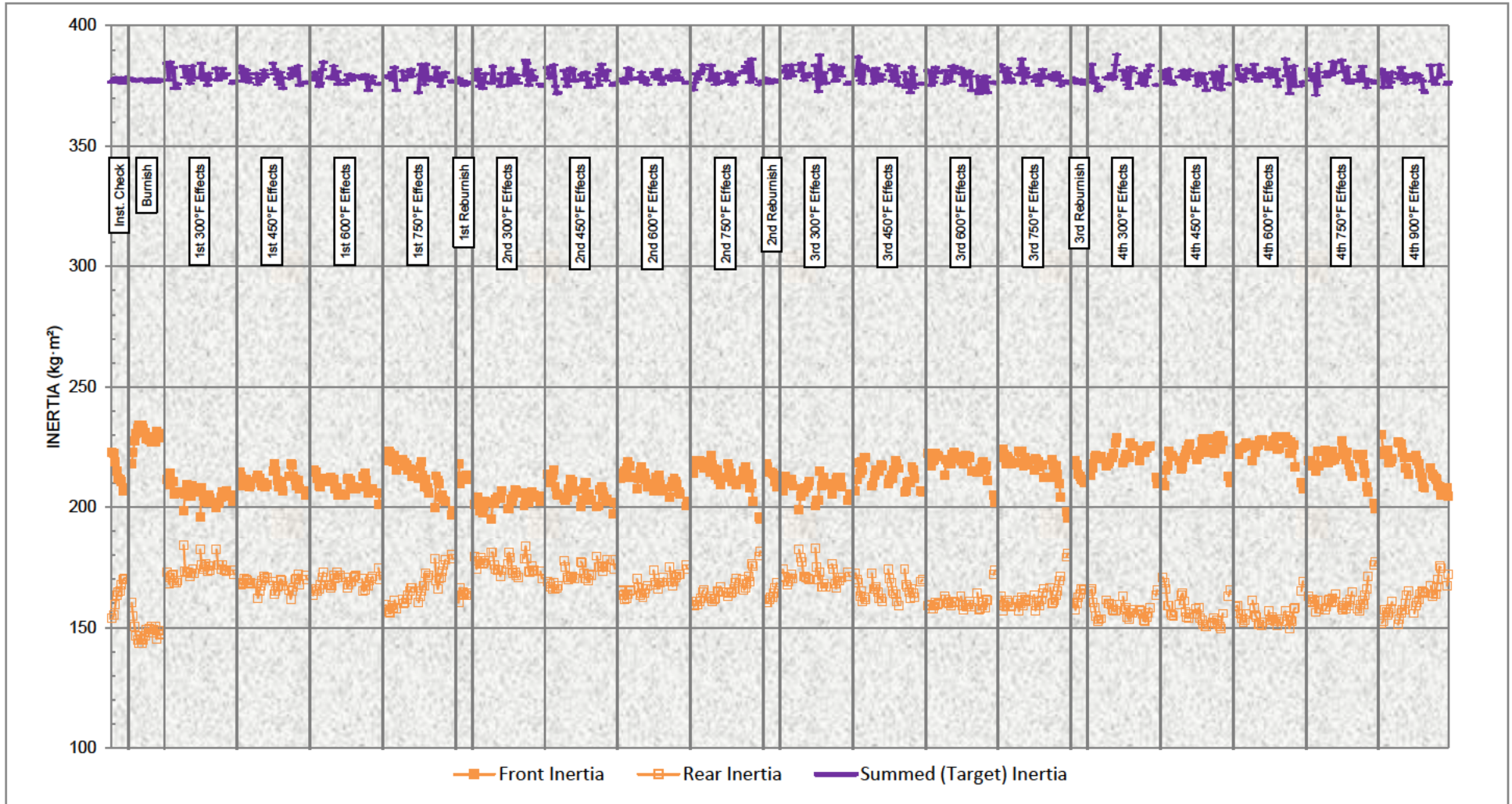
Report Number: 203145-1

Test Report Date: 06 March 2020

NTSB - PERFORMANCE MATRIX

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - FMSI® NUMBERS: 7625-D756 FRONT / 7626-D757 REAR

INERTIA DISTRIBUTION



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-063-23 / M20-064-06

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

Report Number: 203145-1

Test Report Date: 06 March 2020

Test Numbers: M20-063-23 / M20-064-06

Report Number: 203145-1

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

CYCLE	SPEED		TIME		DIST.	DECEL	PRESSURE						TORQUE						TEMPERATURE						FLUID		FRICTION		INERTIA									
	NO.	INIT	FNL	STOP			REPT	TO	AVG	AVERAGE	SUSTAINED	MAXIMUM	AVERAGE	SUSTAINED	MAXIMUM	ROTOR	I/B	O/B	ROTOR	I/B	O/B	ROTOR	I/B	O/B	MAXIMUM	REAR	FRONT	REAR	FRONT	REAR								
		NO.	INIT	FNL	STOP	REPT	STOP		DIST	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT							MAX	INT	MAX	INT	MAX	INT	MAX	INT
		mi/h		s	ft	ft/s ²	lb/in ²						lb ft						F						in ³		μ		slug ft ²									
INSTRUMENT CHECK																																						
30 mi/h - 0.31g Deceleration Rate - 200°F Initial Rotor Temperature																																						
1	29.9	0.5	4.64	0.0	111	8.62	920	929	954	959	1058	1085	2420	1430	990	2836	1688	1148	1720	1192	55	140	57	207	56	165	62	139	56	140	57	163	0.58	0.49	0.27	0.25	222.5	154.1
2	29.9	0.5	4.61	57.7	110	8.73	875	885	910	918	950	982	2454	1446	1008	2824	1667	1157	1717	1192	104	183	103	268	88	208	98	182	90	180	92	203	0.53	0.44	0.28	0.27	222.2	155.0
3	29.9	0.5	4.60	60.0	110	8.78	767	781	908	911	920	937	2477	1433	1044	2813	1635	1178	1667	1219	134	222	159	304	119	243	128	211	114	210	114	232	0.52	0.43	0.27	0.27	218.9	159.4
4	29.9	0.5	4.60	60.1	110	8.76	882	890	901	906	931	962	2471	1405	1067	2806	1608	1198	1670	1260	164	247	178	301	143	267	150	232	138	231	134	253	0.52	0.44	0.27	0.28	215.0	163.3
5	30.0	0.5	4.60	60.1	110	8.80	884	890	899	903	932	957	2468	1390	1079	2836	1608	1228	1626	1293	182	264	197	311	162	282	165	248	152	248	150	268	0.51	0.43	0.27	0.29	211.9	164.5
6	30.0	0.5	4.60	60.1	110	8.80	880	886	900	904	930	935	2470	1387	1083	2810	1585	1225	1632	1275	189	274	208	321	176	290	177	260	165	257	163	278	0.51	0.43	0.27	0.29	211.6	165.2
7	29.9	0.5	4.60	60.6	111	8.71	875	885	913	920	946	958	2456	1368	1088	2798	1570	1228	1620	1304	201	279	216	332	184	292	185	272	174	265	172	288	0.51	0.44	0.26	0.28	210.7	167.6
8	30.0	0.5	4.61	72.7	111	8.75	798	814	928	935	963	974	2453	1347	1106	2806	1540	1266	1594	1331	199	276	214	331	185	291	182	267	177	267	174	284	0.52	0.44	0.25	0.29	206.6	169.7
9	29.9	0.5	4.61	69.3	111	8.71	908	915	925	931	979	1002	2450	1342	1108	2815	1552	1263	1588	1340	199	279	216	334	188	291	186	271	177	268	177	287	0.51	0.44	0.25	0.29	206.6	170.5
10	30.0	0.5	4.64	69.7	111	8.70	862	872	904	909	968	988	2454	1349	1106	2836	1555	1281	1599	1334	202	277	214	336	190	289	185	271	182	271	179	287	0.51	0.44	0.26	0.30	208.0	170.5
BURNISH																																						
40 mi/h - 0.37g Deceleration Rate - 200°F Initial Rotor Temperature or 1 Mile Distance																																						
1	39.9	0.5	5.22	69.3	168	10.18	1002	1024	1192	1199	1314	1325	2869	1653	1216	3355	1971	1384	2045	1493	202	327	218	435	189	348	188	319	183	315	181	349	0.61	0.50	0.25	0.24	217.9	160.3
10	39.9	0.5	5.19	101.6	165	10.37	923	945	1042	1054	1147	1173	2920	1723	1196	3376	2021	1355	2101	1493	238	371	253	459	233	390	196	328	191	323	193	365	0.54	0.46	0.29	0.27	222.9	154.7
20	39.9	0.5	5.15	101.5	163	10.51	759	775	908	916	984	992	2959	1783	1177	3370	2027	1343	2095	1478	244	380	255	471	240	401	194	334	193	321	193	376	0.51	0.44	0.34	0.31	227.5	150.2
30	39.9	0.5	5.12	101.5	161	10.63	758	766	773	778	918	959	2986	1826	1160	3370	2045	1325	2136	1425	247	383	259	487	241	403	193	329	190	320	192	376	0.50	0.43	0.40	0.36	230.5	146.4
40	39.9	0.5	5.09	101.4	160	10.69	736	749	752	762	883	901	3007	1853	1155	3361	2083	1278	2157	1419	248	388	262	508	243	406	194	331	191	321	192	415	0.49	0.42	0.42	0.35	232.5	144.9
50	39.9	0.5	5.09	101.4	160	10.71	702	710	708	711	834	847	3013	1867	1145	3402	2142	1260	2172	1402	250	387	268	519	247	411	190	323	189	311	191	396	0.48	0.41	0.46	0.37	234.0	143.5
60	39.9	0.5	5.07	101.3	159	10.75	647	655	655	661	819	820	3026	1862	1165	3399	2098	1301	2163	1408	256	391	270	526	250	414	196	323	192	316	191	378	0.48	0.41	0.48	0.41	232.3	145.4
70	39.9	0.5	5.08	101.3	159	10.77	646	651	658	660	799	804	3032	1879	1153	3387	2136	1251	2207	1363	258	398	274	547	254	456	192	296	192	322	190	351	0.48	0.41	0.49	0.40	234.1	143.7
80	39.9	0.5	5.07	101.3	159	10.79	563	581	608	613	765	775	3035	1872	1163	3408	2095	1313	2186	1387	268	421	279	554	261	485	193	306	192	320	193	407	0.49	0.40	0.52	0.45	232.7	144.6
90	39.9	0.5	5.06	101.3	159	10.75	637	646	651	657	773	795	3025	1852	1173	3385	2107	1278	2184	1446	270	419	282	522	182	213	194	314	191	334	190	497	0.51	0.41	0.49	0.41	231.0	146.4
100	39.9	0.5	5.05	101.2	158	10.83	559	564	567	570	748	758	3046	1844	1202	3381	2080	1301	2172	1422	266	420	282	545	179	218	197	339	197	341	195	486	0.50	0.40	0.55	0.48	228.5	149.0
110	39.9	0.5	5.06	101.2	159	10.82	561	567	567	571	785	882	3037	1844	1192	3397	2104	1293	2313	1700	265	422	279	539	165	192	196	307	198	352	195	366	0.52	0.42	0.56	0.48	228.7	147.9
120	39.9	0.5	5.06	101.1	159	10.79	561	568	568	572	757	791	3035	1832	1203	3396	2086	1310	2163	1508	261	419	279	485	164	181	196	336	197	345	194	536	0.49	0.41	0.55	0.48	227.8	149.6
130	39.9	0.5	5.05	101.1	159	10.76	578	584	585	589	744	750	3031	1823	1208	3405	2083	1322	2160	1431	266	426	277	469	166	179	198	345	200	347	195	517	0.49	0.41	0.54	0.47	227.3	150.6
140	39.9	0.5	5.05	101.2	159	10.79	575	581	581	586	764	784	3032	1845	1187	3414	2113	1301	2178	1517	267	431	278	562	168	184	199	317	200	340	195	510	0.50	0.41	0.55	0.47	229.4	147.6
150	39.9	0.5	5.05	101.1	159	10.77	557	561	563	565	733	741	3033	1836	1197	3408	2107	1301	2189	1416	265	427	279	548	168	189	198	341	200	338	198	562	0.49	0.40	0.56	0.49	228.7	149.0
160	39.9	0.5	5.07	101.1	159	10.76	556	558	562	563	739	789	3027	1821	1207	3402	2098	1304	2172	1564	264	431	279	452	174	196	199	339	200	343	198	441	0.50	0.41	0.56	0.49	227.0	150.4
170	39.9	0.5	5.06	101.1	159	10.78	546	552	568	571	775	791	3026	1859	1167	3426	2160	1266	2201	1455	269	445	284	599	181	210	195	306	194	347	197	422	0.50	0.41	0.57	0.47	231.5	145.2
180	39.9	0.5	5.06	101.1	158	10.81	543	550	550	555	763	790	3043	1844	1199	3394	2098	1296	2175	1514	266	441	284	460	193	210	200	340	199	349	198	535	0.50	0.42	0.58	0.49	228.9	148.8
190	39.9	0.5	5.06	101.1	159	10.77	588	594	599	602	738	770	3026	1847	1179	3358	2095	1263	2222	1487	268	438	284	468	189	206	200	340	197	339	198	490	0.50	0.41	0.53	0.44	230.1	146.9
200	40.0	0.5	5.05	101.1	160	10.76	595	601	604	608	760	769	3030	1848	1182	3417	2110	1307	2210	1425	270	441	285	507	193	214	197	314	200	345	197	399	0.50	0.41	0.53	0.45	230.3	147.4



CYCLE NO.	SPEED		TIME		DIST.	DECEL	PRESSURE					TORQUE					TEMPERATURE						FLUID		FRICTION		INERTIA											
	INIT	FNL	STOP	REPT			STOP	AVG DIST	AVERAGE		SUSTAINED	MAXIMUM		AVERAGE			SUSTAINED		MAXIMUM		FRONT		REAR		DISPLACE.		COEFF.		FRONT		REAR							
					mi/h	s			ft	ft/s ²		lb/in ²	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	FRONT	REAR	FRONT	REAR	slug ft ²	
FIRST EFFECTIVENESS MATRIX - 300°F																																						
300°F Initial Rotor Temperature																																						
50 - 40 mi/h																																						
1	49.9	39.9	2.56	137.4	175	5.48	353	373	400	403	404	407	1571	864	707	1845	1048	797	1119	829	301	424	316	660	217	228	222	276	223	290	220	381	0.40	0.35	0.40	0.42	211.4	173.1
2	49.9	39.9	1.67	70.2	115	8.35	575	573	609	602	648	609	2350	1304	1046	2709	1511	1198	1850	1266	301	400	312	503	216	226	228	294	228	324	225	359	0.48	0.38	0.37	0.42	209.5	168.0
3	49.8	39.9	1.32	71.4	91	10.49	666	675	803	802	853	812	3010	1675	1335	3747	2127	1620	2322	1664	300	410	313	741	211	229	230	318	229	342	229	390	0.54	0.42	0.40	0.43	214.2	170.7
4	49.9	39.9	1.14	71.9	79	12.18	567	595	1002	1002	1037	1012	3473	1914	1559	4435	2499	1936	2549	2024	300	405	313	626	209	239	232	342	231	348	229	541	0.58	0.46	0.38	0.41	210.8	171.7
5	49.9	39.9	1.05	72.4	72	13.31	857	878	1201	1203	1232	1212	3795	2088	1707	4880	2753	2127	2797	2278	299	410	315	710	206	226	231	349	230	355	230	608	0.63	0.48	0.35	0.37	210.5	172.1
6	49.9	39.9	0.96	75.2	66	14.50	1062	1079	1400	1403	1438	1414	4043	2220	1822	5279	2980	2299	3072	2434	302	405	314	676	207	244	232	346	233	357	232	620	0.68	0.51	0.32	0.35	205.5	168.7
7	49.9	39.9	0.91	74.6	62	15.46	1184	1203	1600	1603	1625	1629	4311	2370	1940	5618	3184	2434	3281	2567	300	410	317	728	205	234	233	349	232	355	232	630	0.74	0.54	0.30	0.32	205.7	168.4
8	49.9	39.9	0.86	79.2	59	16.27	1306	1327	1800	1804	1824	1816	4558	2503	2055	5952	3364	2588	3482	2720	300	409	316	722	205	239	230	350	230	352	230	625	0.79	0.57	0.28	0.30	206.4	169.4
55 - 45 mi/h																																						
1	55.0	44.9	2.54	78.7	193	5.59	386	390	400	401	403	406	1597	828	769	1786	939	847	1027	880	300	407	316	488	201	216	231	352	231	373	230	509	0.35	0.32	0.35	0.44	198.7	184.4
2	55.0	44.9	1.69	81.9	129	8.39	545	556	602	603	687	609	2368	1285	1084	2886	1617	1269	1838	1301	299	418	315	632	201	216	234	369	232	379	232	565	0.45	0.36	0.41	0.44	205.4	173.2
3	55.0	44.9	1.36	84.4	105	10.27	744	752	797	799	832	808	2925	1602	1323	3647	2036	1611	2086	1653	301	419	316	689	199	219	232	357	234	372	232	568	0.48	0.40	0.39	0.42	209.3	172.7
4	55.0	44.9	1.18	86.3	91	11.92	926	938	1002	1002	1022	1011	3376	1840	1536	4255	2369	1886	2428	1998	300	418	317	718	201	226	228	353	233	370	228	601	0.54	0.43	0.36	0.40	207.0	172.8
5	54.9	44.9	1.07	86.0	81	13.26	1017	1031	1201	1202	1238	1217	3716	2023	1693	4709	2623	2086	2729	2228	301	419	316	704	201	245	225	357	232	369	227	641	0.61	0.47	0.33	0.37	204.6	171.3
6	55.0	44.9	1.00	87.3	77	14.09	1296	1304	1397	1401	1428	1416	3963	2150	1813	5146	2868	2278	2945	2411	300	416	320	746	202	229	225	352	230	369	226	670	0.67	0.50	0.31	0.34	204.7	172.6
7	54.9	44.9	0.95	86.5	73	14.82	1181	1195	1601	1600	1630	1616	4234	2308	1926	5229	2924	2305	3160	2517	300	421	321	730	209	239	226	353	231	370	227	672	0.73	0.54	0.28	0.30	209.0	174.3
8	54.9	44.9	0.89	88.8	68	15.72	1027	1052	1799	1804	1827	1820	4438	2416	2022	5683	3181	2502	3337	2656	300	419	320	741	215	234	224	358	231	365	225	671	0.79	0.57	0.27	0.29	206.1	172.5
60 - 50 mi/h																																						
1	59.9	49.9	2.56	89.4	212	5.56	370	380	399	399	403	409	1570	813	757	1771	933	838	1015	862	300	410	320	488	204	214	226	369	229	385	223	530	0.34	0.33	0.35	0.44	196.0	182.4
2	59.9	49.9	1.75	91.8	147	8.03	501	519	603	601	674	610	2301	1247	1055	2709	1496	1213	1685	1245	301	435	320	617	212	215	227	387	232	393	226	630	0.44	0.37	0.37	0.43	208.2	176.1
3	59.9	49.9	1.41	96.2	118	10.05	480	501	802	801	854	810	2838	1533	1305	3458	1900	1558	2001	1620	300	433	322	779	215	220	224	379	231	389	224	644	0.49	0.40	0.36	0.41	204.5	174.2
4	59.9	49.9	1.22	95.8	102	11.55	819	841	1001	1002	1042	1014	3249	1743	1506	4057	2216	1841	2290	1965	299	428	322	752	209	230	222	370	227	387	222	635	0.55	0.44	0.33	0.39	202.5	174.9
5	60.0	49.9	1.11	95.1	93	12.79	1074	1072	1209	1196	1232	1217	3615	1933	1682	4665	2526	2139	2567	2219	300	434	322	756	208	215	220	363	228	387	221	675	0.60	0.48	0.32	0.38	202.8	176.4
6	60.0	49.9	1.03	96.5	86	13.75	1001	1005	1405	1391	1433	1425	3847	2071	1775	4809	2667	2142	2815	2375	301	432	321	768	214	220	223	363	228	388	221	696	0.67	0.51	0.29	0.32	202.1	173.2
7	59.9	49.9	0.97	93.6	81	14.51	1139	1163	1599	1603	1626	1618	4112	2216	1896	5202	2868	2334	3004	2493	301	438	320	791	206	223	223	365	229	398	223	675	0.73	0.54	0.27	0.31	204.9	175.4
8	59.9	49.9	0.92	97.5	77	15.33	1243	1278	1799	1805	1827	1828	4316	2328	1988	5461	3027	2434	3175	2594	299	433	321	769	207	209	223	368	228	408	222	709	0.78	0.58	0.25	0.28	203.7	173.9
65 - 55 mi/h																																						
1	64.9	55.0	2.83	0.0	256	5.01	387	389	399	399	408	403	1428	746	681	1567	835	732	874	791	301	367	316	707	219	240	251	312	253	314	247	297	0.34	0.32	0.32	0.39	199.9	182.5
2	64.9	55.0	1.91	98.1	172	7.45	556	564	602	600	673	605	2095	1119	977	2388	1296	1092	1467	1127	299	378	319	880	205	235	242	312	249	341	243	315	0.44	0.36	0.32	0.38	201.5	176.0
3	65.0	55.0	1.52	98.7	139	9.27	742	751	797	802	867	808	2614	1397	1217	3078	1670	1408	1782	1470	300	398	318	751	195	205	237	322	247	372	238	401	0.49	0.40	0.32	0.37	202.1	176.0
4	64.9	55.0	1.29	99.3	118	10.87	652	664	1000	1002	1032	1012	3063	1652	1412	3769	2063	1706	2148	1779	300	420	319	766	190	207	232	332	243	399	237	504	0.54	0.44	0.31	0.36	203.9	174.3
5	64.9	55.0	1.13	99.6	105	12.16	1107	1116	1201	1205	1229	1213	3464	1868	1596	4355	2381	1974	2476	2030	300	437	320	773	191	208	228	344	242	441	232	574	0.60	0.47	0.30	0.35	206.1	176.0
6	64.9	55.0	1.05	99.9	97	13.22	1038	1056	1399	1402	1440	1422	3728	2016	1712	4712	2582	2130	2726	2248	300	438	318	810	196	209	227	354	240	495	230	619	0.66	0.51	0.28	0.32	204.6	173.7
7	64.9	55.0	0.99	99.5	91	14.14	1220	1240	1598	1602	1625	1618	4000	2167	1834	5048	2779	2269	2957	2393	299	446	321	807	195	207	226	366	236	488	230	658	0.72	0.54	0.26	0.30	205.6	173.9
8	64.9	55.0	0.94	101.6	86	14.91	1654	1649	1807	1793	1823	1817	4223	2296	1927	5526	3083	2443	3148	2523	302	445	320	786	199	210	223	370	237	509	229	706	0.79	0.58	0.26	0.29	206.7	173.4
BEST EFFORT CHECK STOPS - 1800 lbf/in ²																																						
1	55.0	0.5	4.35	103.7	186	17.45	1760	1774	1797	1810	1829	1832	4891	2631	2260	5391	2909	2482	3287	2744	301	573	318	893	206	206	223	511	235	715	227	743	0.82					

CYCLE NO.	SPEED		TIME		DIST. TO STOP DIST	DECEL AVG DIST	PRESSURE						TORQUE						TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA									
	INIT	FNL	STOP	REPT			AVG FRONT	AVG REAR	SUSTAINED FRONT	SUSTAINED REAR	MAXIMUM FRONT	MAXIMUM REAR	AVERAGE			SUSTAINED			MAXIMUM			ROTOR		FRONT		REAR		O/B	O/B	MAXIMUM	MAXIMUM	FRONT	REAR					
	mi/h		s										ft	ft/s ²	lb/ft ²	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX							INT	MAX	INT	MAX	INT
FIRST EFFECTIVENESS MATRIX - 450°F																																						
450°F Initial Rotor Temperature																																						
50 - 40 mi/h																																						
1	49.9	39.9	2.84	121.4	193	4.97	352	360	400	399	404	408	1419	795	625	1559	883	676	947	747	450	550	441	475	379	399	416	544	419	496	403	561	0.33	0.31	0.33	0.36	214.5	168.6
2	49.9	39.9	1.88	48.1	129	7.43	548	548	618	599	677	608	2105	1177	928	2414	1334	1080	1570	1110	452	550	450	485	388	403	414	532	422	521	405	589	0.43	0.35	0.33	0.38	212.7	167.7
3	49.9	39.9	1.52	45.7	104	9.28	729	739	798	803	839	810	2608	1445	1163	3131	1729	1402	1889	1422	451	552	456	491	393	404	419	530	427	537	410	624	0.47	0.39	0.33	0.37	209.0	168.1
4	49.9	39.9	1.32	48.2	91	10.60	814	832	1002	1002	1037	1012	3017	1671	1346	3703	2048	1655	2195	1694	449	547	459	492	395	405	416	529	430	546	413	640	0.54	0.43	0.31	0.35	211.4	170.4
5	49.9	39.9	1.17	46.2	81	11.84	1077	1086	1202	1202	1230	1215	3368	1867	1500	4193	2319	1874	2484	1939	451	548	463	495	401	408	420	532	433	558	417	677	0.60	0.47	0.29	0.33	211.6	170.1
6	49.8	39.9	1.08	47.7	75	12.76	1021	1037	1401	1402	1441	1420	3614	2002	1612	4568	2523	2045	2703	2163	448	553	467	497	402	409	420	536	435	566	420	697	0.67	0.51	0.27	0.31	210.5	169.5
7	49.9	39.9	1.01	49.6	70	13.84	1208	1225	1601	1603	1632	1616	3882	2147	1735	4942	2729	2213	2900	2310	449	550	467	501	402	411	423	534	438	600	422	731	0.73	0.56	0.26	0.29	208.2	168.2
8	49.9	39.9	0.95	49.2	66	14.61	1332	1351	1800	1804	1828	1820	4118	2281	1837	5303	2939	2364	3075	2484	449	554	467	501	405	414	424	538	441	707	424	748	0.80	0.60	0.25	0.28	209.5	168.6
55 - 45 mi/h																																						
1	54.9	44.9	2.70	52.0	204	5.26	381	386	401	402	406	409	1490	831	659	1668	939	729	1001	773	448	558	468	512	406	423	424	561	438	556	424	625	0.31	0.33	0.35	0.38	212.0	168.1
2	55.0	44.9	1.86	53.6	140	7.69	568	565	609	600	680	610	2152	1222	930	2538	1467	1071	1635	1116	450	561	469	514	407	421	422	548	439	570	423	658	0.41	0.37	0.36	0.38	213.3	162.3
3	55.0	44.9	1.52	55.2	115	9.35	726	732	801	800	845	813	2627	1476	1151	3169	1788	1381	1906	1408	449	562	469	509	409	422	419	544	436	577	422	680	0.46	0.41	0.34	0.36	211.8	165.2
4	55.0	44.9	1.29	55.6	99	10.90	795	802	1005	996	1033	1014	3067	1708	1360	3786	2116	1670	2201	1714	449	558	471	510	410	421	417	540	434	604	419	704	0.53	0.45	0.32	0.35	210.2	167.4
5	54.9	44.9	1.17	53.8	89	12.04	984	1005	1201	1201	1237	1213	3394	1874	1520	4258	2352	1906	2502	1965	451	567	470	510	412	424	415	542	436	603	421	727	0.59	0.49	0.30	0.33	208.9	169.4
6	54.9	44.9	1.09	56.4	83	12.91	1089	1104	1401	1402	1439	1416	3673	2024	1649	4618	2541	2077	2732	2181	449	563	469	509	411	421	417	541	436	702	420	729	0.66	0.52	0.27	0.31	210.3	171.3
7	54.9	44.9	1.01	54.5	78	13.77	1327	1351	1601	1603	1626	1614	3887	2137	1750	4957	2723	2234	2924	2340	450	558	470	508	412	422	420	541	436	718	422	762	0.72	0.57	0.26	0.29	208.2	170.4
8	55.0	44.9	0.96	53.5	74	14.53	1238	1270	1800	1803	1831	1822	4115	2266	1849	5296	2918	2378	3083	2490	450	565	470	506	412	427	421	545	438	782	423	801	0.78	0.61	0.24	0.28	209.2	170.7
60 - 50 mi/h																																						
1	59.9	49.9	2.82	55.0	234	5.06	381	386	400	402	409	410	1448	811	638	1594	894	700	971	744	448	570	470	528	415	431	420	565	440	587	425	624	0.31	0.34	0.34	0.37	215.1	169.2
2	59.9	49.9	1.89	58.1	158	7.50	486	492	608	600	689	613	2136	1220	916	2488	1440	1048	1664	1092	450	577	472	524	413	433	418	556	439	599	424	659	0.42	0.38	0.36	0.37	218.2	163.8
3	59.9	49.9	1.51	60.8	127	9.35	726	730	800	797	832	815	2650	1499	1151	3139	1779	1360	1903	1414	449	576	469	518	413	430	413	550	434	610	419	696	0.46	0.42	0.34	0.36	215.0	165.1
4	59.9	49.9	1.31	60.6	109	10.87	862	877	1001	998	1031	1015	3061	1708	1353	3701	2057	1644	2254	1706	448	575	471	516	413	431	409	547	432	667	417	726	0.53	0.46	0.31	0.35	210.9	167.0
5	59.9	49.9	1.17	59.2	98	12.10	977	991	1206	1206	1238	1215	3389	1881	1508	4170	2296	1874	2511	1959	450	573	469	516	416	433	411	547	431	781	414	724	0.59	0.50	0.29	0.33	208.4	167.2
6	59.9	49.9	1.09	59.4	91	12.99	1092	1106	1401	1402	1436	1420	3687	2040	1646	4665	2576	2089	2774	2169	449	575	470	511	414	439	413	547	433	800	405	643	0.66	0.54	0.28	0.31	210.7	170.0
7	59.9	49.9	1.01	58.7	86	13.84	1006	1027	1600	1603	1626	1618	3903	2156	1747	5007	2759	2248	2948	2352	450	574	471	512	417	436	416	547	434	811	397	648	0.72	0.58	0.26	0.30	209.0	169.4
8	60.0	49.9	0.95	58.8	81	14.71	1463	1495	1800	1803	1828	1818	4101	2266	1835	5299	2921	2378	3113	2496	449	570	471	509	416	443	417	550	434	833	396	665	0.79	0.61	0.24	0.28	206.7	167.4
65 - 55 mi/h																																						
1	64.9	55.0	2.87	58.1	260	4.92	384	387	400	400	405	406	1387	780	607	1523	865	658	939	703	450	578	472	541	419	437	416	572	437	602	394	564	0.32	0.34	0.33	0.35	212.7	165.4
2	64.9	55.0	1.94	63.5	174	7.34	557	555	607	602	679	611	2080	1194	886	2426	1402	1024	1617	1060	449	586	474	535	413	438	412	561	433	617	390	602	0.43	0.39	0.35	0.36	218.1	161.9
3	64.9	55.0	1.54	63.0	140	9.10	729	733	805	803	850	810	2594	1475	1119	3081	1750	1331	1900	1372	450	589	472	530	418	437	409	557	431	622	390	653	0.47	0.43	0.33	0.35	217.5	164.9
4	64.9	55.0	1.31	64.4	120	10.70	895	900	1001	999	1044	1014	3023	1695	1329	3674	2054	1620	2225	1673	449	585	473	519	417	436	405	553	428	750	387	665	0.53	0.47	0.31	0.34	212.6	166.6
5	64.9	55.0	1.18	63.1	109	11.81	1074	1074	1208	1199	1236	1217	3358	1862	1496	4328	2431	1897	2511	1945	450	584	471	521	416	437	404	553	427	859	388	650	0.60	0.51	0.30	0.33	211.4	169.9
6	64.9	55.0	1.09	61.8	100	12.88	1237	1237	1404	1395	1437	1417	3640	2005	1635	4709	2608	2101	2732	2163	450	582	473	523	417	450	406	554	428	869	391	672	0.66	0.54	0.28	0.32	208.8	170.3
7	64.9	55.0	1.01	62.5	94	13.51	1346	1355	1604	1602	1626	1617	3859	2126	1733	4942	2720	2222	2903	2346	449	583	475	520	418	435	408	557	430	891	390	656	0.73	0.58	0.26	0.29	211.2	172.1
8	64.9	55.0	0.96	61.7	88	14.50	952	983	1801	1804	1825	1823	4055	2242	1814	5250	2895	2355	3104	2464	449	584	475	517	421	451	414	556	433	859	392	674	0.80	0.62	0.24	0.27	207.5	167.9
BEST EFFORT CHECK STOPS - 1800 lbf/in²																																						
1	55.0	0.5	4.79	64.3	199	16.35	1739	1742	1800	1800	1830	1831	4585	2495	2090	4872	2632	2240	3181	2529	449	693	474	647	418	582	413	671	436	908	395	598	0.84	0				

CYCLE NO.	SPEED		TIME		DIST.	DECEL	PRESSURE					TORQUE					TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA											
	INIT	FNL	STOP	REPT	STOP	AVG	AVERAGE		SUSTAINED		MAXIMUM		AVERAGE		SUSTAINED		MAXIMUM		FRONT		REAR		O/B		FRONT	REAR	FRONT	REAR	FRONT	REAR								
	mi/h			s		ft	ft/s²	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	I/B	O/B	ROTOR	I/B	O/B	INT	MAX	INT	MAX	INT	MAX	in³	in³	μ	μ	FRONT	REAR	slug
FIRST EFFECTIVENESS MATRIX - 600°F 600°F Initial Rotor Temperature																																						
50 - 40 mi/h																																						
1	49.9	39.9	3.05	122.2	207	4.65	368	378	397	401	532	410	1308	742	565	1390	776	614	1239	697	598	702	617	666	555	575	561	662	584	672	534	618	0.43	0.36	0.30	0.32	214.4	163.3
2	49.9	39.9	2.05	44.4	141	6.81	548	553	601	601	674	613	1933	1094	839	2222	1257	965	1449	1012	597	698	620	663	556	573	552	653	576	697	531	652	0.46	0.39	0.32	0.34	215.4	165.2
3	49.8	39.9	1.61	42.9	110	8.65	718	721	803	798	862	814	2452	1383	1068	2933	1664	1269	1747	1307	599	698	619	656	559	572	549	651	571	700	512	670	0.53	0.44	0.31	0.33	214.7	165.8
4	49.8	39.9	1.36	43.5	93	10.26	876	882	1004	1001	1038	1016	2884	1620	1263	3538	1980	1558	2098	1588	600	692	619	656	559	571	542	643	567	710	509	683	0.59	0.48	0.30	0.33	212.0	165.3
5	49.9	39.9	1.20	43.3	82	11.70	1040	1046	1205	1201	1227	1214	3270	1823	1446	4167	2343	1824	2425	1844	599	687	619	653	559	569	539	640	565	749	506	688	0.67	0.52	0.29	0.32	209.0	165.8
6	49.9	39.9	1.09	42.3	76	12.72	985	1003	1399	1401	1425	1415	3569	1979	1590	4565	2535	2030	2706	2113	599	688	622	655	561	569	539	639	565	833	507	687	0.74	0.55	0.27	0.31	208.7	167.7
7	49.9	39.9	1.02	43.3	70	13.65	1047	1069	1601	1603	1631	1618	3886	2149	1737	5045	2797	2248	2930	2316	600	687	623	654	561	573	535	638	563	904	501	701	0.82	0.60	0.26	0.30	211.2	170.7
8	49.8	39.9	0.95	44.9	66	14.42	1019	1049	1800	1804	1834	1823	4139	2279	1860	5450	3010	2440	3148	2529	600	689	624	653	560	573	533	641	560	904	506	726	0.89	0.64	0.25	0.28	212.0	173.0
55 - 45 mi/h																																						
1	54.9	44.9	2.99	44.4	225	4.78	384	384	405	401	498	411	1346	750	597	1455	809	646	1139	708	598	710	625	674	560	582	532	653	558	719	502	662	0.40	0.35	0.30	0.34	210.5	167.6
2	55.0	44.9	2.03	46.1	154	7.03	569	560	616	600	683	614	1987	1114	873	2332	1340	992	1567	1039	599	711	625	672	562	579	532	652	556	747	503	700	0.46	0.40	0.33	0.35	212.4	166.5
3	54.9	44.9	1.59	46.3	121	8.85	712	718	803	803	852	812	2498	1392	1106	2992	1676	1316	1800	1352	600	705	625	667	561	576	527	649	553	784	505	720	0.52	0.44	0.32	0.35	210.9	167.5
4	54.9	44.9	1.36	45.8	105	10.24	823	835	1000	1000	1037	1015	2925	1615	1311	3582	1980	1602	2145	1647	600	706	625	665	563	579	525	644	552	885	502	720	0.59	0.49	0.30	0.34	211.6	171.7
5	55.0	44.9	1.20	46.5	92	11.71	956	969	1202	1202	1229	1218	3297	1810	1487	4134	2272	1862	2423	1903	599	702	625	659	563	579	526	642	552	925	495	733	0.66	0.53	0.29	0.33	207.4	170.4
6	55.0	44.9	1.10	46.0	85	12.66	955	970	1401	1402	1438	1421	3593	1962	1631	4609	2523	2086	2664	2136	599	700	625	658	565	585	526	644	551	937	508	742	0.74	0.57	0.27	0.31	208.0	172.9
7	55.0	44.9	1.02	46.2	78	13.82	1215	1233	1597	1612	1623	1627	3871	2110	1761	4930	2676	2254	2892	2352	599	704	625	658	567	591	527	650	553	948	512	757	0.81	0.61	0.25	0.29	204.8	170.9
8	55.0	44.9	0.97	47.8	74	14.63	1028	1054	1800	1803	1838	1836	4115	2241	1873	5406	2954	2452	3107	2552	599	701	625	655	565	585	528	648	552	949	506	764	0.89	0.65	0.25	0.29	205.5	171.8
60 - 50 mi/h																																						
1	60.0	49.9	3.04	46.4	251	4.75	387	383	410	401	508	411	1330	726	604	1464	806	658	1104	714	601	724	627	686	567	588	530	662	554	751	507	696	0.40	0.36	0.30	0.35	205.1	170.7
2	60.0	49.9	2.03	48.4	169	7.06	556	557	607	601	671	615	1987	1112	875	2270	1275	995	1520	1039	600	727	627	683	564	584	527	659	554	815	513	816	0.45	0.40	0.32	0.35	211.3	166.4
3	60.0	49.9	1.63	49.8	136	8.78	721	722	805	798	857	818	2484	1386	1097	2963	1673	1290	1785	1340	602	724	626	672	564	581	525	655	550	900	513	781	0.52	0.45	0.31	0.34	211.9	167.7
4	59.9	49.9	1.37	50.0	115	10.22	876	885	1002	1005	1033	1019	2894	1607	1287	3544	1962	1582	2122	1614	598	719	625	666	564	581	523	654	549	940	502	725	0.59	0.49	0.30	0.33	210.9	168.9
5	60.0	49.9	1.22	48.6	102	11.64	776	789	1201	1202	1245	1216	3273	1808	1465	4087	2260	1827	2434	1865	601	713	625	664	566	582	526	654	550	956	508	726	0.65	0.53	0.28	0.32	208.5	168.9
6	60.0	49.9	1.11	50.6	93	12.76	1186	1200	1396	1405	1432	1415	3604	1982	1622	4586	2523	2063	2691	2110	597	712	626	662	564	590	521	649	546	965	500	732	0.73	0.57	0.27	0.31	208.4	170.5
7	60.0	49.9	1.03	49.2	87	13.71	1350	1355	1606	1598	1634	1621	3869	2121	1747	5102	2827	2275	2918	2316	598	714	624	661	566	595	526	652	548	977	507	727	0.80	0.61	0.27	0.30	207.6	171.0
8	60.0	49.9	0.97	50.3	82	14.57	1501	1509	1803	1797	1828	1820	4117	2253	1864	5335	2915	2420	3122	2520	599	709	626	657	563	589	525	653	549	986	506	671	0.88	0.65	0.24	0.28	207.5	171.7
65 - 55 mi/h																																						
1	64.9	55.0	3.04	48.7	275	4.67	382	378	409	399	508	412	1316	724	592	1443	797	646	1071	705	600	736	629	689	566	588	527	660	551	750	499	785	0.39	0.35	0.29	0.34	208.3	170.2
2	64.9	55.0	2.02	51.1	184	6.97	547	550	604	600	720	618	1963	1106	857	2261	1281	980	1570	1030	599	739	629	691	564	585	522	663	549	788	505	880	0.48	0.41	0.32	0.34	212.9	165.1
3	64.9	55.0	1.62	51.1	148	8.65	683	690	802	801	911	819	2449	1382	1067	2910	1650	1260	1945	1307	601	737	628	680	564	582	521	655	548	891	523	851	0.54	0.45	0.31	0.33	214.3	165.4
4	64.9	55.0	1.39	52.8	126	10.16	834	850	1002	1001	1098	1020	2867	1600	1267	3474	1939	1535	2077	1573	598	727	626	675	565	584	519	655	544	943	520	669	0.61	0.49	0.29	0.32	211.2	167.3
5	64.9	55.0	1.23	50.5	111	11.52	1029	1035	1202	1199	1228	1216	3204	1768	1436	3919	2148	1771	2364	1824	601	720	629	672	567	587	520	659	546	955	495	587	0.66	0.53	0.27	0.31	206.0	167.3
6	64.9	55.0	1.11	51.4	102	12.55	1189	1197	1404	1402	1431	1423	3519	1937	1583	4443	2434	2009	2659	2074	600	719	629	671	567	603	521	660	545	960	484	585	0.73	0.57	0.26	0.30	207.1	169.3
7	64.9	55.0	1.03	52.0	94	13.57	991	1017	1599	1603	1627	1628	3813	2092	1721	4919	2697	2222	2903	2305	600	716	630	671	568	591	522	662	546	974	449	547	0.80	0.61	0.25	0.29	206.8	170.2
8	64.9	55.0	0.96	51.2	88	14.45	1073	1099	1801	1804	1824	1835	4081	2237	1844	5338	2927	2411	3151	2520	601	718	633	668	569	600	525	661	550	1001	445	474	0.87	0.65	0.25	0.28	207.7	171.2
BEST EFFORT CHECK STOPS - 1800 lbf/in²																																						
1	55.0	0.5	5.01	56.9	201	16.22	1710	1718	1800	1806	1830	1838	4544	2431	2113	4839	2561	2278	3187	2541	600	810	630	785	566	717	525	767	546	1041	413	453						

CYCLE	SPEED		TIME		DIST.	DECEL	PRESSURE						TORQUE						TEMPERATURE						FLUID		FRICTION		INERTIA									
	NO.	INIT	FNL	STOP			REPT	TO	AVG	AVERAGE		SUSTAINED		MAXIMUM		AVERAGE			SUSTAINED			MAXIMUM			ROTOR		FRONT		REAR		DISPLACE.		COEFF.		INERTIA			
		mi/h					s	ft	ft/s ²	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	FRONT	REAR	FRONT
FIRST EFFECTIVENESS MATRIX - 750°F																																						
750°F Initial Rotor Temperature																																						
50 - 40 mi/h																																						
1	49.9	39.9	3.43	104.5	231	4.14	385	385	403	400	519	408	1170	678	492	1269	738	531	1065	582	749	867	784	833	701	727	686	777	707	800	500	530	0.44	0.38	0.28	0.28	219.3	159.3
2	49.9	39.9	2.19	35.1	149	6.43	561	566	602	603	744	612	1816	1062	755	2063	1216	847	1626	885	749	859	786	826	702	721	682	773	706	832	499	531	0.53	0.42	0.30	0.30	221.5	157.5
3	49.9	39.9	1.70	33.1	116	8.30	642	648	803	801	869	815	2347	1379	967	2791	1655	1136	1809	1172	748	856	785	825	703	717	681	770	704	861	500	521	0.56	0.47	0.31	0.30	223.0	156.4
4	49.9	39.9	1.41	34.1	97	9.88	883	890	1002	1004	1031	1022	2785	1636	1149	3447	2033	1414	2101	1461	749	852	787	820	703	717	677	764	702	880	500	513	0.63	0.51	0.31	0.30	222.2	156.1
5	49.9	39.9	1.24	35.2	85	11.29	1042	1054	1201	1206	1234	1227	3203	1864	1339	4060	2381	1679	2476	1729	747	849	788	816	703	717	674	760	697	919	496	507	0.70	0.56	0.30	0.29	221.5	159.1
6	49.9	39.9	1.11	35.0	77	12.47	1203	1212	1401	1404	1427	1426	3508	2036	1472	4556	2644	1912	2782	1953	748	851	786	816	703	719	669	758	694	971	488	505	0.78	0.60	0.28	0.29	219.0	158.3
7	49.9	39.9	1.03	36.1	71	13.47	1262	1286	1601	1603	1628	1628	3843	2223	1619	5119	2983	2136	3066	2186	750	848	785	814	702	724	668	753	689	1008	486	502	0.85	0.64	0.28	0.28	221.5	161.3
8	49.9	39.9	0.95	35.4	66	14.57	1335	1353	1800	1804	1823	1832	4054	2339	1715	5592	3249	2343	3402	2393	750	844	783	814	704	726	668	752	689	1033	481	499	0.92	0.68	0.27	0.27	215.3	157.9
55 - 45 mi/h																																						
1	54.9	44.9	3.36	34.0	252	4.29	381	382	402	400	557	412	1218	702	516	1320	765	555	1186	593	748	868	787	837	708	733	666	752	691	808	478	500	0.44	0.35	0.29	0.29	219.6	161.5
2	54.9	44.9	2.23	37.1	167	6.43	565	565	606	601	719	613	1808	1041	767	2057	1192	865	1502	903	749	864	788	836	705	728	667	762	687	858	478	534	0.49	0.41	0.30	0.30	217.3	160.1
3	54.9	44.9	1.73	35.7	132	8.16	691	696	803	801	874	817	2304	1329	975	2744	1596	1148	1776	1192	749	862	790	831	706	722	667	763	686	900	480	537	0.55	0.45	0.30	0.30	218.6	160.3
4	54.9	44.9	1.45	37.7	110	9.75	880	883	1006	1002	1048	1021	2753	1579	1174	3350	1936	1414	2039	1470	749	857	788	827	706	722	666	763	685	939	482	535	0.62	0.50	0.29	0.30	217.4	161.7
5	54.9	44.9	1.26	37.0	96	11.16	1039	1046	1201	1201	1231	1219	3152	1792	1360	3954	2260	1694	2366	1744	750	854	784	821	706	725	667	763	685	987	484	533	0.68	0.55	0.28	0.30	215.4	163.5
6	54.9	44.9	1.14	37.1	88	12.24	1130	1147	1400	1411	1437	1427	3474	1968	1506	4471	2523	1948	2709	2007	749	854	786	821	707	731	667	761	687	1021	484	521	0.75	0.59	0.27	0.29	215.7	165.1
7	54.9	44.9	1.04	38.0	80	13.35	1345	1356	1592	1597	1642	1625	3800	2145	1655	4975	2818	2157	3001	2222	750	852	783	819	708	733	668	763	686	1041	484	515	0.83	0.63	0.27	0.28	215.6	166.4
8	55.0	44.9	0.98	37.1	76	14.25	1508	1520	1800	1803	1829	1834	4024	2258	1766	5476	3080	2396	3240	2458	750	854	785	817	709	730	670	765	690	1058	482	513	0.90	0.67	0.26	0.28	212.7	166.4
60 - 50 mi/h																																						
1	60.0	49.9	3.33	37.4	275	4.33	390	381	413	399	526	412	1201	683	518	1323	765	558	1030	596	748	873	785	848	713	735	672	771	691	827	484	537	0.41	0.35	0.28	0.29	211.8	160.4
2	59.9	49.9	2.25	39.7	187	6.34	525	529	607	599	715	614	1794	1025	770	2051	1189	862	1473	909	748	872	788	845	707	730	671	785	688	879	486	665	0.49	0.41	0.30	0.30	216.8	162.9
3	59.9	49.9	1.77	38.5	148	8.01	648	660	797	803	899	817	2293	1306	986	2703	1543	1160	1827	1201	749	873	788	838	708	729	674	787	688	940	489	598	0.55	0.45	0.29	0.30	218.8	165.2
4	59.9	49.9	1.49	40.1	123	9.58	893	898	1003	1001	1035	1023	2718	1523	1195	3299	1856	1443	1942	1493	750	867	786	832	708	730	671	788	689	1002	494	636	0.60	0.50	0.28	0.30	213.2	167.3
5	59.9	49.9	1.28	40.2	108	10.97	980	990	1204	1204	1235	1224	3070	1704	1367	3854	2145	1709	2260	1765	749	866	784	825	709	733	671	784	688	1049	497	598	0.67	0.54	0.27	0.30	208.5	167.2
6	59.9	49.9	1.17	38.9	99	11.95	1194	1201	1407	1404	1431	1426	3420	1884	1536	4462	2479	1983	2585	2024	750	861	784	821	711	740	674	784	691	1087	496	570	0.75	0.58	0.27	0.30	211.6	172.5
7	59.9	49.9	1.08	39.3	90	13.16	1236	1252	1601	1603	1629	1624	3715	2039	1676	4813	2638	2175	2850	2254	749	859	782	820	712	737	676	786	693	1089	495	544	0.82	0.62	0.25	0.29	207.9	170.9
8	60.0	49.9	1.01	38.9	85	13.96	1346	1362	1801	1804	1834	1822	3926	2140	1786	5208	2827	2381	3045	2452	748	859	783	819	711	734	682	788	698	1109	495	532	0.89	0.66	0.24	0.28	205.7	171.7
65 - 55 mi/h																																						
1	64.9	55.0	3.58	39.2	322	3.94	371	380	401	400	405	412	1113	587	525	1205	638	567	676	602	749	863	783	857	712	733	685	800	703	896	495	563	0.33	0.35	0.24	0.30	199.8	178.7
2	64.9	55.0	2.33	38.8	210	6.12	559	563	604	603	693	616	1745	971	774	1966	1095	871	1331	906	749	885	788	857	709	733	691	815	706	944	500	732	0.47	0.40	0.27	0.30	213.0	169.6
3	64.9	55.0	1.78	39.9	162	7.93	725	729	803	800	901	819	2229	1248	981	2626	1478	1148	1650	1192	748	882	789	843	707	735	690	815	707	997	502	779	0.55	0.45	0.28	0.30	211.1	166.0
4	64.9	55.0	1.52	41.3	138	9.27	840	848	1002	1002	1034	1020	2627	1451	1176	3161	1750	1411	1891	1461	748	880	785	836	708	737	691	813	707	1080	506	712	0.59	0.50	0.26	0.30	209.9	170.2
5	64.9	55.0	1.33	40.6	122	10.52	1039	1043	1203	1196	1232	1223	2940	1602	1338	3565	1933	1632	2172	1712	749	873	785	831	711	748	689	810	710	1100	510	687	0.67	0.54	0.24	0.29	204.3	170.7
6	64.9	55.0	1.22	40.3	110	11.56	923	922	1400	1401	1431	1423	3261	1767	1494	4064	2178	1886	2387	1959	750	872	784	833	712	746	690	805	714	1112	512	646	0.74	0.58	0.23	0.28	205.1	173.4
7	64.9	55.0	1.11	39.5	102	12.54	1326	1336	1598	1603	1637	1624	3540	1897	1643	4500	2399	2101	2605	2192	749	873	784	832	714	745	694	809	718	1129	517	631	0.82	0.63	0.23	0.28	203.0	175.9
8	64.9	55.0	1.05	40.4	96	13.27	1365	1382	1801	1804	1836	1827	3764	2002	1763	4916	2597	2319	2830	2417	748	870	785	829	714	745	697	811	720	1135	517	610	0.89	0.67	0.22	0.27	202.3	178.2
BEST EFFORT CHECK STOPS - 1800 lbf/in²																																						
1	54.9	0.5	5.42	42.8	218	14.90	1692	1700	1799	1803	1843	1834	4188	2185	2003	4358	2278	2080	2868	2452	749	967	781	943	712	874	700	907	723	1187	516	607	0.91	0.68</				

Test Numbers: M20-063-23 / M20-064-06

Report Number: 203145-1

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

CYCLE NO.	SPEED		TIME		DIST.	DECEL	PRESSURE						TORQUE						TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA										
	INIT	FNL	STOP	REPT			TO	AVG	AVERAGE		SUSTAINED		MAXIMUM		AVERAGE			SUSTAINED			MAXIMUM			ROTOR		I/B		O/B		ROTOR		I/B		O/B		MAXIMUM		SUSTAINED	
	mi/h		s		ft	ft/s ²	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	FRONT	REAR	FRONT	REAR	FRONT
FIRST REBURNISH																																							
40 mi/h - 0.37g Deceleration Rate - 200°F Initial Rotor Temperature or 1 Mile Distance																																							
1	40.0	0.5	5.20	70.3	168	10.18	1002	1024	1192	1199	1314	1325	2869	1653	1216	3355	1971	1384	2045	1493	202	327	218	435	189	348	188	319	183	315	181	349	0.61	0.50	0.25	0.24	217.9	160.3	
5	39.9	0.5	5.09	101.0	160	10.68	640	643	651	651	824	858	2996	1671	1325	3355	1918	1437	2007	1588	237	400	241	377	217	294	225	403	220	412	177	453	0.49	0.43	0.44	0.46	209.8	166.4	
10	39.9	0.5	5.06	101.0	159	10.80	573	581	594	598	756	797	3029	1714	1315	3388	1918	1470	2089	1608	246	417	255	395	228	324	237	407	236	481	174	460	0.47	0.42	0.49	0.52	213.0	163.5	
15	39.9	0.5	5.07	101.0	159	10.78	556	559	565	566	721	743	3027	1706	1321	3391	1915	1476	2021	1558	244	411	255	398	228	328	232	394	232	504	177	463	0.46	0.40	0.51	0.55	212.4	164.5	
20	40.0	0.5	5.08	101.0	159	10.80	569	576	582	587	732	791	3020	1702	1317	3338	1930	1408	2048	1655	240	408	252	393	224	337	227	378	228	537	175	445	0.46	0.42	0.50	0.51	211.5	163.7	
25	39.9	0.5	5.05	101.0	158	10.83	549	559	587	588	738	816	3041	1721	1320	3387	1959	1428	2104	1661	238	408	248	393	222	341	223	371	227	527	174	365	0.46	0.42	0.50	0.51	213.1	163.5	
30	40.0	0.5	5.06	101.0	159	10.80	433	461	595	602	704	738	3025	1703	1322	3394	1930	1464	2033	1629	238	403	246	390	220	343	223	375	224	531	173	373	0.45	0.41	0.49	0.51	211.6	164.3	
35	40.0	0.5	5.07	101.0	159	10.82	578	576	586	582	704	758	3033	1708	1325	3305	1886	1419	2060	1664	237	404	247	385	220	347	223	370	222	553	170	317	0.45	0.41	0.49	0.51	211.7	164.3	

CYCLE NO.	SPEED		TIME		DIST. TO STOP	DECEL	PRESSURE						TORQUE						TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA									
	INIT	FNL	STOP	REPT			AVG	AVERAGE		SUSTAINED		MAXIMUM		AVERAGE			SUSTAINED			MAXIMUM			ROTOR I/B	FRONT		REAR		MAXIMUM		SUSTAINED		FRONT	REAR					
	mi/h		s				ft	ft/s²	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	in³	μ	slug ft²	
SECOND EFFECTIVENESS MATRIX - 300°F																																						
300°F Initial Rotor Temperature																																						
50 - 40 mi/h																																						
1	49.9	39.9	2.52	126.8	171	5.58	380	388	400	399	405	413	1582	836	746	1762	962	800	995	939	300	383	302	366	273	304	290	370	293	550	220	356	0.33	0.33	0.36	0.42	201.1	179.3
2	49.9	39.9	1.68	56.1	115	8.38	565	571	599	601	695	618	2358	1269	1089	2772	1476	1296	1723	1357	298	394	307	364	271	315	298	402	298	665	219	414	0.45	0.37	0.37	0.45	203.1	174.3
3	49.9	39.9	1.40	56.0	96	9.99	661	671	804	801	857	825	2842	1519	1323	3464	1856	1608	1942	1670	300	394	308	360	272	329	301	417	303	741	221	434	0.50	0.41	0.35	0.42	204.0	177.7
4	49.9	39.9	1.20	62.2	83	11.59	922	924	1003	1002	1033	1025	3239	1714	1525	4051	2136	1915	2213	1977	295	385	304	353	270	319	299	412	301	756	221	501	0.56	0.45	0.32	0.40	198.3	176.5
5	49.9	39.9	1.09	61.6	74	12.89	1112	1111	1196	1190	1228	1229	3636	1914	1722	4609	2417	2192	2490	2243	293	382	303	349	269	317	300	422	302	770	221	537	0.61	0.49	0.31	0.39	199.1	179.2
6	49.9	39.9	0.98	64.3	68	14.13	1169	1188	1402	1402	1435	1431	3938	2081	1857	5143	2706	2437	2765	2476	289	377	301	340	268	307	301	424	301	775	222	605	0.68	0.52	0.29	0.37	197.6	176.4
7	49.9	39.9	0.91	64.9	63	15.24	914	930	1603	1604	1629	1635	4280	2272	2008	5633	2992	2641	3080	2703	288	373	297	343	264	306	300	422	300	771	222	633	0.74	0.56	0.28	0.35	200.0	176.7
8	49.9	39.9	0.85	64.4	60	16.05	1586	1605	1804	1818	1827	1837	4547	2420	2127	6167	3293	2874	3337	2903	287	369	297	340	266	303	300	422	301	797	222	674	0.80	0.59	0.28	0.33	202.3	177.8
55 - 45 mi/h																																						
1	55.0	44.9	2.62	64.9	196	5.52	351	360	400	396	405	416	1547	803	745	1727	915	812	950	888	285	392	298	380	266	292	300	422	304	585	225	404	0.32	0.31	0.35	0.43	195.2	181.1
2	55.0	44.9	1.78	69.5	136	7.94	563	564	599	596	700	616	2269	1196	1073	2656	1402	1254	1647	1322	284	412	294	365	261	301	299	446	304	669	222	584	0.44	0.36	0.35	0.44	202.0	181.2
3	55.0	44.9	1.41	71.6	108	10.04	580	596	798	808	891	825	2825	1509	1316	3494	1856	1638	2024	1670	284	404	289	356	262	309	301	437	304	739	220	608	0.50	0.40	0.35	0.43	201.6	175.9
4	54.9	44.9	1.20	71.1	91	11.74	443	457	1003	1002	1039	1027	3303	1778	1525	4158	2243	1915	2340	1974	283	394	292	349	262	310	299	438	304	768	220	620	0.55	0.44	0.34	0.40	203.2	174.2
5	55.0	44.9	1.07	71.5	83	13.07	927	941	1202	1203	1231	1232	3682	1989	1693	4768	2579	2189	2635	2231	283	387	293	347	263	310	300	432	302	812	221	613	0.61	0.48	0.32	0.38	204.1	173.7
6	55.0	44.9	0.99	70.5	75	14.33	1045	1063	1403	1403	1439	1434	4031	2174	1857	5302	2868	2434	2948	2487	283	383	292	347	264	310	300	437	304	841	220	654	0.67	0.52	0.31	0.37	203.6	173.9
7	54.9	44.9	0.90	71.1	69	15.55	1111	1130	1603	1604	1638	1634	4346	2361	1985	5783	3151	2632	3237	2700	283	385	298	345	263	309	299	435	304	848	222	642	0.73	0.55	0.30	0.35	203.7	171.3
8	54.9	44.9	0.85	69.3	65	16.45	1287	1306	1802	1804	1838	1841	4661	2533	2129	6270	3423	2847	3493	2897	289	389	299	349	267	316	303	441	305	862	223	695	0.79	0.58	0.29	0.33	206.5	173.6
60 - 50 mi/h																																						
1	59.9	49.9	2.49	72.2	210	5.64	422	391	445	402	547	416	1578	837	741	1842	1021	821	1304	897	291	420	301	398	268	301	300	436	306	599	222	430	0.38	0.31	0.35	0.43	199.2	176.2
2	59.9	49.9	1.80	74.9	150	7.88	558	568	597	605	740	619	2235	1171	1064	2624	1352	1272	1732	1313	289	430	298	385	267	309	300	455	303	725	220	576	0.46	0.35	0.34	0.44	199.3	181.2
3	60.0	49.9	1.43	74.5	121	9.84	651	665	792	792	908	823	2804	1491	1313	3382	1803	1579	1927	1670	288	430	296	370	267	323	301	459	307	790	221	503	0.49	0.40	0.34	0.42	203.4	179.0
4	59.9	49.9	1.22	77.7	101	11.65	725	732	1000	996	1035	1022	3268	1758	1510	4101	2204	1897	2316	1959	288	418	296	366	268	327	299	458	306	823	219	640	0.54	0.43	0.33	0.40	202.4	173.8
5	60.0	49.9	1.08	74.9	92	12.97	1120	1103	1218	1191	1237	1230	3644	1978	1667	4744	2617	2127	2653	2210	290	412	299	368	271	320	300	452	308	853	221	561	0.61	0.47	0.32	0.38	204.5	172.4
6	60.0	49.9	0.99	71.7	84	14.14	1239	1248	1409	1413	1439	1430	4000	2180	1820	5279	2889	2390	2962	2420	293	415	303	363	274	327	300	448	308	866	224	638	0.66	0.51	0.31	0.36	207.0	172.7
7	60.0	49.9	0.92	73.2	78	15.33	1464	1461	1595	1586	1632	1634	4321	2359	1962	5659	3098	2561	3222	2629	296	418	306	369	276	323	299	449	310	889	226	622	0.72	0.54	0.29	0.34	206.5	171.7
8	60.0	49.9	0.86	73.0	73	16.40	1030	1049	1802	1804	1833	1840	4599	2514	2086	6179	3402	2777	3470	2821	299	414	309	366	278	330	299	449	309	886	226	639	0.78	0.57	0.28	0.32	205.7	170.7
65 - 55 mi/h																																						
1	64.9	55.0	2.61	77.4	235	5.42	396	380	432	404	503	416	1531	810	721	1783	965	818	1145	885	299	442	311	414	280	311	298	457	310	643	231	433	0.37	0.31	0.34	0.43	200.8	178.7
2	64.9	55.0	1.84	76.1	167	7.61	519	519	631	605	716	620	2187	1145	1042	2665	1437	1228	1611	1290	301	461	310	408	280	324	299	481	311	786	230	587	0.44	0.35	0.34	0.43	201.8	183.7
3	64.9	55.0	1.46	77.5	133	9.60	702	709	805	796	914	818	2751	1472	1279	3300	1765	1535	1965	1599	299	461	309	394	278	332	301	472	313	845	233	601	0.50	0.39	0.33	0.41	205.8	178.7
4	64.9	55.0	1.23	78.8	112	11.44	802	813	1003	1001	1035	1021	3200	1723	1477	4016	2172	1844	2254	1909	300	444	309	385	280	337	301	466	312	896	231	617	0.55	0.43	0.33	0.39	202.0	173.2
5	64.9	55.0	1.08	78.8	100	12.86	935	947	1203	1202	1236	1223	3618	1963	1655	4627	2520	2107	2644	2154	299	440	310	384	279	336	299	465	312	911	231	576	0.60	0.46	0.32	0.37	204.9	172.8
6	64.9	55.0	1.00	78.7	93	13.81	829	851	1393	1387	1437	1423	3929	2123	1805	5025	2715	2310	2903	2399	300	435	313	380	281	338	298	468	314	922	232	557	0.66	0.50	0.29	0.35	206.3	175.4
7	64.9	55.0	0.93	79.9	85	15.04	1183	1203	1602	1603	1630	1627	4232	2289	1943	5609	3051	2558	3139	2602	300	435	312	376	281	331	299	462	314	945	233	542	0.72	0.54	0.29	0.34	204.2	173.3
8	64.9	55.0	0.86	81.8	80	15.96	1629	1661	1789	1822	1833	1832	4507	2439	2068	6099	3328	2771	3396	2859	301	433	313	372	282	334	296	457	311	929	233	554	0.78	0.57	0.28	0.32	205.0	173.9
BEST EFFORT CHECK STOPS - 1800 lbf/in²																																						
1	54.9	0.5	3.86	85.2	168	19.31	1754	1761	1798	1804	1848	1839	5407	2913	2494	6128	3331	2797	3839	2974	301	584	312	532	282	486	296	616	309	934	231	548	0.79	0.58</				

CYCLE NO.	SPEED		TIME		DIST. STOP	DECEL STOP	PRESSURE					TORQUE					TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA											
	INIT	FNL	STOP	REPT			TO	AVG	AVERAGE	SUSTAINED	MAXIMUM	AVERAGE	SUSTAINED	MAXIMUM	FRONT	I/B	O/B	ROTOR	I/B	O/B	FRONT	I/B	O/B	ROTOR	I/B	O/B	FRONT	REAR	FRONT	REAR	FRONT	REAR						
	mi/h		s		ft	ft/s²	lb/in²					lb ft					F						in³		μ		slug ft²											
SECOND EFFECTIVENESS MATRIX - 450°F																																						
450°F Initial Rotor Temperature																																						
50 - 40 mi/h																																						
1	49.9	39.9	2.57	122.3	175	5.47	384	385	403	400	511	412	1559	870	689	1759	986	773	1281	841	443	554	451	534	405	435	450	559	457	672	335	432	0.36	0.29	0.37	0.41	213.6	169.0
2	49.8	39.9	1.80	47.4	123	7.75	550	563	587	598	708	620	2184	1214	970	2524	1405	1119	1667	1219	443	570	459	534	406	442	449	572	459	815	337	517	0.44	0.34	0.36	0.39	210.2	168.0
3	49.9	39.9	1.47	48.5	101	9.48	704	731	774	803	898	826	2686	1507	1179	3317	1847	1470	2163	1514	445	562	461	527	410	450	449	569	460	879	335	516	0.51	0.38	0.36	0.39	213.2	166.9
4	49.9	39.9	1.26	48.9	87	11.13	794	806	1003	1002	1029	1029	3144	1767	1377	3992	2263	1729	2325	1785	448	557	465	525	414	455	451	565	459	915	334	492	0.54	0.42	0.34	0.36	213.1	166.0
5	49.9	39.9	1.12	49.7	77	12.45	766	772	1201	1196	1237	1229	3559	1997	1563	4603	2611	1992	2688	2051	449	551	467	523	417	458	451	566	458	928	336	474	0.61	0.46	0.33	0.35	215.3	168.4
6	49.9	39.9	1.01	50.2	70	13.80	971	989	1401	1403	1445	1431	3854	2146	1708	5151	2900	2251	2998	2305	450	552	468	525	421	462	450	560	462	927	336	470	0.67	0.50	0.31	0.34	208.7	166.1
7	49.9	39.9	0.92	53.4	64	15.06	915	951	1602	1603	1635	1634	4171	2306	1866	5665	3172	2493	3272	2564	451	547	468	521	419	460	445	564	460	923	338	448	0.73	0.54	0.30	0.33	205.5	166.2
8	49.9	39.9	0.87	52.1	60	16.11	1271	1290	1801	1803	1834	1836	4471	2460	2011	6160	3434	2726	3523	2774	448	538	472	521	422	457	446	559	455	932	341	455	0.79	0.57	0.29	0.32	204.9	167.5
55 - 45 mi/h																																						
1	54.9	44.9	2.67	50.6	201	5.33	390	381	418	403	525	413	1515	809	706	1759	959	800	1180	856	450	561	475	563	423	448	448	572	458	745	342	431	0.37	0.30	0.35	0.42	203.7	177.7
2	54.9	44.9	1.85	54.4	141	7.65	501	501	612	597	710	616	2153	1156	998	2526	1369	1157	1644	1225	450	582	472	558	418	455	447	585	460	834	352	494	0.44	0.35	0.34	0.41	202.8	175.1
3	54.9	44.9	1.47	55.4	111	9.67	740	734	821	806	875	828	2700	1471	1229	3358	1862	1496	1950	1540	450	576	470	547	418	461	451	583	460	882	347	484	0.50	0.39	0.34	0.39	204.1	170.6
4	55.0	44.9	1.25	54.8	96	11.26	809	826	1002	1011	1030	1030	3171	1744	1427	4019	2234	1785	2281	1832	450	568	470	536	419	461	450	582	462	891	347	488	0.55	0.43	0.34	0.37	207.7	170.0
5	55.0	44.9	1.12	56.3	86	12.54	818	838	1194	1192	1230	1231	3574	1976	1598	4612	2582	2030	2659	2101	450	566	473	535	423	470	451	577	463	916	344	462	0.61	0.47	0.33	0.36	211.4	171.0
6	55.0	44.9	1.02	56.6	78	13.85	1055	1070	1402	1402	1431	1436	3936	2175	1761	5202	2906	2296	2986	2361	450	565	473	530	424	469	447	574	457	915	347	467	0.67	0.50	0.31	0.34	210.7	170.6
7	55.0	44.9	0.94	57.9	73	14.84	1414	1413	1608	1596	1633	1640	4226	2329	1897	5644	3148	2496	3293	2594	449	560	473	529	422	466	445	577	455	949	347	467	0.73	0.54	0.30	0.33	210.6	171.5
8	55.0	44.9	0.87	59.2	68	15.98	1496	1514	1807	1817	1829	1843	4493	2464	2029	6158	3399	2759	3535	2818	451	556	472	525	427	462	443	570	456	974	346	469	0.80	0.57	0.28	0.32	206.8	170.3
60 - 50 mi/h																																						
1	60.0	49.9	2.74	58.7	226	5.29	352	355	403	398	525	414	1488	789	699	1612	859	753	1169	856	450	568	474	565	425	451	440	579	456	755	347	449	0.38	0.31	0.32	0.40	200.2	177.4
2	59.9	49.9	1.89	58.0	158	7.50	552	557	602	602	704	616	2122	1134	988	2479	1337	1142	1582	1219	450	598	475	564	423	463	445	592	457	837	353	504	0.44	0.35	0.34	0.40	203.0	176.7
3	59.9	49.9	1.50	59.0	126	9.40	706	731	778	803	896	821	2665	1455	1210	3220	1753	1467	1998	1523	449	592	474	555	423	472	450	595	461	892	348	503	0.51	0.39	0.34	0.38	207.7	172.7
4	59.9	49.9	1.26	62.0	106	11.12	885	903	1004	1001	1055	1023	3153	1741	1412	3975	2219	1756	2284	1818	448	587	474	540	424	476	447	586	458	917	349	492	0.56	0.43	0.33	0.37	210.1	170.4
5	59.9	49.9	1.13	62.0	95	12.50	977	991	1206	1208	1232	1221	3545	1959	1585	4532	2511	2021	2688	2066	448	583	474	540	424	474	445	583	457	928	347	494	0.61	0.46	0.31	0.35	210.3	170.2
6	59.9	49.9	1.02	62.6	85	13.93	999	1014	1402	1403	1440	1432	3886	2129	1757	5149	2850	2299	2965	2369	451	574	473	533	428	477	444	585	458	966	351	487	0.67	0.50	0.31	0.35	205.1	169.3
7	59.9	49.9	0.94	63.7	79	14.94	1401	1416	1604	1613	1630	1638	4208	2291	1917	5671	3122	2549	3219	2582	451	565	473	533	428	469	444	581	454	983	350	478	0.73	0.54	0.29	0.33	205.7	172.1
8	59.9	49.9	0.87	63.2	74	15.87	1297	1318	1801	1805	1821	1841	4430	2400	2030	6099	3343	2756	3452	2841	452	559	472	529	429	470	442	583	456	1008	350	470	0.79	0.57	0.28	0.32	202.9	171.7
65 - 55 mi/h																																						
1	64.9	55.0	2.78	63.5	251	5.08	370	378	395	400	517	415	1438	758	680	1579	832	747	1116	826	449	582	476	570	427	455	440	587	455	771	351	424	0.37	0.34	0.32	0.39	200.1	179.7
2	64.9	55.0	1.87	64.4	171	7.47	550	555	601	601	711	617	2090	1116	974	2411	1290	1121	1561	1198	451	616	474	570	423	465	446	604	456	863	353	469	0.45	0.35	0.32	0.39	200.4	175.0
3	64.9	55.0	1.52	64.0	138	9.26	719	725	804	801	896	819	2636	1429	1207	3184	1741	1443	2007	1508	448	601	473	556	425	478	444	603	458	927	350	490	0.51	0.39	0.33	0.38	207.0	174.9
4	64.9	55.0	1.28	66.5	118	10.82	885	898	1001	996	1029	1019	3098	1682	1416	3768	2045	1723	2201	1794	450	589	474	548	425	477	444	604	457	952	352	522	0.54	0.43	0.31	0.36	208.5	175.5
5	64.9	55.0	1.13	67.6	104	12.25	944	957	1203	1202	1223	1220	3464	1882	1581	4458	2437	2021	2538	2068	449	579	474	540	428	475	443	598	457	978	347	500	0.60	0.46	0.31	0.35	206.2	173.2
6	64.9	55.0	1.03	67.1	94	13.49	961	980	1402	1406	1438	1420	3818	2058	1760	4963	2673	2290	2844	2343	450	574	476	541	425	479	443	598	455	1003	351	501	0.67	0.50	0.29	0.34	204.7	175.1
7	65.0	55.0	0.95	66.6	87	14.73	1261	1287	1602	1602	1628	1627	4144	2220	1923	5497	2971	2526	3107	2591	449	571	475	539	425	474	440	599	457	1031	353	498	0.73	0.54	0.28	0.33	202.2	175.1
8	64.9	55.0	0.89	67.8	83	15.39	1214	1229	1802	1804	1827	1828	4375	2333	2042	5969	3213	2756	3334	2833	448	567	475	531	425	471	437	600	457	1043	353	490	0.80	0.57	0.27	0.32	203.4	178.0
BEST EFFORT CHECK STOPS - 1800 lbf/in²																																						
1	55.0	0.5	4.19	70.0	179	18.14	1733	1744	1798	1807	1829	1845	5075	2665	2410	5686	2989	2697	3252	2874	449	694	476	684	426	609	442	731	455	1050	353	429	0.80	0.58	0.25	0.31	197.1	178.2
2	54.9	0.5	3.98	138.7	169	19.22	1720	1727	1800	1804	1825	1841	5392	2894	2498	5936	3154	2782	3694	299																		

Test Numbers: M20-063-23 / M20-064-06

Report Number: 203145-1

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

CYCLE	SPEED		TIME		DIST.	DECEL	PRESSURE				TORQUE						TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA											
	INIT	FNL	STOP	REPT			TO	AVG	AVERAGE		SUSTAINED		MAXIMUM		AVERAGE			SUSTAINED			MAXIMUM			ROTOR	I/B	O/B	ROTOR	I/B	O/B	MAXIMUM	SUSTAINED	FRONT	REAR					
	NO.				STOP	DIST	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	FRONT	REAR	FRONT	REAR	FRONT	REAR		
	mi/h		s		ft	ft/s ²	lb/in ²				lb ft						F						in ³		μ		slug ft ²											
SECOND REBURNISH																																						
40 mi/h - 0.37g Deceleration Rate - 200°F Initial Rotor Temperature or 1 Mile Distance																																						
1	39.8	0.5	5.17	0.0	168	10.18	1002	1024	1192	1199	1314	1325	2869	1653	1216	3355	1971	1384	2045	1493	202	327	218	435	189	348	188	319	183	315	181	349	0.61	0.50	0.25	0.24	217.9	160.3
5	39.9	0.5	5.12	28.6	162	10.53	709	717	720	726	914	944	2959	1701	1259	3394	2004	1390	2101	1523	196	371	200	401	171	305	192	367	171	568	132	595	0.54	0.42	0.42	0.40	216.7	160.4
10	39.9	0.5	5.10	101.6	162	10.62	621	636	694	696	854	886	2978	1699	1279	3393	1950	1443	2071	1508	237	420	241	417	215	356	223	377	214	602	181	599	0.52	0.42	0.42	0.44	214.7	161.6
15	39.9	0.5	5.09	101.6	161	10.64	576	593	681	680	837	876	2989	1701	1287	3387	1953	1434	2051	1546	243	418	247	412	219	355	229	391	224	540	189	653	0.52	0.42	0.43	0.44	214.6	162.3
20	39.9	0.5	5.11	101.5	161	10.64	645	648	655	655	834	870	2988	1698	1290	3382	1945	1437	2036	1520	246	419	247	401	221	363	226	389	221	513	201	656	0.52	0.42	0.45	0.46	214.2	162.7
25	39.9	0.5	5.10	101.4	161	10.63	693	702	704	712	837	868	2992	1692	1301	3379	1933	1446	2051	1552	245	414	249	389	220	362	226	396	221	524	202	668	0.52	0.42	0.41	0.43	213.4	164.1
30	39.9	0.5	5.09	101.4	161	10.67	721	731	737	745	834	870	3000	1676	1324	3379	1889	1490	2030	1573	243	406	244	372	220	355	231	400	225	555	199	676	0.52	0.42	0.39	0.42	210.8	166.5
35	40.0	0.5	5.08	101.4	161	10.66	672	680	682	686	836	876	2993	1654	1339	3402	1897	1505	2030	1623	238	400	240	352	215	351	230	406	227	575	205	659	0.52	0.42	0.42	0.46	208.2	168.5

Test Numbers: M20-063-23 / M20-064-06

Report Number: 203145-1

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

CYCLE NO.	SPEED		TIME		DIST.	DECEL	PRESSURE						TORQUE						TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA									
	INIT	FNL	STOP	REPT			TO	AVG	AVERAGE		SUSTAINED		MAXIMUM		AVERAGE			SUSTAINED			MAXIMUM			ROTOR	I/B	O/B	ROTOR	I/B	O/B	MAXIMUM	SUSTAINED	FRONT	REAR					
	mi/h		s		ft	ft/s ²	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	FRONT	REAR	FRONT	REAR	FRONT	REAR		
THIRD REBURNISH																																						
40 mi/h - 0.37g Deceleration Rate - 200°F Initial Rotor Temperature or 1 Mile Distance																																						
1	39.9	0.5	5.13	88.9	168	10.18	1002	1024	1192	1199	1314	1325	2869	1653	1216	3355	1971	1384	2045	1493	202	327	218	435	189	348	188	319	183	315	181	349	0.61	0.50	0.25	0.24	217.9	160.3
5	39.9	0.5	5.13	101.2	162	10.58	768	778	805	810	856	863	2970	1730	1240	3370	1992	1378	2033	1467	249	405	249	357	222	361	218	368	213	334	212	303	0.49	0.33	0.37	0.36	219.4	157.2
10	39.9	0.5	5.11	101.3	162	10.58	627	647	755	757	844	858	2978	1716	1262	3399	1953	1446	2007	1508	260	420	262	366	231	376	223	386	219	339	218	313	0.48	0.33	0.39	0.40	217.6	160.0
15	39.9	0.5	5.12	101.2	162	10.60	726	731	738	740	853	876	2974	1688	1285	3370	1906	1464	2024	1579	257	420	262	367	231	372	224	409	220	344	220	323	0.49	0.33	0.39	0.42	213.7	162.6
20	40.0	0.5	5.11	101.2	161	10.63	649	672	753	762	841	884	2983	1685	1298	3376	1915	1461	1977	1585	257	422	261	369	232	377	224	421	222	345	221	329	0.48	0.33	0.38	0.40	212.7	163.8
25	39.9	0.5	5.11	101.2	162	10.60	688	699	736	740	845	878	2982	1671	1311	3373	1903	1470	1965	1582	256	420	260	369	230	375	224	430	222	349	221	339	0.48	0.33	0.39	0.42	211.5	165.9
30	39.9	0.5	5.12	101.1	161	10.61	659	675	741	747	850	871	2980	1668	1312	3390	1906	1484	1956	1599	253	420	260	372	229	377	226	433	219	348	223	343	0.48	0.33	0.39	0.42	210.9	165.9
35	39.9	0.5	5.10	101.2	161	10.67	593	620	752	758	850	861	2987	1671	1316	3399	1912	1487	1965	1611	255	419	260	375	230	379	224	416	221	347	219	344	0.47	0.33	0.38	0.41	210.1	165.6



**Brake Performance Study Attachment 3: Dynamometer Testing Report: Downhill Braking
Simulation Test– 2001 Ford Excursion with Limousine Conversion, 8600 lbs**

Schoharie, NY

HWY19H001

NATIONAL TRANSPORTATION SAFETY BOARD SCHOHARIE, NY DOWNHILL BRAKING SIMULATION TEST

Client NTSB Acquisition and Lease Management Division
490 L'Enfant Plaza East SW
Washington, DC 20594-0003

Report Number 203145-2
(8,600 lb GVW)

Vehicle Simulated 2001 Ford Excursion with Limousine Conversion

Front Lining Edge Code MPV 2000-EE

Rear Lining Edge Code MPV 2000-EE

Test Completion Date 20 March 2020

Signature

Kevin C. Machus, Test Engineer
for Greening Testing Laboratories, Inc.

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NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

Test Numbers	M20-064-07
Test Program Number	3947.01.20V02 - 2001 FORD EXCURSION.TST
Vehicle System Simulated	2001 Ford Excursion with Limousine Conversion
Reference	Contract No. 9531BM20P0015
Test Date(s)	20 March 2020
Date Test Report Prepared	27 March 2020
Test Report Prepared By	K. Machus
Gross Vehicle Weight	8,600 lbs (per NTSB)
Static Rolling Radius	16.1 inches (based on revolutions per mile of LT265/75R16D tires)
Test Inertia (without loss)	240.4 slug·ft ²
Parasitic Loss	3.0% (based on vehicle measurements)
Test Inertia (with loss)	233.2 slug·ft ²
Equivalent 1/2 Vehicle Weight	4,172 lbs

	Front Disc Brake	Rear Disc Brake
Lining Edge Code	MPV 2000-EE	MPV 2000-EE
Brake Pad Part Number	Motorcraft BR1266	Motorcraft BR1275
Brake Pad FMSI® Number	7625-D756	7626-D757
Brake Configuration	dual piston, separate function caliper disc brake	dual piston, separate function caliper disc brake
Piston Diameter(s)	2 x 54 mm	2 x 46 mm
Rotor Part Number	Ford 1G3Z-1V102-AB	Ford YC3Z-2C026-BB
Brake Size (nominal) Rotor Diameter x Thickness	13.0 x 1.5 inches	12.8 x 1.2 inches
Rotor Mass (nominal)	20.7 kg	10.9 kg
Rotor Effective Radius	5.599 inches	5.529 inches
Wheel Rotation	right hand	left hand
Test Fixture	096622	190316
Date Parts Received	16 January 2020	16 January 2020

*NOTE: Parts were previously used on Grade Simulation shake down tests.

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

DATA NOTES

- 1 All average and sustained values shown in this report are calculated with respect to **DISTANCE**.
- 2 The data presented in this report has been gathered as follows:
 - START Threshold = 50 lbf·ft of brake torque during brake apply.
 - AVERAGE = average value between START and STOP Threshold levels.
 - INITIAL Data Point = Values are taken at the point where the control level is achieved.
 - SUSTAINED Data = average value between the INITIAL and END data points.
 - END Data Point = Values are taken 0.1 seconds prior to the STOP threshold
 - MAXIMUM = maximum value observed in the SUSTAINED Data Interval.
 - STOP Threshold = brake release
 - FINAL temperature is the highest temperature value observed in a 4.0 second "window" beginning 1.0 seconds after brake release.
- 3 Brake application is initiated when the control temperature (rotor) reaches the desired initial brake temperature.
- 4 Cooling Air Temperature = 80°F (±5°F)
- 5 Cooling Air Velocity = 20 mi/h for front brake, 2 mi/h for rear brake as determined by cooling curves conducted on a 2001 Ford Expedition.
- 6 For all stops which show "zero" (0) or negative values for some of the computed pressure, torque or coefficient values:

These stops achieved final speed but did not achieve the torque level required for the particular stop. Since the START data and STOP data thresholds were satisfied, deceleration rate, distance, time to stop, etc., are accurate values, and can be used for data comparison purposes.

The presence of "zero" values generally is caused by lack of brake performance, resulting in a "clamp" condition. "Clamp" condition is defined by the brake calling for the maximum pressure the test section allows ("clamp" pressure) and the brake being unable to attain the deceleration rate required in the test section at that pressure.
- 7 Thermocouple locations and depths:
 - Front Rotor: Center of inboard rubbing track at a depth of 0.040 inches
 - Front Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches
 - Front Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches
 - Rear Rotor: Center of inboard rubbing track at a depth of 0.040 inches
 - Rear Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches
 - Rear Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

COMPUTED DATA DESCRIPTIONS

SPEED

INIT = Speed start threshold is achieved.

FNL = Brake release speed

TIME

STOP = Time elapsed between start threshold and brake release

REPT = Time elapsed between cycles

DISTANCE

STOP = Distance elapsed between start threshold and brake release

REPT = Distance elapsed between cycles

DECEL

AVG = Average deceleration measured from start threshold to brake release

PRESSURE

AVERAGE = Average pressure from start threshold to brake release

SUSTAINED = Average pressure from point control level is achieved to brake release

MAXIMUM = Maximum pressure from start threshold to brake release

TORQUE

AVERAGE = Average torque from start threshold to brake release

SUSTAINED = Average torque from point control level is achieved to brake release

MAXIMUM = Maximum torque from start threshold to brake release

TEMPERATURE

INT = Temperature at start threshold

MAX = Maximum temperature between start threshold and 0.1 seconds after brake release

FLUID DISPLACEMENT

MAX = Maximum fluid displacement between start threshold and brake release

FRICITION COEFFICIENT

SUST = Friction coefficient (μ) calculated using the following formula:

$$\mu = \frac{\text{Sustained Torque (lbf}\cdot\text{ft)} / \text{Rotor Effective Radius (ft)}}{\text{Sustained Pressure (lbf/in}^2\text{)} * \text{Total Caliper Piston Area (in}^2\text{)}} * 0.5$$

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

TEST ROUTE - NEW AMSTERDAM TO SCHOHARIE NEW YORK

Cycle	Mile	Latitude (GPS)	Longitude (GPS)	Altitude (ft)	Grade Input (%g)	Braking Deceleration (g)	Apply Speed (mi/h)	Release Speed (mi/h)
0	0.0	42.94908	-74.18265	574.1	--	--	--	--
1	10.8	42.94409	-74.35478	293.3	-0.14%	0.2	60	30
2	11.1	42.94722	-74.35869	296.3	0.21%	0.2	30	20
3	11.2	42.94865	-74.35809	288.1	-1.69%	0.2	20	0
4	11.7	42.94957	-74.36914	287.4	0.28%	0.2	40	0
5	14.6	42.91169	-74.35237	469.5	0.40%	0.2	55	40
6	15.6	42.89860	-74.34632	647.3	5.20%	0.2	55	35
7	15.7	42.89696	-74.34592	666.0	0.80%	0.2	35	15
8	17.0	42.87979	-74.34609	802.8	0.90%	0.2	55	40
9	17.7	42.86949	-74.34253	871.7	5.27%	0.2	55	50
10	18.4	42.86000	-74.33732	1016.7	3.88%	0.2	50	40
11	20.4	42.83745	-74.35430	1200.1	1.12%	0.2	55	40
12	21.8	42.82276	-74.33815	1259.2	1.09%	0.2	55	30
13	22.6	42.81189	-74.33648	1295.6	-1.10%	0.2	55	40
14	24.5	42.78596	-74.33829	1284.1	0.19%	0.2	55	40
15	25.3	42.77450	-74.33766	1075.5	-4.69%	0.2	55	40
16	25.7	42.76815	-74.33585	955.1	-5.45%	0.2	45	0
17	26.5	42.75714	-74.33045	681.8	-10.46%	0.2	45	0
18	29.4	42.71859	-74.33721	676.2	0.59%	0.2	55	40
19	30.4	42.70533	-74.33539	633.2	2.50%	0.2	40	0
20	31.5	42.71097	-74.31464	681.4	3.31%	0.2	55	0
21	33.6	42.71540	-74.27608	1183.4	4.71%	0.2	55	0
2 MINUTE STOP - BRAKES RELEASED								
22	33.9			1078.1	-5.92%	0.2	60	55
23	34.0			1033.7	-5.92%	0.2	60	55
24	34.2			989.3	-5.92%	0.2	60	55
25	34.3			944.9	-5.92%	0.2	60	55
26	34.5			900.6	-5.92%	0.2	60	55
27	34.6			856.2	-5.92%	0.2	60	55
28	34.8			811.8	-5.92%	0.2	60	55
29	34.9			767.4	-5.92%	0.2	60	55
30	35.0			723.1	-5.92%	0.2	60	55
31	35.2	42.70259	-74.29994	678.5	-5.95%	0.2	60	55
32	35.4	42.70043	-74.30176	628.3	-5.40%	0.2	50	0

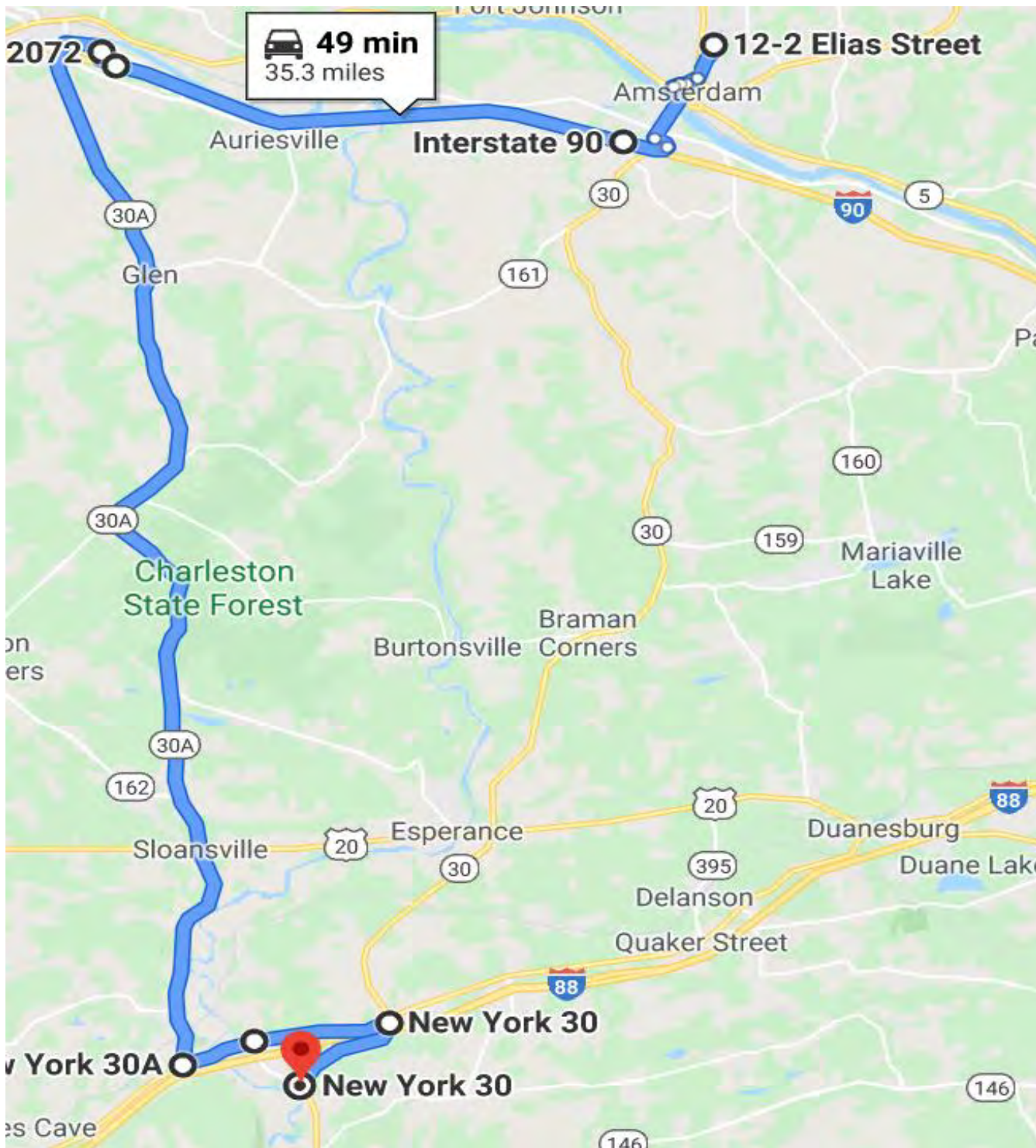
*NOTE: Test route was derived using the following criteria:

Speed limit and warning speeds were identified along the simulated route and used to control speed in the simulations. At Stop signs and controlled signalized intersections along the simulated route complete stops were modeled. At last stop before the final downhill descent a completed stop of 2 minutes was modeled. During downhill descents if the speed exceeded the posted speed limit by 5 mph braking at a maximum of 0.2 g was applied to reduce the speed to the speed limit.

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

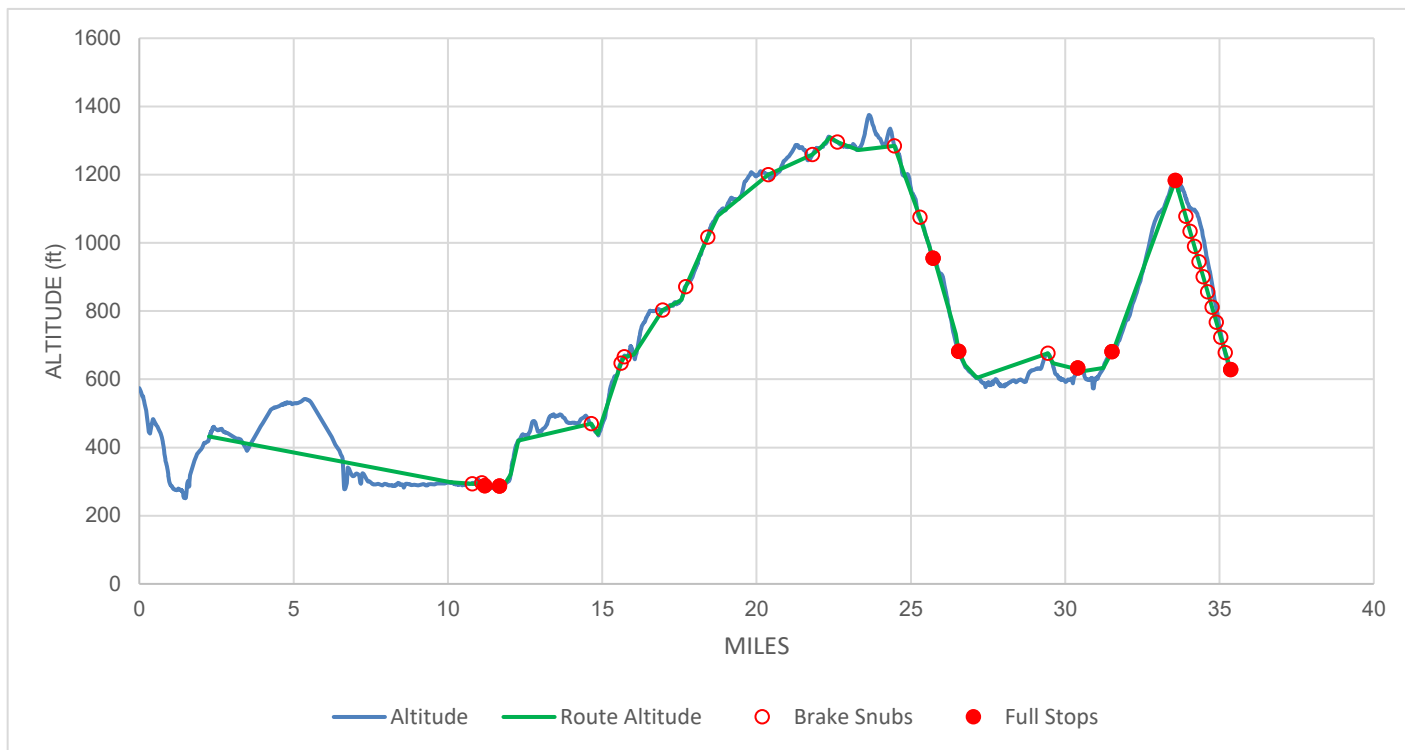
TEST ROUTE - OVERVIEW MAP



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

TEST ROUTE - PROFILE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

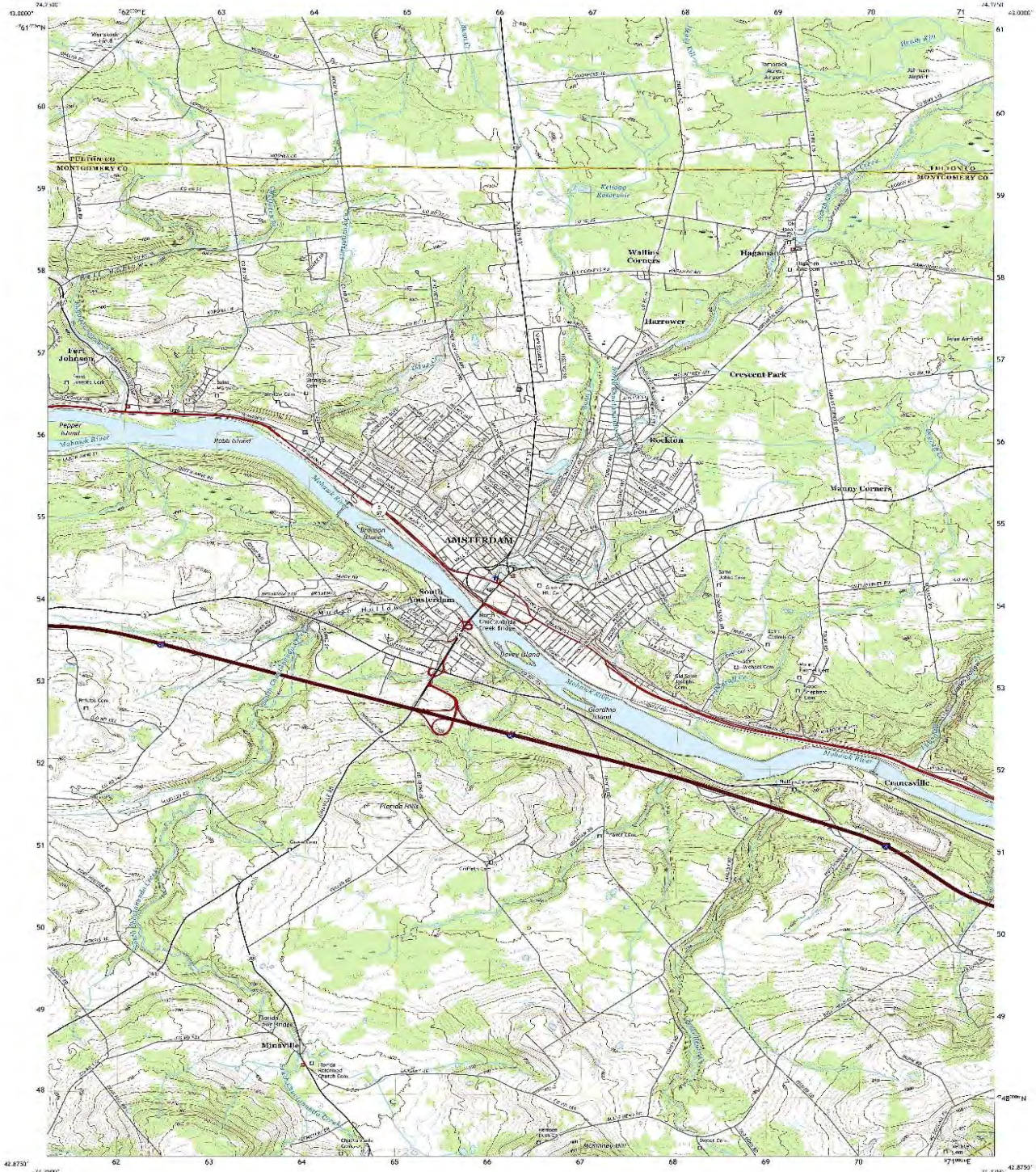
TEST ROUTE - AMSTERDAM QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



AMSTERDAM QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

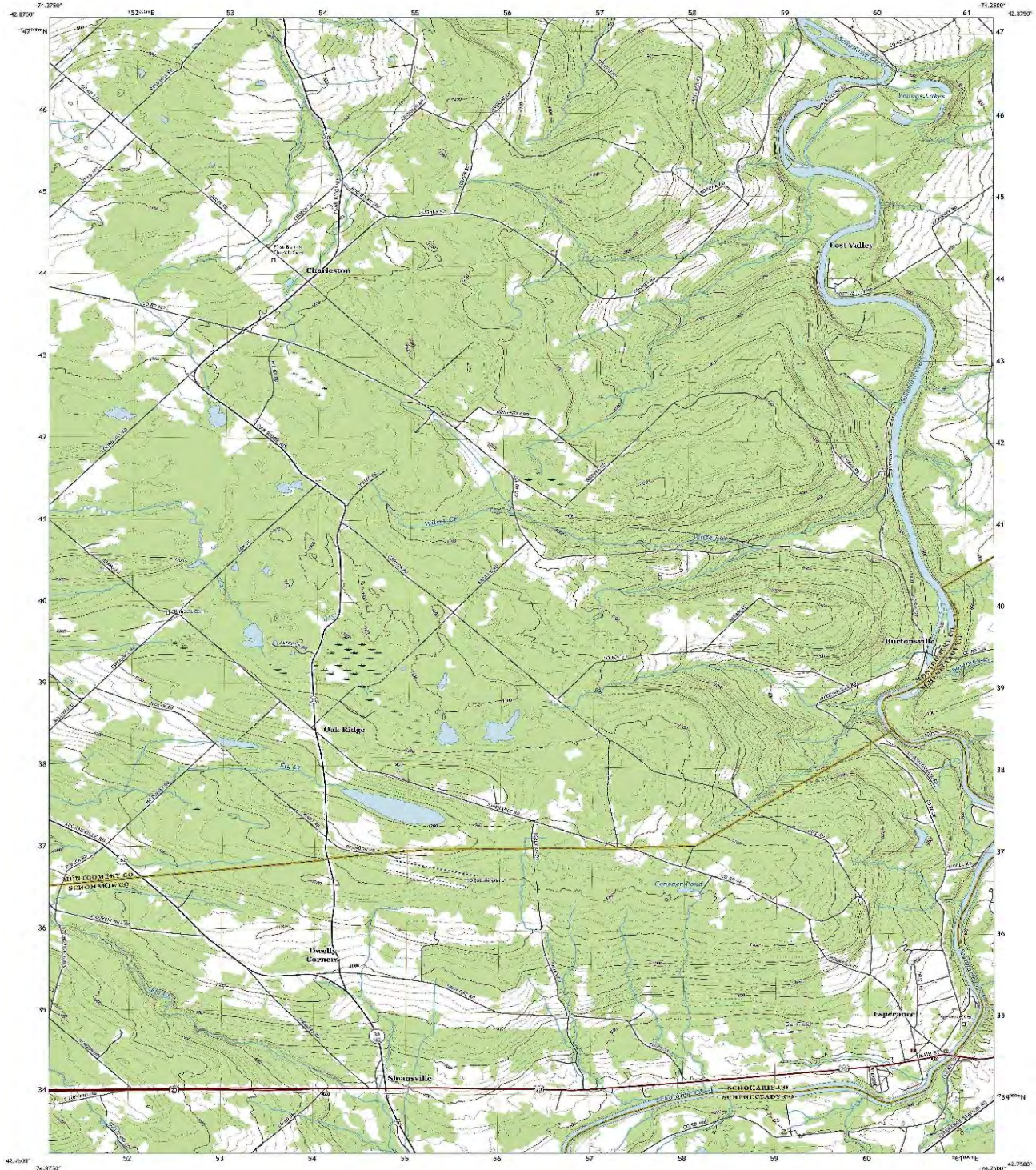
TEST ROUTE - ESPERANCE QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



ESPERANCE QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

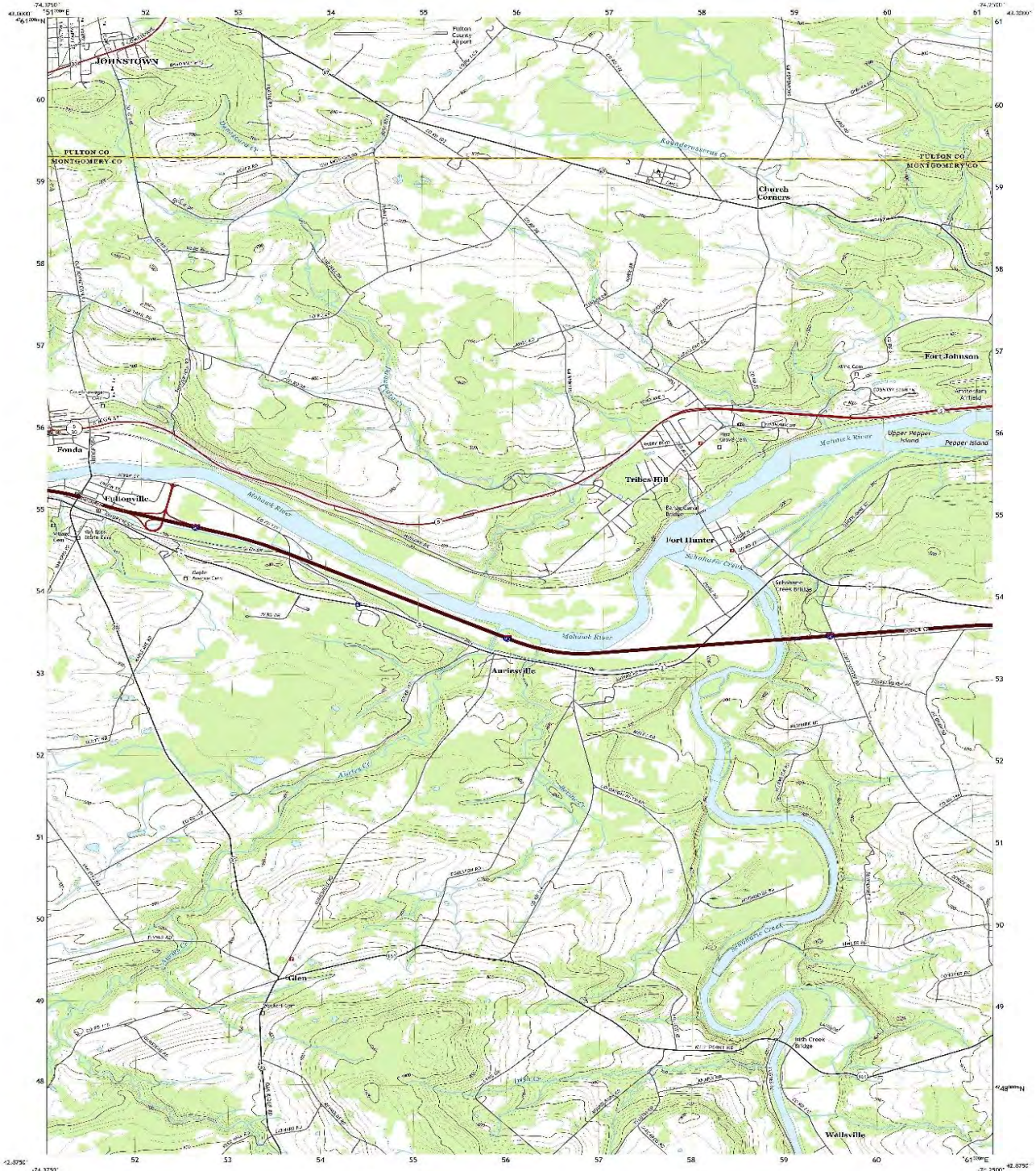
TEST ROUTE - TRIBES HILL QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



TRIBES HILL QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

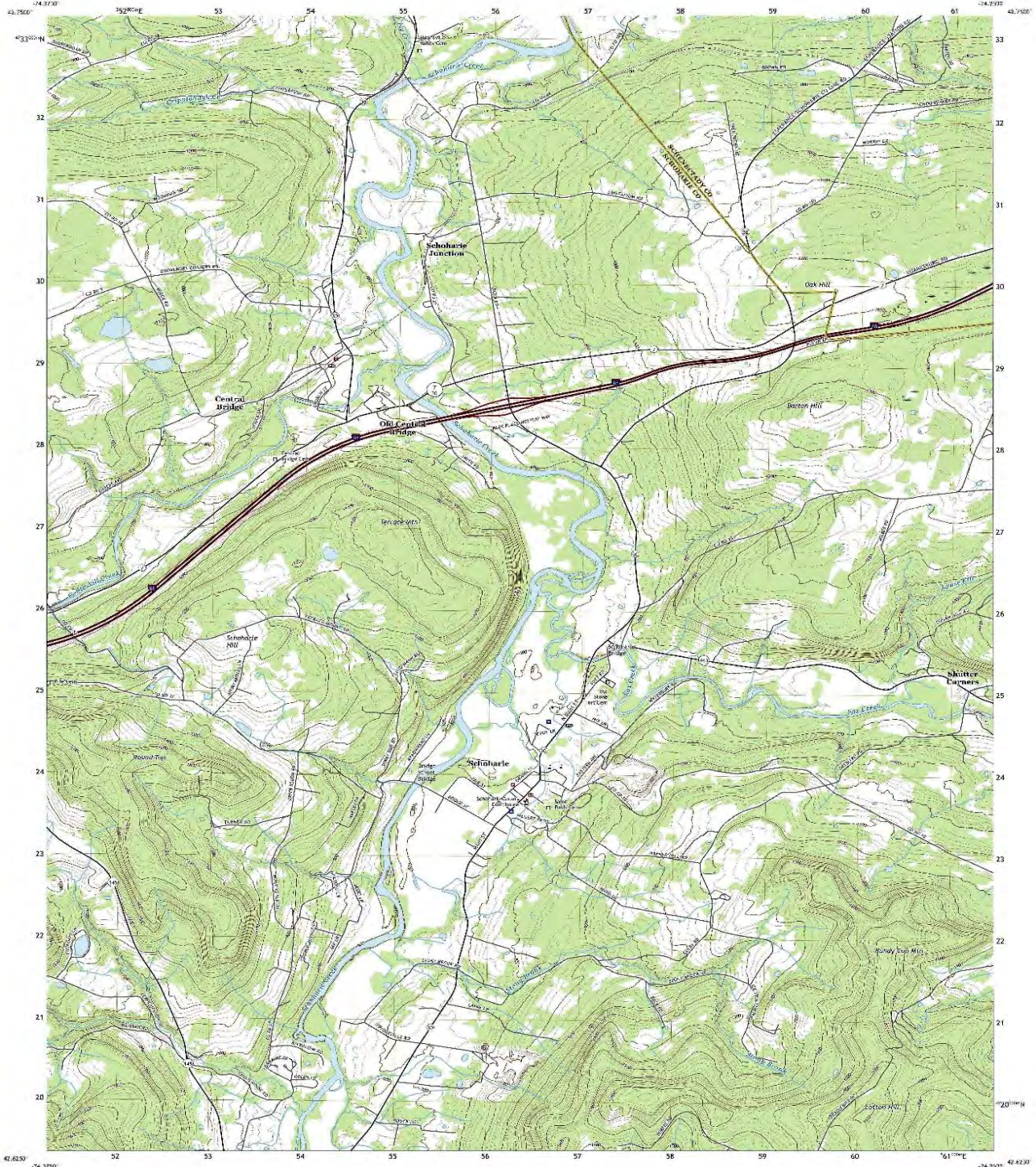
TEST ROUTE - SCHOHARIE QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



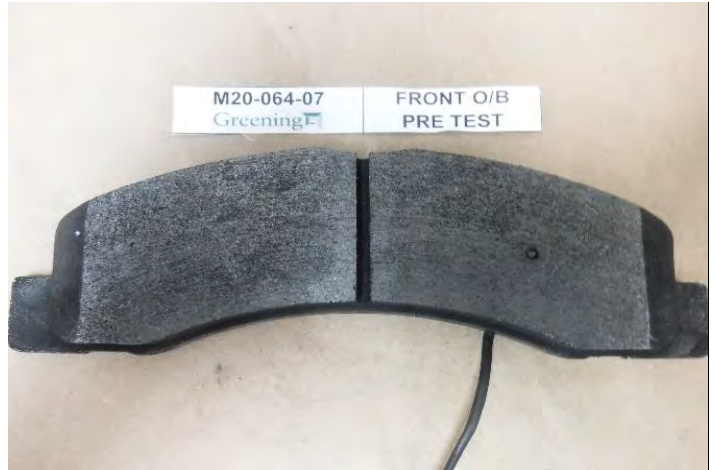
SCHOHARIE QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

PRE TEST PHOTOGRAPHS - FRONT BRAKE



Test Numbers: M20-064-07

Report Number: 203145-2

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

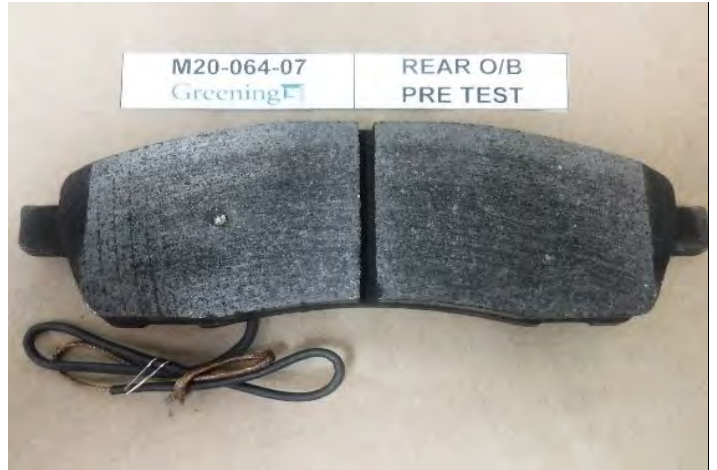
NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

PRE TEST PHOTOGRAPHS - REAR BRAKE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

POST TEST VISUAL INSPECTION - FRONT BRAKE

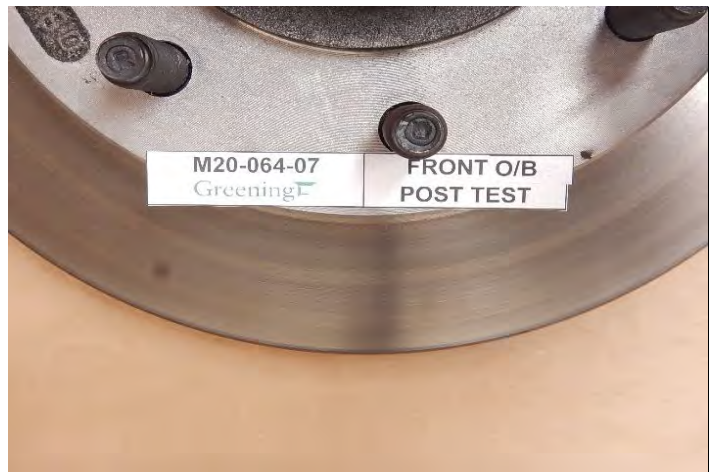
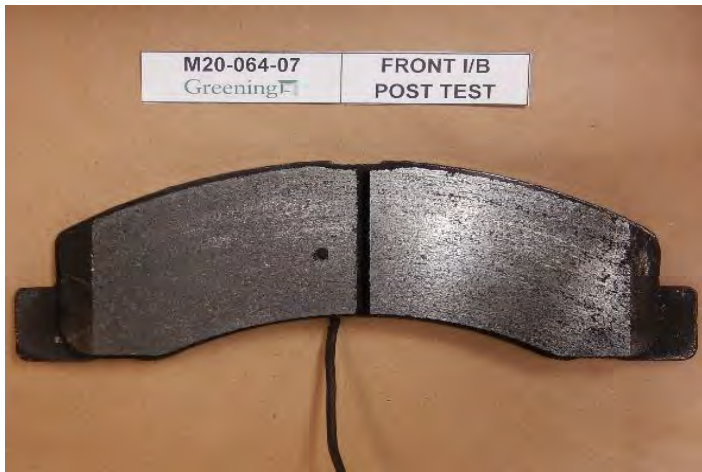
Inboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is blue/grey in color.

All other test hardware appears in good condition.

PHOTOGRAPHS



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

POST TEST VISUAL INSPECTION - REAR BRAKE

Inboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

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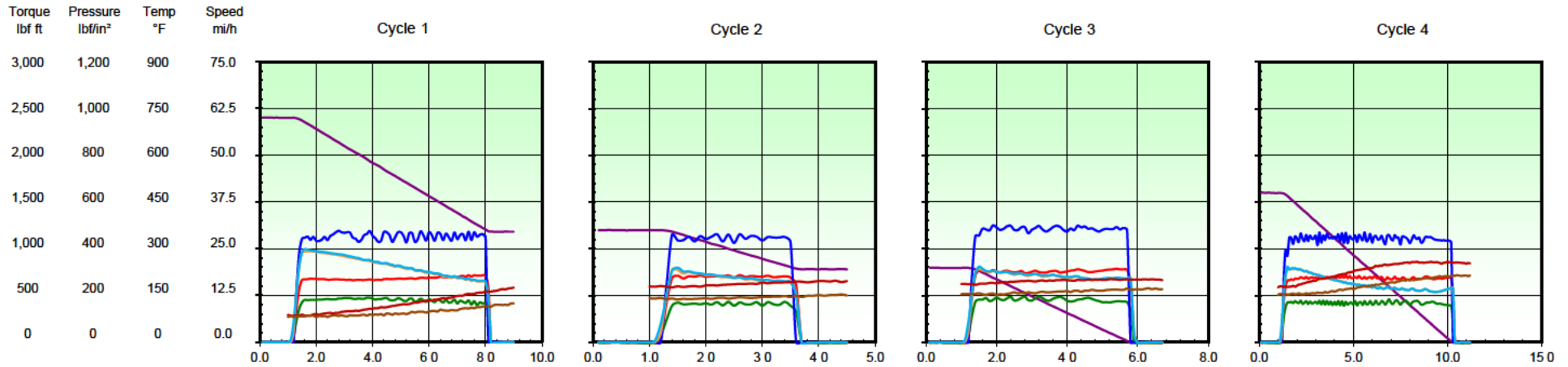
PHOTOGRAPHS



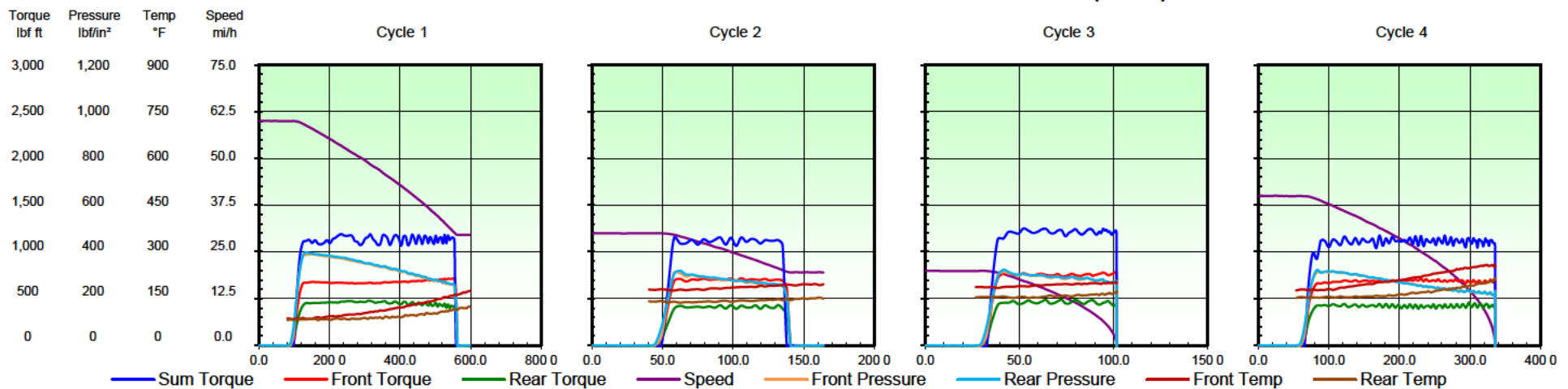
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GWW

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-07

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

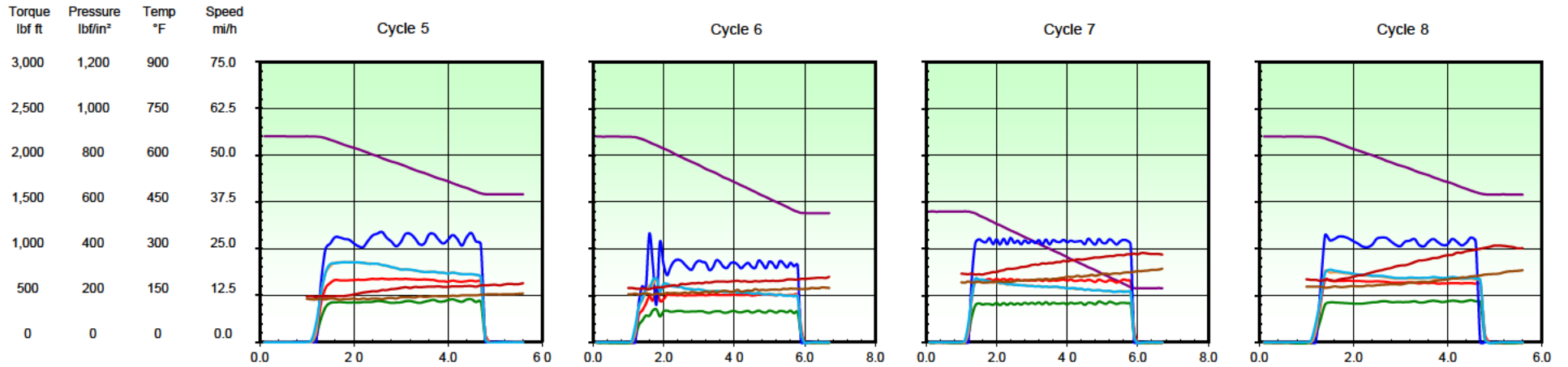
Report Number: 203145-2

Test Report Date: 20 March 2020

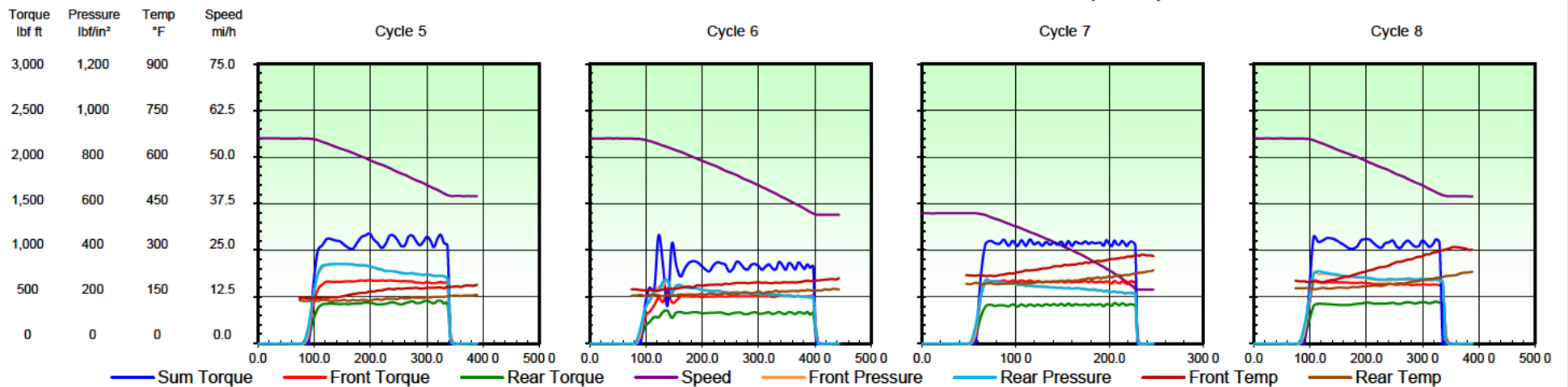
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GWW

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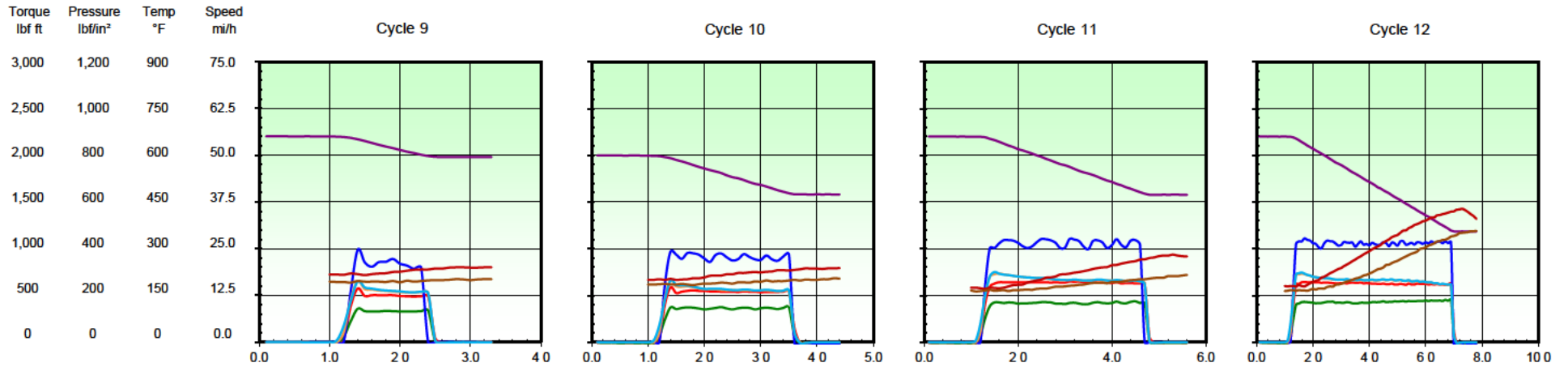
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Test Report Date: 20 March 2020

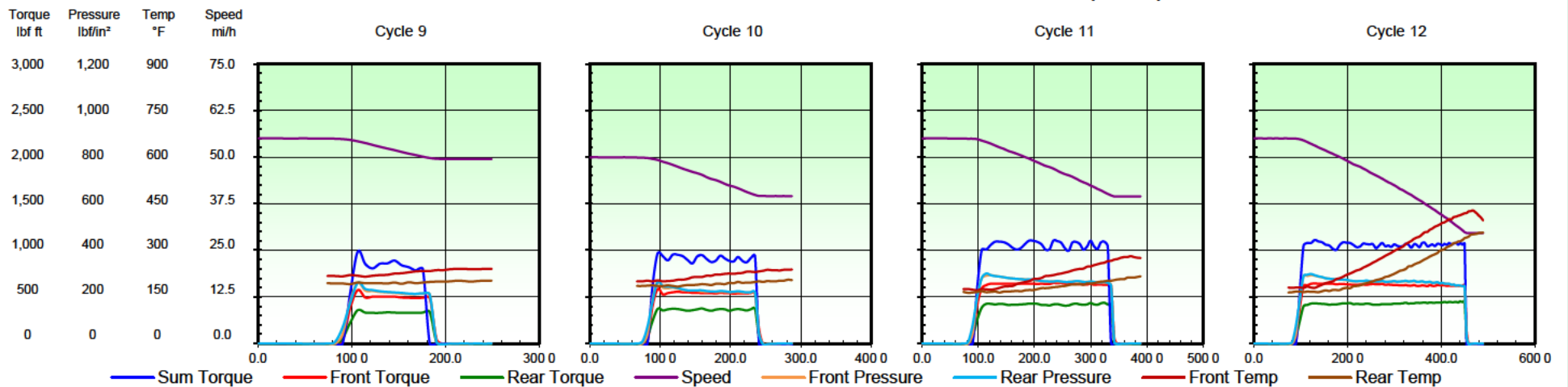
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GWW

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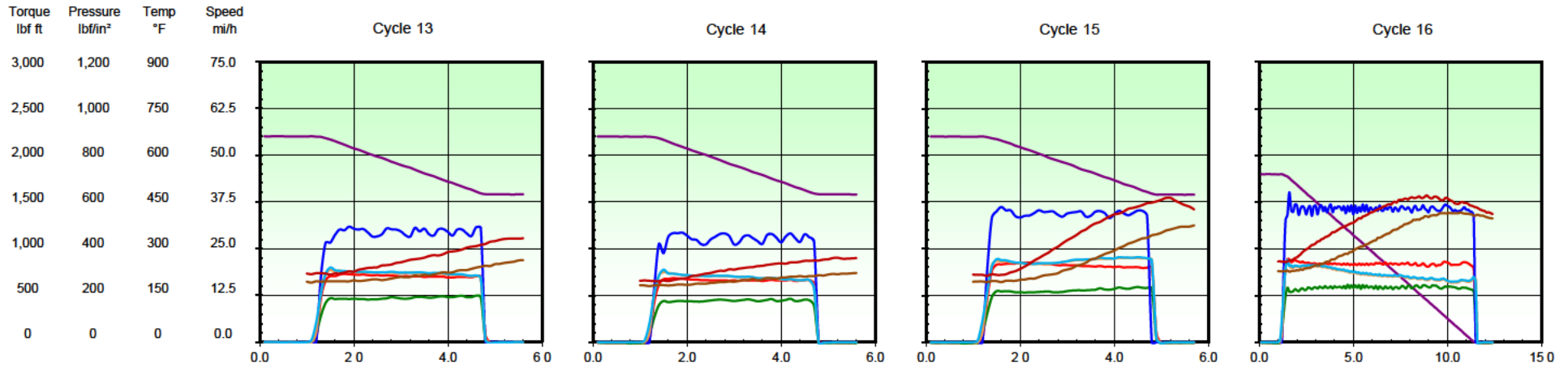
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Test Report Date: 20 March 2020

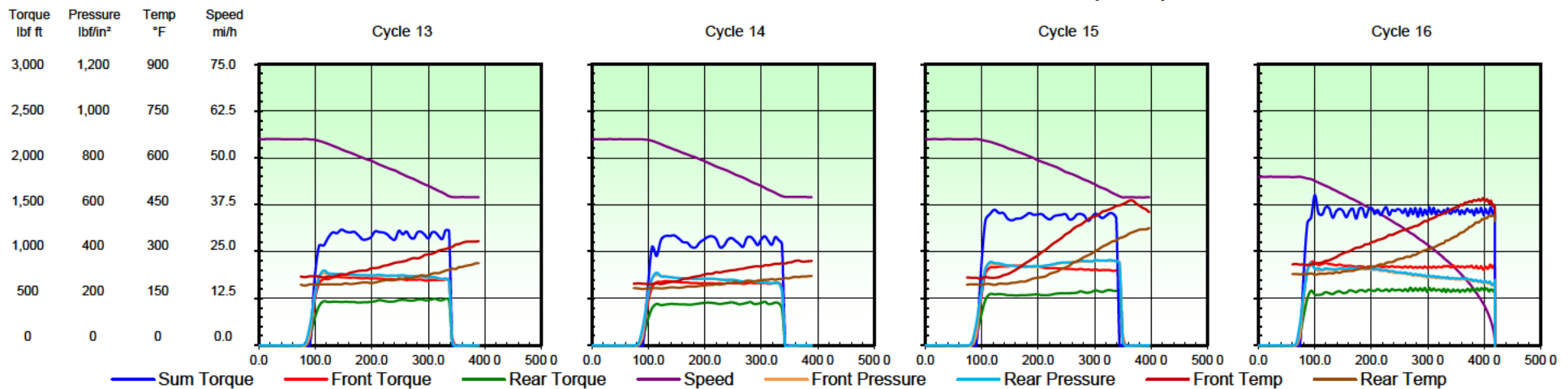
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GWW

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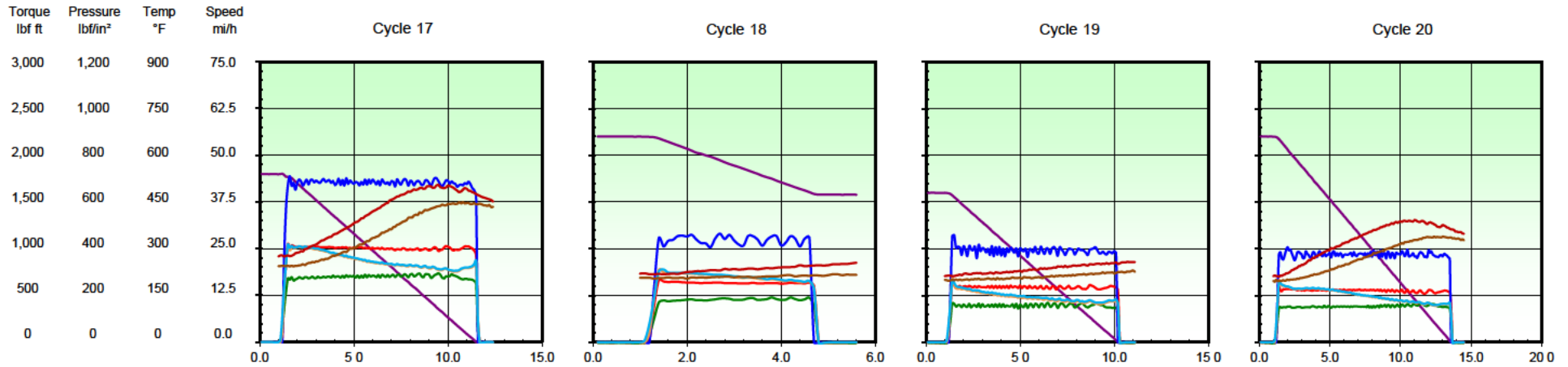
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Test Report Date: 20 March 2020

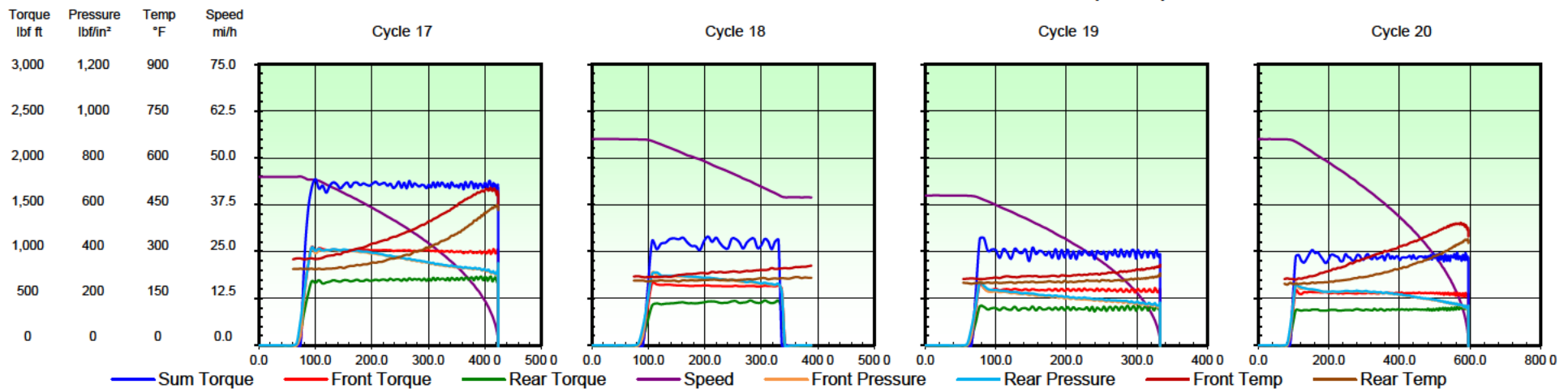
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

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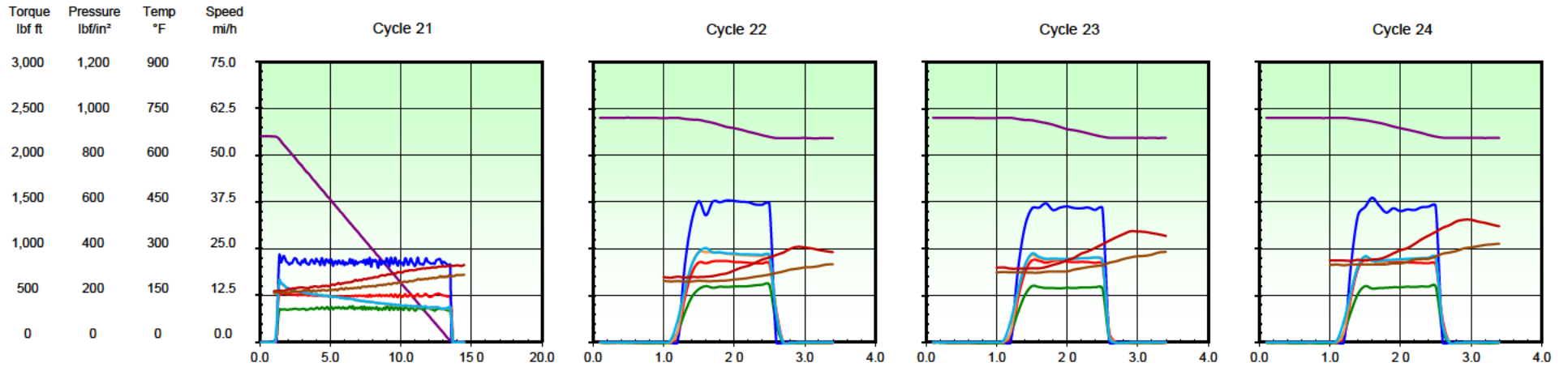
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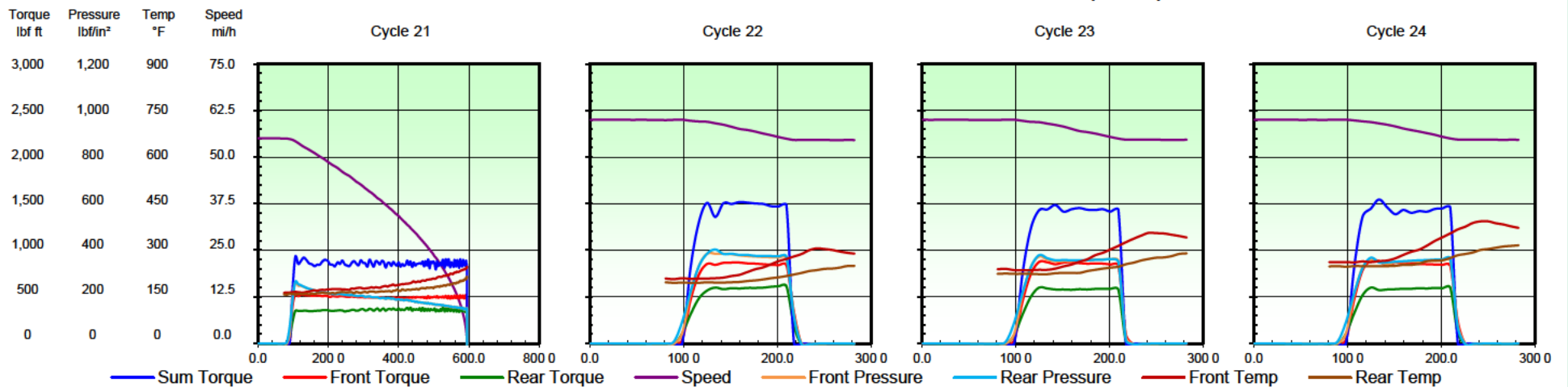
Report Number: 203145-2

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NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW
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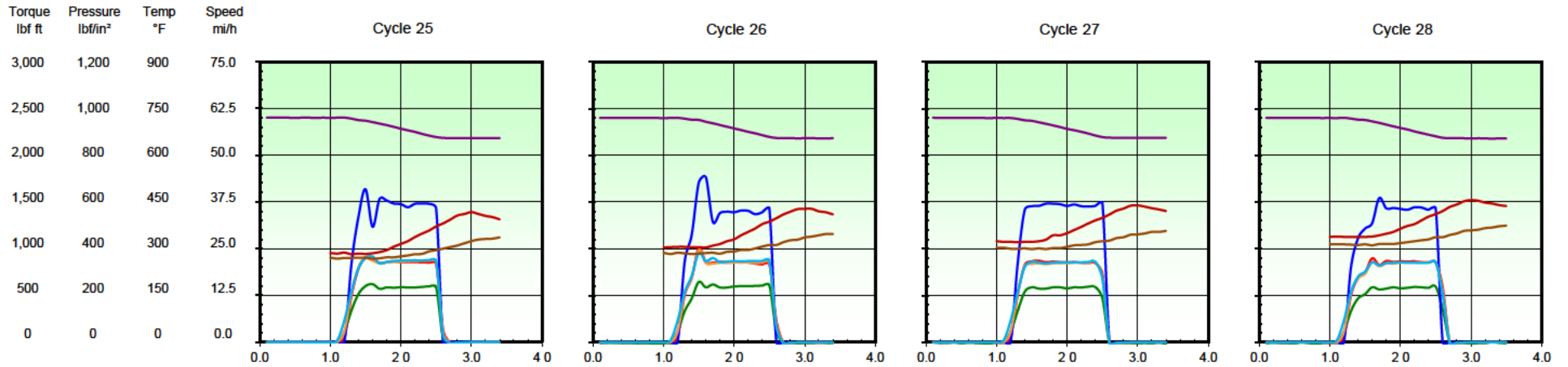
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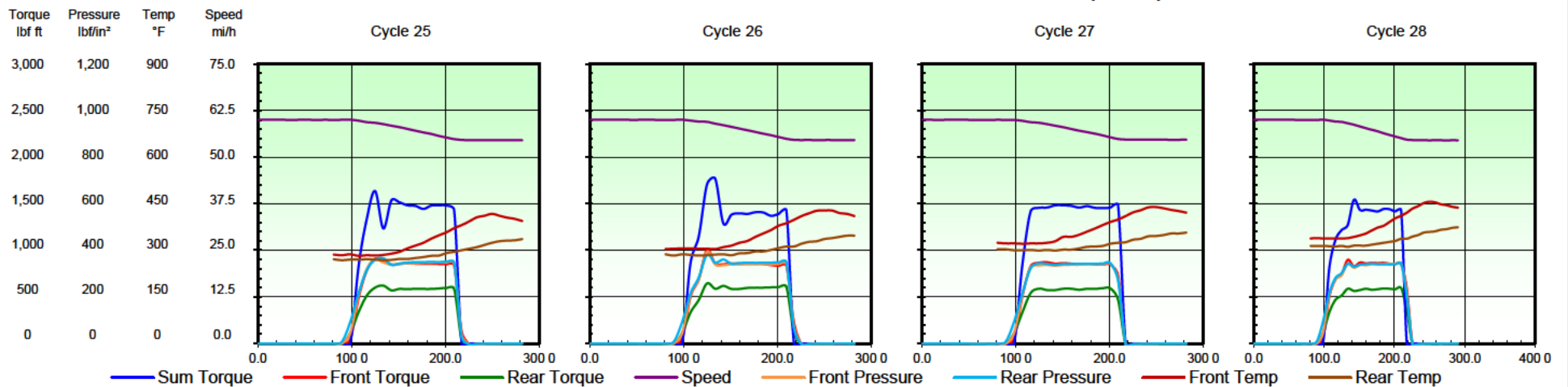
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

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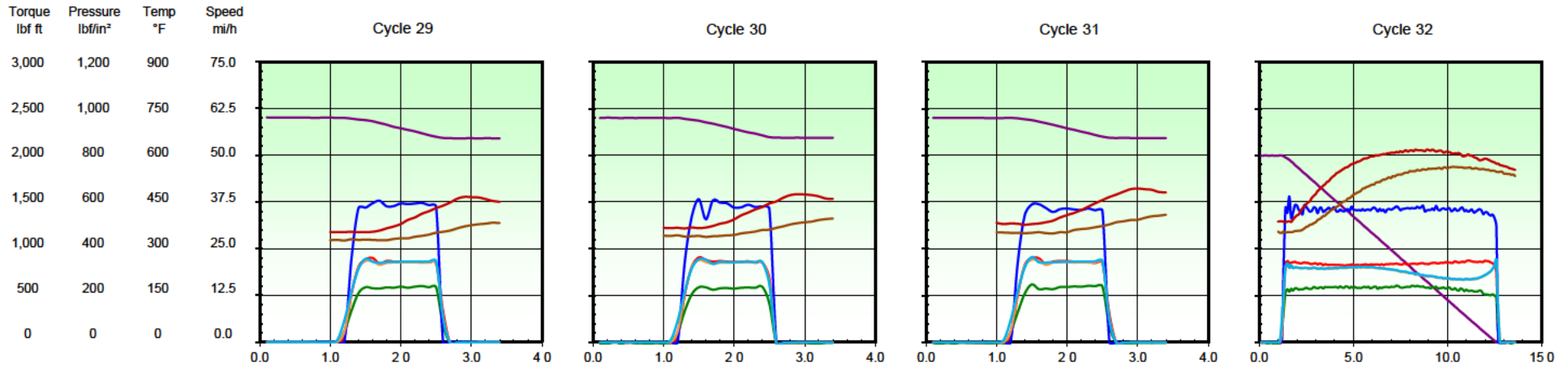
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Test Report Date: 20 March 2020

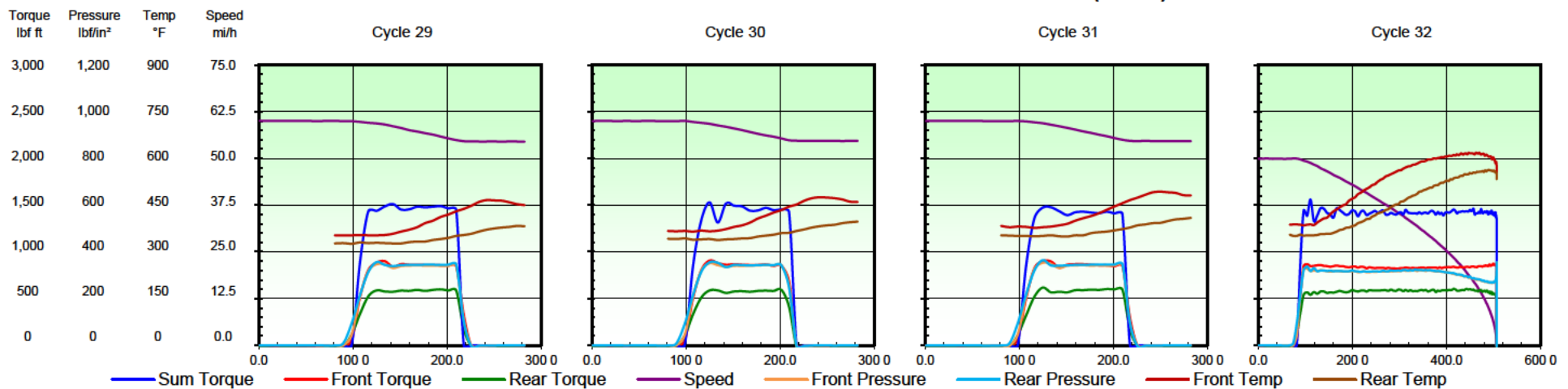
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

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Test Numbers: M20-064-07

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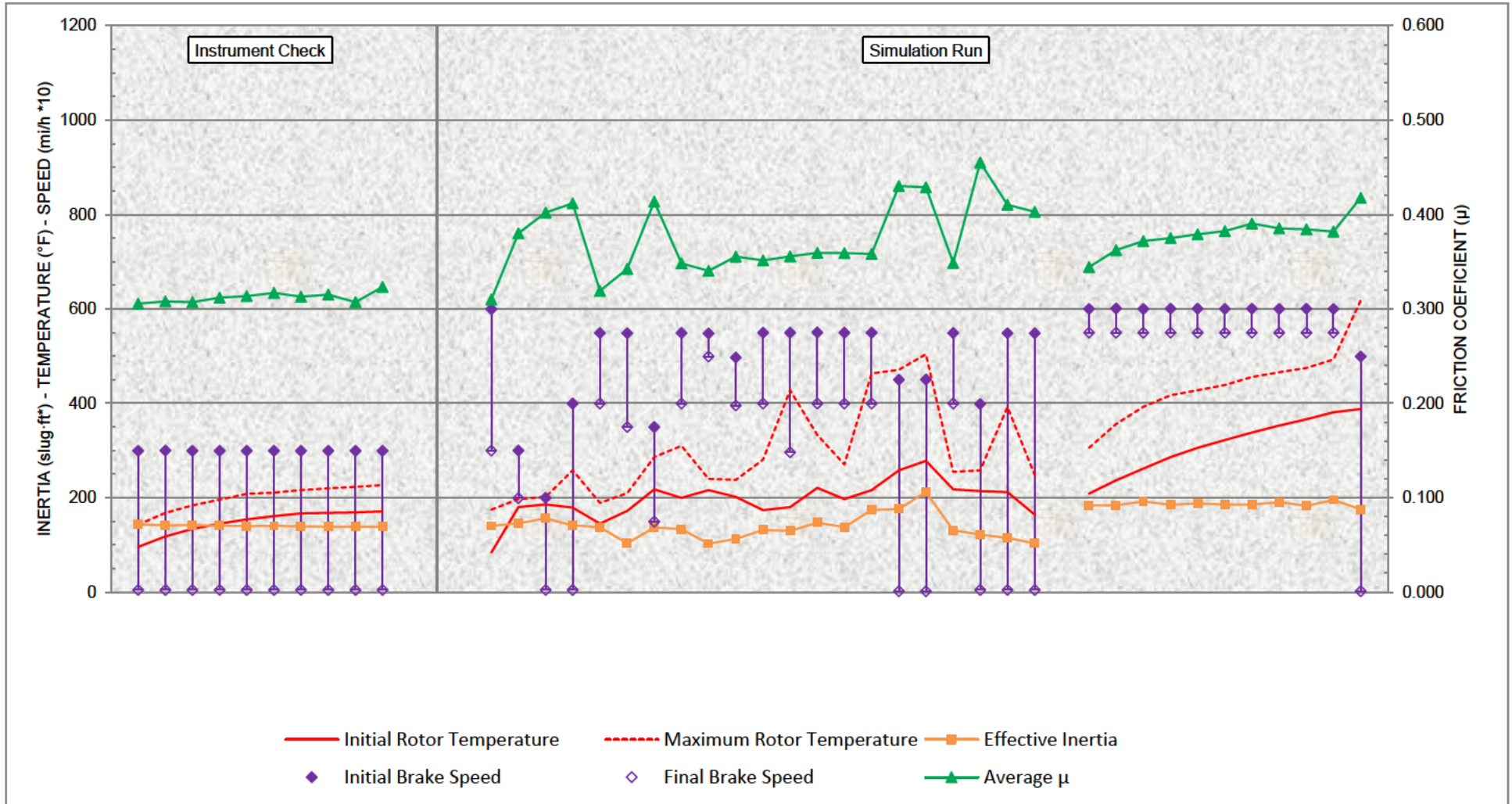
Report Number: 203145-2

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NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GWW

TEST PERFORMANCE PROFILE - FRONT BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-07

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

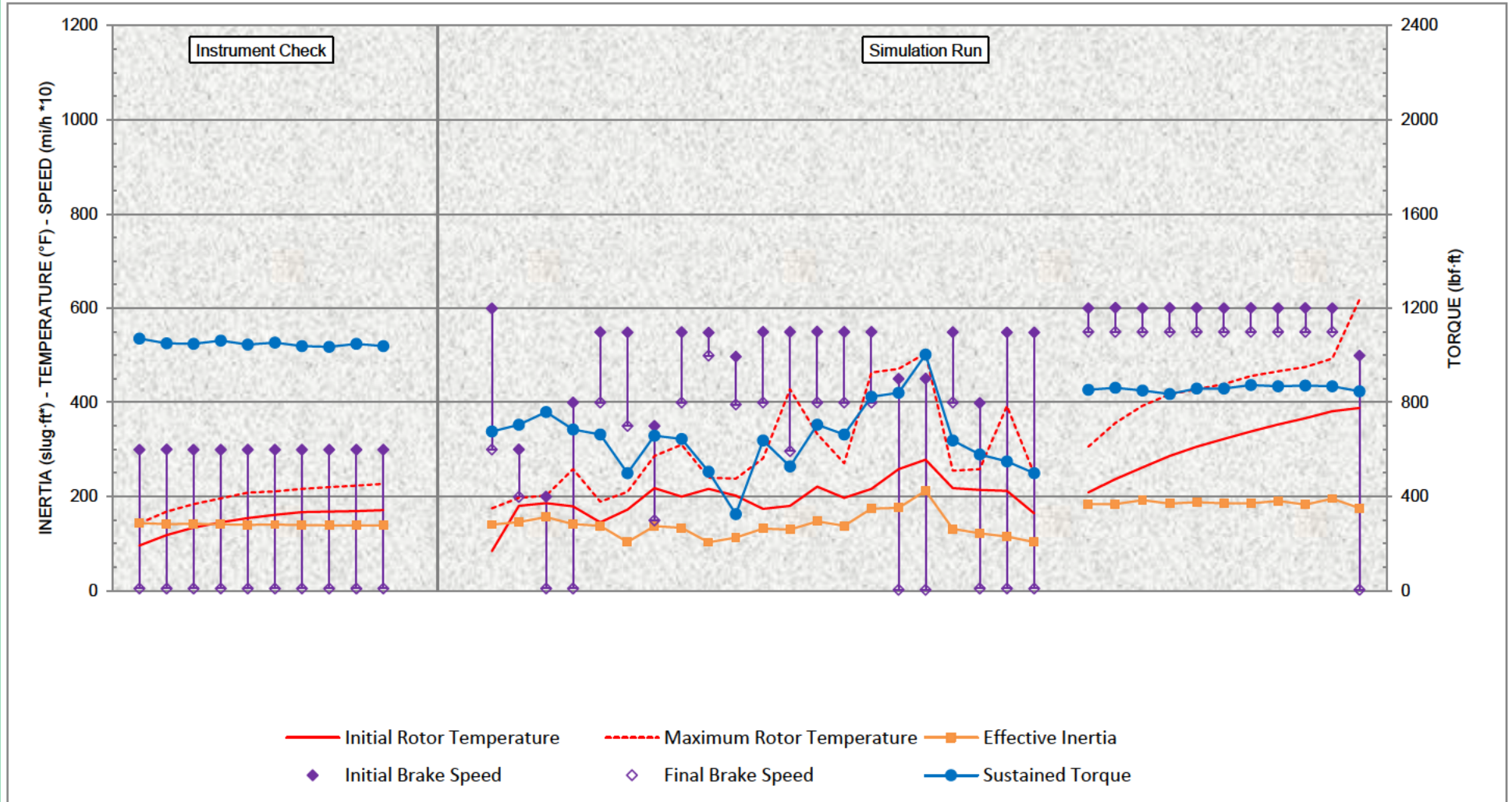
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NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GWW

TEST PERFORMANCE PROFILE - FRONT BRAKE



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Test Numbers: M20-064-07

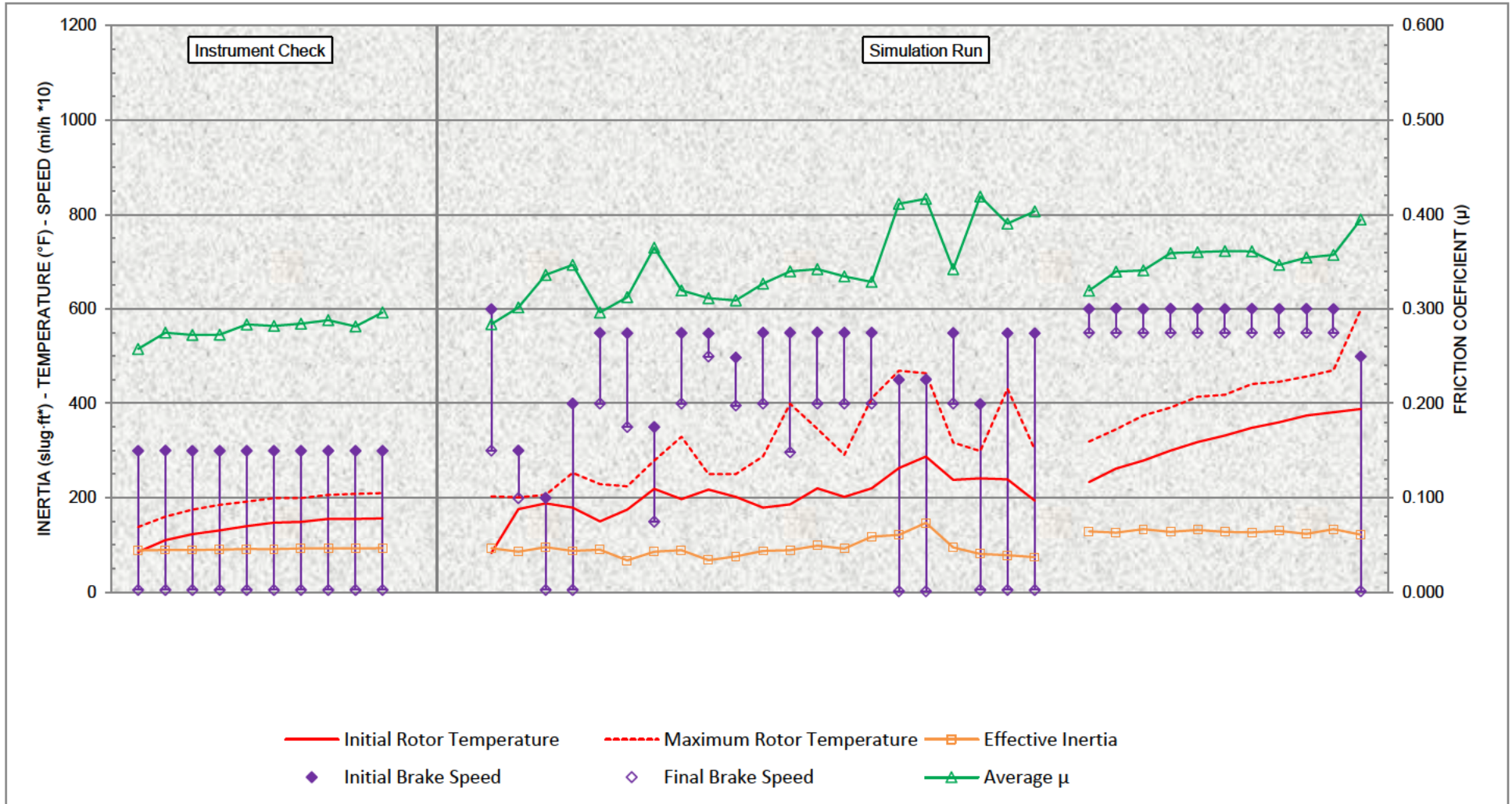
Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

Report Number: 203145-2

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW
TEST PERFORMANCE PROFILE - REAR BRAKE

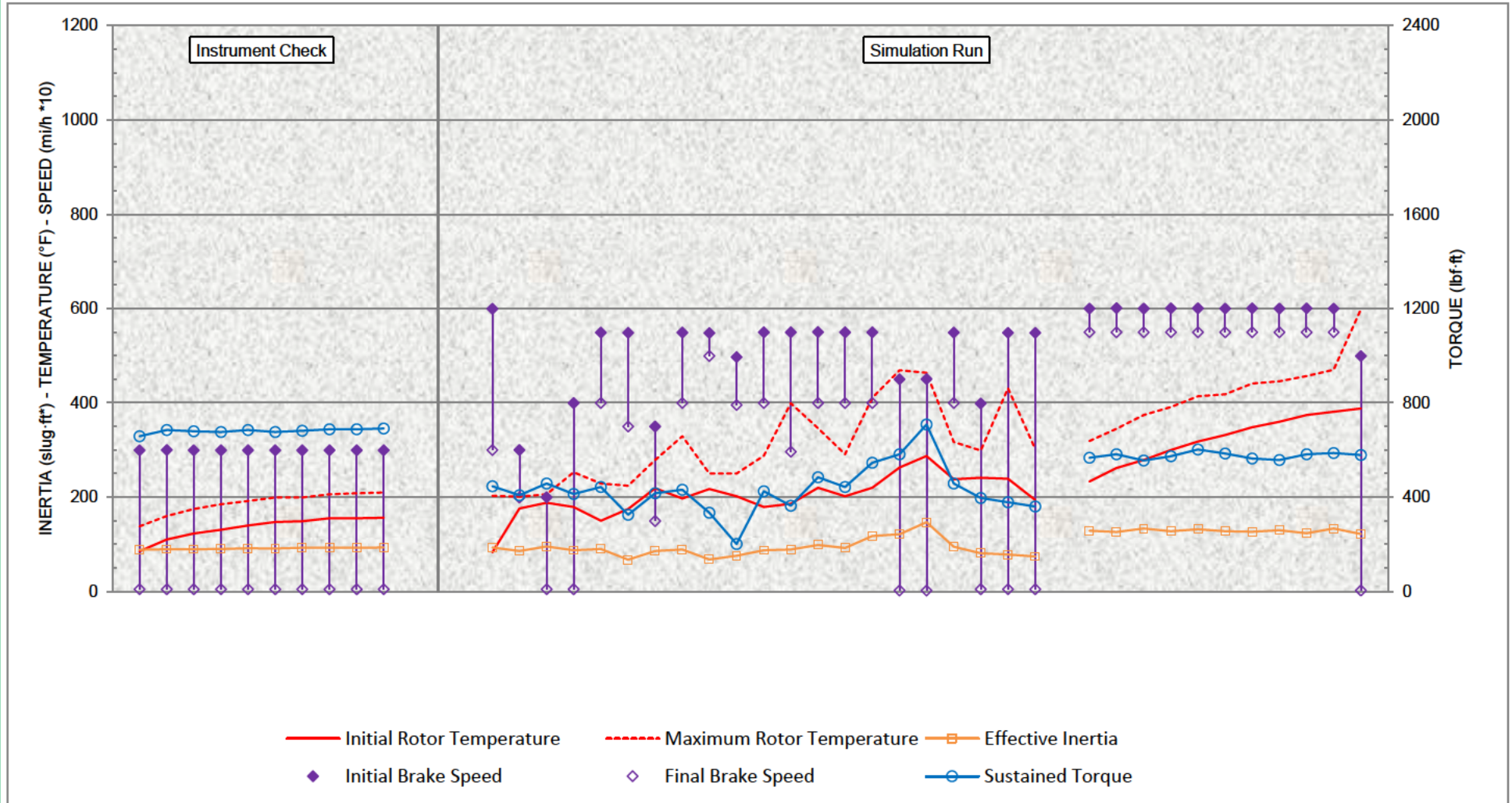


Client: NTSB Acquisition and Lease Management Division
 Test Numbers: M20-064-07
 Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear
 Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear
 Report Number: 203145-2
 Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW

TEST PERFORMANCE PROFILE - REAR BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-07

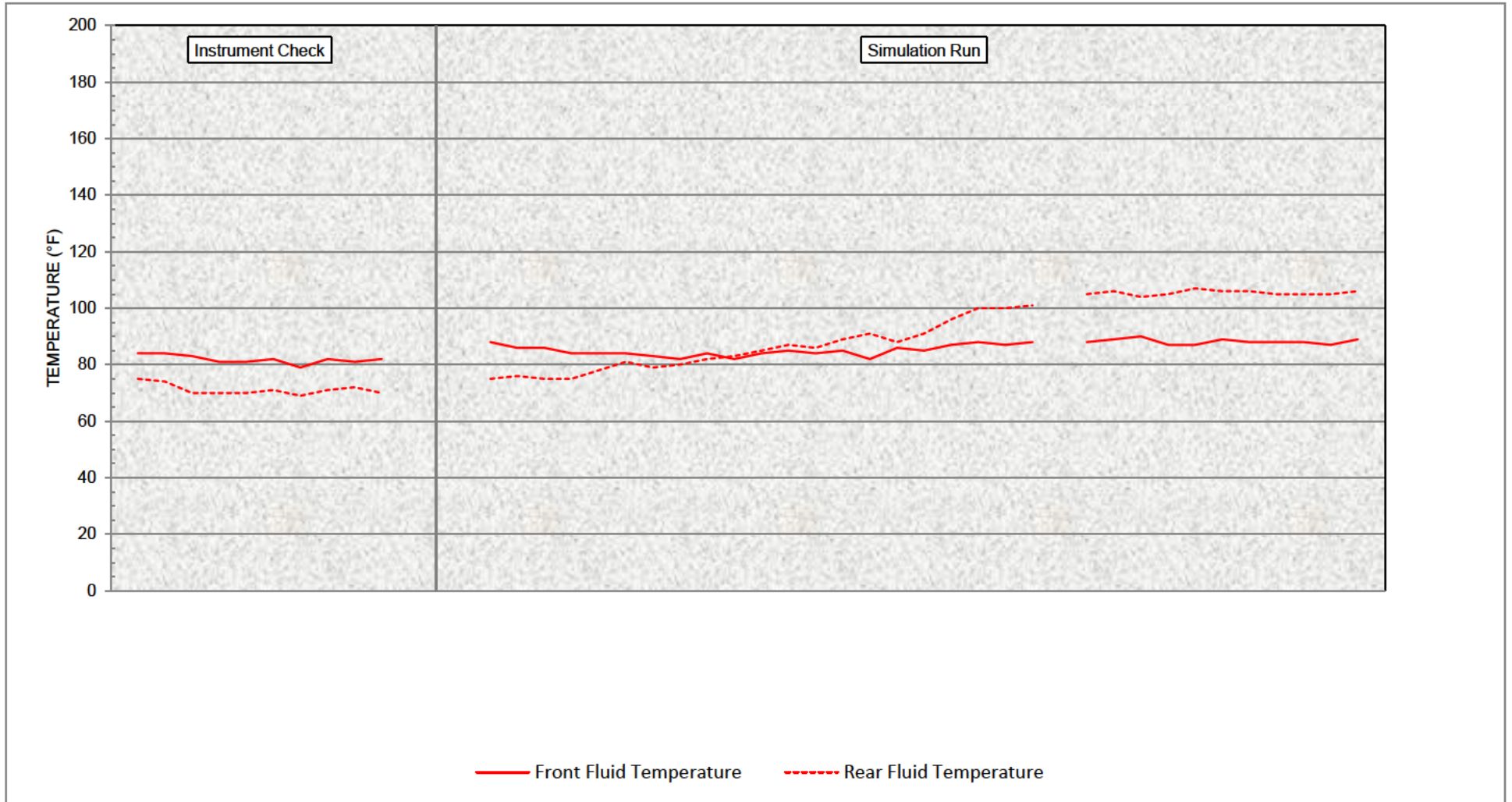
Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

Report Number: 203145-2

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GVW
BRAKE FLUID TEMPERATURE

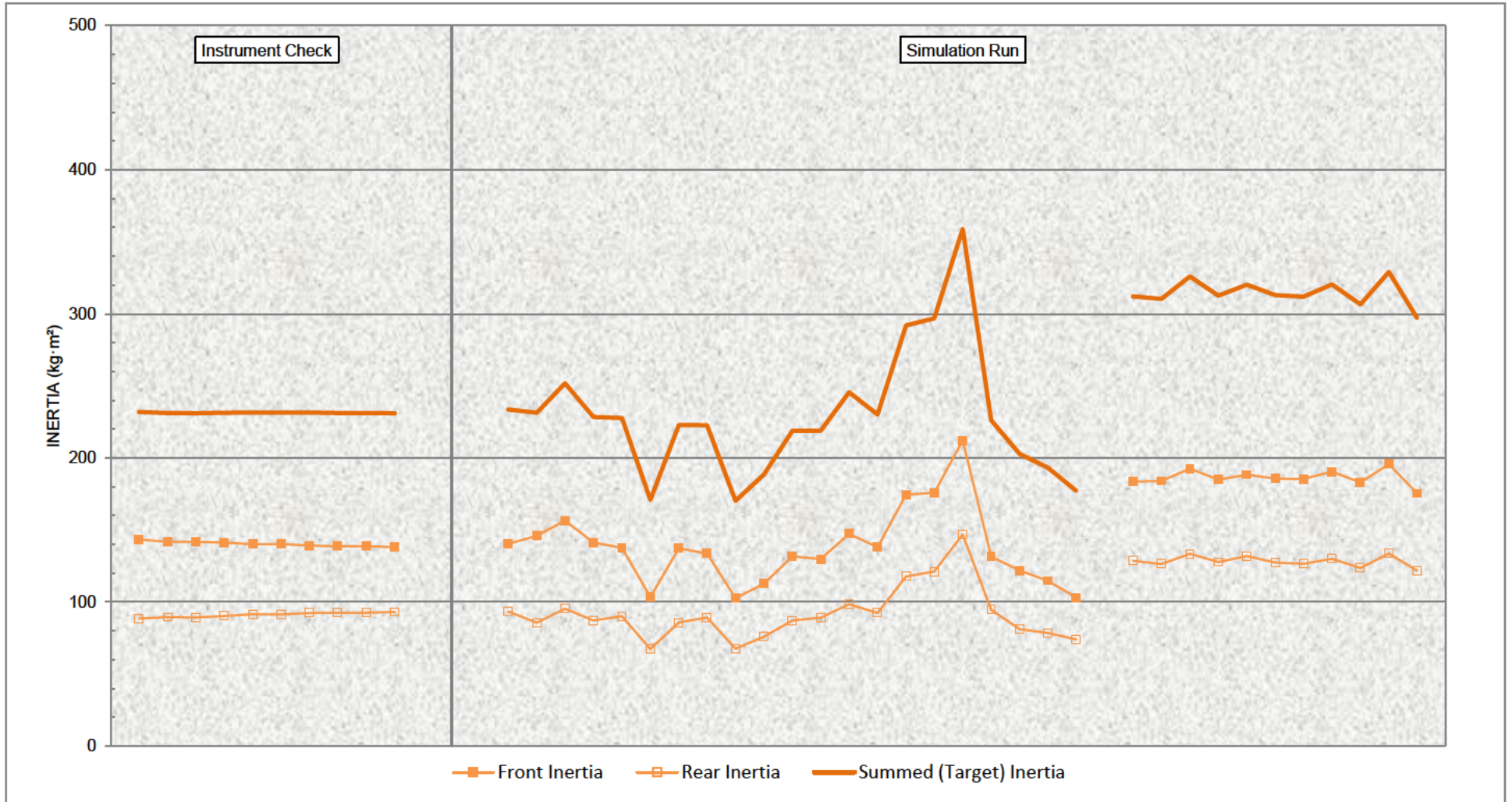


Client: NTSB Acquisition and Lease Management Division
 Test Numbers: M20-064-07
 Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear
 Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear
 Report Number: 203145-2
 Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - 8,600 LB GWW

INERTIA DISTRIBUTION



Client: NTSB Acquisition and Lease Management Division
 Test Numbers: M20-064-07
 Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear
 Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear
 Report Number: 203145-2
 Test Report Date: 20 March 2020

Test Numbers: M20-064-07

Report Number: 203145-2

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

CYCLE NO.	SPEED		TIME		DISTANCE		DECEL		PRESSURE				TORQUE						TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA									
	INIT	FNL	STOP	REPT	STOP	REPT	AVG	AVERAGE		SUSTAINED		MAXIMUM		AVERAGE		SUSTAINED		MAXIMUM		FRONT		REAR		FLUID		MAXIMUM		SUSTAINED		FRONT	REAR							
	mi/h		s		ft		ft/s ²	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	FRONT	REAR	FRONT	REAR	FRONT

INSTRUMENT CHECK

30 mi/h - 0.31g Deceleration Rate - 200°F Initial Rotor Temperature

1	30.0	0.5	4.49	0.0	105	0	9.22	522	532	529	538	555	591	1593	985	608	1729	1071	658	1148	720	96	143	99	143	93	127	84	85	138	87	124	89	128	75	0.40	0.32	0.31	0.26	143.3	88.6
2	30.0	0.5	4.47	60.1	104	60	9.25	435	441	515	525	563	601	1593	976	617	1736	1051	685	1124	744	118	168	116	163	107	146	84	110	160	102	144	105	147	74	0.39	0.32	0.31	0.27	141.7	89.5
3	29.9	0.5	4.48	60.1	104	60	9.25	510	521	515	525	539	559	1594	978	616	1727	1048	679	1095	705	134	184	129	179	117	161	83	123	175	114	158	119	160	70	0.37	0.30	0.31	0.27	141.8	89.3
4	29.9	0.5	4.47	60.1	104	60	9.28	423	427	514	522	558	571	1600	976	624	1738	1062	676	1121	723	145	196	141	191	128	172	81	131	185	126	169	124	167	70	0.37	0.30	0.31	0.27	141.1	90.2
5	30.0	0.5	4.47	60.1	104	60	9.28	497	503	503	509	553	556	1601	968	632	1730	1045	685	1104	732	154	208	149	202	136	181	81	140	192	135	179	133	176	70	0.36	0.30	0.31	0.28	140.0	91.4
6	29.9	0.5	4.46	60.1	104	60	9.28	496	500	502	505	553	553	1602	970	631	1730	1054	676	1104	720	161	211	157	208	142	186	82	147	199	138	183	140	182	71	0.36	0.29	0.32	0.28	140.2	91.2
7	29.9	0.5	4.48	60.1	104	60	9.27	494	499	501	505	538	542	1600	962	638	1721	1039	682	1077	729	167	216	160	215	145	191	79	149	199	145	188	142	185	69	0.35	0.29	0.31	0.28	139.2	92.4
8	30.0	0.5	4.47	60.1	104	60	9.31	492	500	496	503	556	560	1604	962	641	1724	1036	688	1116	756	168	220	169	218	149	195	82	155	206	144	193	147	190	71	0.36	0.29	0.32	0.29	138.7	92.5
9	29.9	0.5	4.46	60.1	104	60	9.27	509	509	515	515	544	556	1597	958	639	1736	1048	688	1086	732	169	223	172	223	152	198	81	155	208	150	196	150	193	72	0.35	0.29	0.31	0.28	138.7	92.5
10	30.0	0.5	4.46	60.1	104	60	9.27	470	477	485	491	530	551	1596	953	643	1730	1039	691	1086	750	171	227	174	226	151	200	82	156	210	153	198	149	194	70	0.35	0.29	0.32	0.30	138.0	93.1

Table with columns: SPEED, TIME, DISTANCE, DECEL, PRESSURE, TORQUE, TEMPERATURE, FLUID, FRICTION, INERTIA. Includes sub-headers for FRONT/REAR measurements and units like mi/h, s, ft, lbf/in², lbf ft, F, in³, μ, slug ft². Title: DOWNHILL SIMULATION TEST 0.20g Deceleration Rate.





**Brake Performance Study Attachment 4: Dynamometer Testing Report: Downhill Braking
Simulation Test– 2001 Ford Excursion with Limousine Conversion, 13565 lbs**

Schoharie, NY

HWY19H001

NATIONAL TRANSPORTATION SAFETY BOARD SCHOHARIE, NY DOWNHILL BRAKING SIMULATION TEST

Client NTSB Acquisition and Lease Management Division
490 L'Enfant Plaza East SW
Washington, DC 20594-0003

Report Number 203145-3
(Used Parts - 13,565 lb GVW)

Vehicle Simulated 2001 Ford Excursion with Limousine Conversion

Front Lining Edge Code MPV 2000-EE

Rear Lining Edge Code MPV 2000-EE

Test Completion Date 20 March 2020

Signature

Kevin C. Machus, Test Engineer
for Greening Testing Laboratories, Inc.

This test report issued in Adobe® Acrobat® format only.
Original retained on file at
Greening Testing Laboratories, Inc.
Complete test report in Microsoft® Excel format available upon request.



Greening Testing Laboratories, Inc.

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Detroit, Michigan 48234-2742 U.S.A.
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NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

Test Numbers	M20-064-08
Test Program Number	3947.01.20V01 - 2001 FORD EXCURSION.TST
Vehicle System Simulated	2001 Ford Excursion with Limousine Conversion
Reference	Contract No. 9531BM20P0015
Test Date(s)	20 March 2020
Date Test Report Prepared	27 March 2020
Test Report Prepared By	K. Machus
Gross Vehicle Weight	13,565 lbs (per NTSB)
Static Rolling Radius	16.1 inches (based on revolutions per mile of LT265/75R16D tires)
Test Inertia (without loss)	379.2 slug·ft ²
Parasitic Loss	3.0% (based on vehicle measurements)
Test Inertia (with loss)	368.8 slug·ft ²
Equivalent 1/2 Vehicle Weight	6,579 lbs

	Front Disc Brake	Rear Disc Brake
Lining Edge Code	MPV 2000-EE	MPV 2000-EE
Brake Pad Part Number	Motorcraft BR1266	Motorcraft BR1275
Brake Pad FMSI® Number	7625-D756	7626-D757
Brake Configuration	dual piston, separate function caliper disc brake	dual piston, separate function caliper disc brake
Piston Diameter(s)	2 x 54 mm	2 x 46 mm
Rotor Part Number	Ford 1G3Z-1V102-AB	Ford YC3Z-2C026-BB
Brake Size (nominal) Rotor Diameter x Thickness	13.0 x 1.5 inches	12.8 x 1.2 inches
Rotor Mass (nominal)	20.7 kg	10.9 kg
Rotor Effective Radius	5.599 inches	5.529 inches
Wheel Rotation	right hand	left hand
Test Fixture	096622	190316
Date Parts Received	16 January 2020	16 January 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

DATA NOTES

1 All average and sustained values shown in this report are calculated with respect to **DISTANCE**.

2 The data presented in this report has been gathered as follows:

START Threshold = 50 lbf·ft of brake torque during brake apply.

AVERAGE = average value between START and STOP Threshold levels.

INITIAL Data Point = Values are taken at the point where the control level is achieved.

SUSTAINED Data = average value between the INITIAL and END data points.

END Data Point = Values are taken 0.1 seconds prior to the STOP threshold

MAXIMUM = maximum value observed in the SUSTAINED Data Interval.

STOP Threshold = brake release

FINAL temperature is the highest temperature value observed in a 4.0 second "window" beginning 1.0 seconds after brake release.

3 Brake application is initiated when the control temperature (rotor) reaches the desired initial brake temperature.

4 Cooling Air Temperature = 80°F (±5°F)

5 Cooling Air Velocity = 20 mi/h for front brake, 2 mi/h for rear brake as determined by cooling curves conducted on a 2001 Ford Expedition.

6 For all stops which show "zero" (0) or negative values for some of the computed pressure, torque or coefficient values:

These stops achieved final speed but did not achieve the torque level required for the particular stop. Since the START data and STOP data thresholds were satisfied, deceleration rate, distance, time to stop, etc., are accurate values, and can be used for data comparison purposes.

The presence of "zero" values generally is caused by lack of brake performance, resulting in a "clamp" condition. "Clamp" condition is defined by the brake calling for the maximum pressure the test section allows ("clamp" pressure) and the brake being unable to attain the deceleration rate required in the test section at that pressure.

7 Thermocouple locations and depths:

Front Rotor: Center of inboard rubbing track at a depth of 0.040 inches

Front Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches

Front Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches

Rear Rotor: Center of inboard rubbing track at a depth of 0.040 inches

Rear Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches

Rear Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

COMPUTED DATA DESCRIPTIONS

SPEED

INIT = Speed start threshold is achieved.

FNL = Brake release speed

TIME

STOP = Time elapsed between start threshold and brake release

REPT = Time elapsed between cycles

DISTANCE

STOP = Distance elapsed between start threshold and brake release

REPT = Distance elapsed between cycles

DECEL

AVG = Average deceleration measured from start threshold to brake release

PRESSURE

AVERAGE = Average pressure from start threshold to brake release

SUSTAINED = Average pressure from point control level is achieved to brake release

MAXIMUM = Maximum pressure from start threshold to brake release

TORQUE

AVERAGE = Average torque from start threshold to brake release

SUSTAINED = Average torque from point control level is achieved to brake release

MAXIMUM = Maximum torque from start threshold to brake release

TEMPERATURE

INT = Temperature at start threshold

MAX = Maximum temperature between start threshold and 0.1 seconds after brake release

FLUID DISPLACEMENT

MAX = Maximum fluid displacement between start threshold and brake release

FRICTION COEFFICIENT

SUST = Friction coefficient (μ) calculated using the following formula:

$$\mu = \frac{\text{Sustained Torque (lbf}\cdot\text{ft)} / \text{Rotor Effective Radius (ft)}}{\text{Sustained Pressure (lbf/in}^2\text{)} * \text{Total Caliper Piston Area (in}^2\text{)}} * 0.5$$

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

TEST ROUTE - NEW AMSTERDAM TO SCHOHARIE NEW YORK

Cycle	Mile	Latitude (GPS)	Longitude (GPS)	Altitude (ft)	Grade Input (%g)	Braking Deceleration (g)	Apply Speed (mi/h)	Release Speed (mi/h)
0	0.0	42.94908	-74.18265	574.1	--	--	--	--
1	10.8	42.94409	-74.35478	293.3	-0.14%	0.2	60	30
2	11.1	42.94722	-74.35869	296.3	0.21%	0.2	30	20
3	11.2	42.94865	-74.35809	288.1	-1.69%	0.2	20	0
4	11.7	42.94957	-74.36914	287.4	0.28%	0.2	40	0
5	14.6	42.91169	-74.35237	469.5	0.40%	0.2	55	40
6	15.6	42.89860	-74.34632	647.3	5.20%	0.2	55	35
7	15.7	42.89696	-74.34592	666.0	0.80%	0.2	35	15
8	17.0	42.87979	-74.34609	802.8	0.90%	0.2	55	40
9	17.7	42.86949	-74.34253	871.7	5.27%	0.2	55	50
10	18.4	42.86000	-74.33732	1016.7	3.88%	0.2	50	40
11	20.4	42.83745	-74.35430	1200.1	1.12%	0.2	55	40
12	21.8	42.82276	-74.33815	1259.2	1.09%	0.2	55	30
13	22.6	42.81189	-74.33648	1295.6	-1.10%	0.2	55	40
14	24.5	42.78596	-74.33829	1284.1	0.19%	0.2	55	40
15	25.3	42.77450	-74.33766	1075.5	-4.69%	0.2	55	40
16	25.7	42.76815	-74.33585	955.1	-5.45%	0.2	45	0
17	26.5	42.75714	-74.33045	681.8	-10.46%	0.2	45	0
18	29.4	42.71859	-74.33721	676.2	0.59%	0.2	55	40
19	30.4	42.70533	-74.33539	633.2	2.50%	0.2	40	0
20	31.5	42.71097	-74.31464	681.4	3.31%	0.2	55	0
21	33.6	42.71540	-74.27608	1183.4	4.71%	0.2	55	0
2 MINUTE STOP - BRAKES RELEASED								
22	33.9			1078.1	-5.92%	0.2	60	55
23	34.0			1033.7	-5.92%	0.2	60	55
24	34.2			989.3	-5.92%	0.2	60	55
25	34.3			944.9	-5.92%	0.2	60	55
26	34.5			900.6	-5.92%	0.2	60	55
27	34.6			856.2	-5.92%	0.2	60	55
28	34.8			811.8	-5.92%	0.2	60	55
29	34.9			767.4	-5.92%	0.2	60	55
30	35.0			723.1	-5.92%	0.2	60	55
31	35.2	42.70259	-74.29994	678.5	-5.95%	0.2	60	55
32	35.4	42.70043	-74.30176	628.3	-5.40%	0.2	50	0

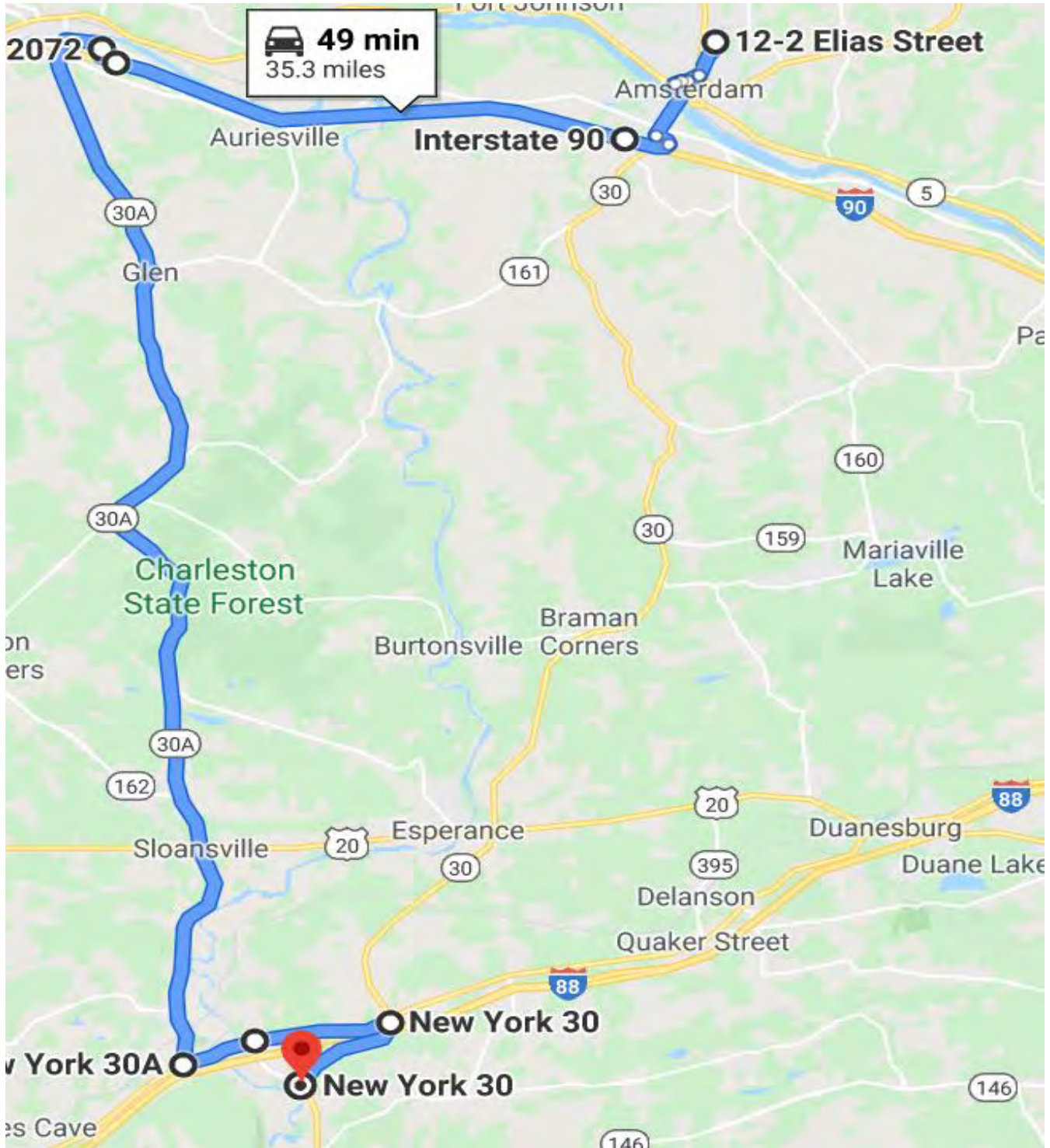
*NOTE: Test route was derived using the following criteria:

Speed limit and warning speeds were identified along the simulated route and used to control speed in the simulations. At Stop signs and controlled signalized intersections along the simulated route complete stops were modeled. At last stop before the final downhill descent a completed stop of 2 minutes was modeled. During downhill descents if the speed exceeded the posted speed limit by 5 mph braking at a maximum of 0.2 g was applied to reduce the speed to the speed limit.

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

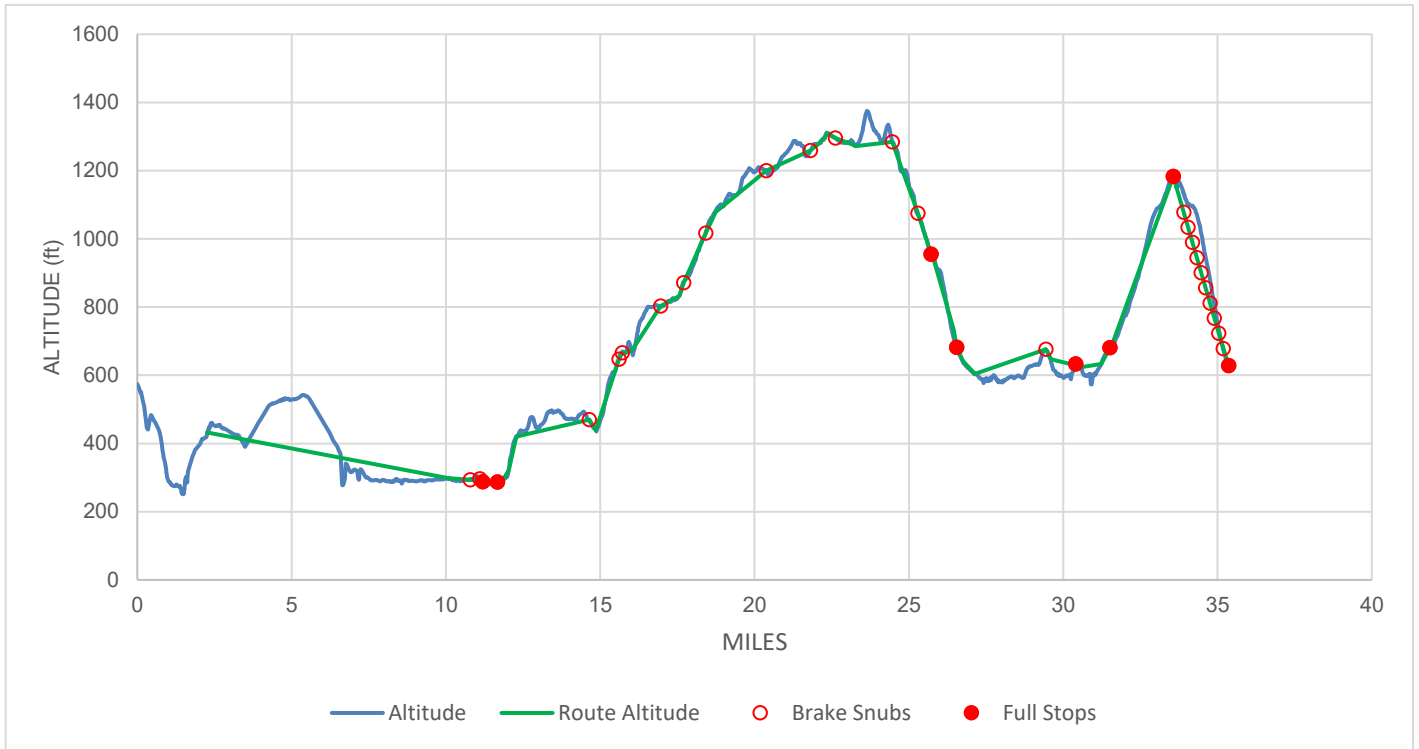
TEST ROUTE - OVERVIEW MAP



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

TEST ROUTE - PROFILE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

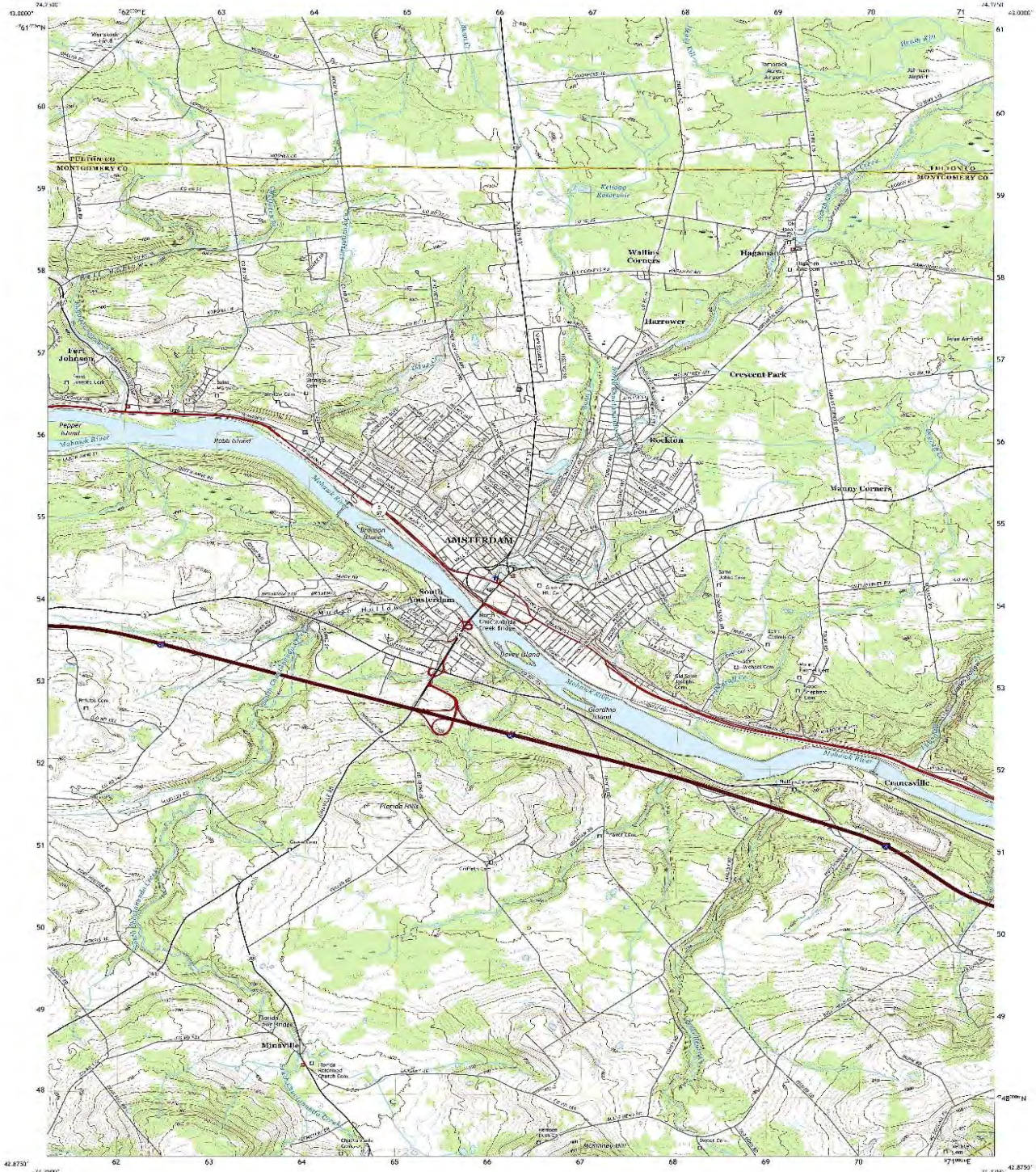
TEST ROUTE - AMSTERDAM QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



AMSTERDAM QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

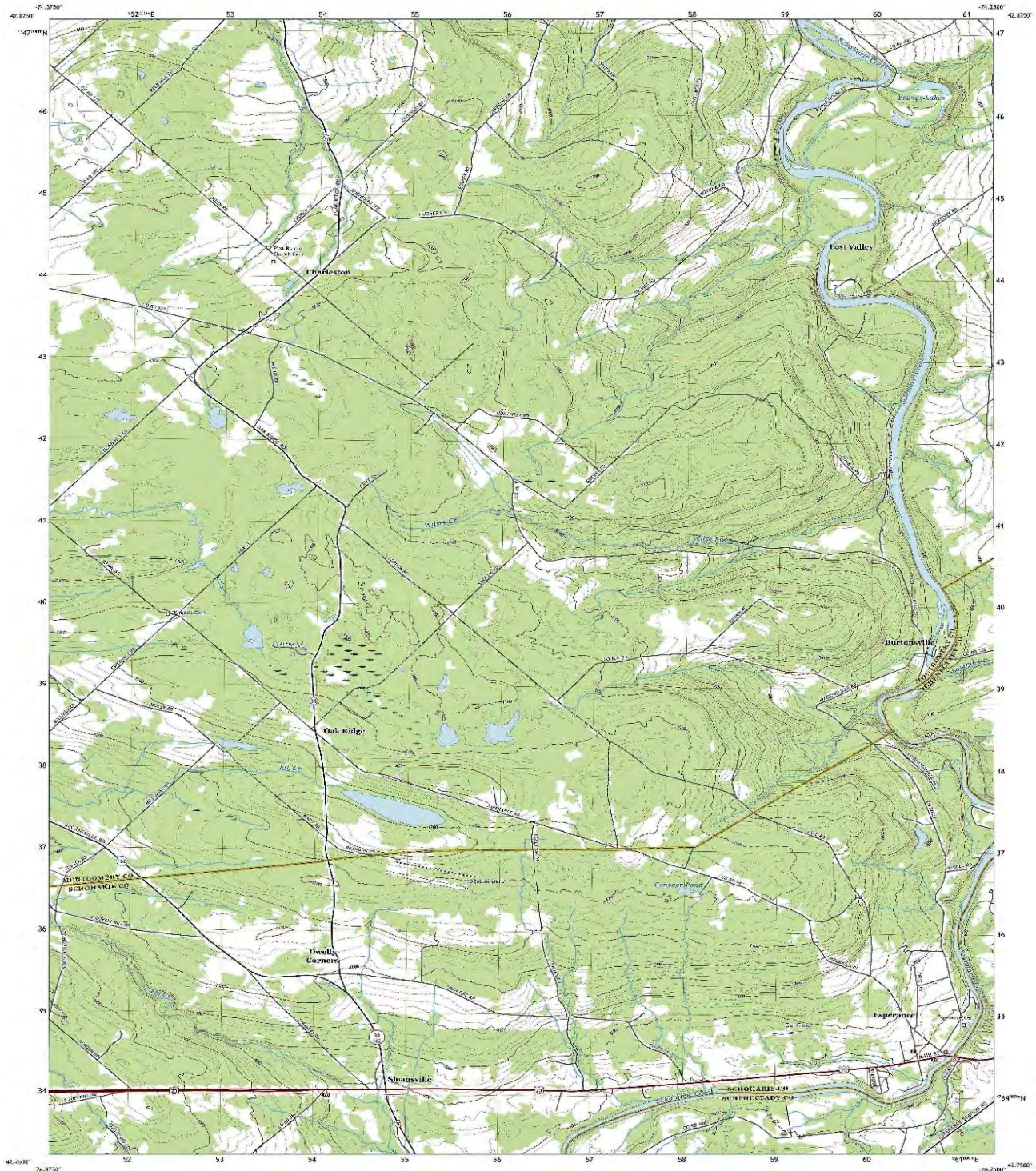
TEST ROUTE - ESPERANCE QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



ESPERANCE QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

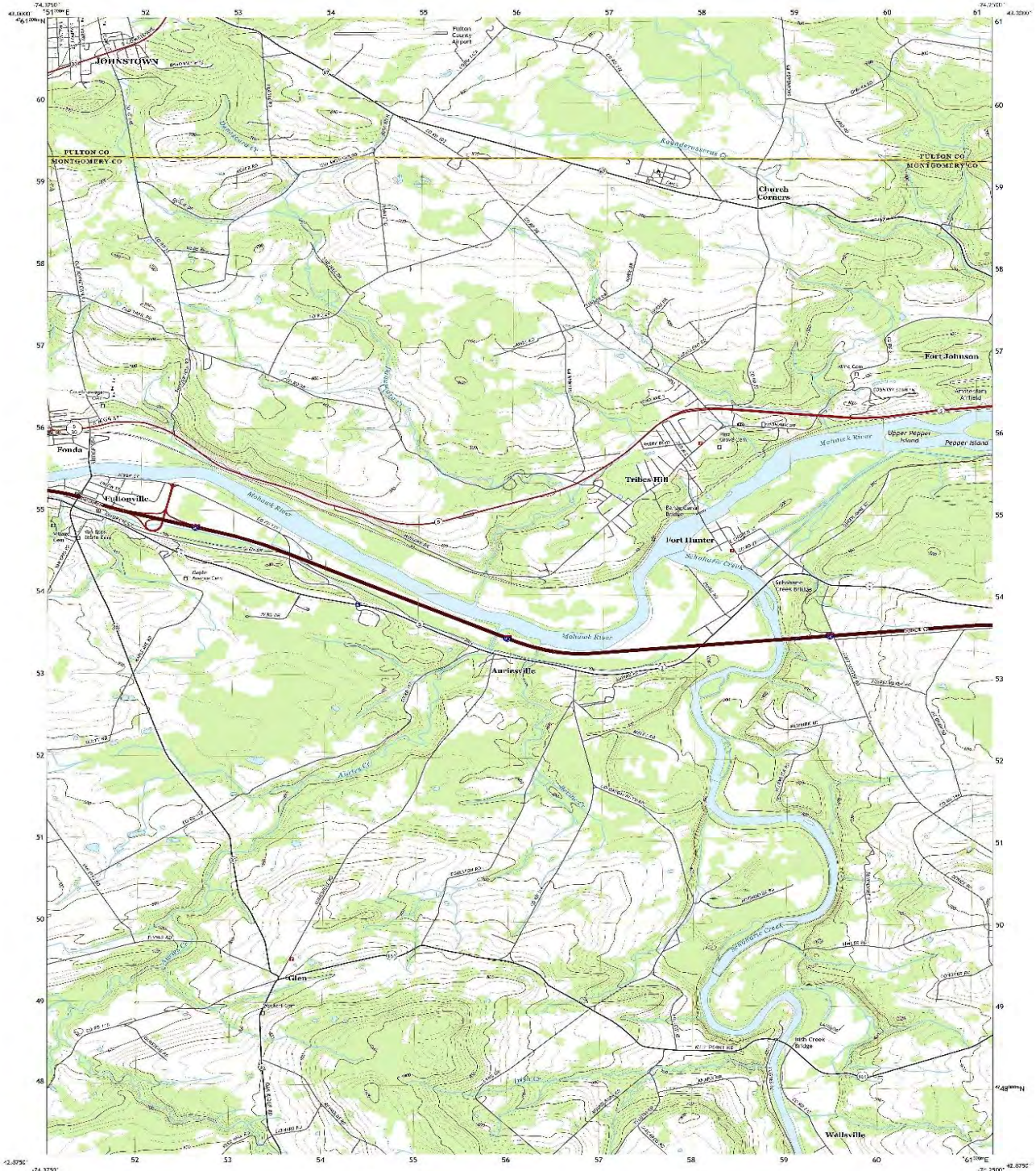
TEST ROUTE - TRIBES HILL QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



TRIBES HILL QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

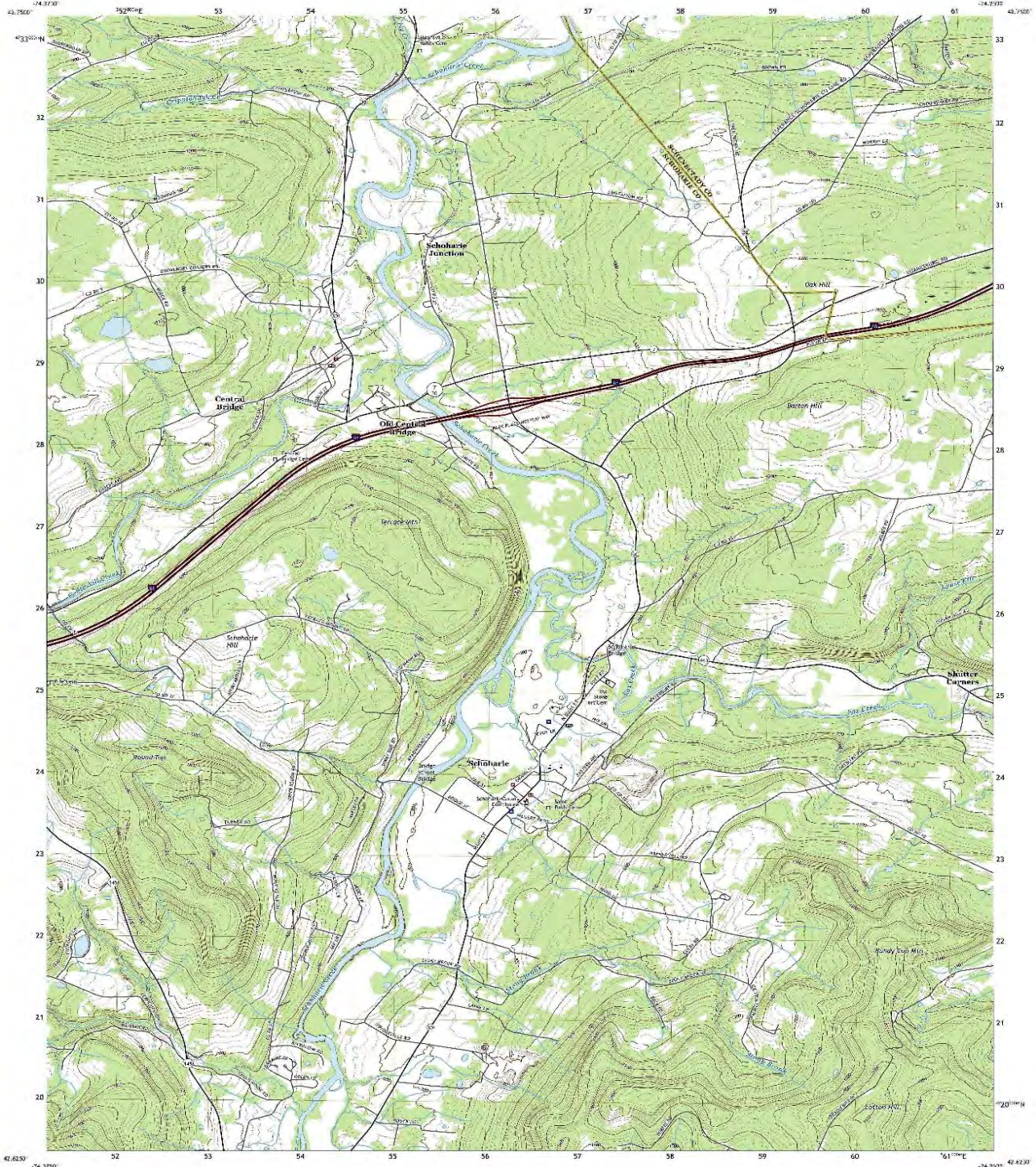
TEST ROUTE - SCHOHARIE QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



SCHOHARIE QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



Test Numbers: M20-064-08

Report Number: 203145-3

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

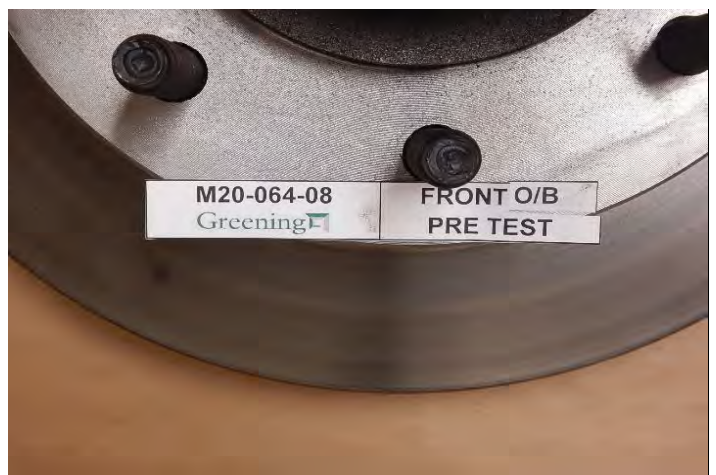
NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

PRE TEST PHOTOGRAPHS - FRONT BRAKE



Test Numbers: M20-064-08

Report Number: 203145-3

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

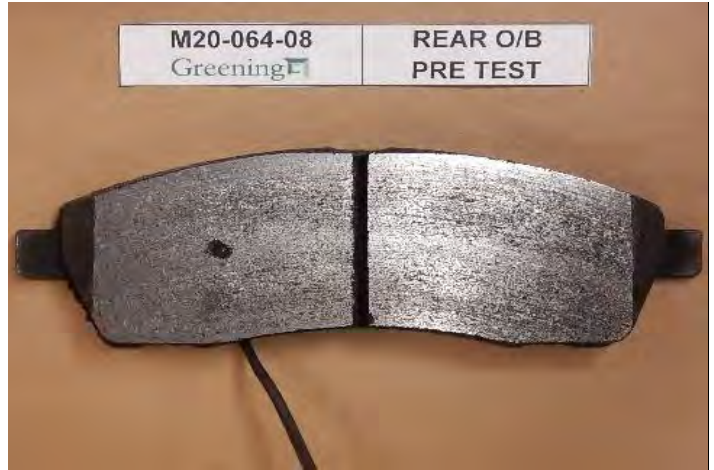
NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

PRE TEST PHOTOGRAPHS - REAR BRAKE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

POST TEST VISUAL INSPECTION - FRONT BRAKE

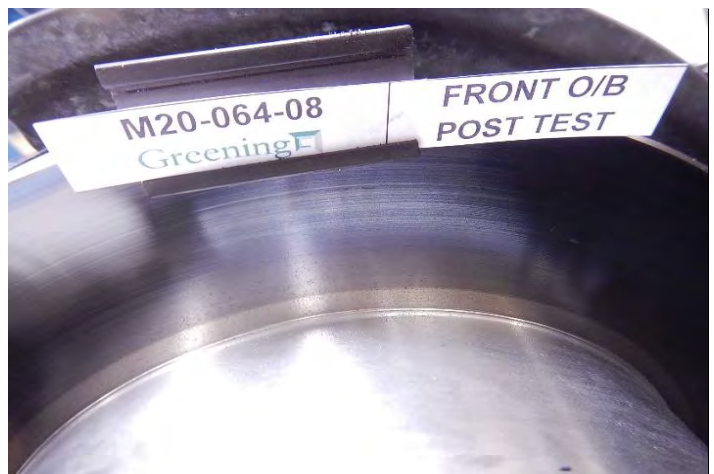
Inboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is blue/grey in color.

All other test hardware appears in good condition.

PHOTOGRAPHS



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

POST TEST VISUAL INSPECTION - REAR BRAKE

Inboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

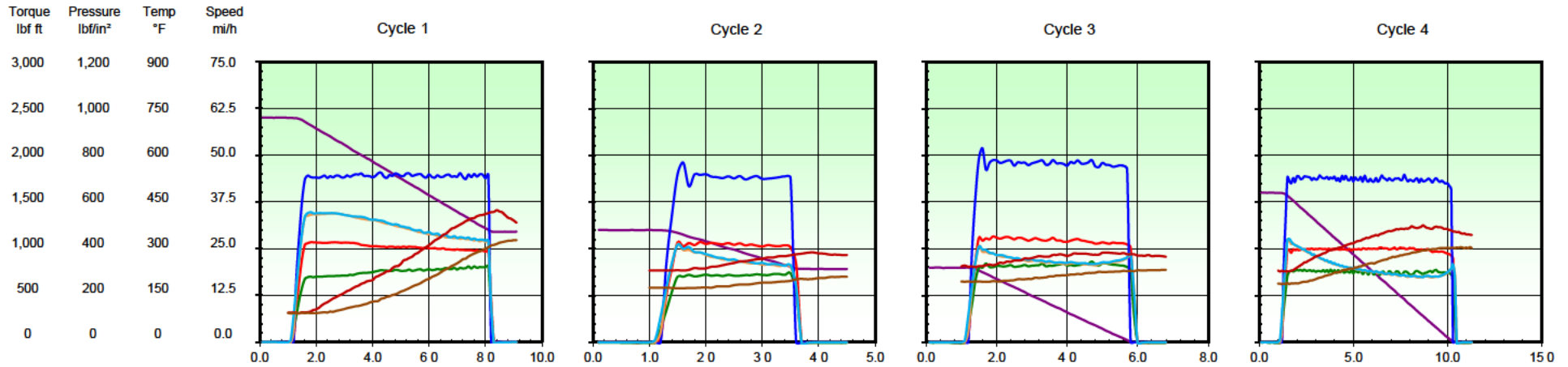
Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is blue/grey color.

All other test hardware appears in good condition.

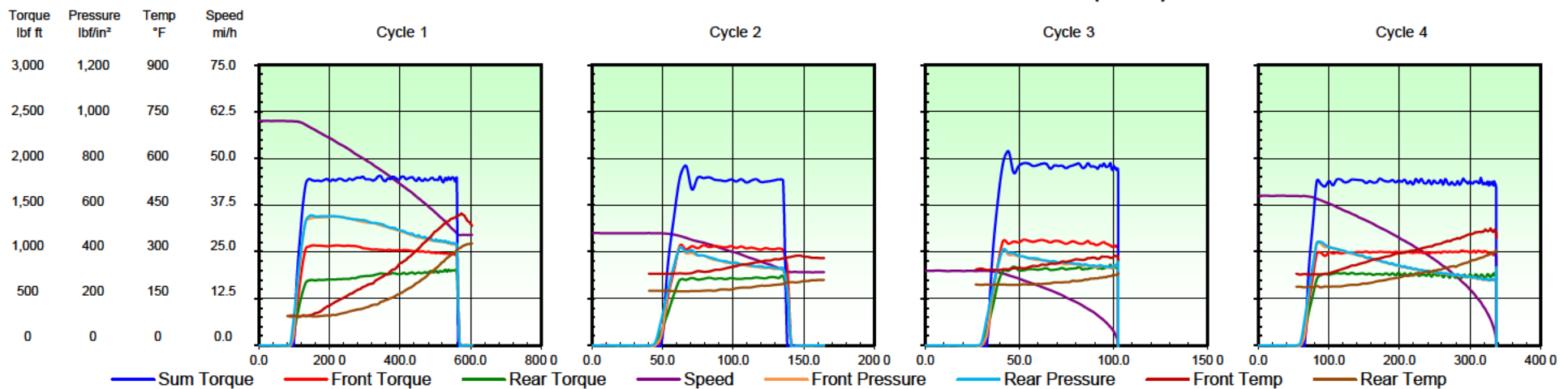
PHOTOGRAPHS



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWV
GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-08

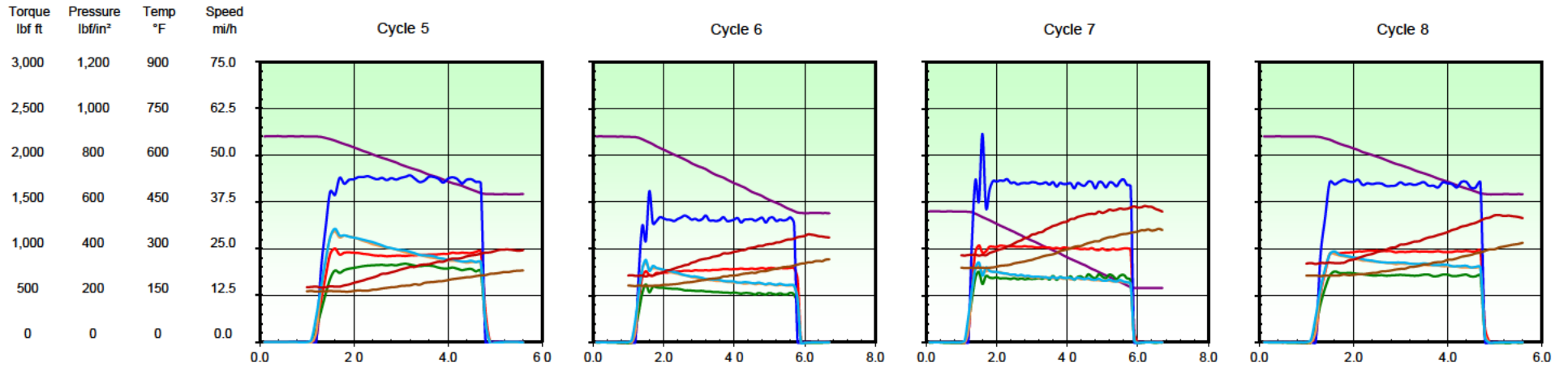
Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

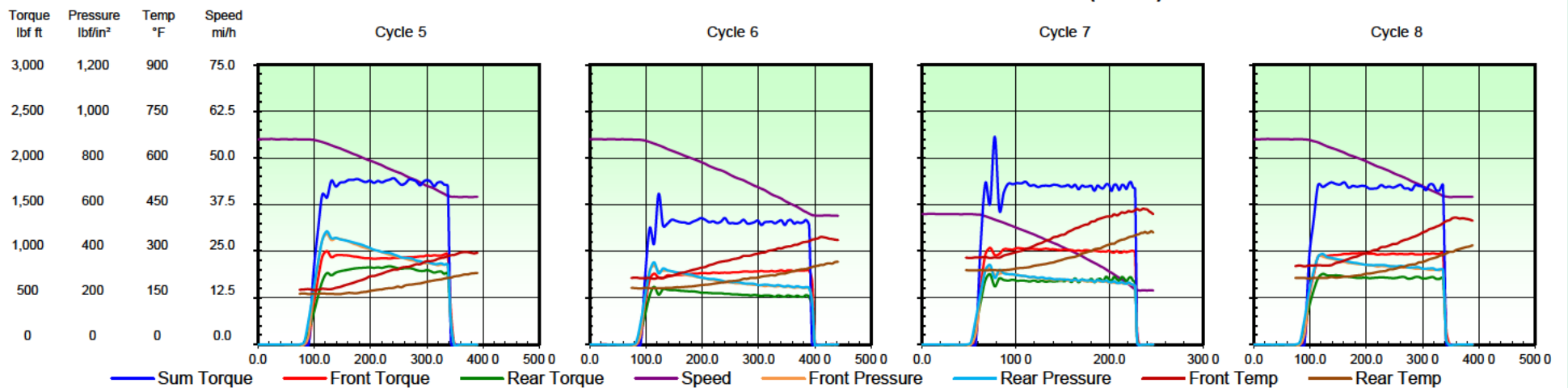
Report Number: 203145-3

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)

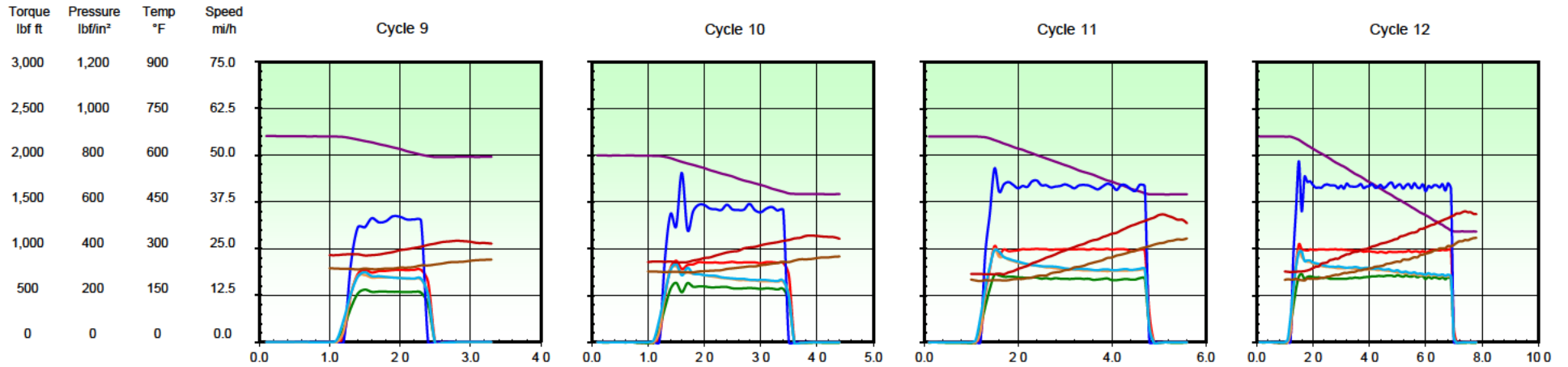


GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)

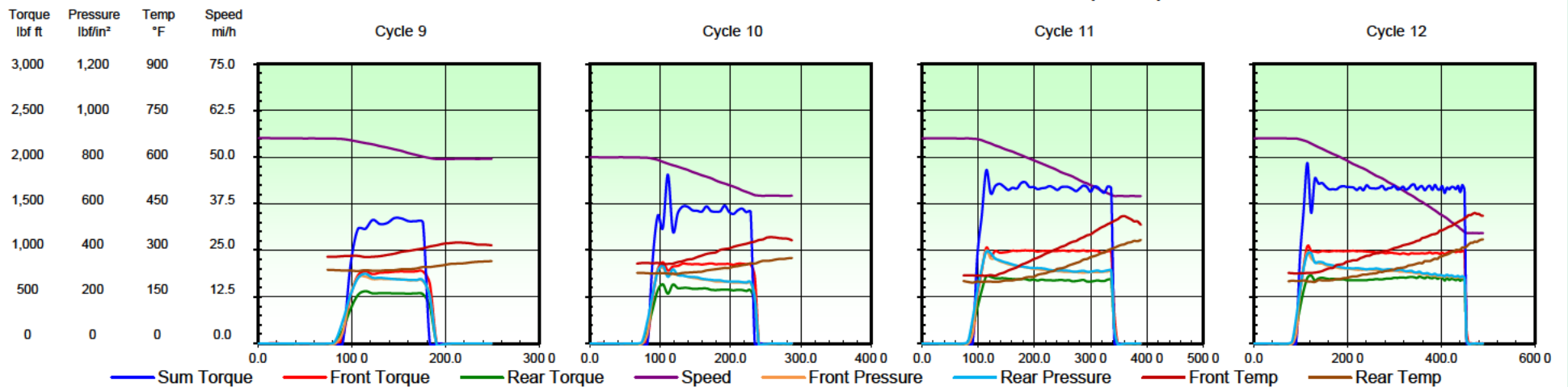


Client: NTSB Acquisition and Lease Management Division
 Test Numbers: M20-064-08
 Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear
 Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear
 Report Number: 203145-3
 Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-08

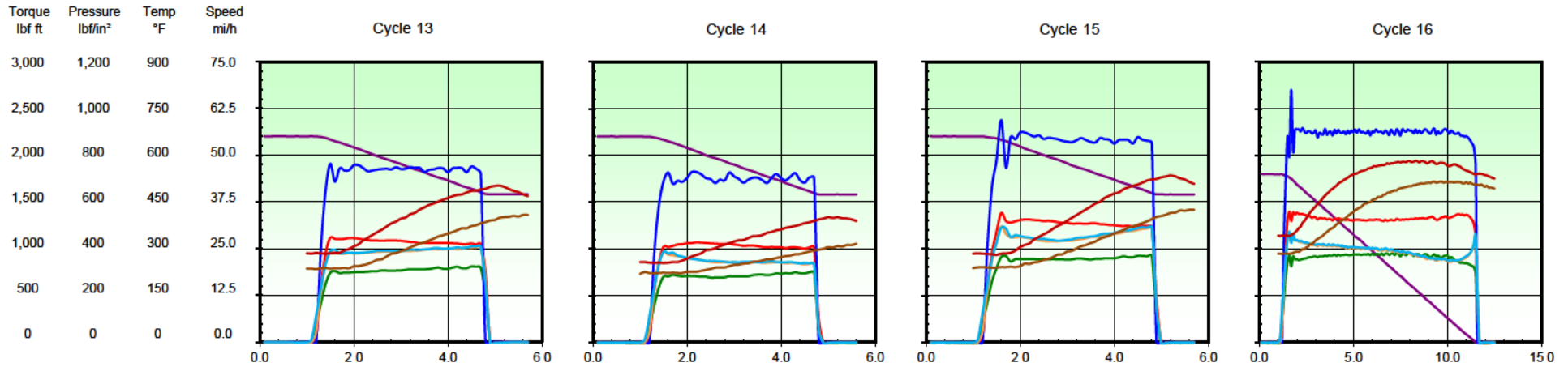
Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

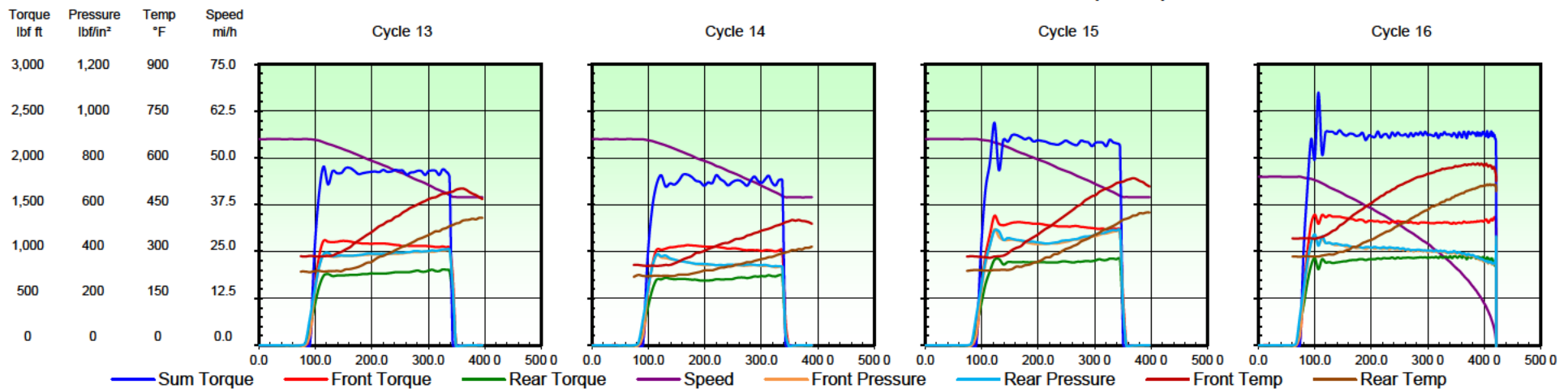
Report Number: 203145-3

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWV
GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-08

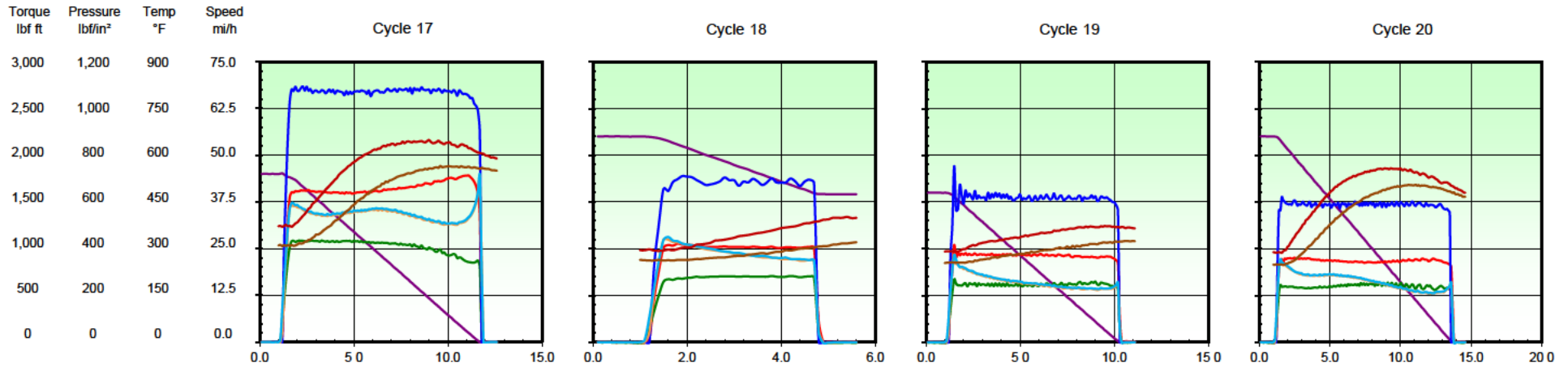
Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

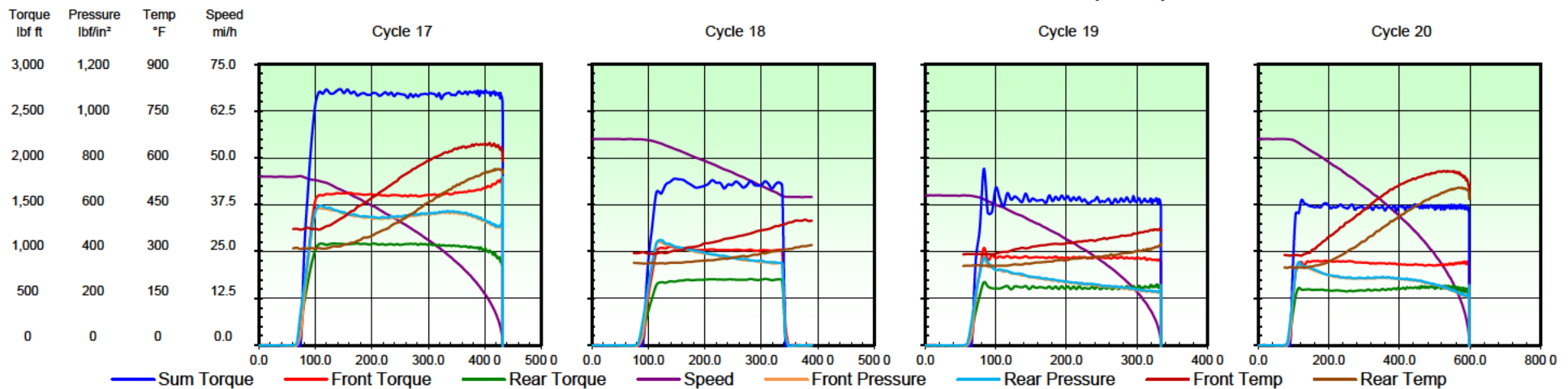
Report Number: 203145-3

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-08

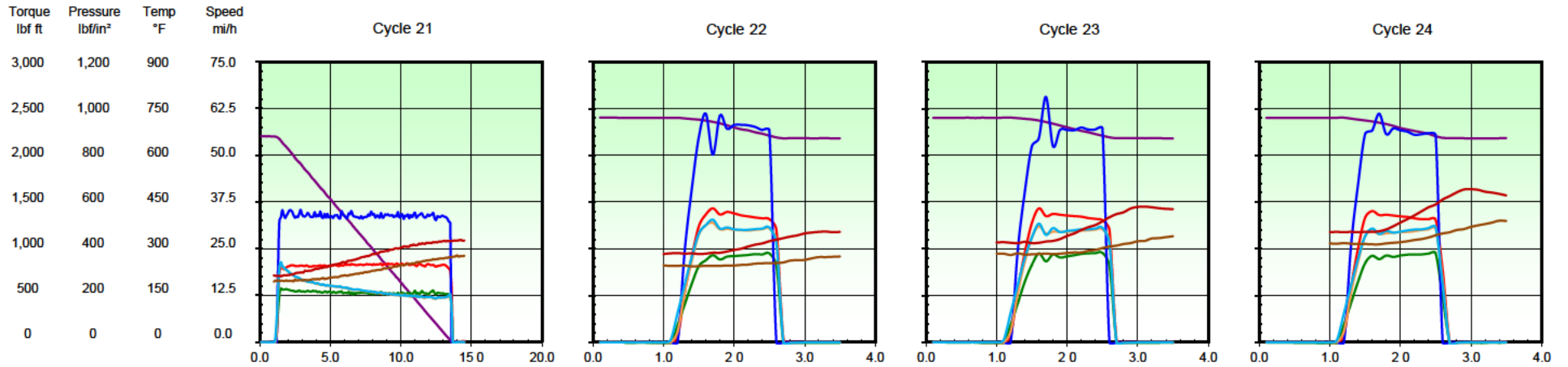
Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

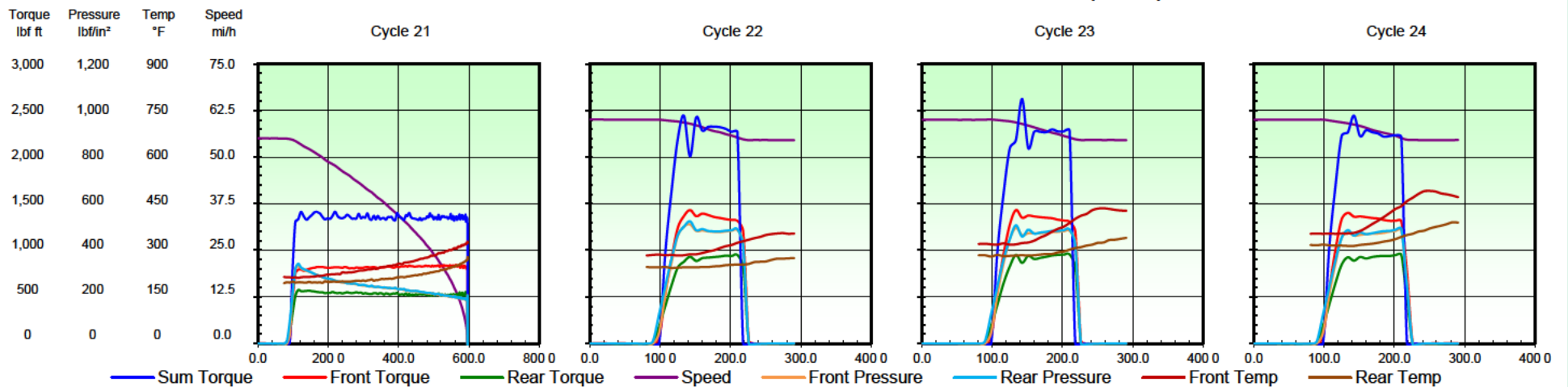
Report Number: 203145-3

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-08

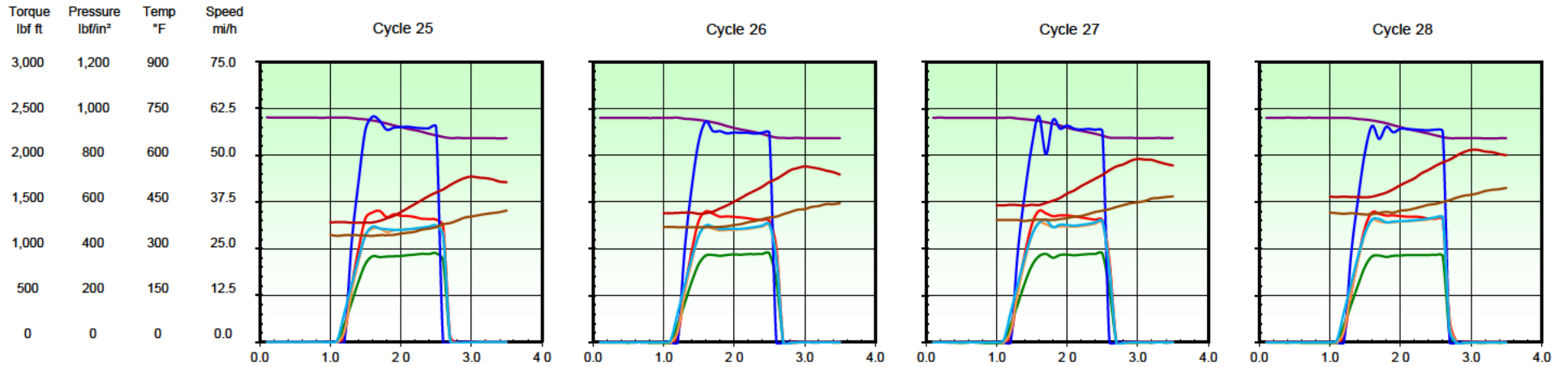
Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

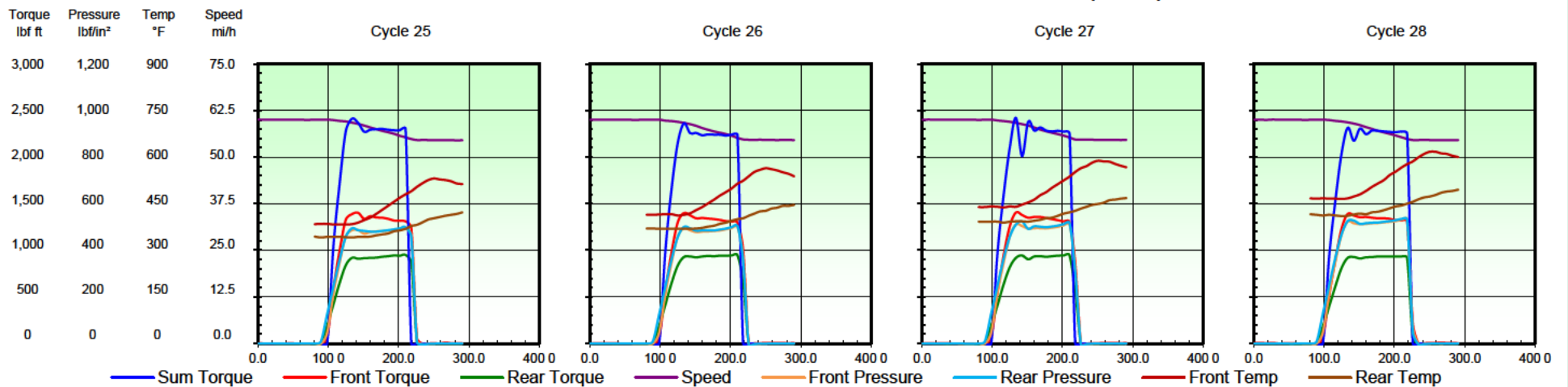
Report Number: 203145-3

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-08

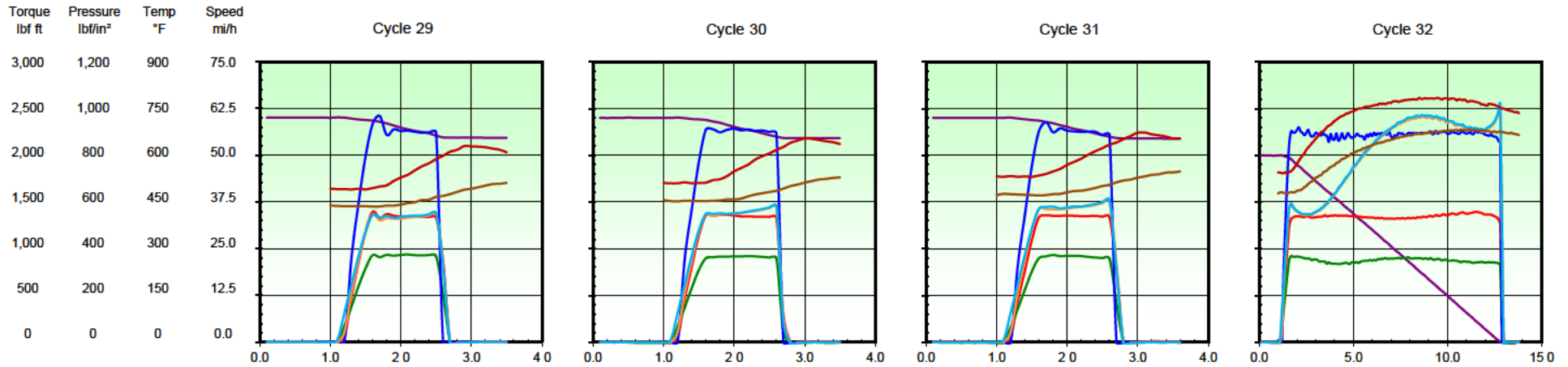
Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

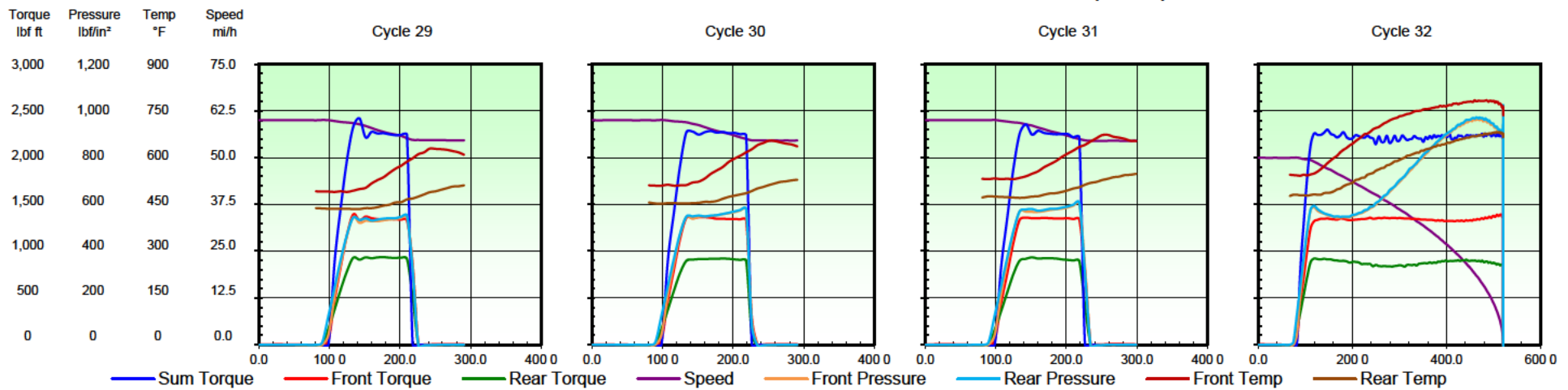
Report Number: 203145-3

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-08

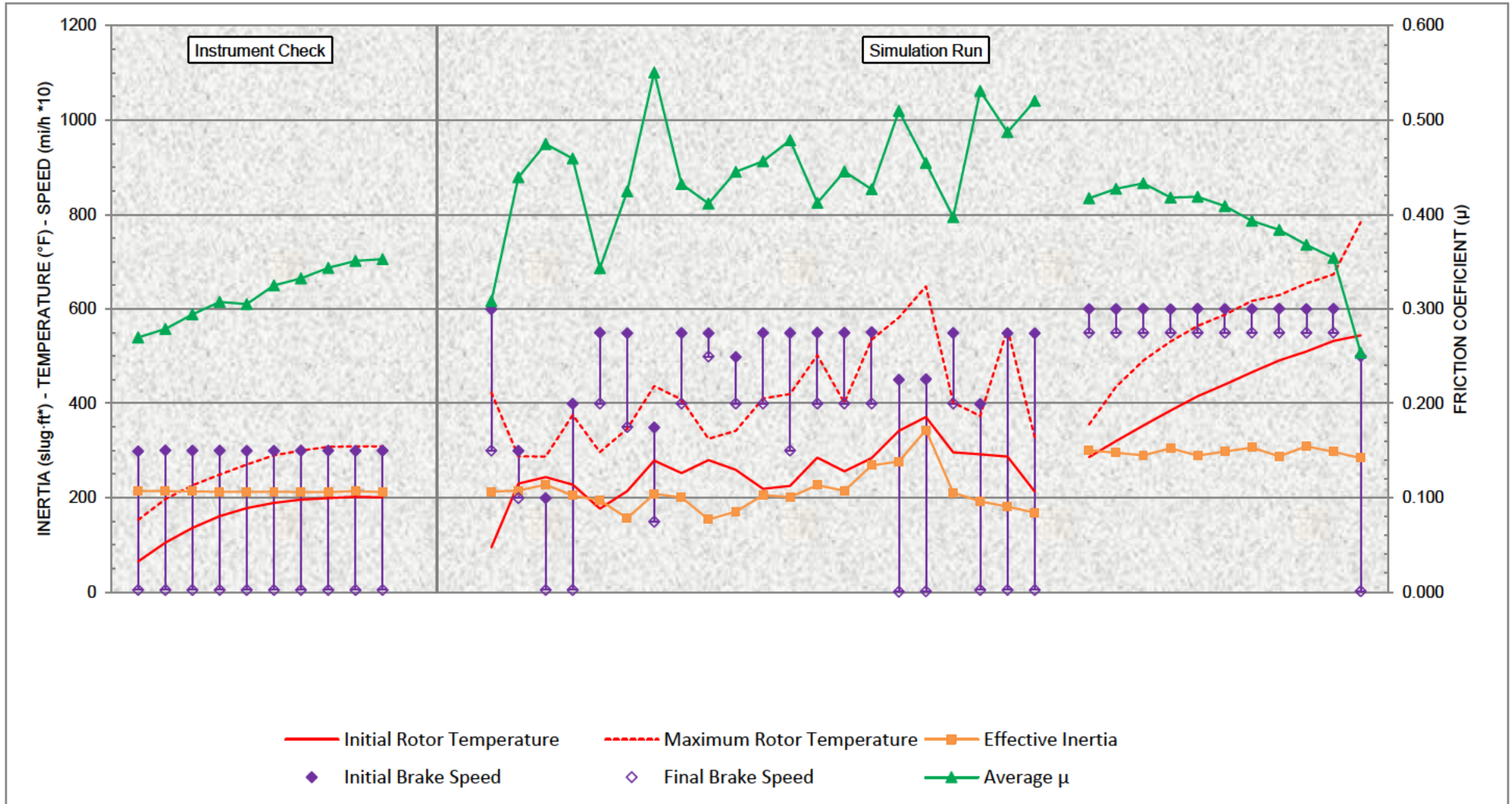
Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

Report Number: 203145-3

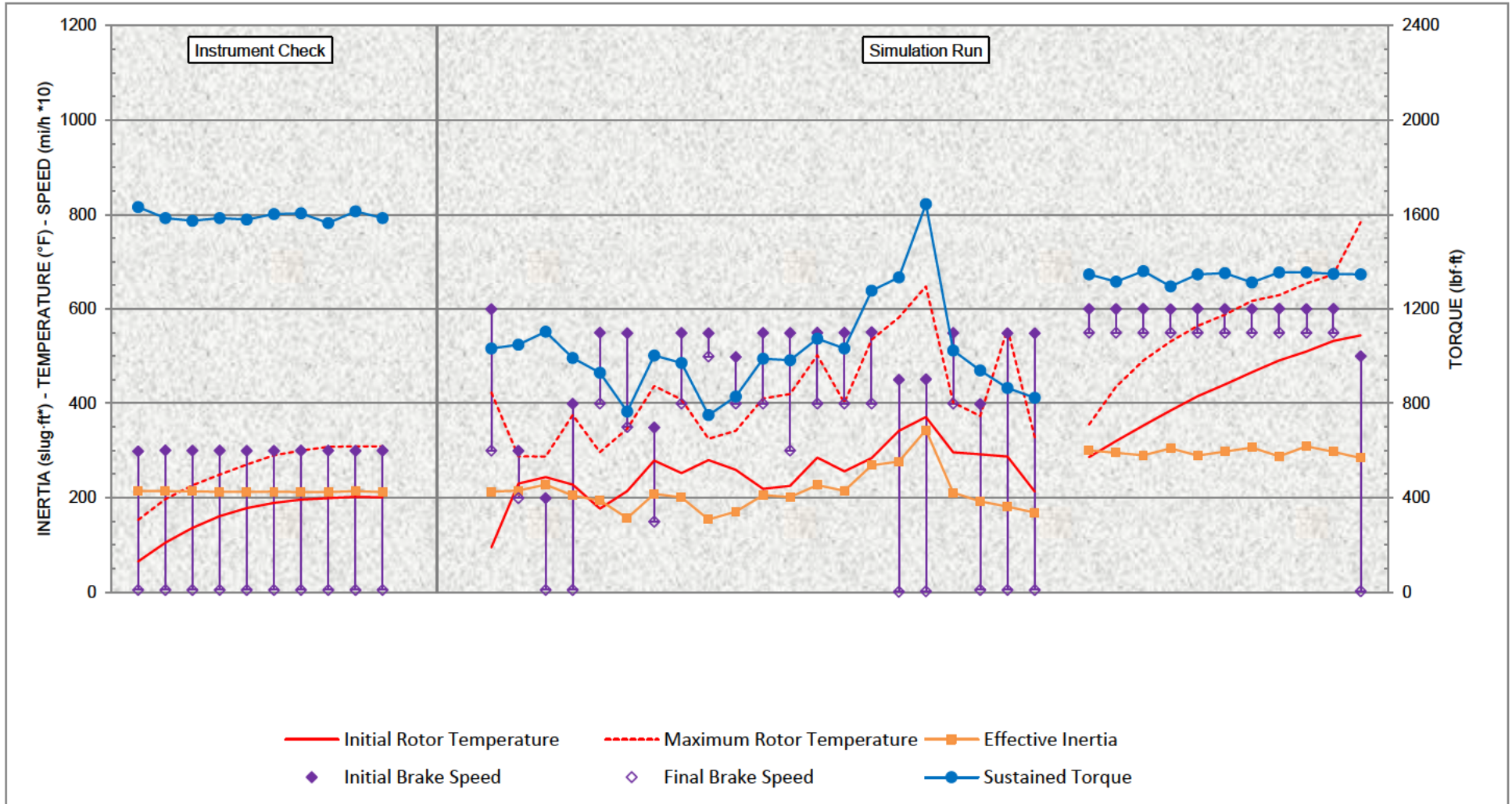
Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
TEST PERFORMANCE PROFILE - FRONT BRAKE



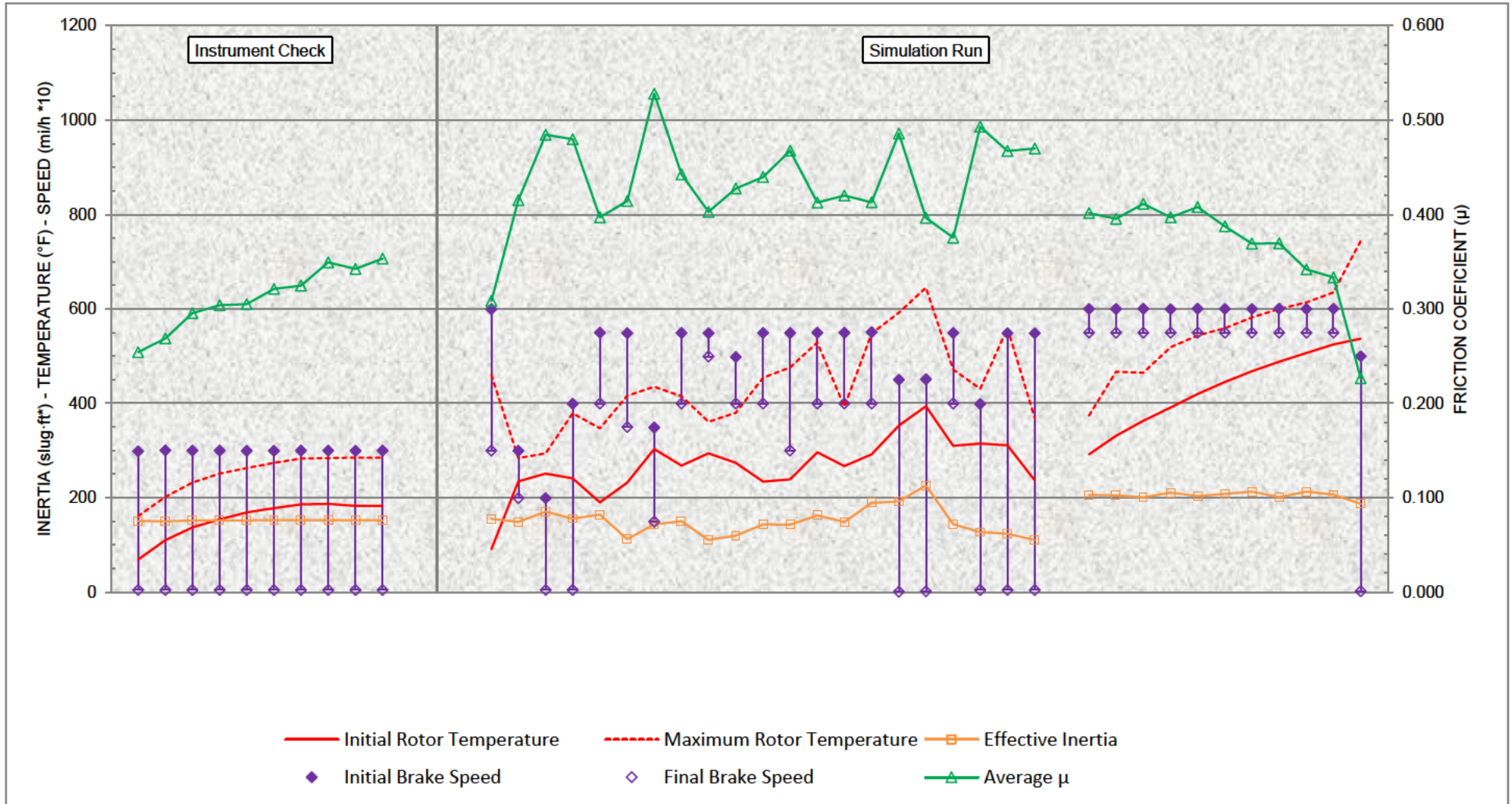
Client: NTSB Acquisition and Lease Management Division
 Test Numbers: M20-064-08
 Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear
 Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear
 Report Number: 203145-3
 Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
TEST PERFORMANCE PROFILE - FRONT BRAKE



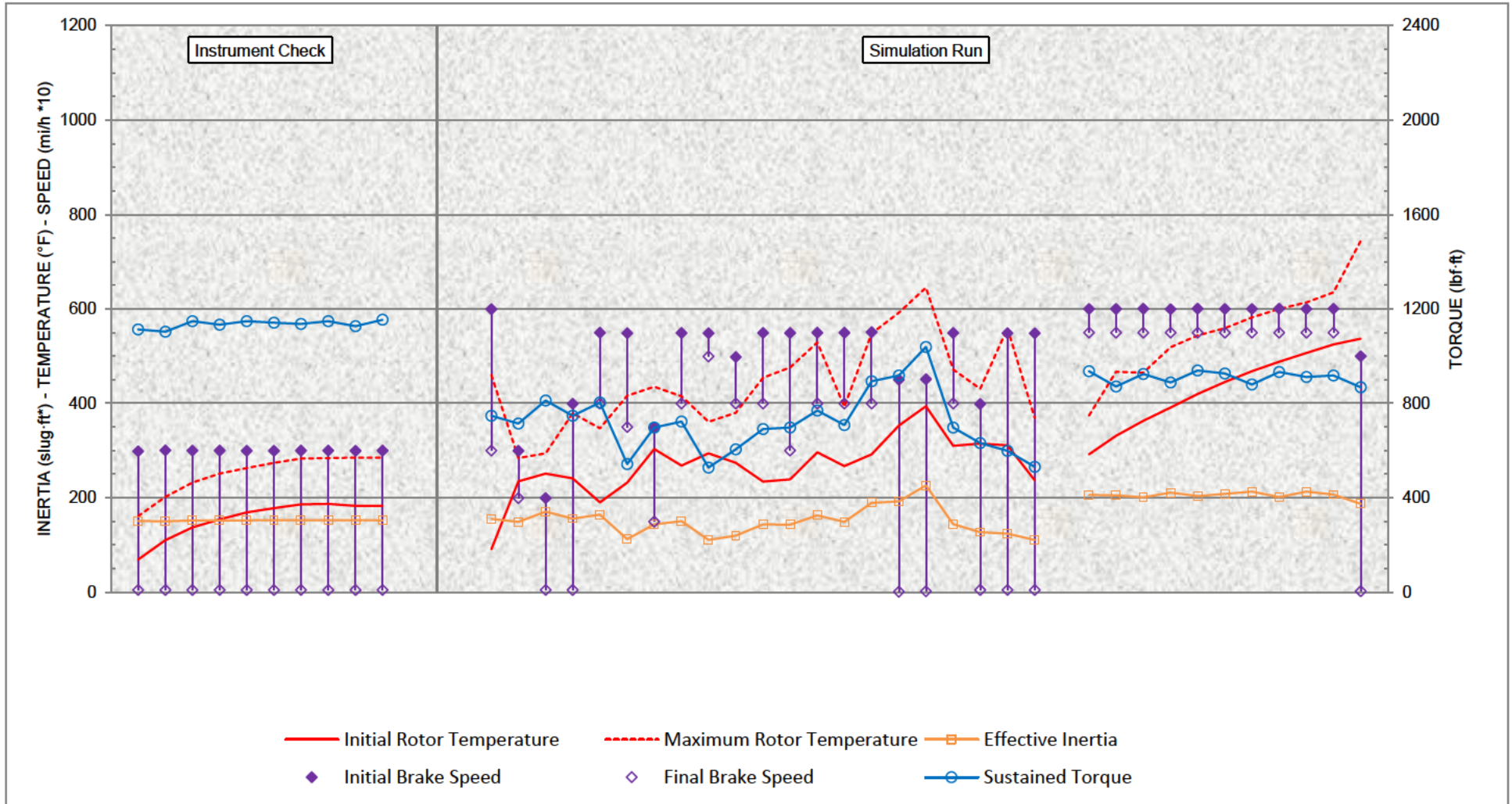
Client: NTSB Acquisition and Lease Management Division
 Test Numbers: M20-064-08
 Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear
 Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear
 Report Number: 203145-3
 Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
TEST PERFORMANCE PROFILE - REAR BRAKE



Client: NTSB Acquisition and Lease Management Division
 Test Numbers: M20-064-08
 Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear
 Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear
 Report Number: 203145-3
 Test Report Date: 20 March 2020

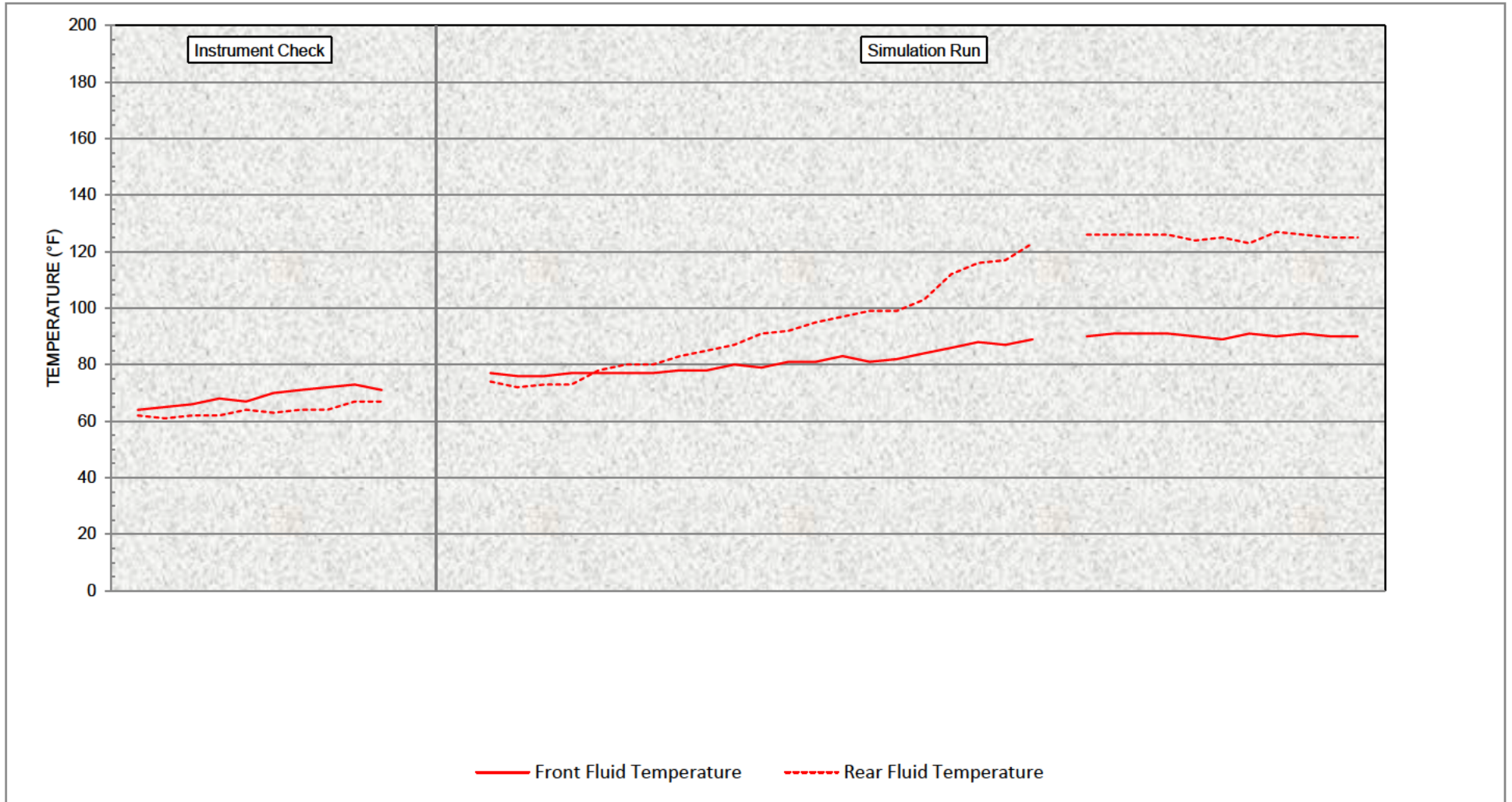
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW
TEST PERFORMANCE PROFILE - REAR BRAKE



Client: NTSB Acquisition and Lease Management Division
 Test Numbers: M20-064-08
 Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear
 Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear
 Report Number: 203145-3
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NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW

BRAKE FLUID TEMPERATURE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-08

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

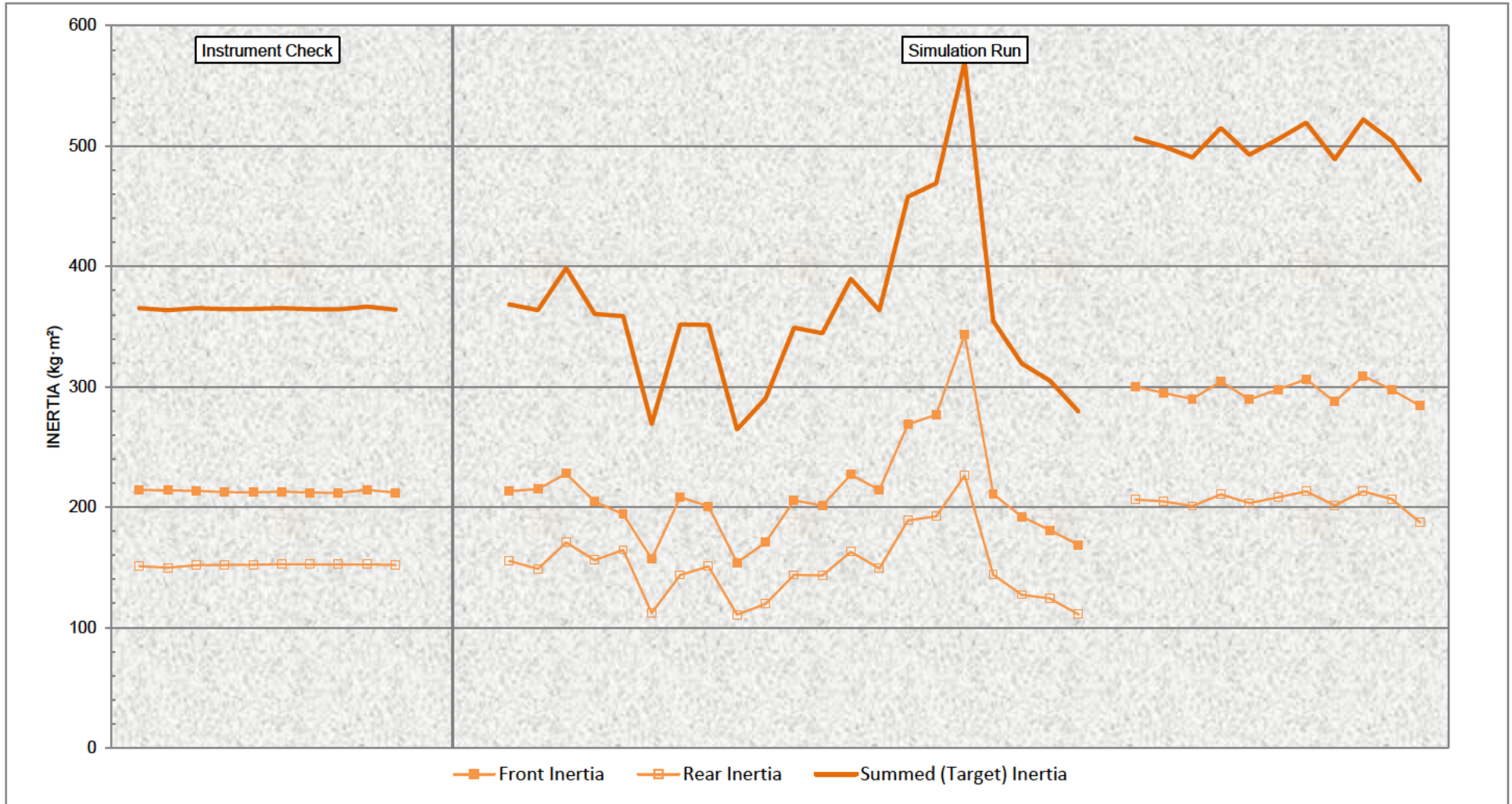
Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

Report Number: 203145-3

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST
 2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GWW

INERTIA DISTRIBUTION



Client: NTSB Acquisition and Lease Management Division
 Test Numbers: M20-064-08
 Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear
 Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear
 Report Number: 203145-3
 Test Report Date: 20 March 2020

Test Numbers: M20-064-08

Report Number: 203145-3

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

CYCLE NO.	SPEED		TIME		DISTANCE		DECEL		PRESSURE				TORQUE						TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA												
	INIT	FNL	STOP	REPT	STOP	REPT	AVG	AVERAGE	SUSTAINED	MAXIMUM	AVERAGE	SUSTAINED	MAXIMUM	ROTOR	FRONT		REAR		ROTOR	FRONT		REAR		MAXIMUM	SUSTAINED	FRONT	REAR														
	mi/h		s		ft		ft/s ²	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	FRONT	REAR	FRONT	REAR	FRONT	REAR	FRONT	REAR												
INSTRUMENT CHECK																																									
30 mi/h - 0.31g Deceleration Rate - 200°F Initial Rotor Temperature																																									
1	29.8	0.5	4.56	0.0	108	0	8.87	903	915	913	922	1046	1060	2414	1417	997	2745	1632	1113	1706	1172	65	153	68	134	64	126	64	69	161	64	139	69	134	62	2.75	1.93	0.27	0.25	214.4	150.9
2	30.0	0.5	4.62	58.1	110	58	8.79	830	839	858	865	910	923	2384	1402	981	2689	1585	1104	1679	1154	105	197	92	165	88	153	65	110	202	95	171	95	160	61	0.89	0.38	0.28	0.27	214.0	149.8
3	30.0	0.5	4.61	60.0	110	60	8.78	601	645	807	818	868	896	2392	1398	994	2721	1573	1148	1655	1180	136	226	119	190	114	181	66	137	232	119	194	114	184	62	0.46	0.31	0.29	0.30	213.6	151.8
4	30.0	0.5	4.59	60.1	109	60	8.85	717	728	778	785	843	873	2404	1402	1002	2718	1585	1133	1655	1204	161	249	142	209	134	205	68	154	251	143	213	137	203	62	0.43	0.29	0.31	0.30	212.6	152.0
5	30.0	0.5	4.60	60.1	109	60	8.86	555	601	781	793	821	849	2409	1403	1006	2727	1579	1148	1641	1180	178	270	160	225	149	223	67	169	263	156	226	151	217	64	0.41	0.28	0.31	0.30	212.3	152.3
6	30.0	0.5	4.57	60.1	109	60	8.84	730	736	744	749	804	832	2408	1403	1005	2744	1602	1142	1644	1178	189	290	175	238	157	239	70	178	274	166	235	163	227	63	0.41	0.28	0.33	0.32	212.9	152.5
7	30.0	0.5	4.57	60.1	109	60	8.88	716	725	729	737	817	851	2412	1403	1009	2741	1605	1136	1655	1222	196	300	186	252	170	249	71	186	283	174	242	171	236	64	0.41	0.28	0.33	0.32	212.1	152.4
8	30.0	0.5	4.57	66.8	109	67	8.89	531	560	687	692	797	838	2415	1404	1010	2712	1564	1148	1673	1207	199	308	193	257	174	253	72	187	284	177	243	174	239	64	0.40	0.27	0.34	0.35	211.9	152.5
9	29.9	0.5	4.57	72.1	109	72	8.85	684	685	694	693	786	811	2419	1414	1005	2741	1614	1127	1661	1192	202	309	195	258	175	253	73	183	285	176	242	174	239	67	0.40	0.27	0.35	0.34	214.3	152.3
10	30.0	0.5	4.56	70.9	108	71	8.92	670	680	678	688	778	818	2421	1410	1010	2739	1585	1154	1673	1237	201	309	198	262	177	255	71	183	285	176	243	171	241	67	0.40	0.27	0.35	0.35	212.1	151.9

CYCLE	SPEED		TIME		DISTANCE		DECEL	PRESSURE					TORQUE					TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA													
	INIT	FNL	STOP	REPT	STOP	REPT		AVG	AVERAGE	SUSTAINED	MAXIMUM	AVERAGE	SUSTAINED	MAXIMUM	ROTOR	I/B	O/B	FLUID	ROTOR	I/B	O/B	FLUID	MAXIMUM	SUSTAINED	FRONT	REAR	FRONT	REAR													
	NO.						DIST	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	FRONT	REAR	FRONT	REAR	FRONT	REAR						
	mi/h		s		ft	ft/s ²	lbf/in ²					lbf ft					F						in ³		μ		slug ft ²														
DOWNHILL SIMULATION TEST																																									
0.20g Deceleration Rate																																									
1	59.9	30.0	6.94	595.1	467	50440	6.20	497	501	506	510	555	586	1704	986	718	1780	1033	747	1107	832	95	423	101	320	93	327	77	91	460	92	260	99	379	74	0.34	0.25	0.31	0.31	213.3	155.2
2	29.9	19.9	2.38	48.9	91	2335	5.93	359	359	360	362	438	461	1607	950	657	1762	1048	714	1142	835	230	288	195	255	175	210	76	235	284	209	264	188	221	72	0.29	0.21	0.44	0.42	214.9	148.7
3	19.9	0.5	4.58	23.5	71	714	5.99	352	354	351	353	434	458	1781	1018	763	1916	1104	812	1225	939	244	287	215	266	195	232	76	251	294	228	273	214	249	73	0.28	0.20	0.47	0.48	227.9	170.7
4	39.9	0.5	9.06	56.6	275	2632	6.24	324	326	326	328	460	499	1678	952	725	1739	992	747	1086	897	228	375	206	369	187	305	77	241	379	230	371	219	321	73	0.30	0.21	0.46	0.48	204.6	155.9
5	54.9	39.9	3.52	214.0	251	16090	6.10	387	401	409	426	503	546	1630	882	747	1733	930	803	1113	912	177	297	188	322	163	230	77	190	347	203	321	199	284	78	0.32	0.23	0.34	0.40	194.2	164.5
6	54.9	35.0	4.55	71.1	305	5628	6.31	268	272	272	276	376	443	1264	738	527	1308	765	543	962	809	214	346	211	378	181	266	77	232	416	236	356	225	327	80	0.28	0.20	0.42	0.41	157.0	112.0
7	34.9	14.9	4.61	20.0	172	1107	6.20	272	275	275	278	376	463	1626	963	664	1700	1003	697	1352	1012	279	437	280	408	238	364	77	303	435	290	407	279	375	80	0.27	0.19	0.55	0.53	208.3	143.6
8	54.9	39.9	3.52	93.5	250	6890	6.10	316	323	339	344	410	410	1597	912	685	1694	971	723	1036	806	252	408	249	376	214	319	78	268	415	277	397	259	359	83	0.28	0.19	0.43	0.44	200.7	150.7
9	54.9	49.9	1.17	57.6	96	4528	5.85	248	248	275	276	316	339	1154	671	482	1278	750	528	844	626	280	325	272	316	235	265	78	294	361	299	340	285	318	85	0.24	0.18	0.41	0.40	154.0	110.7
10	49.8	39.9	2.29	56.5	155	4178	6.16	274	291	281	298	365	418	1332	783	549	1434	829	605	1124	821	259	342	257	333	227	275	80	274	380	283	347	274	328	87	0.27	0.20	0.45	0.43	170.7	119.6
11	54.9	39.9	3.52	113.8	251	9107	6.08	320	325	327	331	436	496	1582	931	651	1680	989	691	1175	918	219	410	230	374	197	333	79	234	454	252	334	246	370	91	0.29	0.22	0.46	0.44	205.5	143.6
12	54.9	30.0	5.71	101.4	362	8092	6.28	306	311	310	314	423	471	1613	942	670	1680	983	697	1195	888	225	420	231	413	201	335	81	239	476	253	433	247	391	92	0.29	0.21	0.48	0.47	201.3	143.2
13	55.0	39.9	3.56	64.4	254	4891	6.04	384	386	393	393	408	435	1753	1021	732	1844	1074	770	1163	862	285	502	278	485	235	408	81	296	529	301	428	290	443	95	0.28	0.21	0.41	0.41	227.0	162.7
14	54.9	39.9	3.51	128.6	251	10310	6.10	343	349	350	355	397	410	1653	975	678	1741	1033	708	1101	791	256	401	260	365	223	316	83	267	393	284	408	272	331	97	0.29	0.21	0.45	0.42	214.4	149.0
15	55.1	39.9	3.61	62.2	258	4903	5.98	419	428	452	456	522	577	2041	1198	843	2172	1278	894	1473	1136	284	535	282	494	241	425	81	292	548	302	451	287	458	99	0.32	0.24	0.43	0.41	268.8	189.1
16	45.0	0.1	10.39	42.1	351	2786	6.20	367	377	395	398	516	611	2168	1279	889	2252	1334	918	1685	1178	342	582	331	572	284	515	82	353	592	348	542	331	524	99	0.33	0.24	0.51	0.49	276.8	192.4
17	45.1	0.2	10.54	86.3	361	4791	6.06	548	554	546	552	704	710	2571	1550	1021	2683	1644	1039	1791	1160	371	648	369	626	310	565	84	394	645	391	577	373	576	103	0.36	0.26	0.45	0.40	343.6	226.2
18	54.9	39.9	3.51	210.3	250	15770	6.11	378	382	389	391	469	479	1614	959	655	1721	1024	697	1107	744	296	402	316	460	262	321	86	310	472	341	462	335	419	112	0.32	0.23	0.40	0.38	210.8	143.9
19	39.8	0.5	9.00	94.2	271	5613	6.29	263	266	267	270	410	472	1498	901	597	1571	939	632	1175	874	292	373	304	410	255	325	88	315	431	335	435	323	397	116	0.31	0.23	0.53	0.49	192.1	127.3
20	54.9	0.5	12.39	91.9	511	6165	6.33	266	269	268	270	376	420	1440	854	586	1464	865	599	1042	779	287	558	298	551	249	505	87	311	559	329	506	320	514	117	0.30	0.22	0.49	0.47	181.0	124.0
21	54.8	0.5	12.35	262.4	509	20000	6.35	235	235	239	238	362	371	1324	799	525	1355	824	531	862	641	213	328	234	340	196	278	89	237	369	266	371	262	340	123	0.29	0.22	0.52	0.47	168.6	110.8
2 MINUTE STOP WITH VEHICLE IN PARK																																									
22	60.0	55.0	1.38	38.1	120	1866	5.17	451	460	487	491	563	632	1953	1158	795	2282	1346	936	1614	1077	286	355	282	368	245	275	90	292	374	301	380	293	333	126	0.34	0.26	0.42	0.40	300.3	206.3
23	60.0	55.0	1.36	14.5	118	1250	5.26	432	437	465	464	525	581	1959	1156	803	2187	1316	871	1599	1107	320	435	330	435	282	340	91	331	467	333	414	323	395	126	0.31	0.25	0.43	0.40	294.9	204.8
24	60.1	55.0	1.33	14.5	117	1250	5.37	439	444	474	473	498	525	1962	1159	803	2284	1360	924	1449	1012	353	491	367	459	317	390	91	363	465	355	432	348	401	126	0.30	0.23	0.43	0.41	289.8	200.8
25	60.0	55.0	1.39	14.5	120	1251	5.13	445	451	468	471	544	616	1970	1164	806	2184	1296	888	1585	1142	385	531	396	498	342	422	91	391	519	377	452	373	446	126	0.32	0.25	0.42	0.40	304.5	210.6
26	60.0	55.0	1.35	14.5	117	1250	5.33	443	449	485	485	514	543	1958	1150	808	2285	1346	939	1446	1024	415	564	422	522	369	446	90	420	544	397	472	396	467	124	0.31	0.23	0.42	0.41	289.5	203.4
27	60.0	55.0	1.38	14.5	121	1250	5.15	432	445	499	504	549	609	1941	1143	798	2279	1352	927	1517	1121	440	588	449	543	392	468	89	445	559	418	490	419	488	125	0.33	0.24	0.41	0.39	297.8	208.0
28	60.0	55.0	1.42	14.5	124	1251	5.01	466	471	504	502	541	559	1938	1142	795	2193	1313	880	1414	989	466	617	472	565	413	495	91	468	582	437	514	439	510	123	0.34	0.23	0.39	0.37	306.2	213.1
29</																																									



**Brake Performance Study Attachment 5: Dynamometer Testing Report: Downhill Braking
Simulation Test– 2001 Ford Excursion with Limousine Conversion, 13565 lbs -Front
Brakes Only**

Schoharie, NY

HWY19H001

NATIONAL TRANSPORTATION SAFETY BOARD SCHOHARIE, NY DOWNHILL BRAKING SIMULATION TEST

Client NTSB Acquisition and Lease Management Division
490 L'Enfant Plaza East SW
Washington, DC 20594-0003

Report Number 203145-4
(Used Parts - 13,565 lb GVW - Front Brake Only)

Vehicle Simulated 2001 Ford Excursion with Limousine Conversion

Front Lining Edge Code MPV 2000-EE

Rear Lining Edge Code MPV 2000-EE

Test Completion Date 20 March 2020

Signature

Kevin C. Machus, Test Engineer
for Greening Testing Laboratories, Inc.

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NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

Test Numbers	M20-064-09
Test Program Number	3947.02.20V01 - 2001 FORD EXCURSION.TST
Vehicle System Simulated	2001 Ford Excursion with Limousine Conversion
Reference	Contract No. 9531BM20P0015
Test Date(s)	20 March 2020
Date Test Report Prepared	27 March 2020
Test Report Prepared By	K. Machus
Gross Vehicle Weight	13,565 lbs (per NTSB)
Static Rolling Radius	16.1 inches (based on revolutions per mile of LT265/75R16D tires)
Test Inertia (without loss)	379.2 slug·ft ²
Parasitic Loss	3.0% (based on vehicle measurements)
Test Inertia (with loss)	368.8 slug·ft ²
Equivalent 1/2 Vehicle Weight	6,579 lbs

	<u>Front Disc Brake</u>	<u>Rear Disc Brake</u>
Lining Edge Code	MPV 2000-EE	MPV 2000-EE
Brake Pad Part Number	Motorcraft BR1266	Motorcraft BR1275
Brake Pad FMSI® Number	7625-D756	7626-D757
Brake Configuration	dual piston, separate function caliper disc brake	dual piston, separate function caliper disc brake
Piston Diameter(s)	2 x 54 mm	2 x 46 mm
Rotor Part Number	Ford 1G3Z-1V102-AB	Ford YC3Z-2C026-BB
Brake Size (nominal) Rotor Diameter x Thickness	13.0 x 1.5 inches	12.8 x 1.2 inches
Rotor Mass (nominal)	20.7 kg	10.9 kg
Rotor Effective Radius	5.599 inches	5.529 inches
Wheel Rotation	right hand	left hand
Test Fixture	096622	190316
Date Parts Received	16 January 2020	16 January 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

DATA NOTES

1 All average and sustained values shown in this report are calculated with respect to **DISTANCE**.

2 The data presented in this report has been gathered as follows:

START Threshold = 50 lbf·ft of brake torque during brake apply.

AVERAGE = average value between START and STOP Threshold levels.

INITIAL Data Point = Values are taken at the point where the control level is achieved.

SUSTAINED Data = average value between the INITIAL and END data points.

END Data Point = Values are taken 0.1 seconds prior to the STOP threshold

MAXIMUM = maximum value observed in the SUSTAINED Data Interval.

STOP Threshold = brake release

FINAL temperature is the highest temperature value observed in a 4.0 second "window" beginning 1.0 seconds after brake release.

3 Brake application is initiated when the control temperature (rotor) reaches the desired initial brake temperature.

4 Cooling Air Temperature = 80°F (±5°F)

5 Cooling Air Velocity = 20 mi/h for front brake, 2 mi/h for rear brake as determined by cooling curves conducted on a 2001 Ford Expedition.

6 For all stops which show "zero" (0) or negative values for some of the computed pressure, torque or coefficient values:

These stops achieved final speed but did not achieve the torque level required for the particular stop. Since the START data and STOP data thresholds were satisfied, deceleration rate, distance, time to stop, etc., are accurate values, and can be used for data comparison purposes.

The presence of "zero" values generally is caused by lack of brake performance, resulting in a "clamp" condition. "Clamp" condition is defined by the brake calling for the maximum pressure the test section allows ("clamp" pressure) and the brake being unable to attain the deceleration rate required in the test section at that pressure.

7 Thermocouple locations and depths:

Front Rotor: Center of inboard rubbing track at a depth of 0.040 inches

Front Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches

Front Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches

Rear Rotor: Center of inboard rubbing track at a depth of 0.040 inches

Rear Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches

Rear Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

COMPUTED DATA DESCRIPTIONS

SPEED

INIT = Speed start threshold is achieved.

FNL = Brake release speed

TIME

STOP = Time elapsed between start threshold and brake release

REPT = Time elapsed between cycles

DISTANCE

STOP = Distance elapsed between start threshold and brake release

REPT = Distance elapsed between cycles

DECEL

AVG = Average deceleration measured from start threshold to brake release

PRESSURE

AVERAGE = Average pressure from start threshold to brake release

SUSTAINED = Average pressure from point control level is achieved to brake release

MAXIMUM = Maximum pressure from start threshold to brake release

TORQUE

AVERAGE = Average torque from start threshold to brake release

SUSTAINED = Average torque from point control level is achieved to brake release

MAXIMUM = Maximum torque from start threshold to brake release

TEMPERATURE

INT = Temperature at start threshold

MAX = Maximum temperature between start threshold and 0.1 seconds after brake release

FLUID DISPLACEMENT

MAX = Maximum fluid displacement between start threshold and brake release

FRICTION COEFFICIENT

SUST = Friction coefficient (μ) calculated using the following formula:

$$\mu = \frac{\text{Sustained Torque (lbf}\cdot\text{ft)} / \text{Rotor Effective Radius (ft)}}{\text{Sustained Pressure (lbf/in}^2\text{)} * \text{Total Caliper Piston Area (in}^2\text{)}} * 0.5$$

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

TEST ROUTE - NEW AMSTERDAM TO SCHOHARIE NEW YORK

Cycle	Mile	Latitude (GPS)	Longitude (GPS)	Altitude (ft)	Grade Input (%g)	Braking Deceleration (g)	Apply Speed (mi/h)	Release Speed (mi/h)
0	0.0	42.94908	-74.18265	574.1	--	--	--	--
1	10.8	42.94409	-74.35478	293.3	-0.14%	0.2	60	30
2	11.1	42.94722	-74.35869	296.3	0.21%	0.2	30	20
3	11.2	42.94865	-74.35809	288.1	-1.69%	0.2	20	0
4	11.7	42.94957	-74.36914	287.4	0.28%	0.2	40	0
5	14.6	42.91169	-74.35237	469.5	0.40%	0.2	55	40
6	15.6	42.89860	-74.34632	647.3	5.20%	0.2	55	35
7	15.7	42.89696	-74.34592	666.0	0.80%	0.2	35	15
8	17.0	42.87979	-74.34609	802.8	0.90%	0.2	55	40
9	17.7	42.86949	-74.34253	871.7	5.27%	0.2	55	50
10	18.4	42.86000	-74.33732	1016.7	3.88%	0.2	50	40
11	20.4	42.83745	-74.35430	1200.1	1.12%	0.2	55	40
12	21.8	42.82276	-74.33815	1259.2	1.09%	0.2	55	30
13	22.6	42.81189	-74.33648	1295.6	-1.10%	0.2	55	40
14	24.5	42.78596	-74.33829	1284.1	0.19%	0.2	55	40
15	25.3	42.77450	-74.33766	1075.5	-4.69%	0.2	55	40
16	25.7	42.76815	-74.33585	955.1	-5.45%	0.2	45	0
17	26.5	42.75714	-74.33045	681.8	-10.46%	0.2	45	0
18	29.4	42.71859	-74.33721	676.2	0.59%	0.2	55	40
19	30.4	42.70533	-74.33539	633.2	2.50%	0.2	40	0
20	31.5	42.71097	-74.31464	681.4	3.31%	0.2	55	0
21	33.6	42.71540	-74.27608	1183.4	4.71%	0.2	55	0
2 MINUTE STOP - BRAKES RELEASED								
22	33.9			1078.1	-5.92%	0.2	60	55
23	34.0			1033.7	-5.92%	0.2	60	55
24	34.2			989.3	-5.92%	0.2	60	55
25	34.3			944.9	-5.92%	0.2	60	55
26	34.5			900.6	-5.92%	0.2	60	55
27	34.6			856.2	-5.92%	0.2	60	55
28	34.8			811.8	-5.92%	0.2	60	55
29	34.9			767.4	-5.92%	0.2	60	55
30	35.0			723.1	-5.92%	0.2	60	55
31	35.2	42.70259	-74.29994	678.5	-5.95%	0.2	60	55
32	35.4	42.70043	-74.30176	628.3	-5.40%	0.2	50	0

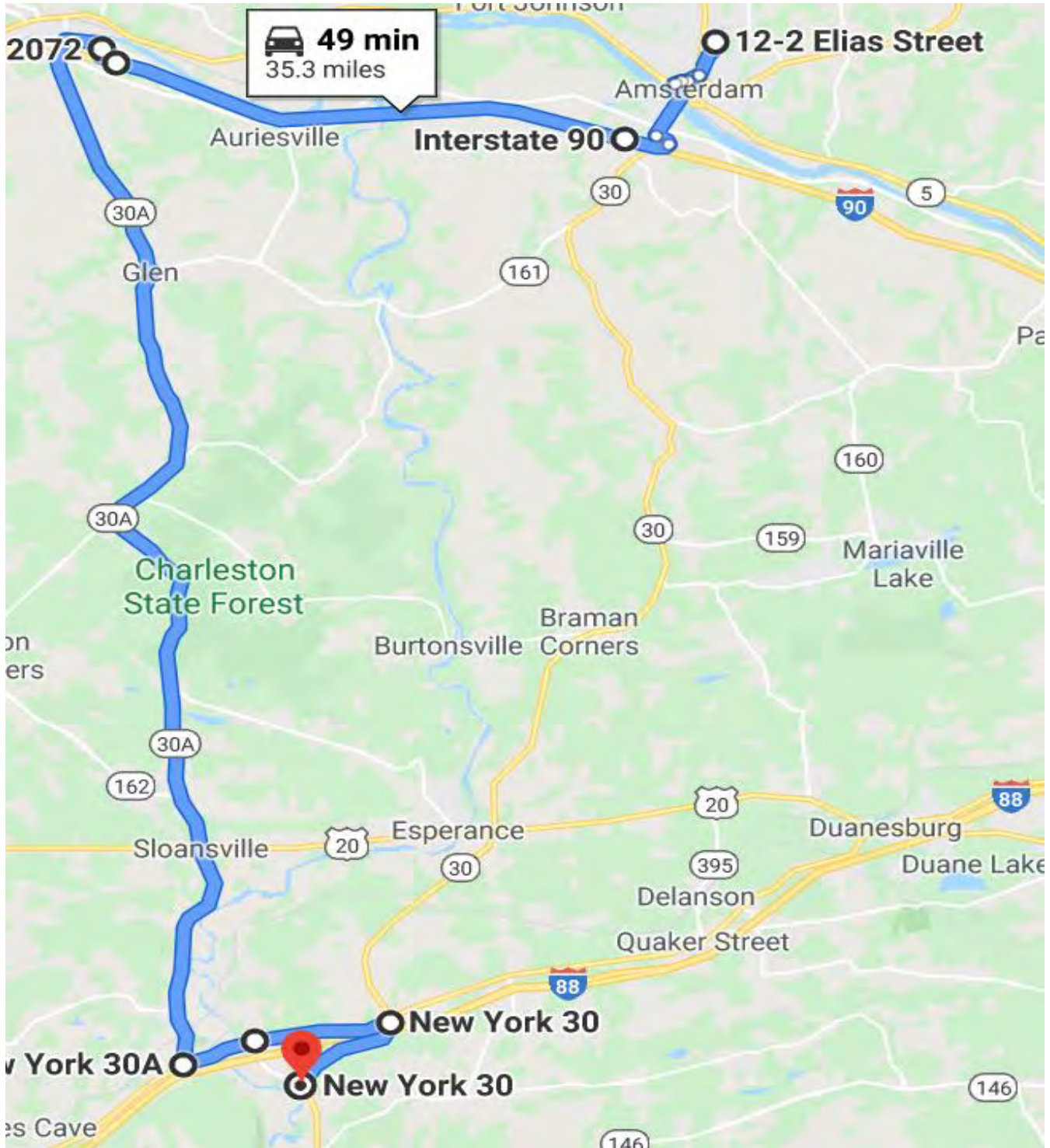
*NOTE: Test route was derived using the following criteria:

Speed limit and warning speeds were identified along the simulated route and used to control speed in the simulations. At Stop signs and controlled signalized intersections along the simulated route complete stops were modeled. At last stop before the final downhill descent a completed stop of 2 minutes was modeled. During downhill descents if the speed exceeded the posted speed limit by 5 mph braking at a maximum of 0.2 g was applied to reduce the speed to the speed limit.

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

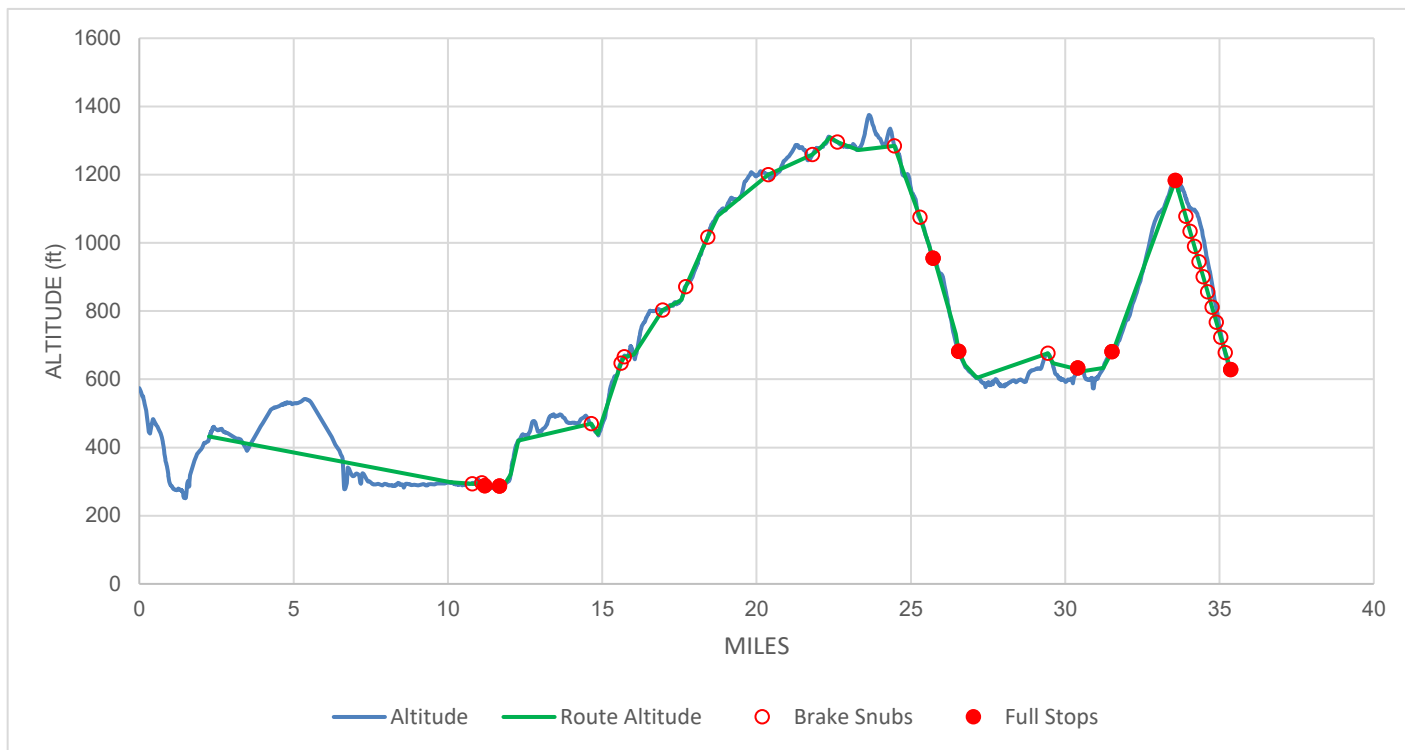
TEST ROUTE - OVERVIEW MAP



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

TEST ROUTE - PROFILE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

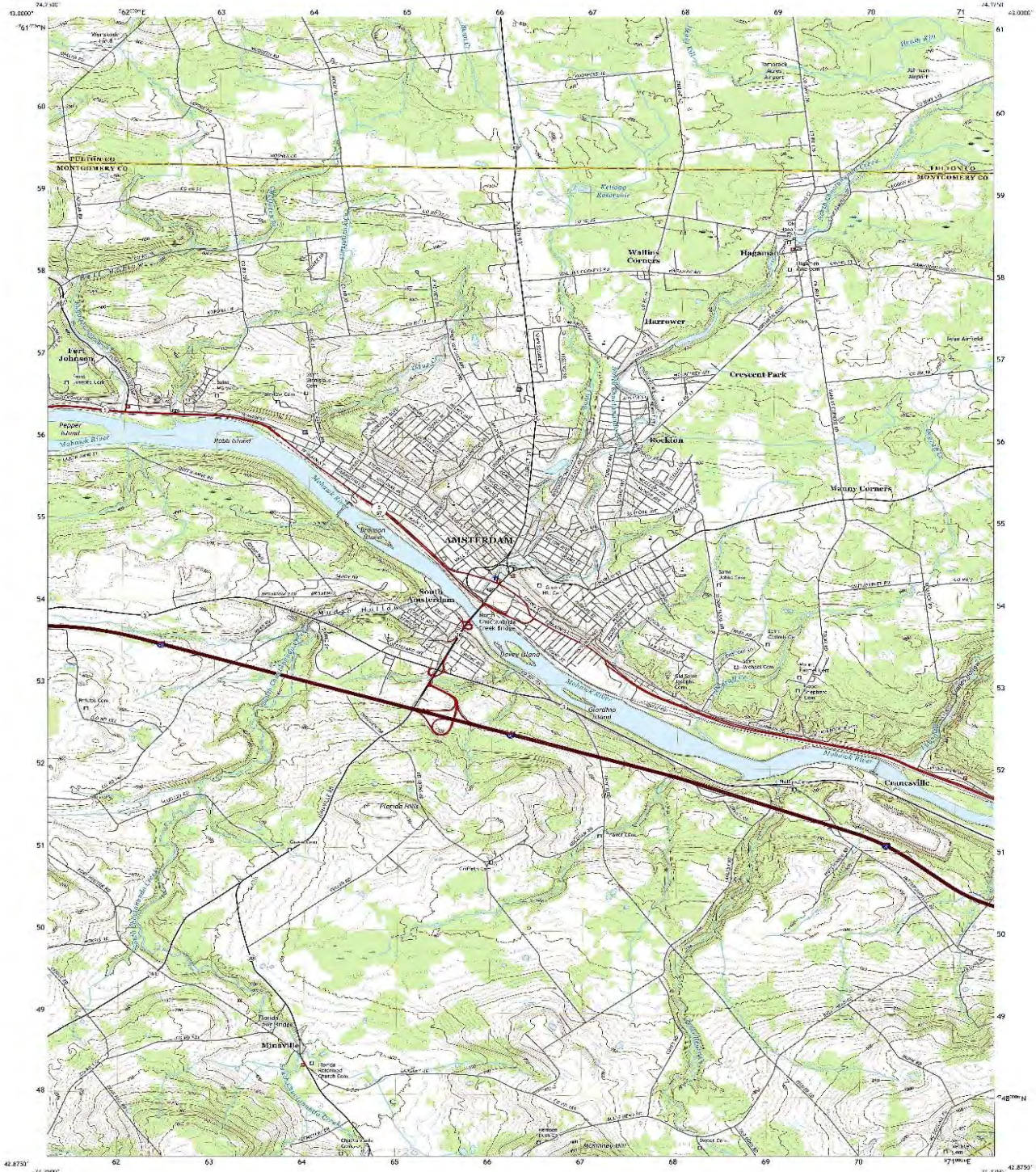
TEST ROUTE - AMSTERDAM QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



AMSTERDAM QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

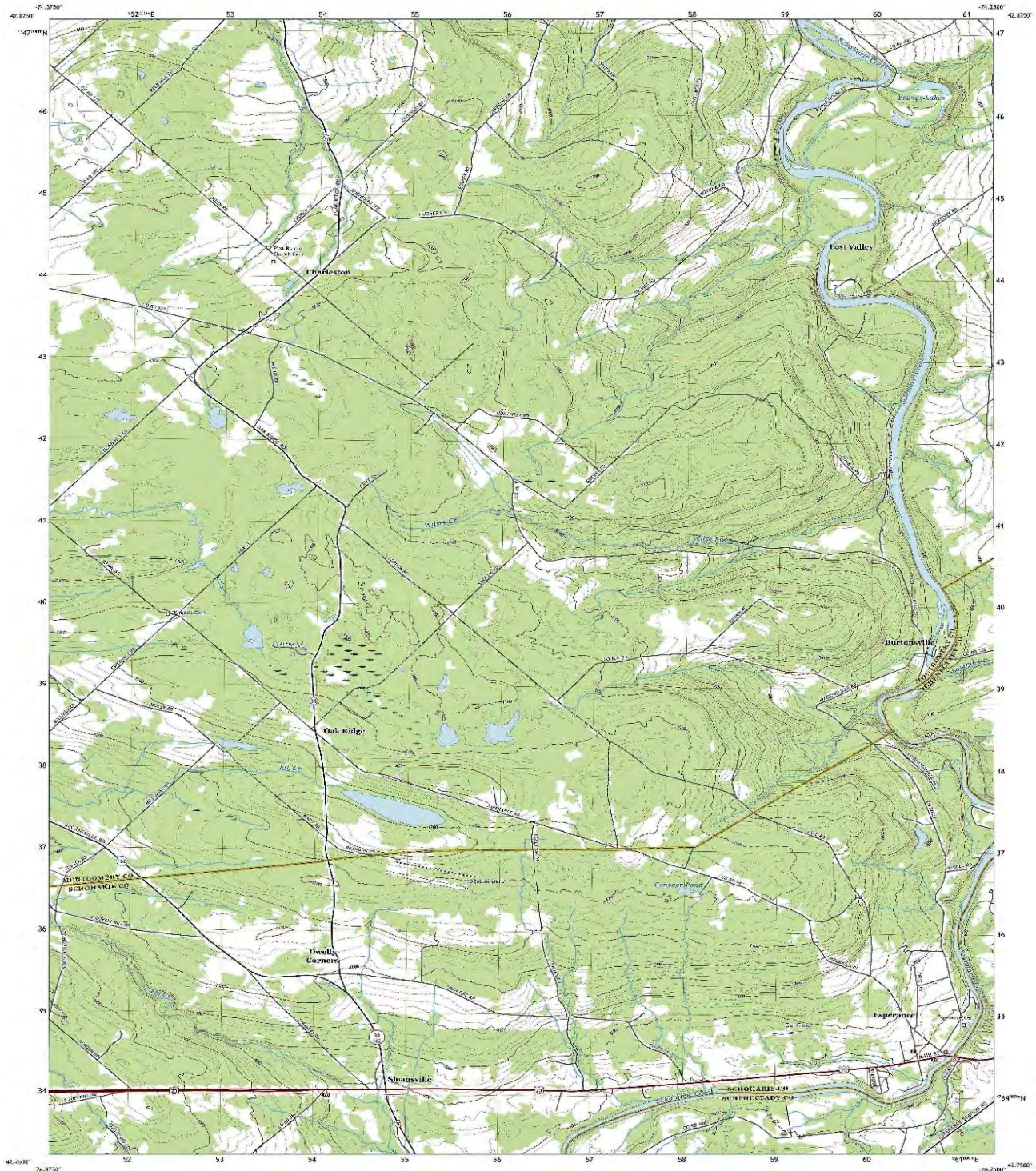
TEST ROUTE - ESPERANCE QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



ESPERANCE QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

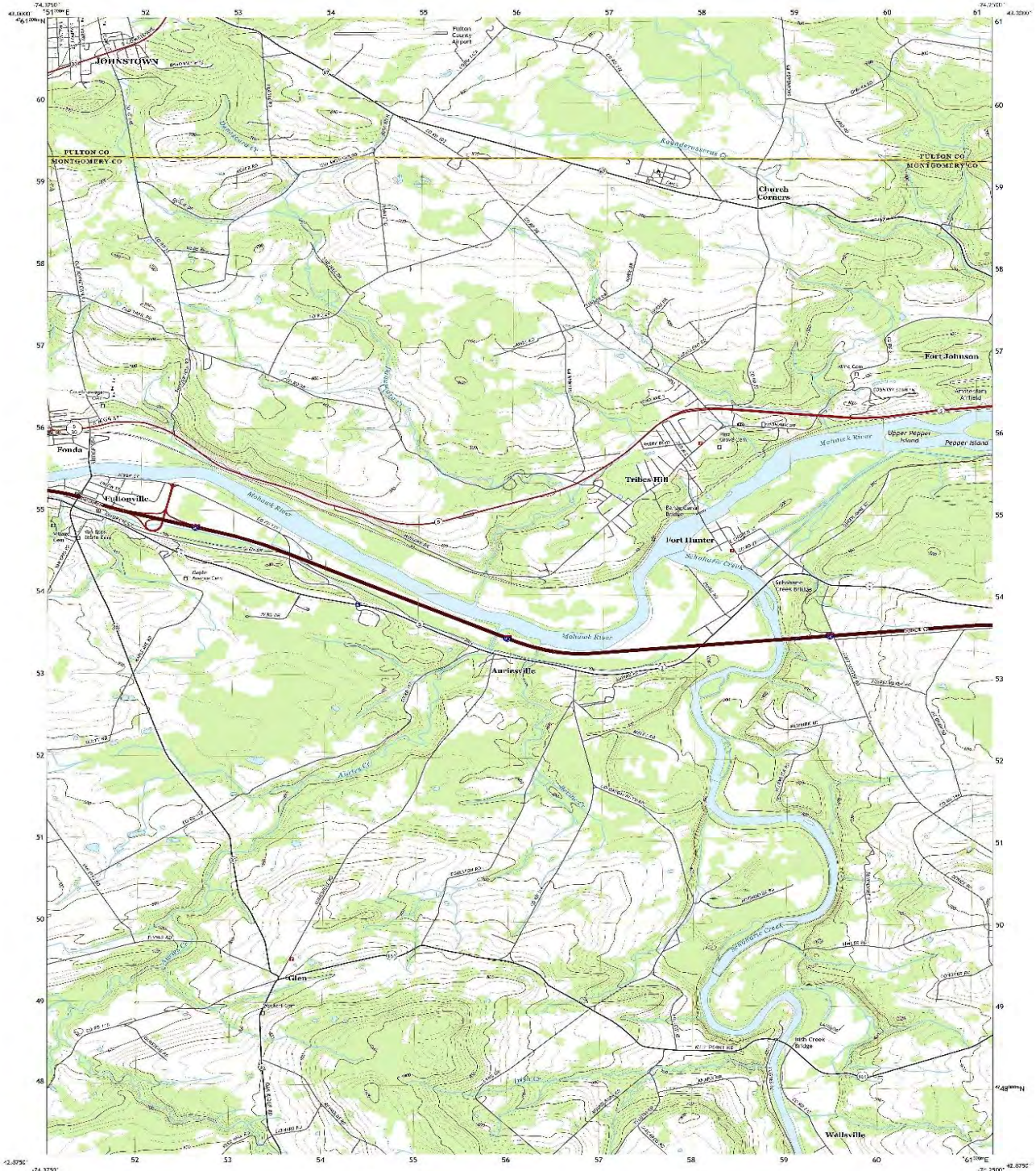
TEST ROUTE - TRIBES HILL QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



TRIBES HILL QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

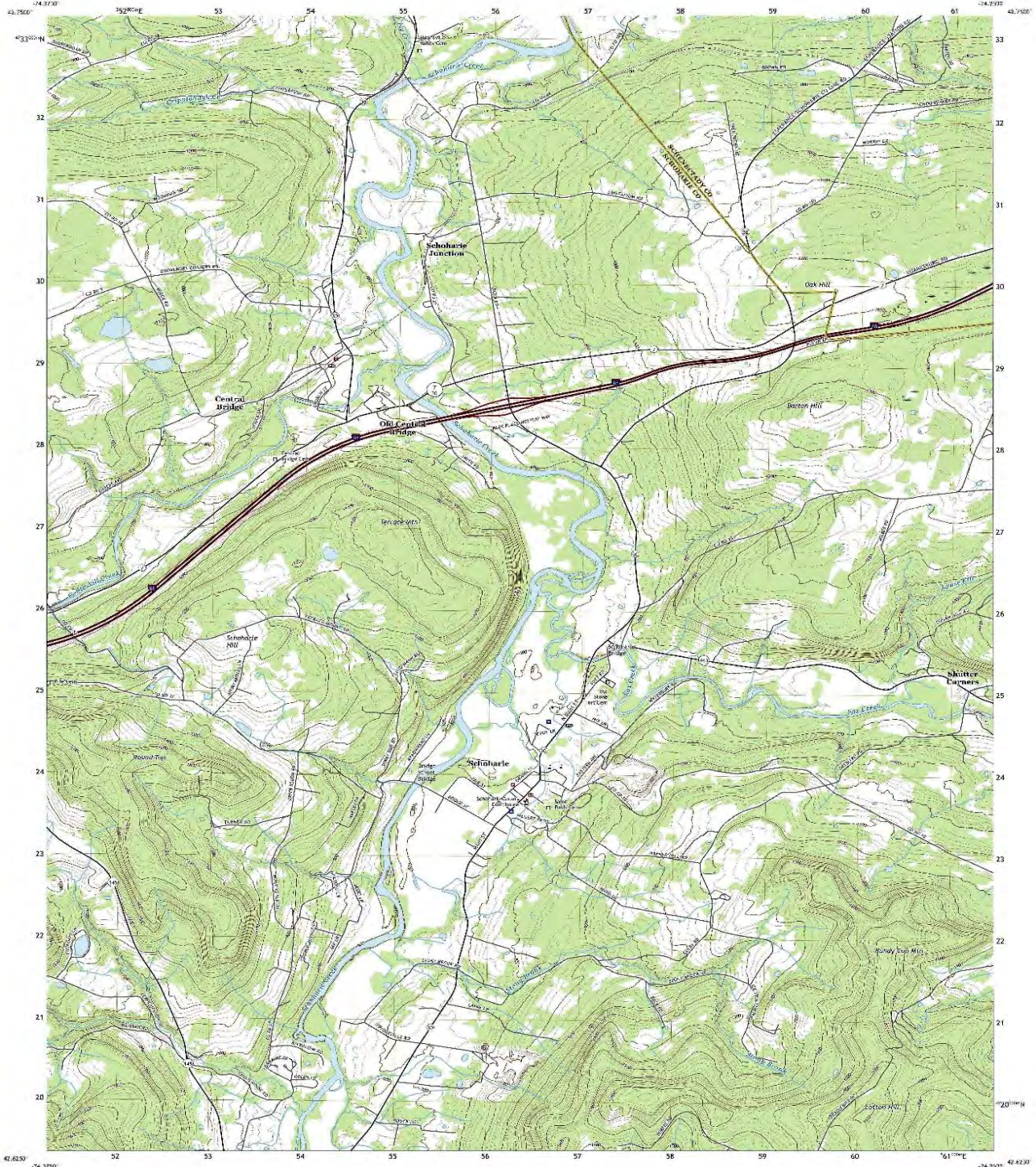
TEST ROUTE - SCHOHARIE QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



SCHOHARIE QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



Test Numbers: M20-064-09

Report Number: 203145-4

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

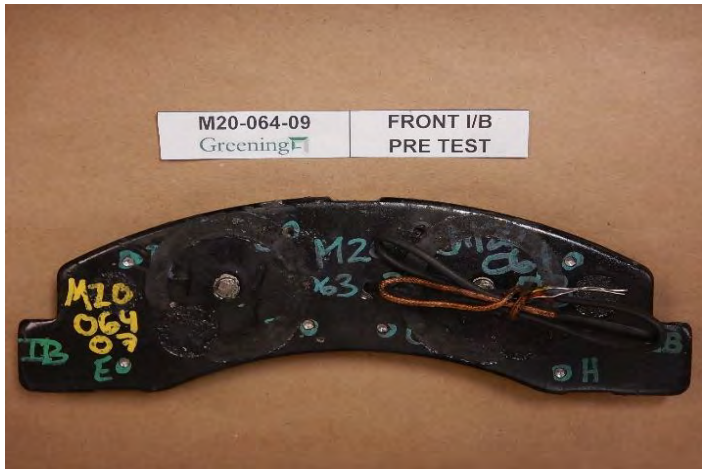
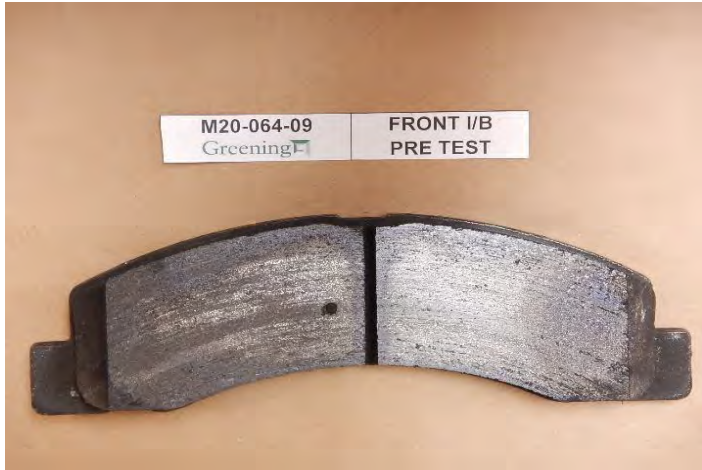
NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

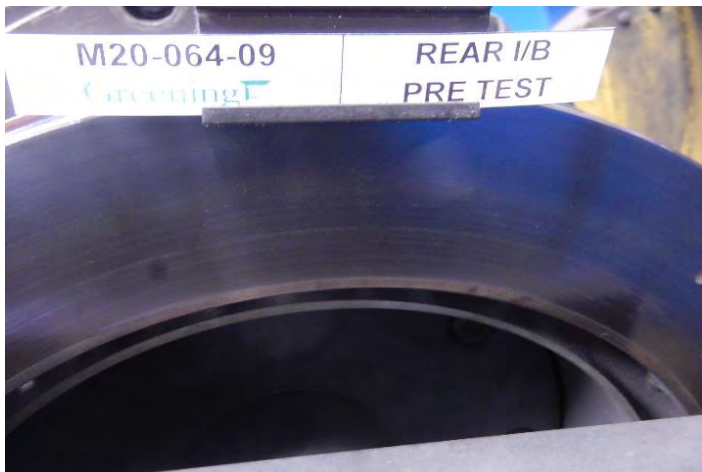
PRE TEST PHOTOGRAPHS - FRONT BRAKE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

PRE TEST PHOTOGRAPHS - REAR BRAKE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

POST TEST VISUAL INSPECTION - FRONT BRAKE

Inboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Outboard Pad: The pad has light flaking, light glazing, light grooving, light pitting and light resin bleed.

Rotor: The braking surface has light grooving, light hot spots, light lining transfer and is blue/grey in color.

All other test hardware appears in good condition.

PHOTOGRAPHS



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

POST TEST VISUAL INSPECTION - REAR BRAKE

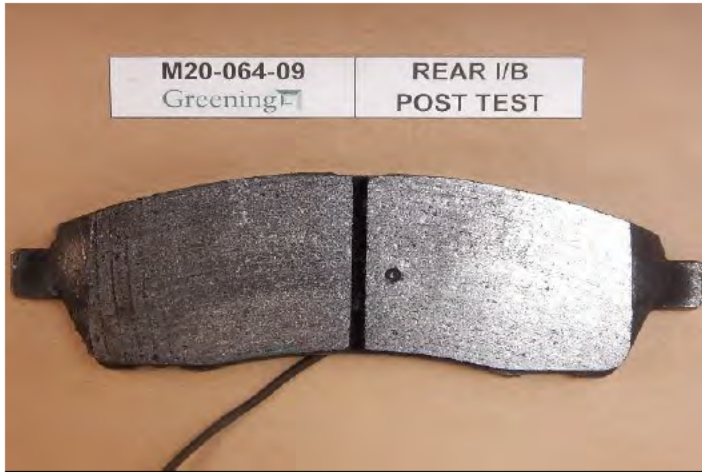
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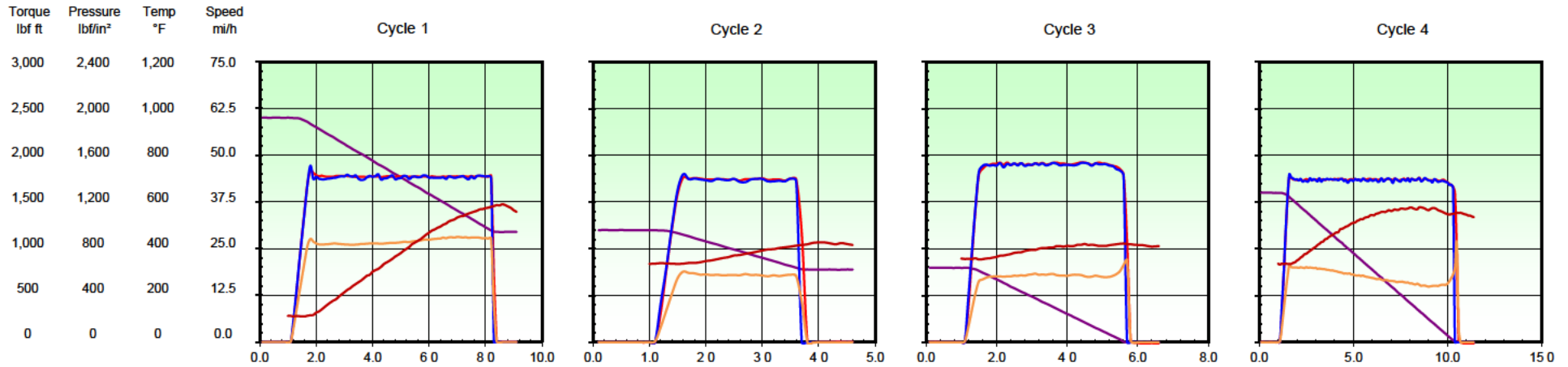
PHOTOGRAPHS



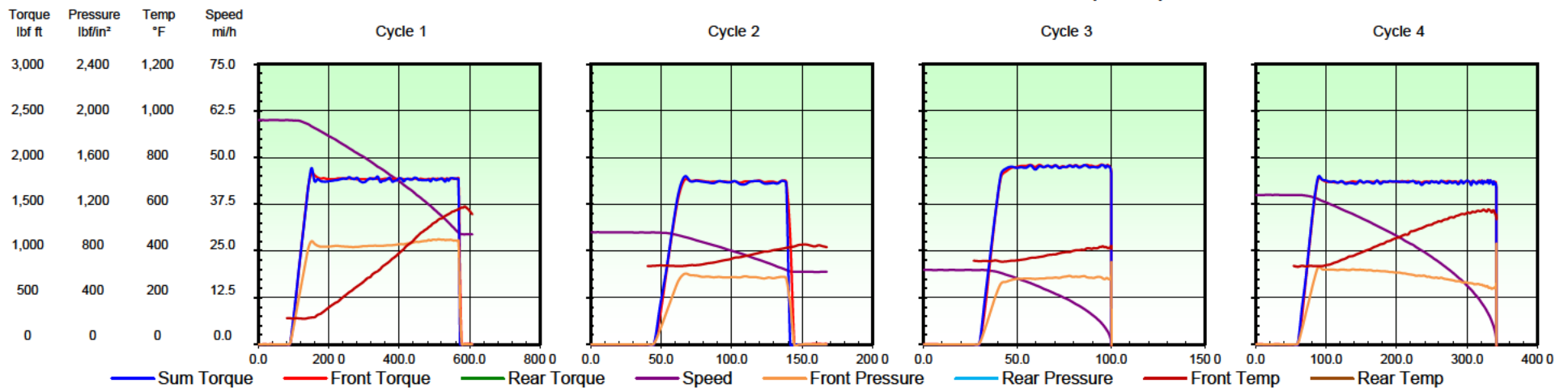
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-09

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

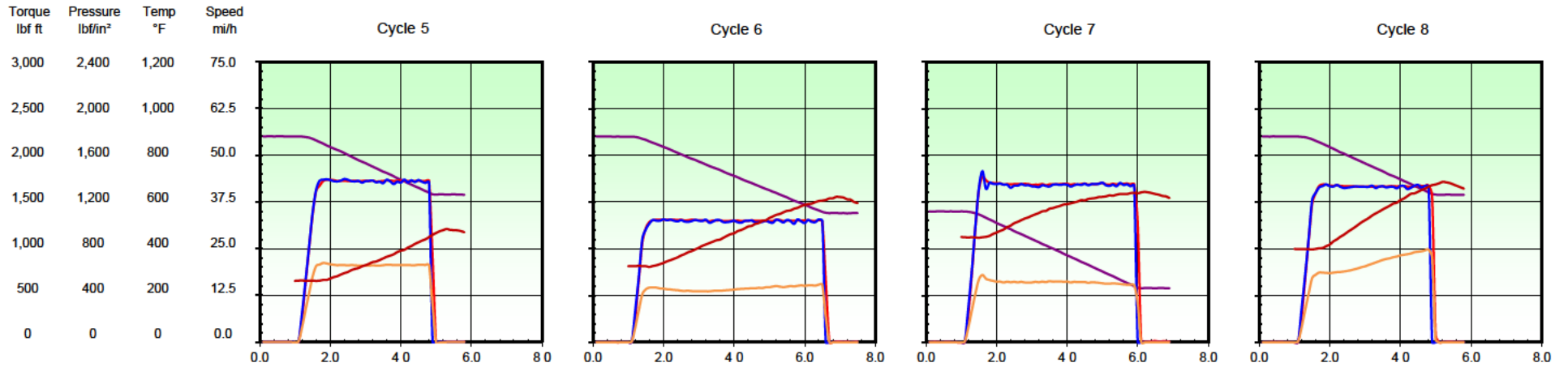
Report Number: 203145-4

Test Report Date: 20 March 2020

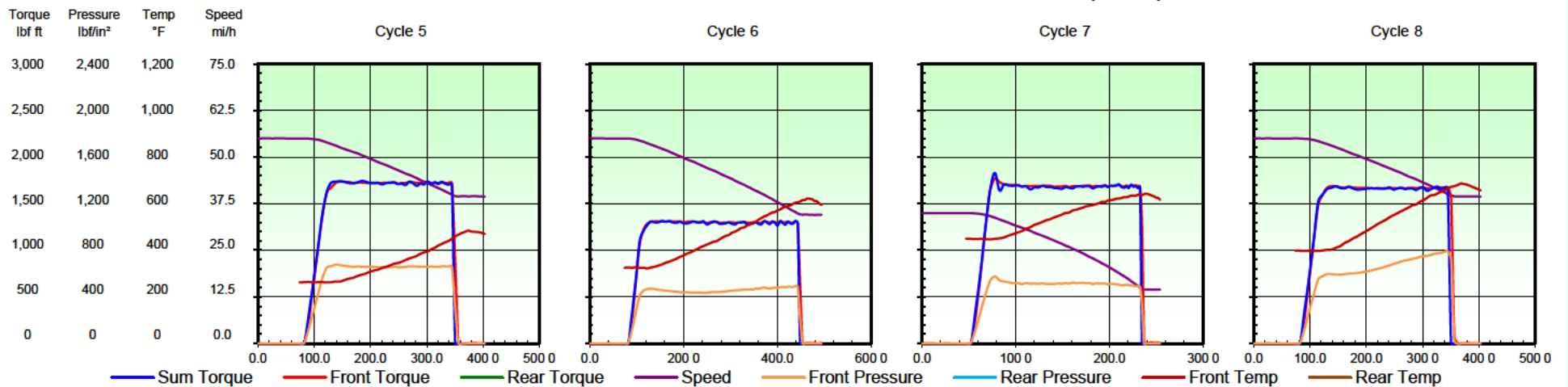
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

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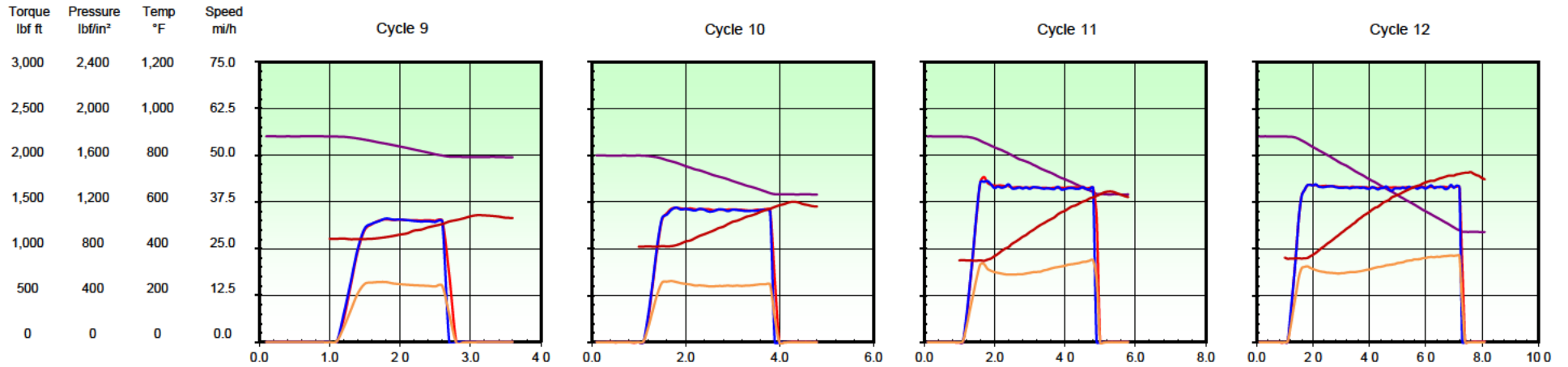
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Test Report Date: 20 March 2020

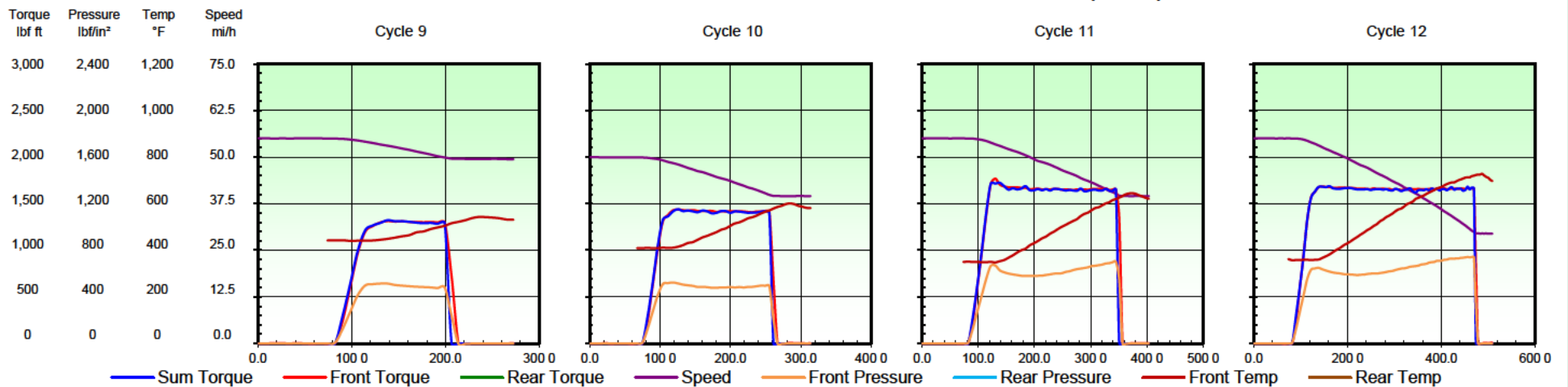
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

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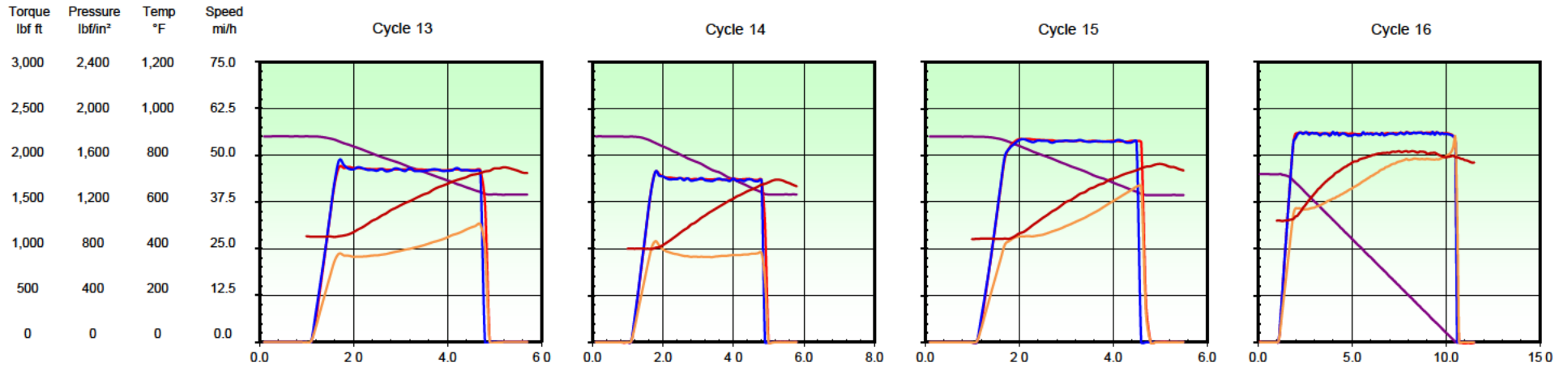
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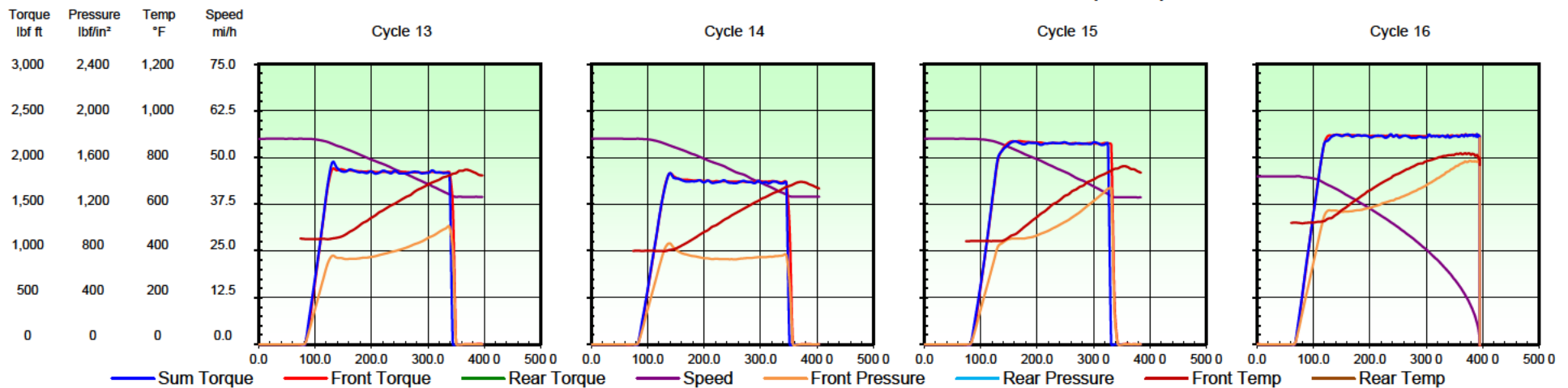
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

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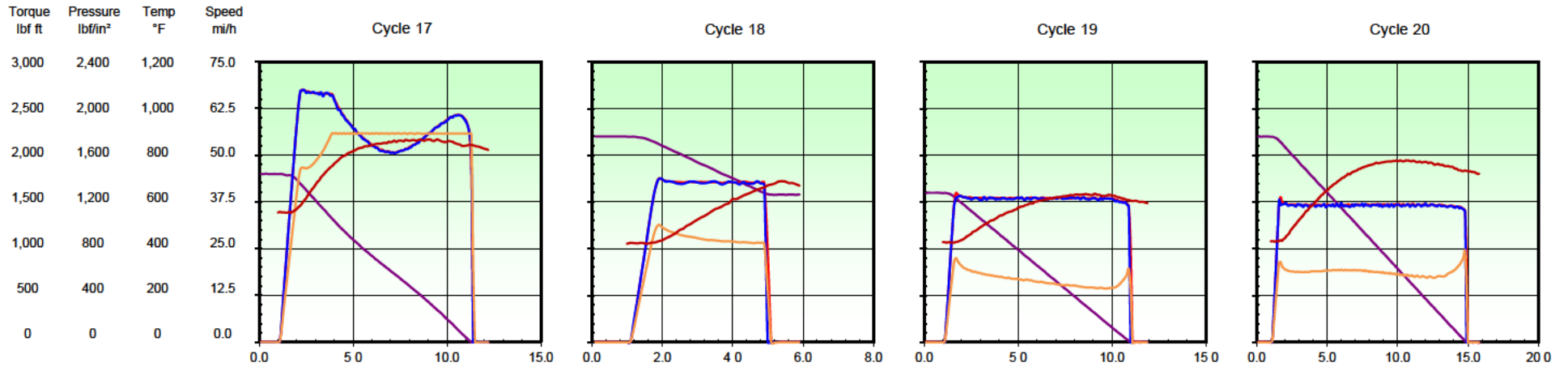
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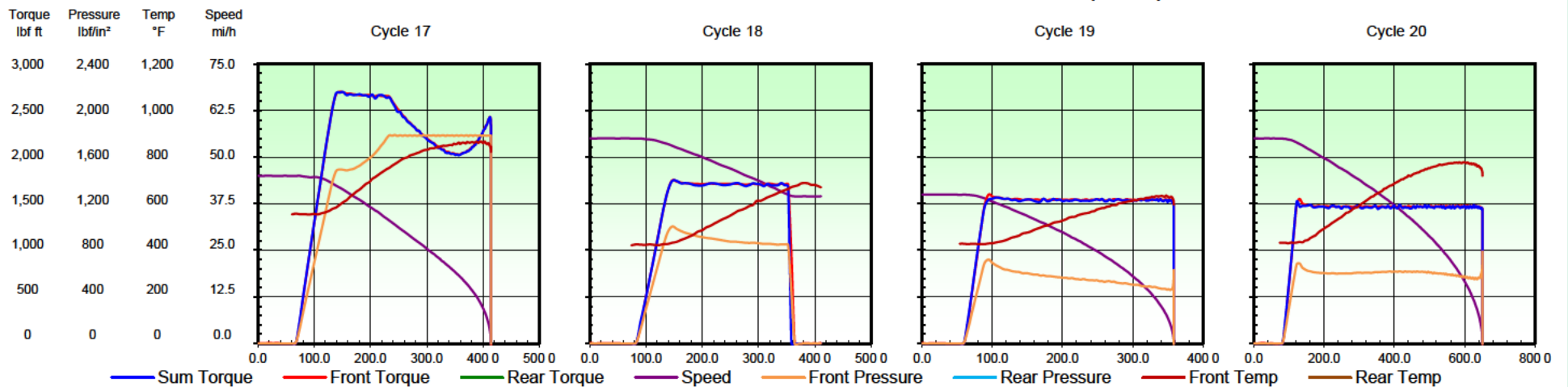
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

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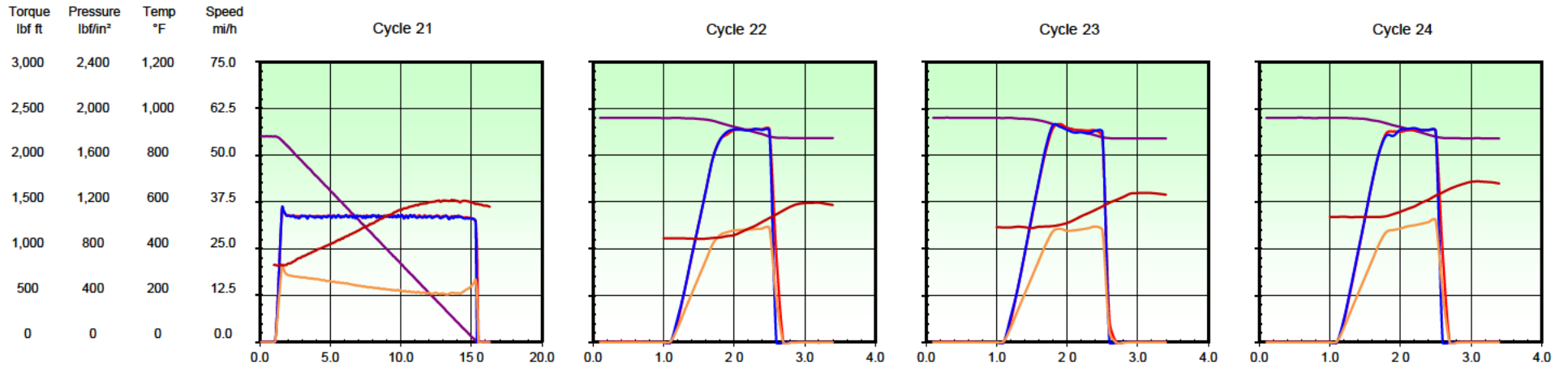
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Test Report Date: 20 March 2020

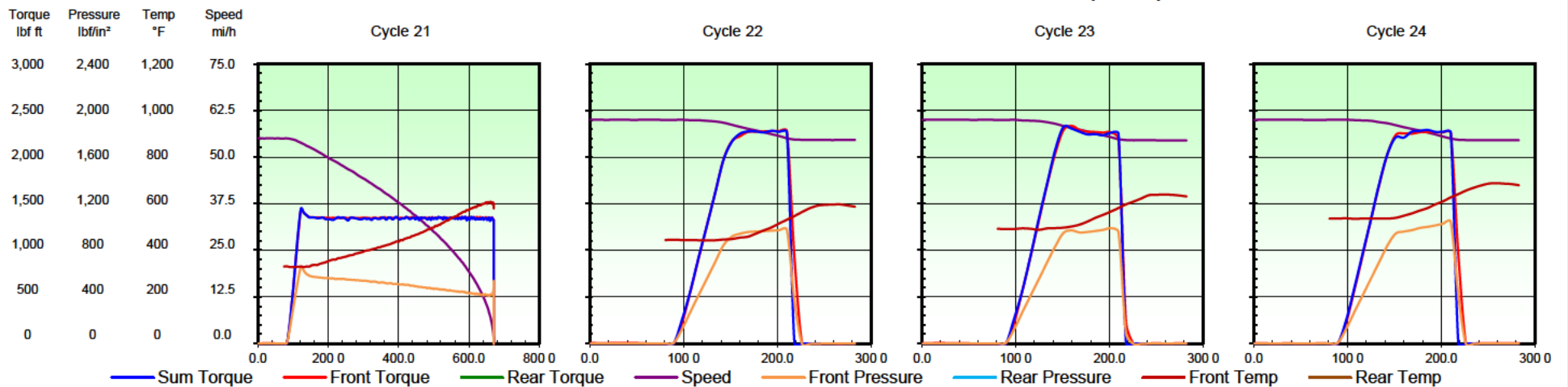
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

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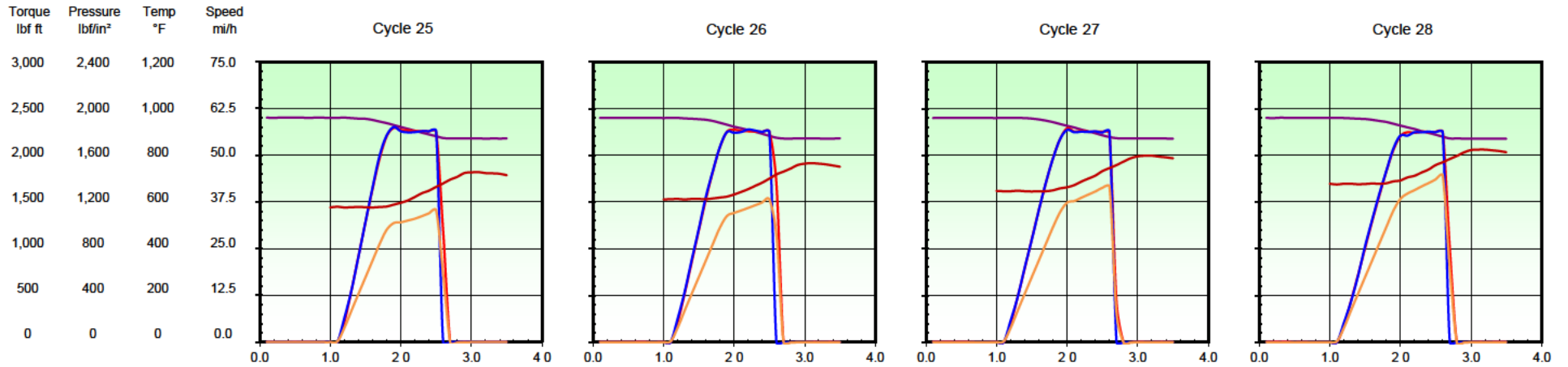
Report Number: 203145-4

Test Report Date: 20 March 2020

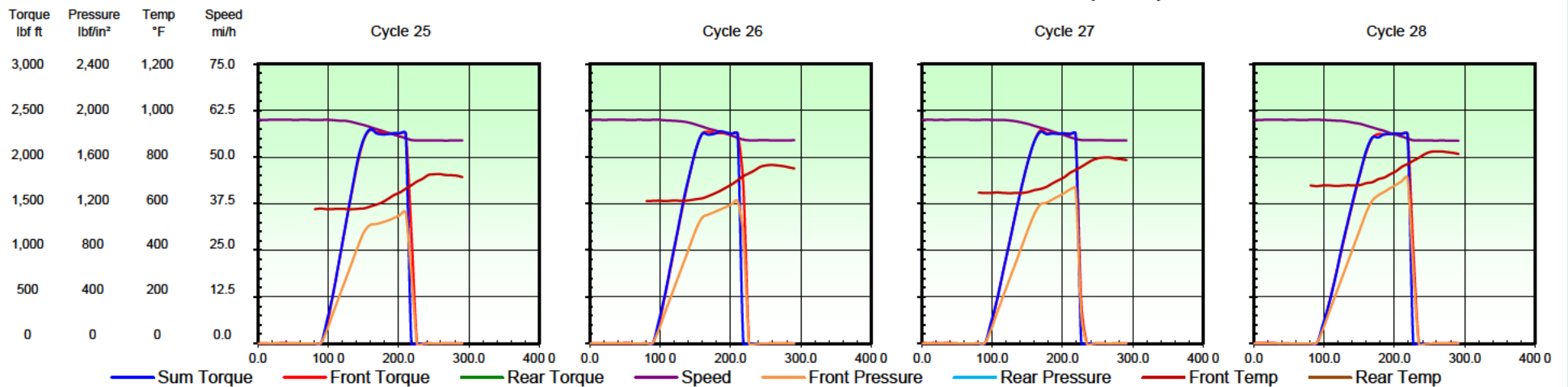
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

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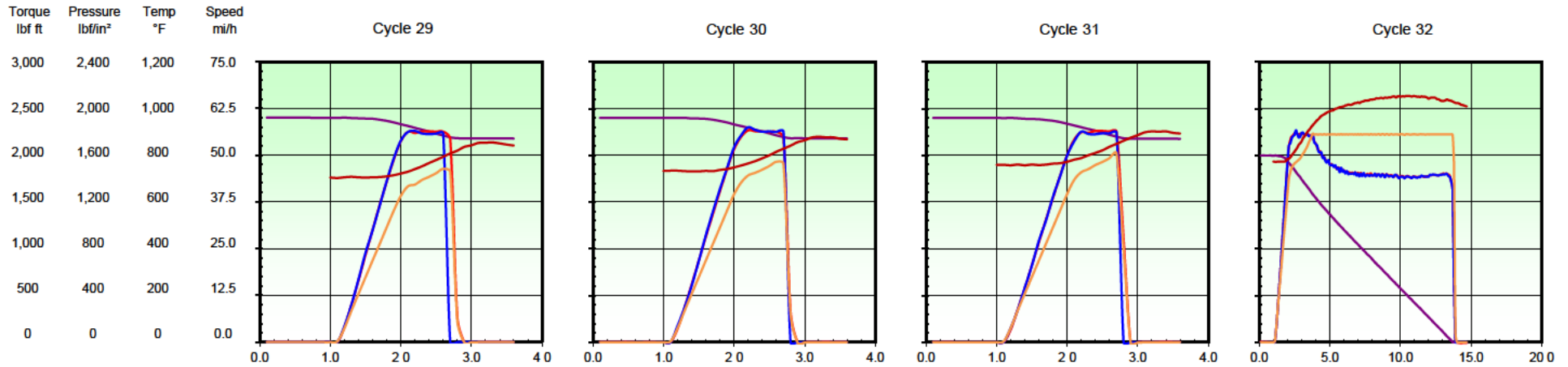
Report Number: 203145-4

Test Report Date: 20 March 2020

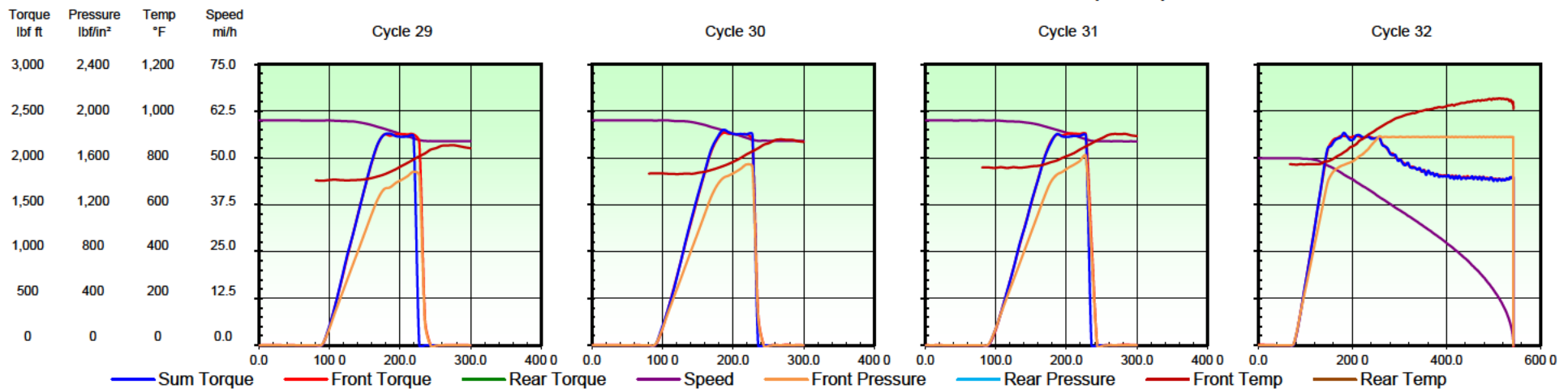
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-09

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

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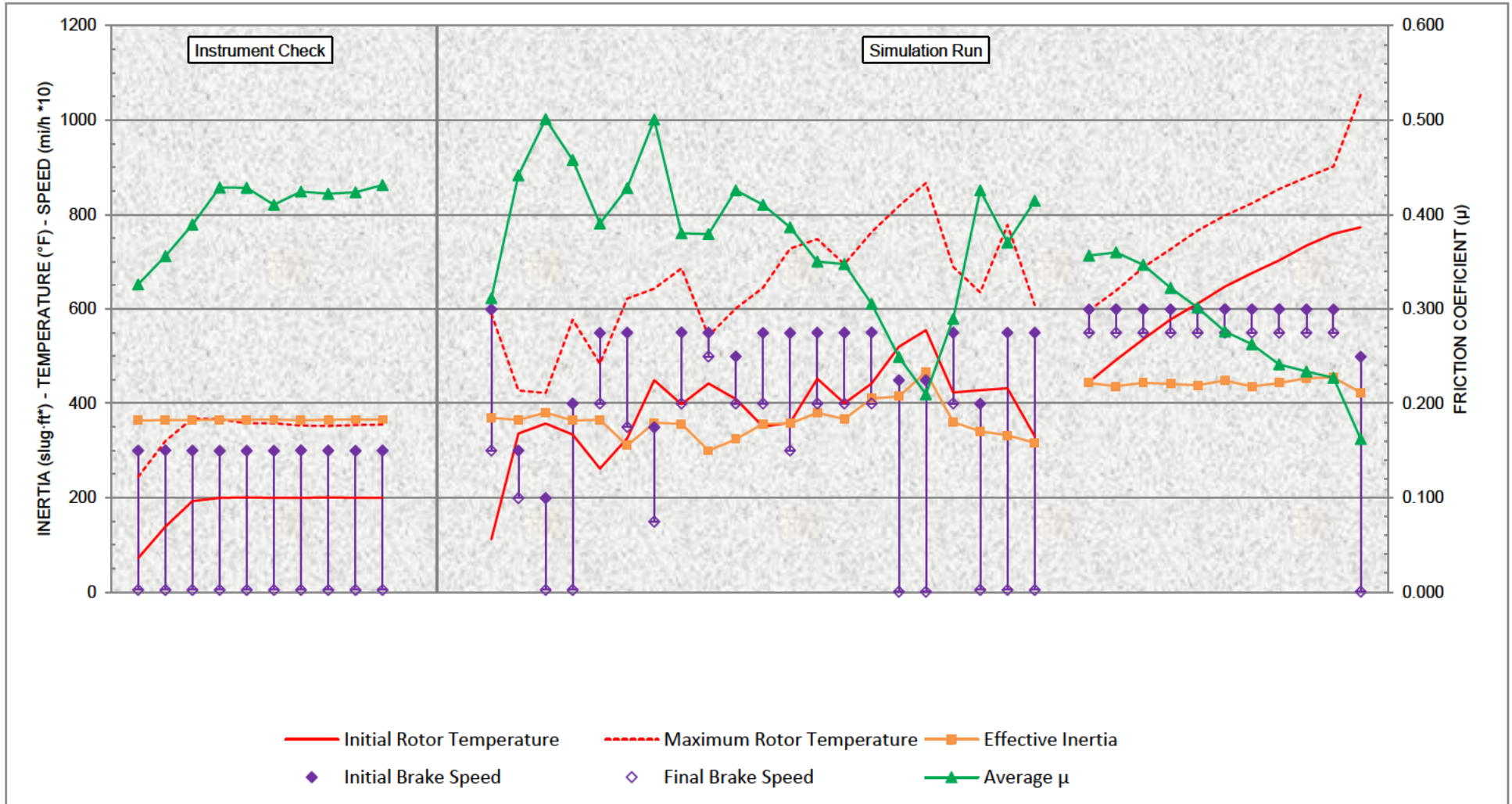
Report Number: 203145-4

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

TEST PERFORMANCE PROFILE - FRONT BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-09

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

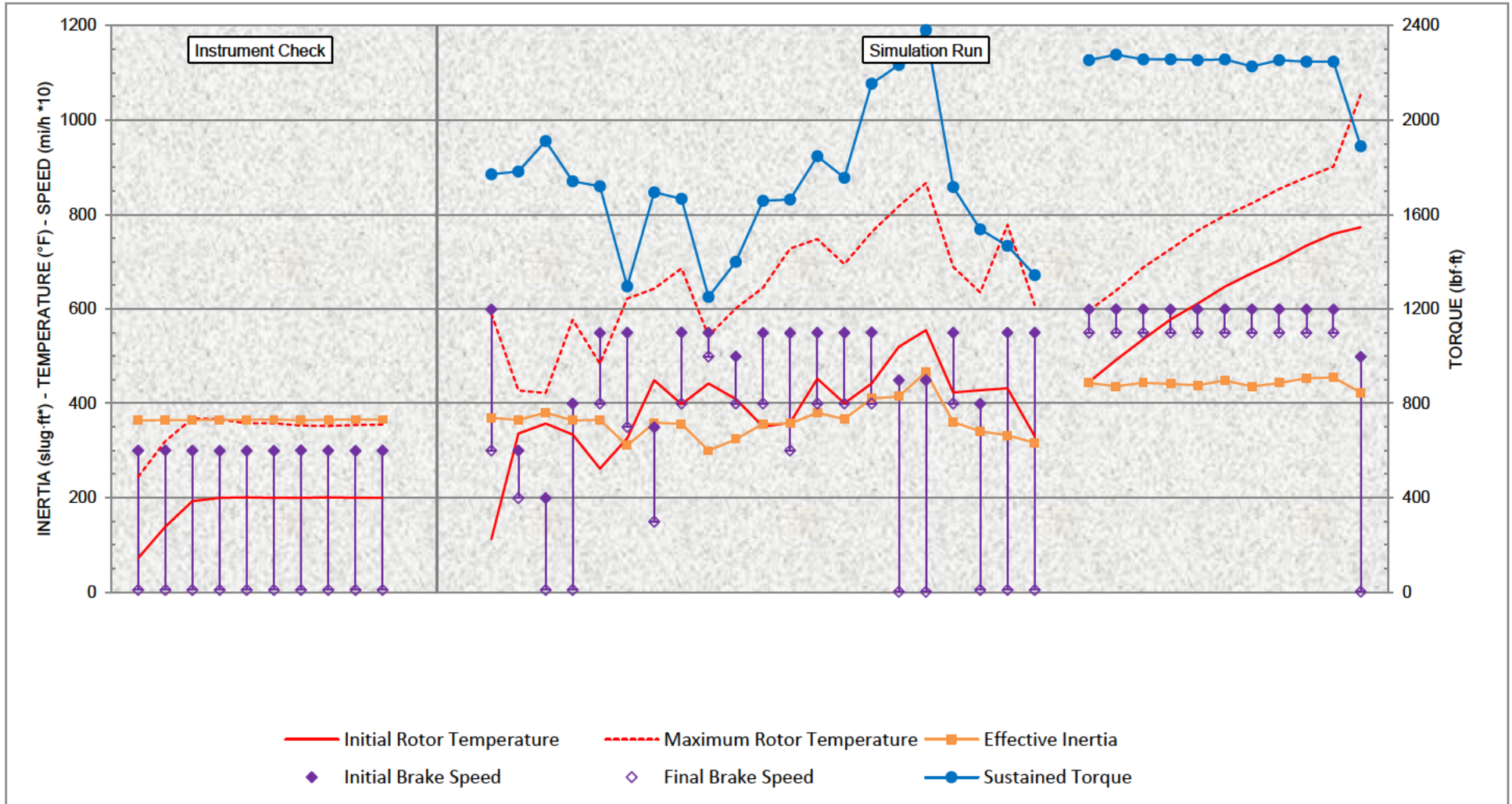
Report Number: 203145-4

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

TEST PERFORMANCE PROFILE - FRONT BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-09

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

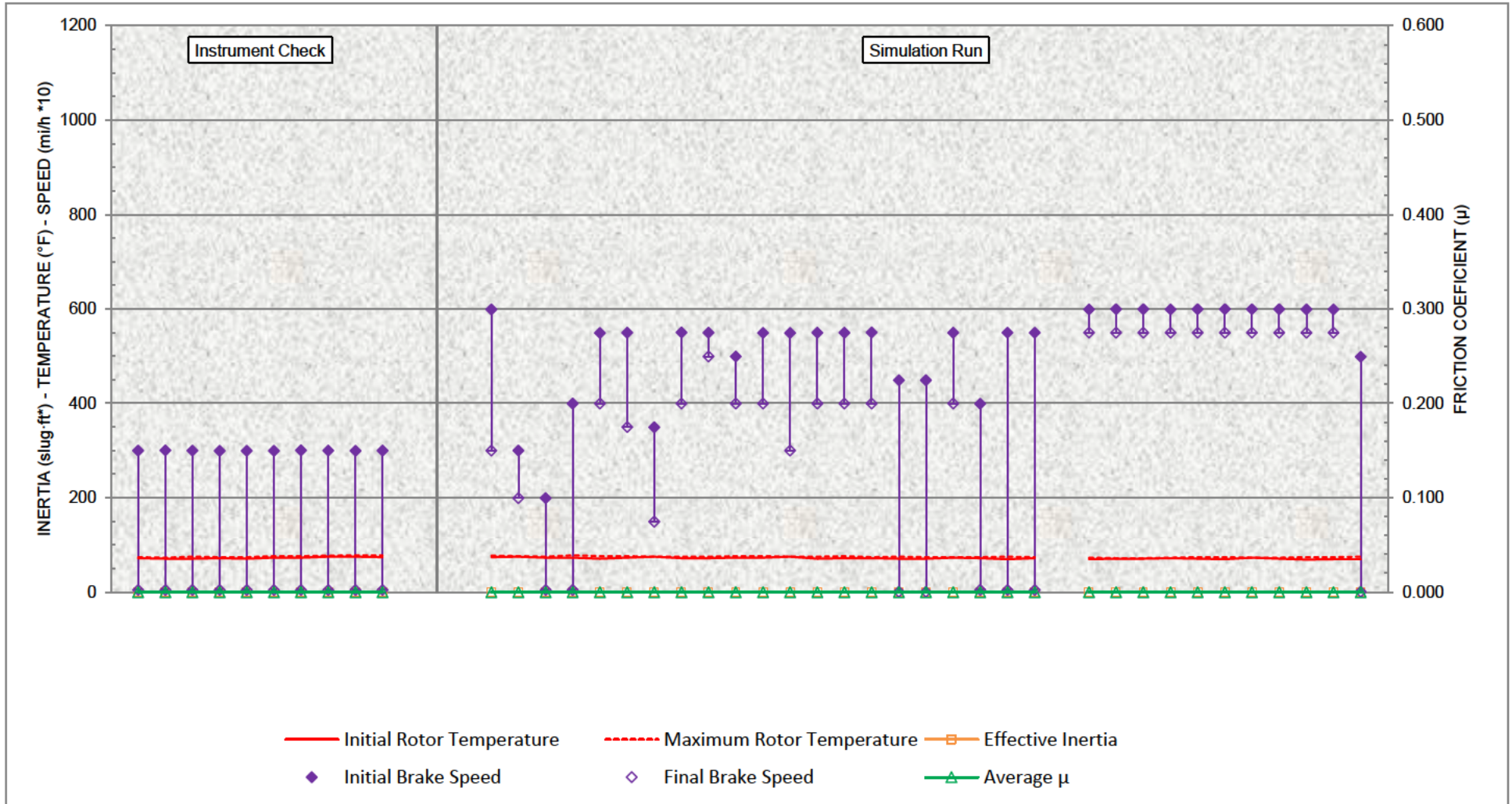
Report Number: 203145-4

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

TEST PERFORMANCE PROFILE - REAR BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-09

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

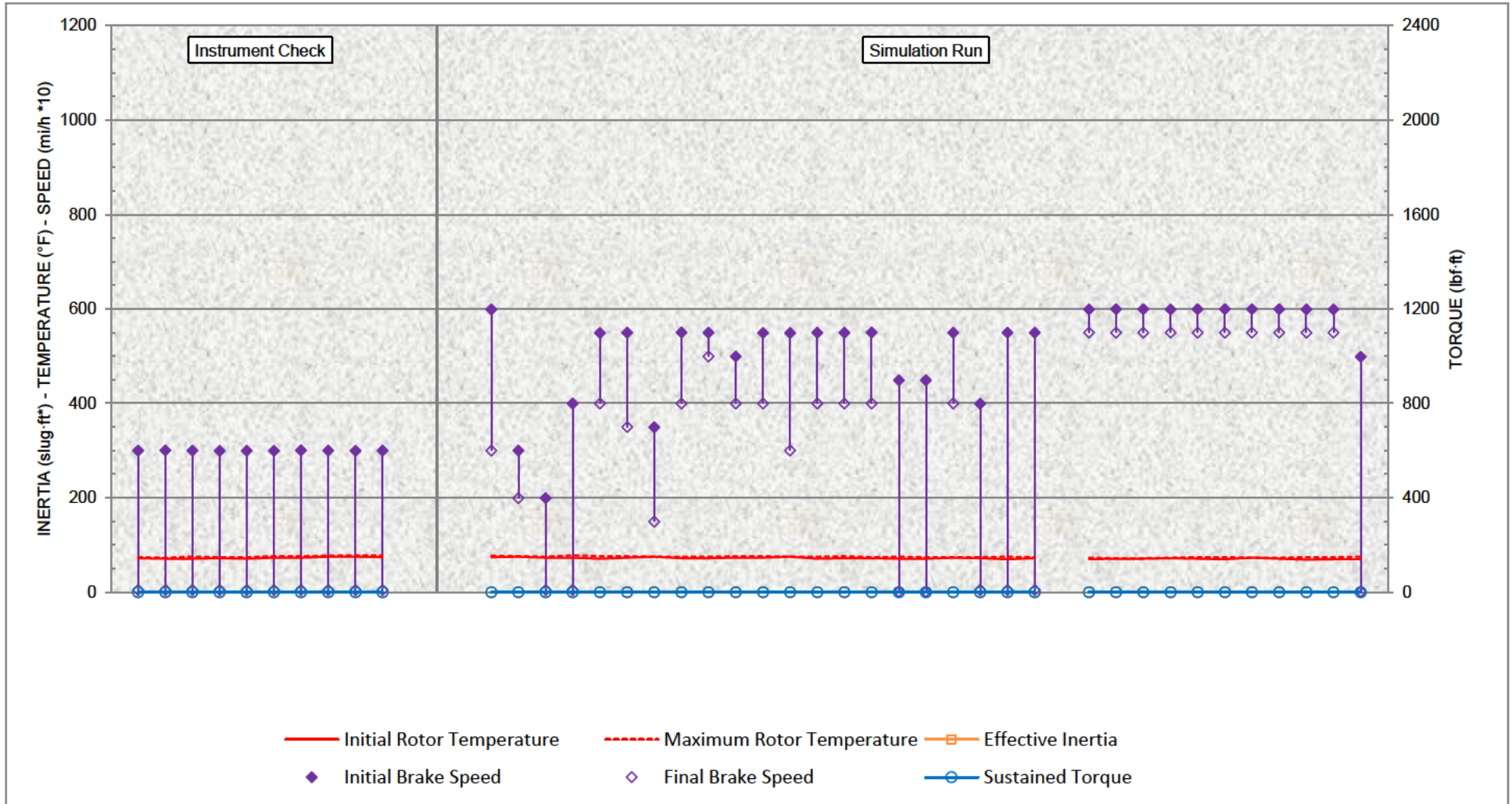
Report Number: 203145-4

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

TEST PERFORMANCE PROFILE - REAR BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-09

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

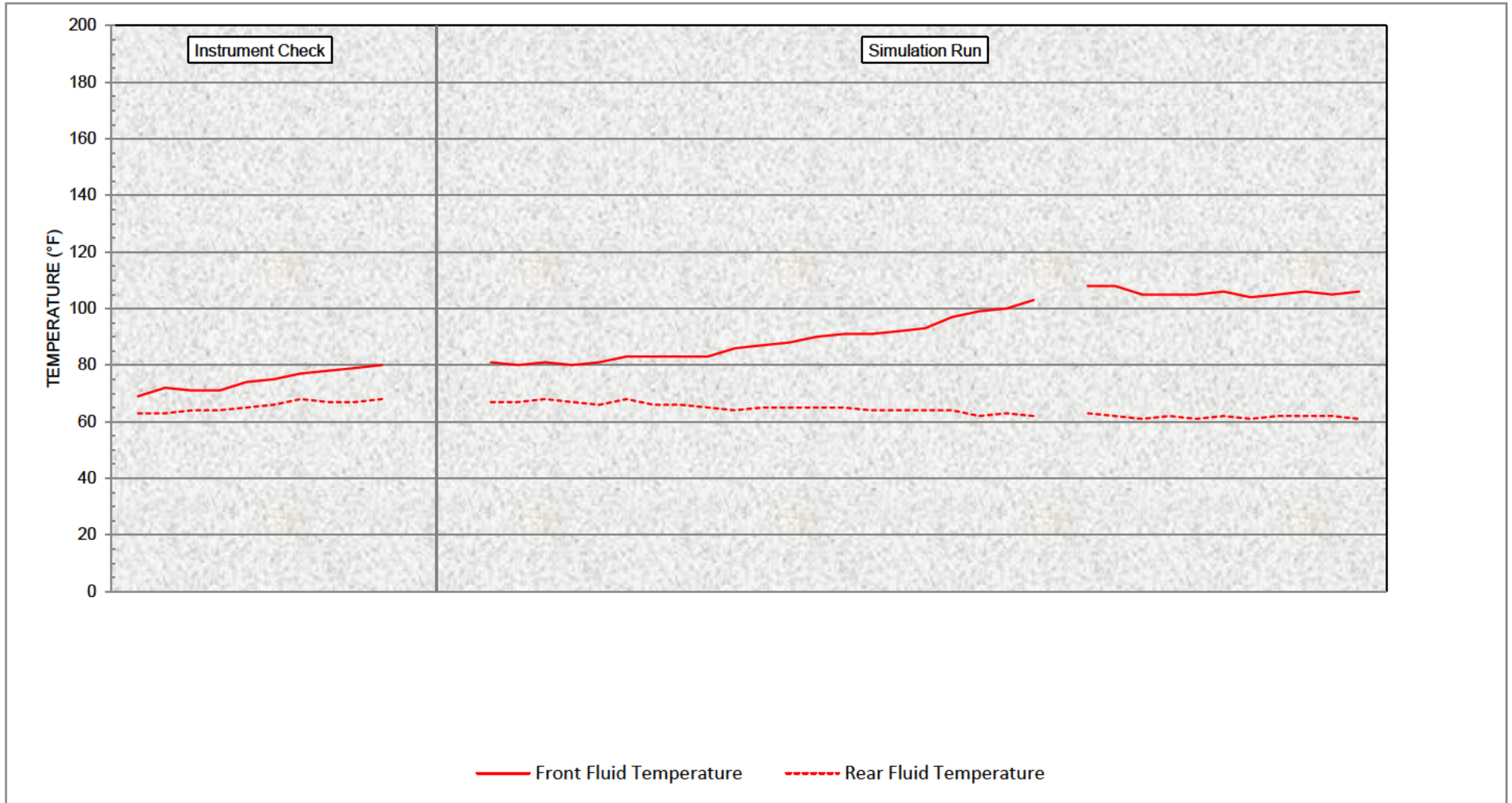
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Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

BRAKE FLUID TEMPERATURE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-09

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

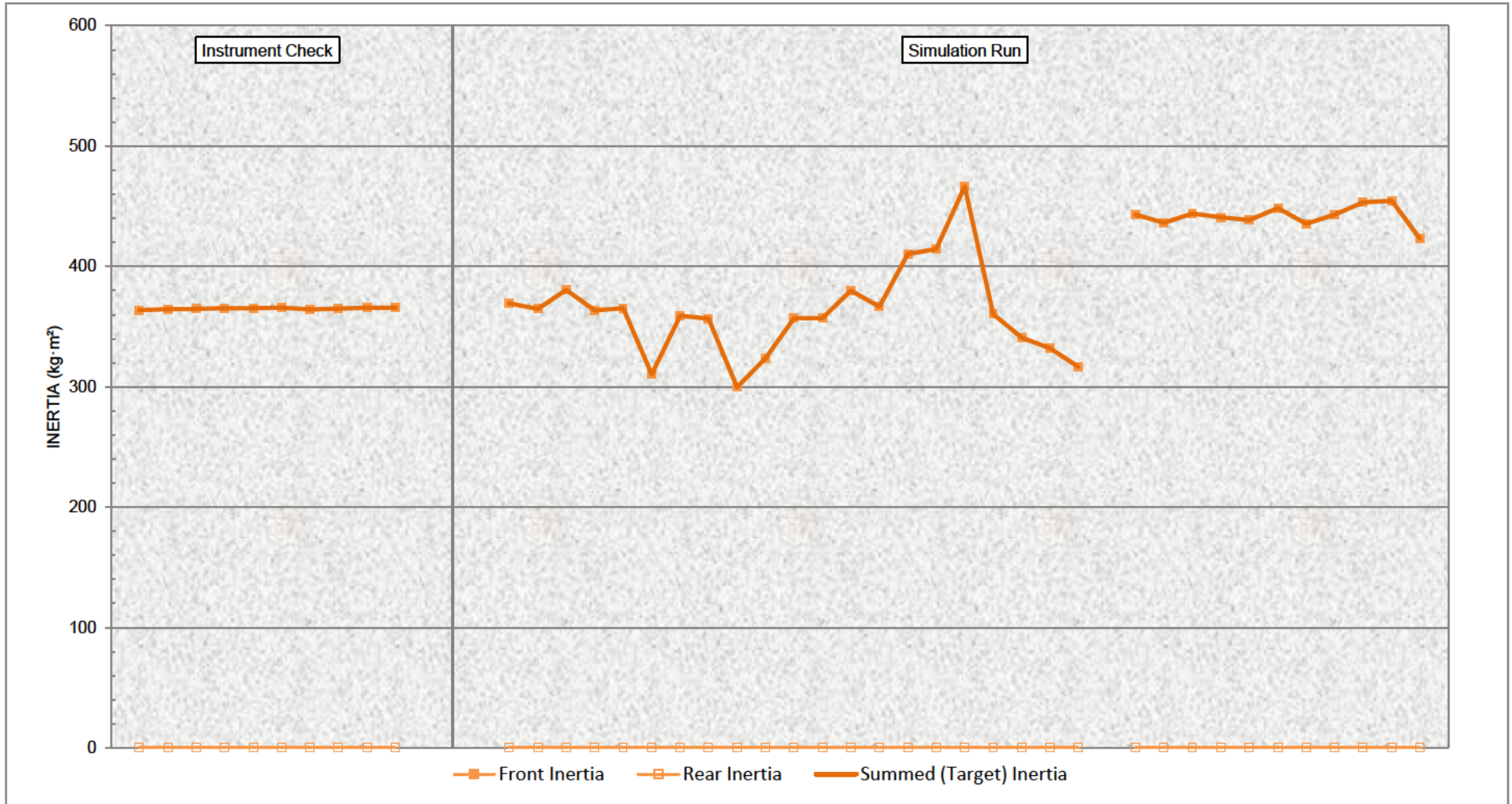
Report Number: 203145-4

Test Report Date: 20 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - FRONT ONLY

INERTIA DISTRIBUTION



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-09

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

Report Number: 203145-4

Test Report Date: 20 March 2020



**Brake Performance Study Attachment 6: Dynamometer Testing Report: Downhill Braking
Simulation Test– 2001 Ford Excursion with Limousine Conversion, 13565 lbs -1/2 Rear
Brakes**

Schoharie, NY

HWY19H001

NATIONAL TRANSPORTATION SAFETY BOARD SCHOHARIE, NY DOWNHILL BRAKING SIMULATION TEST

Client NTSB Acquisition and Lease Management Division
490 L'Enfant Plaza East SW
Washington, DC 20594-0003

Report Number 203145-5
(Used Parts - 13,565 lb GVW -1 Failed Rear Caliper)

Vehicle Simulated 2001 Ford Excursion with Limousine Conversion

Front Lining Edge Code MPV 2000-EE

Rear Lining Edge Code MPV 2000-EE

Test Completion Date 21 March 2020

Signature

Kevin C. Machus, Test Engineer
for Greening Testing Laboratories, Inc.

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Original retained on file at
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Complete test report in Microsoft® Excel format available upon request.



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NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

Test Numbers	M20-064-10
Test Program Number	3947.01.20V01 - 2001 FORD EXCURSION.TST
Vehicle System Simulated	2001 Ford Excursion with Limousine Conversion
Reference	Contract No. 9531BM20P0015
Test Date(s)	21 March 2020
Date Test Report Prepared	27 March 2020
Test Report Prepared By	K. Machus
Gross Vehicle Weight	13,565 lbs (per NTSB)
Static Rolling Radius	16.1 inches (based on revolutions per mile of LT265/75R16D tires)
Test Inertia (without loss)	379.2 slug·ft ²
Parasitic Loss	3.0% (based on vehicle measurements)
Test Inertia (with loss)	368.8 slug·ft ²
Equivalent 1/2 Vehicle Weight	6,579 lbs

	Front Disc Brake	Rear Disc Brake
Lining Edge Code	MPV 2000-EE	MPV 2000-EE
Brake Pad Part Number	Motorcraft BR1266	Motorcraft BR1275
Brake Pad FMSI® Number	7625-D756	7626-D757
Brake Configuration	dual piston, separate function caliper disc brake	dual piston, separate function caliper disc brake
Piston Diameter(s)	2 x 54 mm	2 x 46 mm
Rotor Part Number	Ford 1G3Z-1V102-AB	Ford YC3Z-2C026-BB
Brake Size (nominal) Rotor Diameter x Thickness	13.0 x 1.5 inches	12.8 x 1.2 inches
Rotor Mass (nominal)	20.7 kg	10.9 kg
Rotor Effective Radius	5.599 inches	5.529 inches
Wheel Rotation	right hand	left hand
Test Fixture	096622	190316
Date Parts Received	16 January 2020	16 January 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

DATA NOTES

1 All average and sustained values shown in this report are calculated with respect to **DISTANCE**.

2 The data presented in this report has been gathered as follows:

START Threshold = 50 lbf·ft of brake torque during brake apply.

AVERAGE = average value between START and STOP Threshold levels.

INITIAL Data Point = Values are taken at the point where the control level is achieved.

SUSTAINED Data = average value between the INITIAL and END data points.

END Data Point = Values are taken 0.1 seconds prior to the STOP threshold

MAXIMUM = maximum value observed in the SUSTAINED Data Interval.

STOP Threshold = brake release

FINAL temperature is the highest temperature value observed in a 4.0 second "window" beginning 1.0 seconds after brake release.

3 Brake application is initiated when the control temperature (rotor) reaches the desired initial brake temperature.

4 Cooling Air Temperature = 80°F (±5°F)

5 Cooling Air Velocity = 20 mi/h for front brake, 2 mi/h for rear brake as determined by cooling curves conducted on a 2001 Ford Expedition.

6 For all stops which show "zero" (0) or negative values for some of the computed pressure, torque or coefficient values:

These stops achieved final speed but did not achieve the torque level required for the particular stop. Since the START data and STOP data thresholds were satisfied, deceleration rate, distance, time to stop, etc., are accurate values, and can be used for data comparison purposes.

The presence of "zero" values generally is caused by lack of brake performance, resulting in a "clamp" condition. "Clamp" condition is defined by the brake calling for the maximum pressure the test section allows ("clamp" pressure) and the brake being unable to attain the deceleration rate required in the test section at that pressure.

7 Thermocouple locations and depths:

Front Rotor: Center of inboard rubbing track at a depth of 0.040 inches

Front Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches

Front Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches

Rear Rotor: Center of inboard rubbing track at a depth of 0.040 inches

Rear Inboard Pad: Centered radially and 0.5 inches toward the leading side of the slot set to a depth of 0.060 inches

Rear Outboard Pad: Center of the leading side of the slot set to a depth of 0.060 inches

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

COMPUTED DATA DESCRIPTIONS

SPEED

INIT = Speed start threshold is achieved.

FNL = Brake release speed

TIME

STOP = Time elapsed between start threshold and brake release

REPT = Time elapsed between cycles

DISTANCE

STOP = Distance elapsed between start threshold and brake release

REPT = Distance elapsed between cycles

DECEL

AVG = Average deceleration measured from start threshold to brake release

PRESSURE

AVERAGE = Average pressure from start threshold to brake release

SUSTAINED = Average pressure from point control level is achieved to brake release

MAXIMUM = Maximum pressure from start threshold to brake release

TORQUE

AVERAGE = Average torque from start threshold to brake release

SUSTAINED = Average torque from point control level is achieved to brake release

MAXIMUM = Maximum torque from start threshold to brake release

TEMPERATURE

INT = Temperature at start threshold

MAX = Maximum temperature between start threshold and 0.1 seconds after brake release

FLUID DISPLACEMENT

MAX = Maximum fluid displacement between start threshold and brake release

FRICITION COEFFICIENT

SUST = Friction coefficient (μ) calculated using the following formula:

$$\mu = \frac{\text{Sustained Torque (lbf}\cdot\text{ft)} / \text{Rotor Effective Radius (ft)}}{\text{Sustained Pressure (lbf/in}^2\text{)} * \text{Total Caliper Piston Area (in}^2\text{)}} * 0.5$$

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

TEST ROUTE - NEW AMSTERDAM TO SCHOHARIE NEW YORK

Cycle	Mile	Latitude (GPS)	Longitude (GPS)	Altitude (ft)	Grade Input (%g)	Braking Deceleration (g)	Apply Speed (mi/h)	Release Speed (mi/h)
0	0.0	42.94908	-74.18265	574.1	--	--	--	--
1	10.8	42.94409	-74.35478	293.3	-0.14%	0.2	60	30
2	11.1	42.94722	-74.35869	296.3	0.21%	0.2	30	20
3	11.2	42.94865	-74.35809	288.1	-1.69%	0.2	20	0
4	11.7	42.94957	-74.36914	287.4	0.28%	0.2	40	0
5	14.6	42.91169	-74.35237	469.5	0.40%	0.2	55	40
6	15.6	42.89860	-74.34632	647.3	5.20%	0.2	55	35
7	15.7	42.89696	-74.34592	666.0	0.80%	0.2	35	15
8	17.0	42.87979	-74.34609	802.8	0.90%	0.2	55	40
9	17.7	42.86949	-74.34253	871.7	5.27%	0.2	55	50
10	18.4	42.86000	-74.33732	1016.7	3.88%	0.2	50	40
11	20.4	42.83745	-74.35430	1200.1	1.12%	0.2	55	40
12	21.8	42.82276	-74.33815	1259.2	1.09%	0.2	55	30
13	22.6	42.81189	-74.33648	1295.6	-1.10%	0.2	55	40
14	24.5	42.78596	-74.33829	1284.1	0.19%	0.2	55	40
15	25.3	42.77450	-74.33766	1075.5	-4.69%	0.2	55	40
16	25.7	42.76815	-74.33585	955.1	-5.45%	0.2	45	0
17	26.5	42.75714	-74.33045	681.8	-10.46%	0.2	45	0
18	29.4	42.71859	-74.33721	676.2	0.59%	0.2	55	40
19	30.4	42.70533	-74.33539	633.2	2.50%	0.2	40	0
20	31.5	42.71097	-74.31464	681.4	3.31%	0.2	55	0
21	33.6	42.71540	-74.27608	1183.4	4.71%	0.2	55	0
2 MINUTE STOP - BRAKES RELEASED								
22	33.9			1078.1	-5.92%	0.2	60	55
23	34.0			1033.7	-5.92%	0.2	60	55
24	34.2			989.3	-5.92%	0.2	60	55
25	34.3			944.9	-5.92%	0.2	60	55
26	34.5			900.6	-5.92%	0.2	60	55
27	34.6			856.2	-5.92%	0.2	60	55
28	34.8			811.8	-5.92%	0.2	60	55
29	34.9			767.4	-5.92%	0.2	60	55
30	35.0			723.1	-5.92%	0.2	60	55
31	35.2	42.70259	-74.29994	678.5	-5.95%	0.2	60	55
32	35.4	42.70043	-74.30176	628.3	-5.40%	0.2	50	0

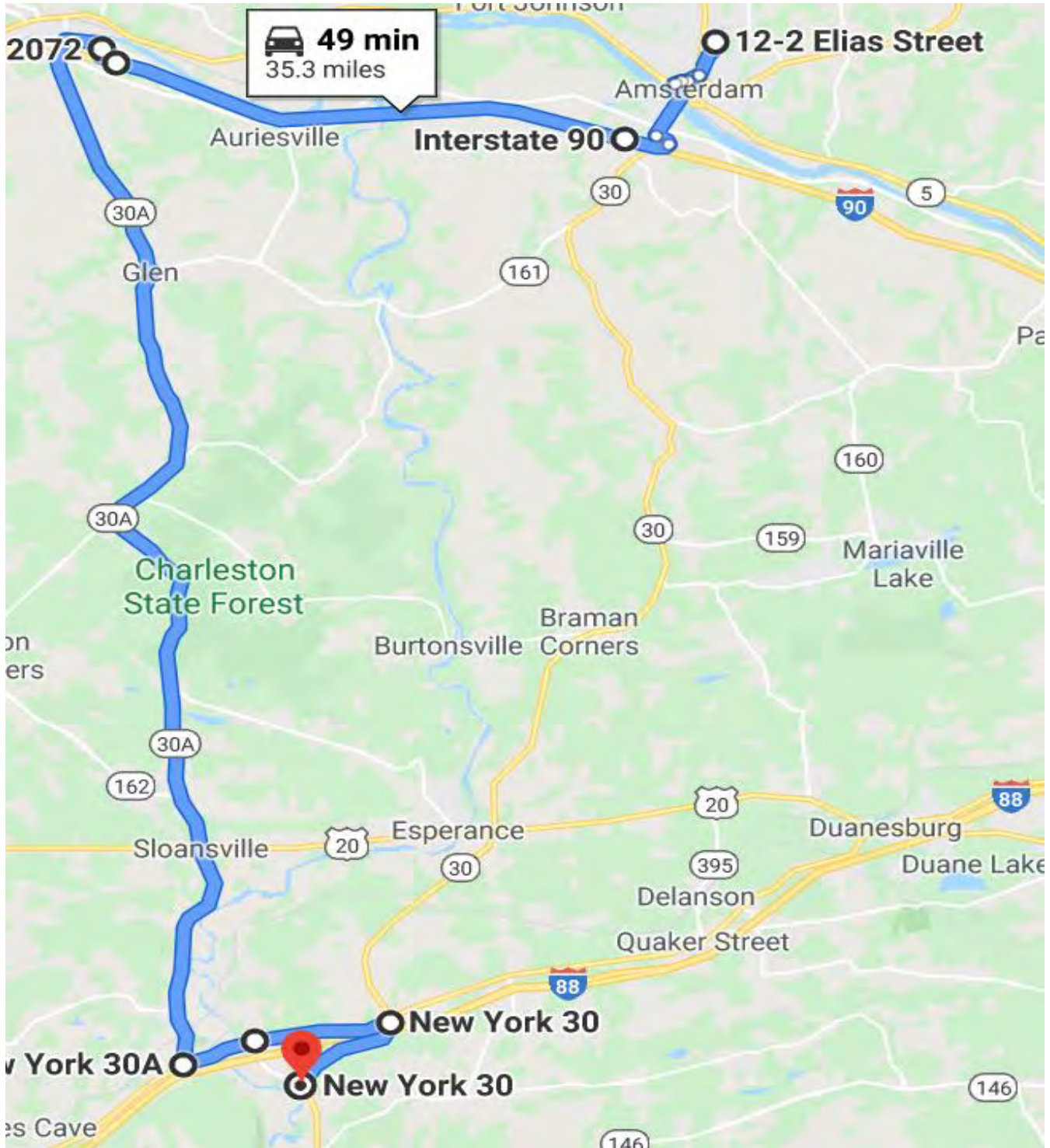
*NOTE: Test route was derived using the following criteria:

Speed limit and warning speeds were identified along the simulated route and used to control speed in the simulations. At Stop signs and controlled signalized intersections along the simulated route complete stops were modeled. At last stop before the final downhill descent a completed stop of 2 minutes was modeled. During downhill descents if the speed exceeded the posted speed limit by 5 mph braking at a maximum of 0.2 g was applied to reduce the speed to the speed limit.

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

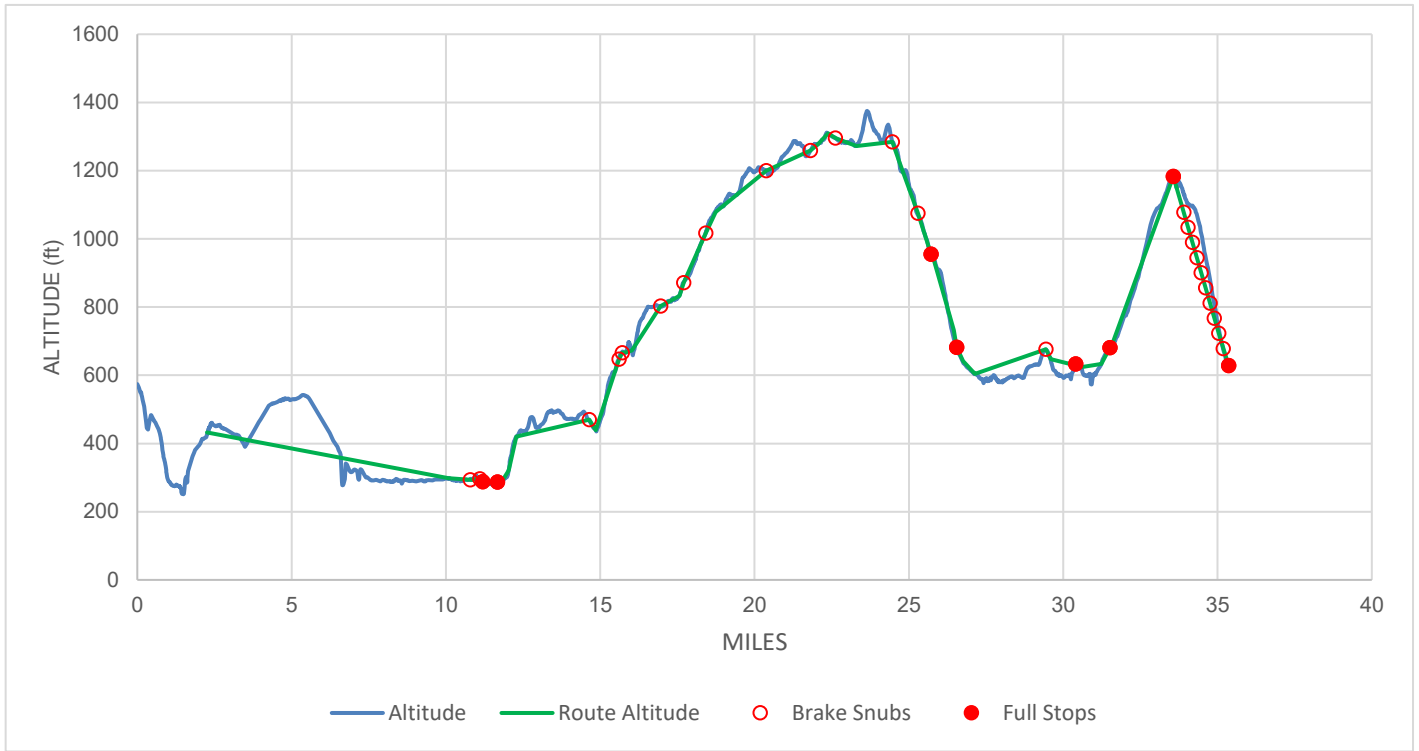
TEST ROUTE - OVERVIEW MAP



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

TEST ROUTE - PROFILE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

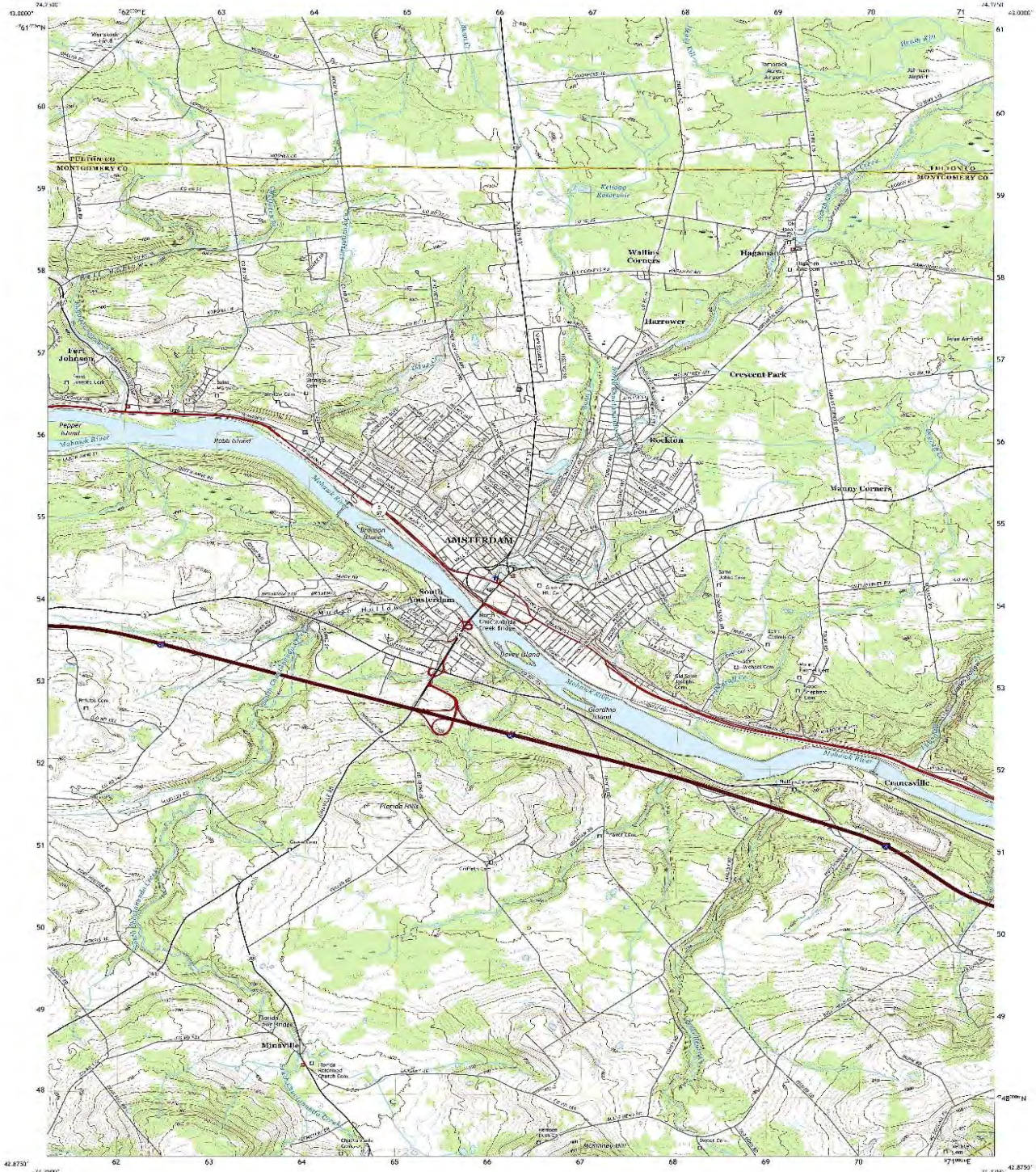
TEST ROUTE - AMSTERDAM QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



AMSTERDAM QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

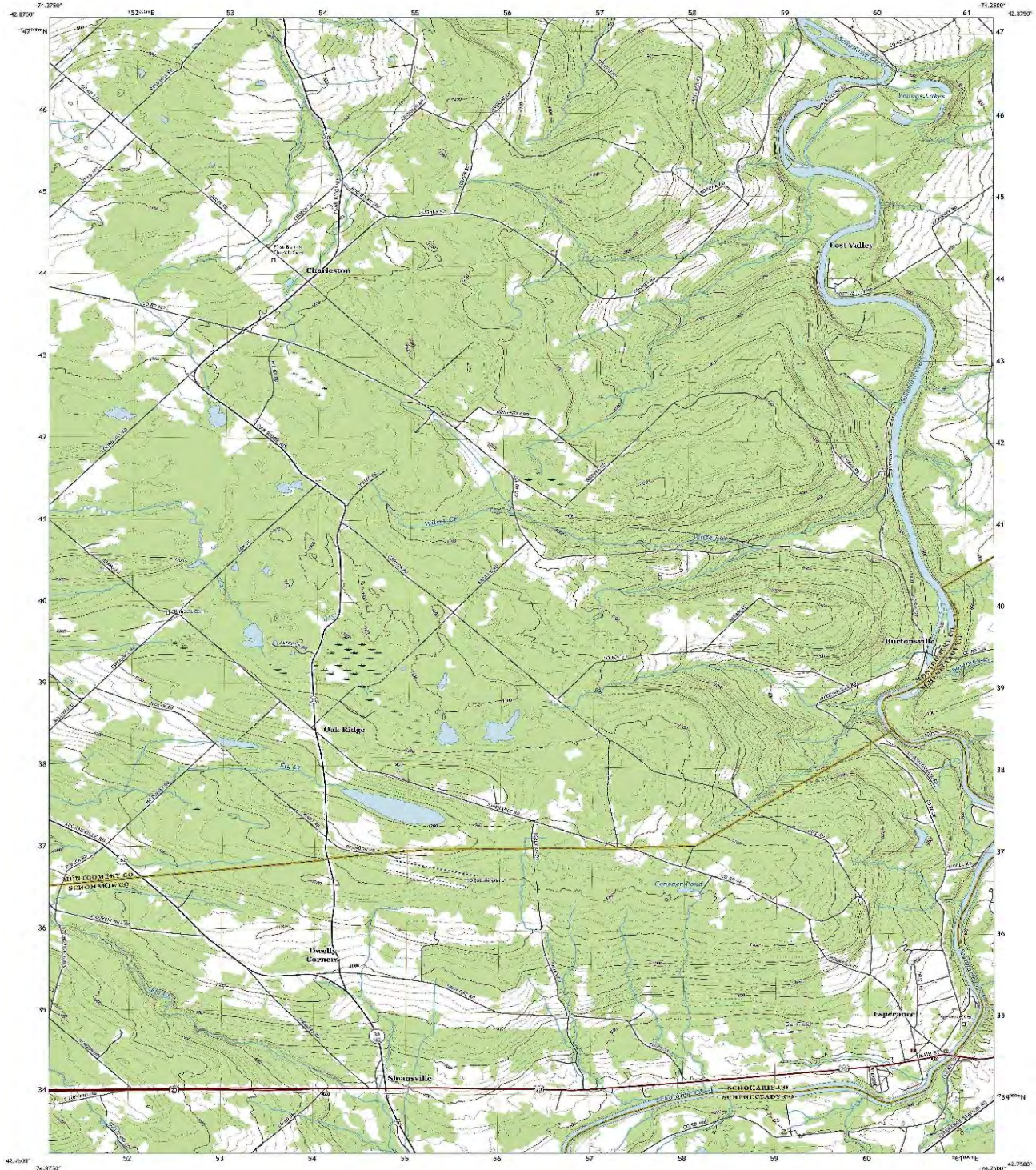
TEST ROUTE - ESPERANCE QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



ESPERANCE QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

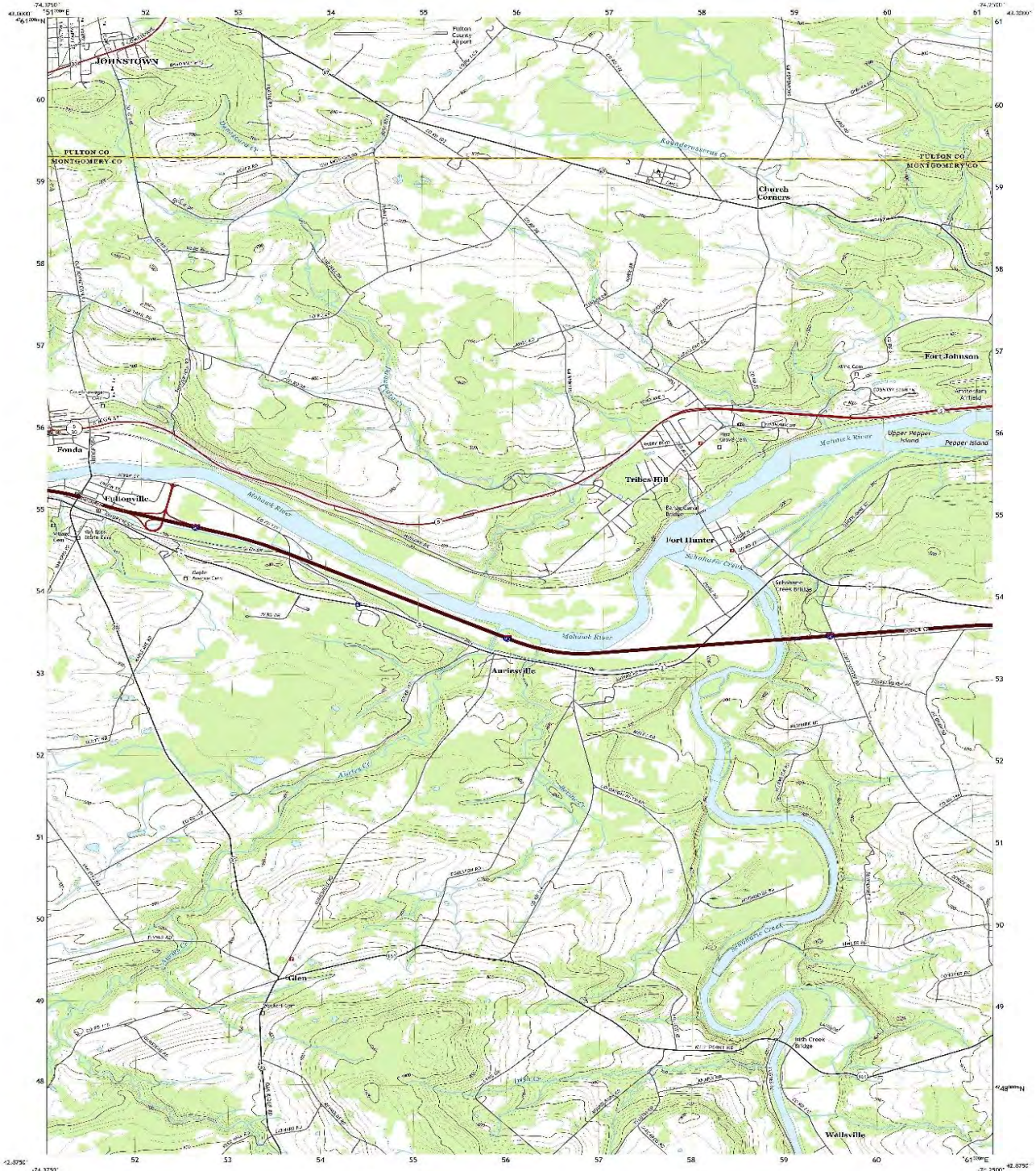
TEST ROUTE - TRIBES HILL QUADRANGLE



U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY



TRIBES HILL QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

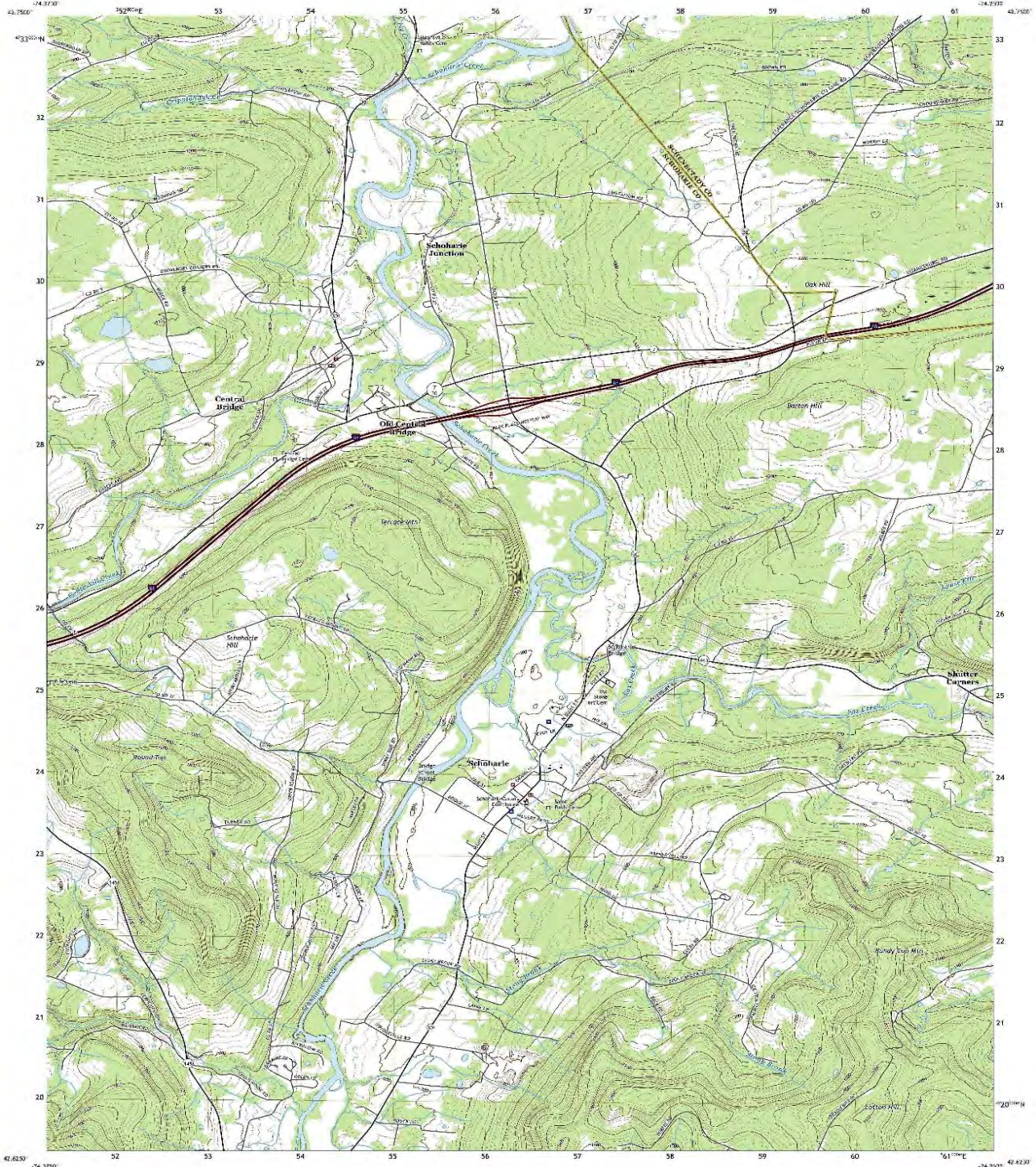
TEST ROUTE - SCHOHARIE QUADRANGLE



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U.S. GEOLOGICAL SURVEY



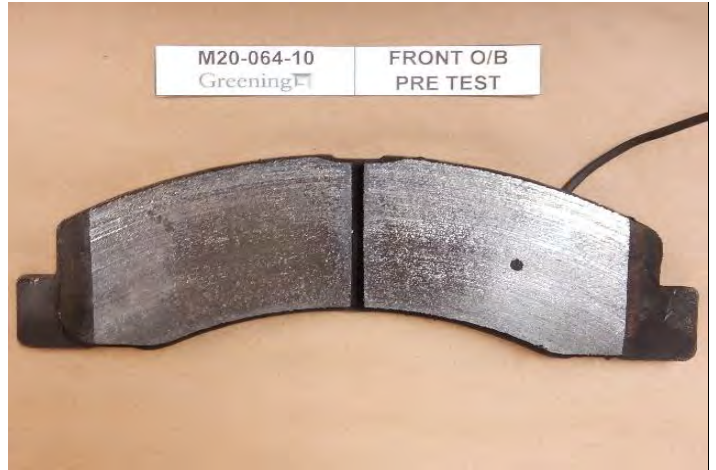
SCHOHARIE QUADRANGLE
NEW YORK
7.5-MINUTE SERIES



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

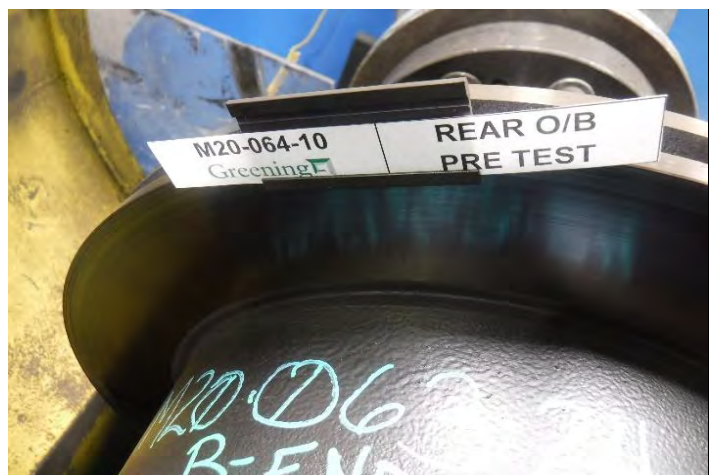
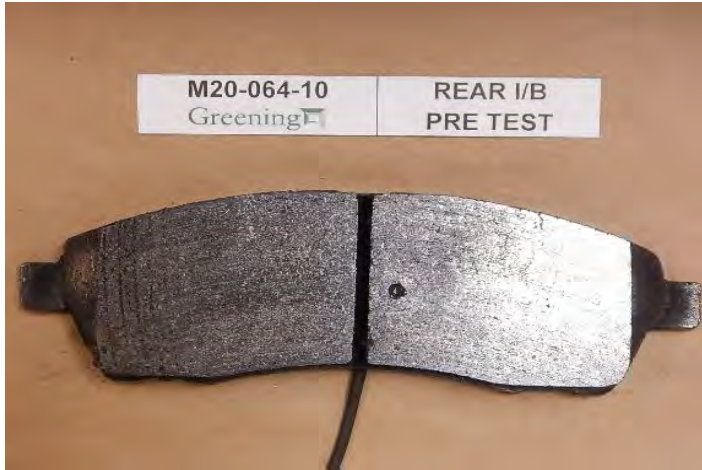
PRE TEST PHOTOGRAPHS - FRONT BRAKE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

PRE TEST PHOTOGRAPHS - REAR BRAKE



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

POST TEST VISUAL INSPECTION - FRONT BRAKE

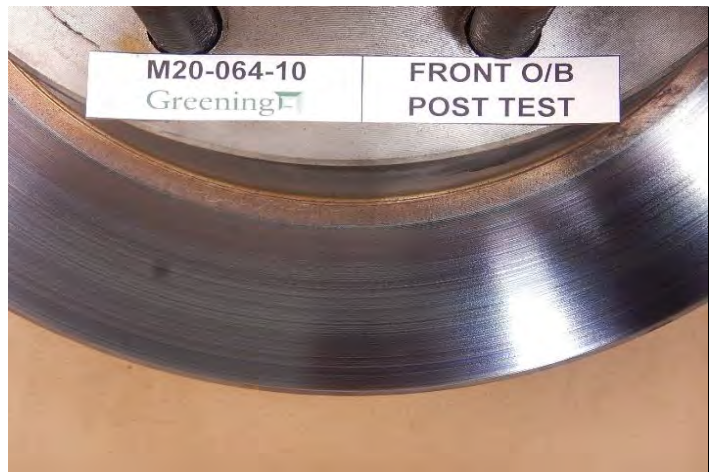
Inboard Pad: The pad has light flaking, light glazing, light grooving, moderate pitting and light resin bleed.

Outboard Pad: The pad has light flaking, light glazing, light grooving, moderate pitting and light resin bleed.

Rotor: The braking surface has light grooving, light heat checks, light hot spots, light lining transfer and is black/blue/grey in color.

All other test hardware appears in good condition.

PHOTOGRAPHS



NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

POST TEST VISUAL INSPECTION - REAR BRAKE

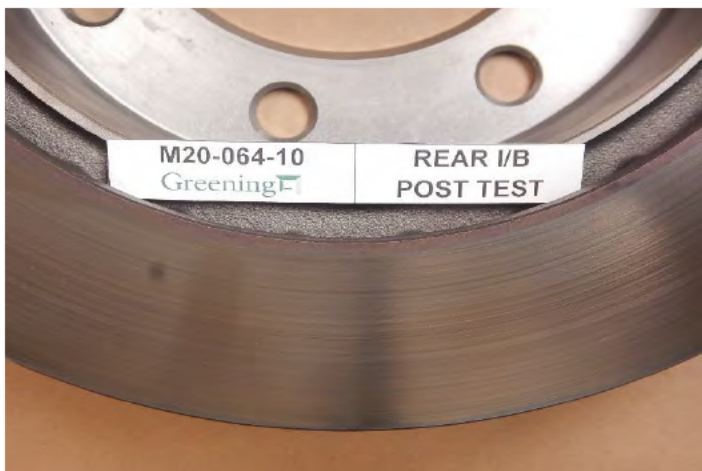
Inboard Pad: The pad has light flaking, light glazing, light grooving, moderate pitting and light resin bleed.

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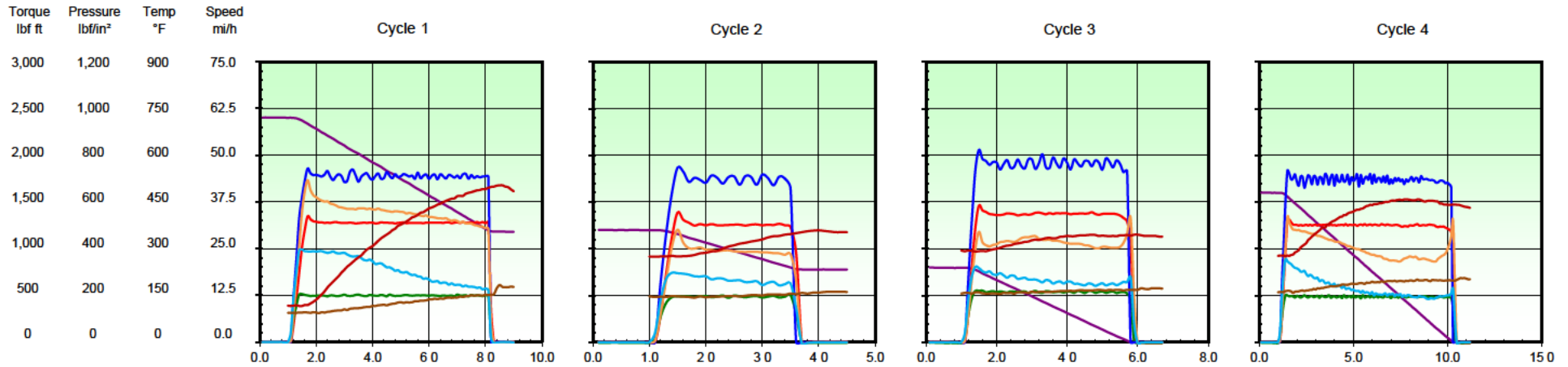
PHOTOGRAPHS



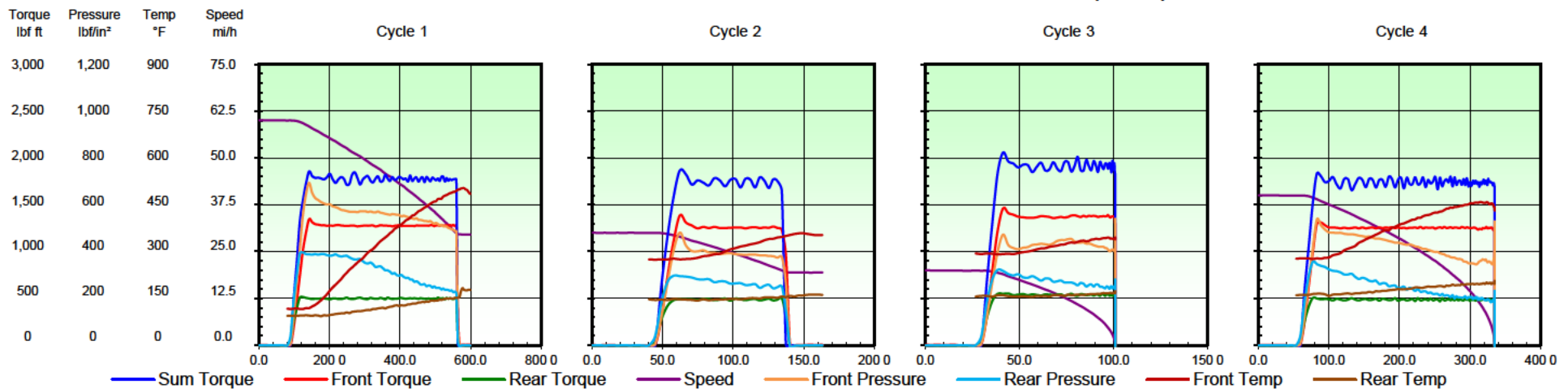
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

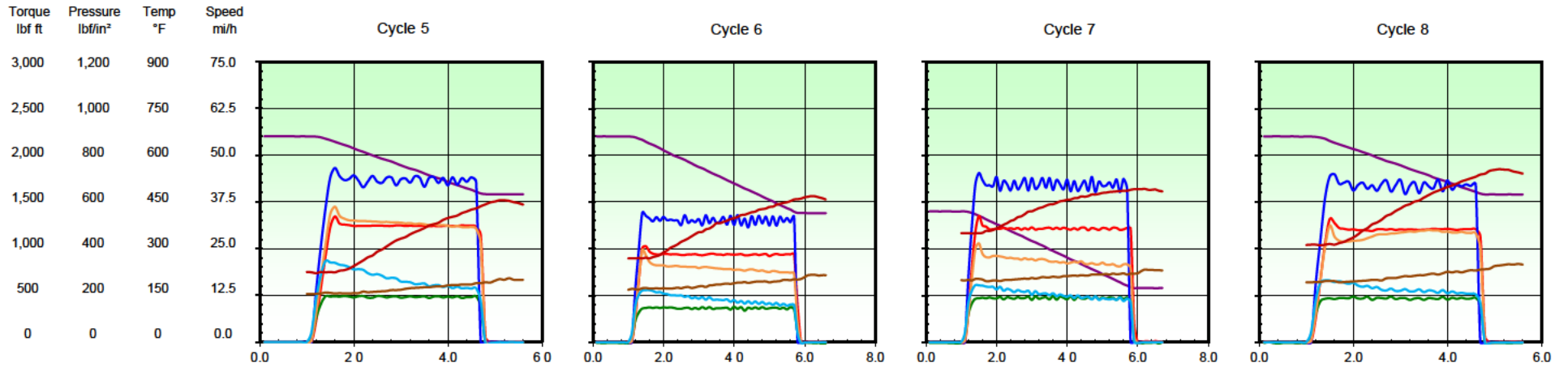
Report Number: 203145-5

Test Report Date: 21 March 2020

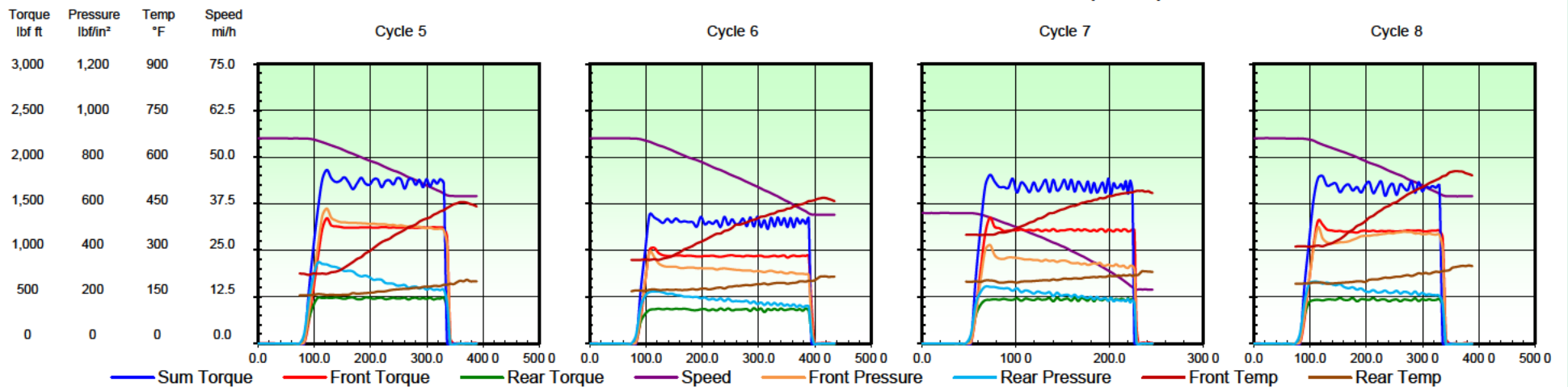
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

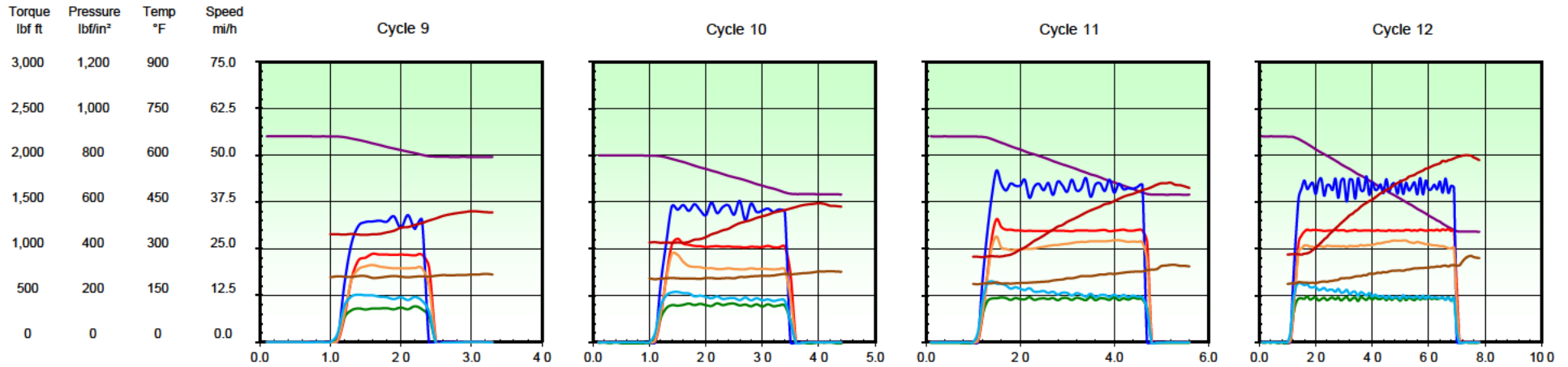
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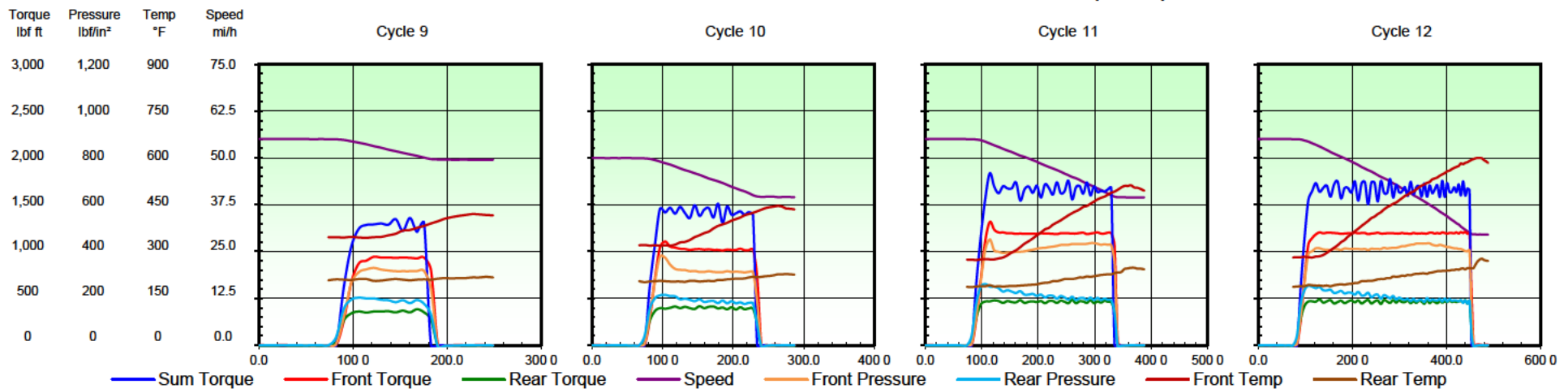
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

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GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

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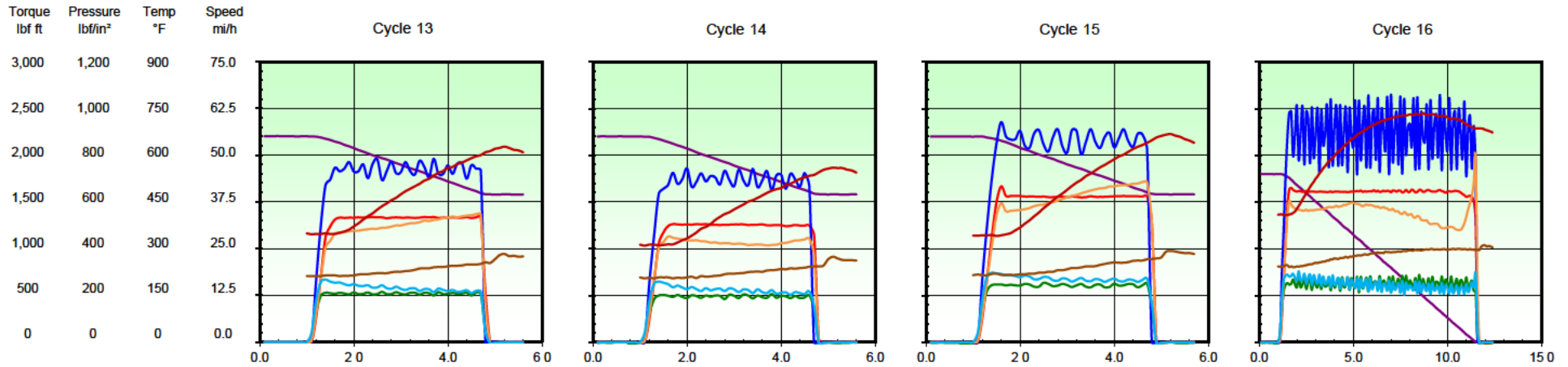
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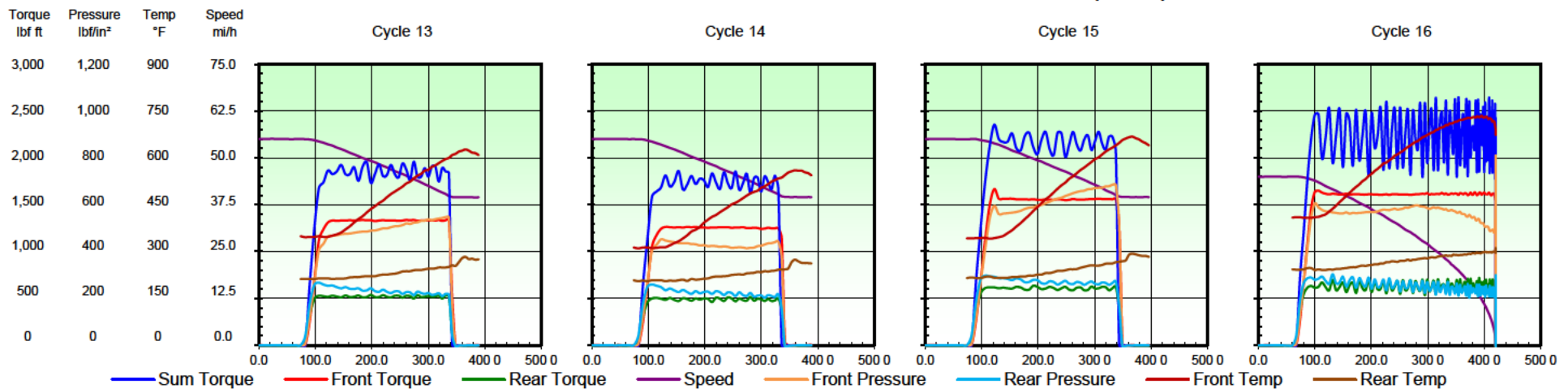
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



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Client: NTSB Acquisition and Lease Management Division

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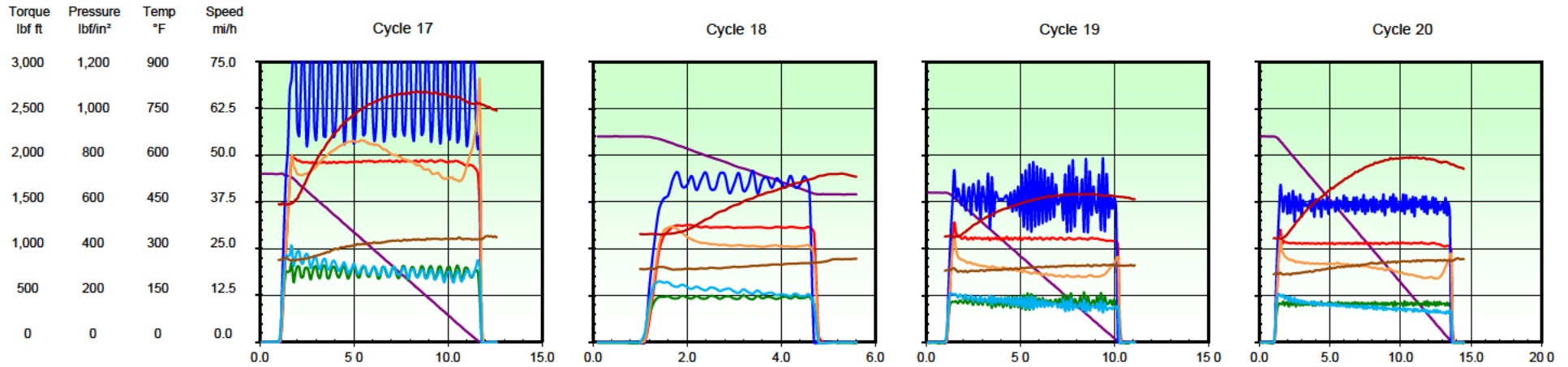
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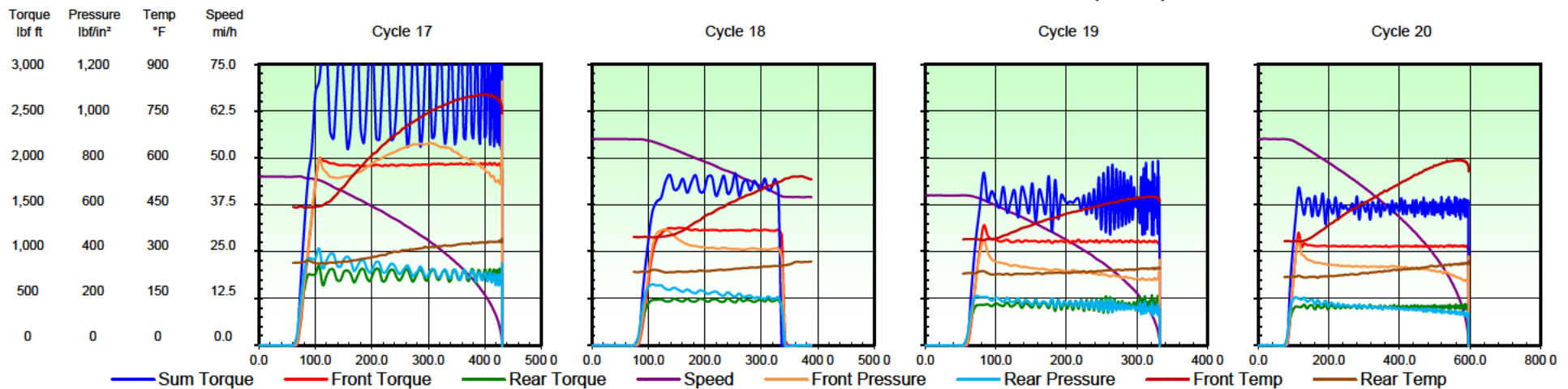
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

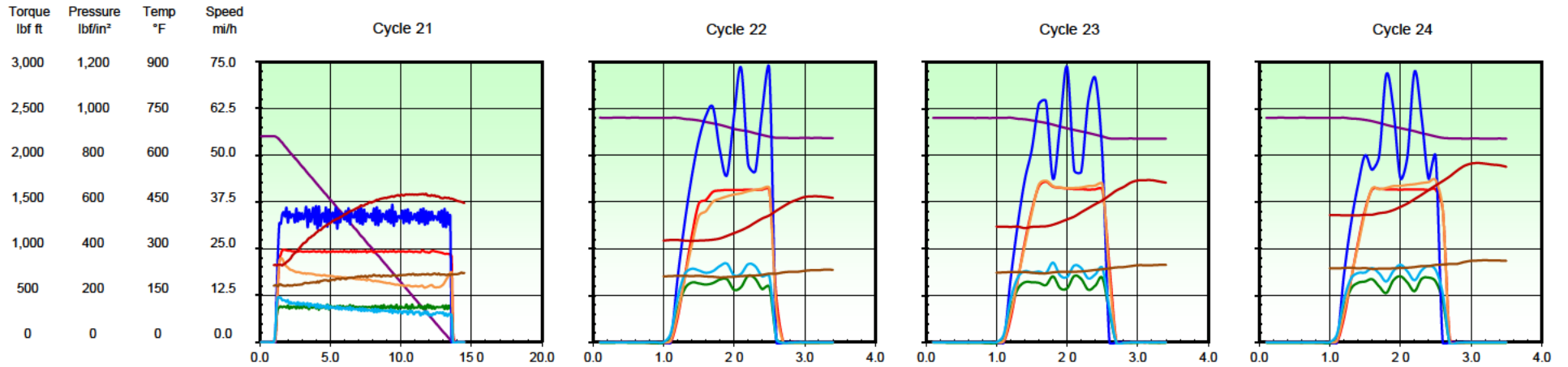
Report Number: 203145-5

Test Report Date: 21 March 2020

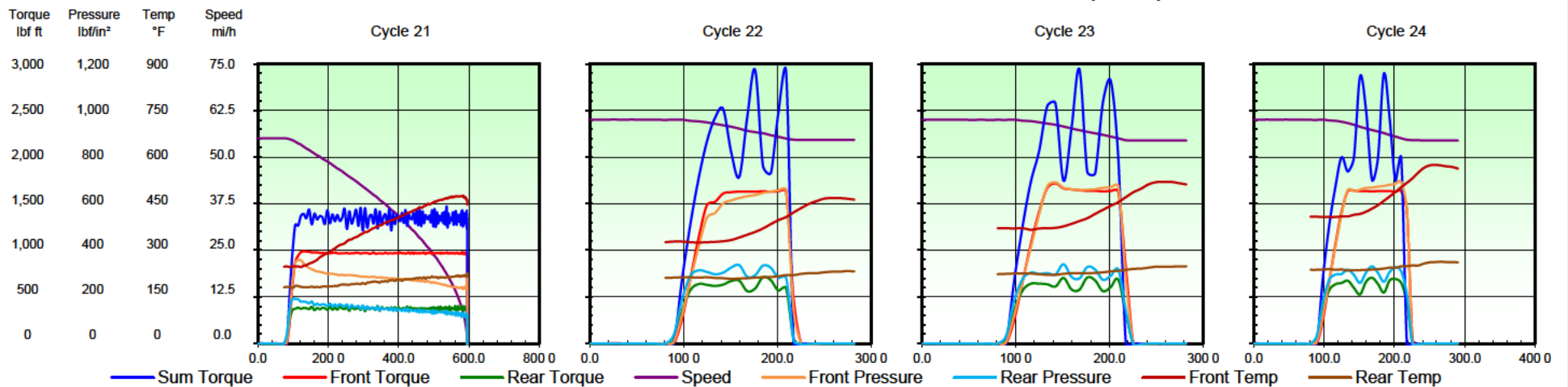
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

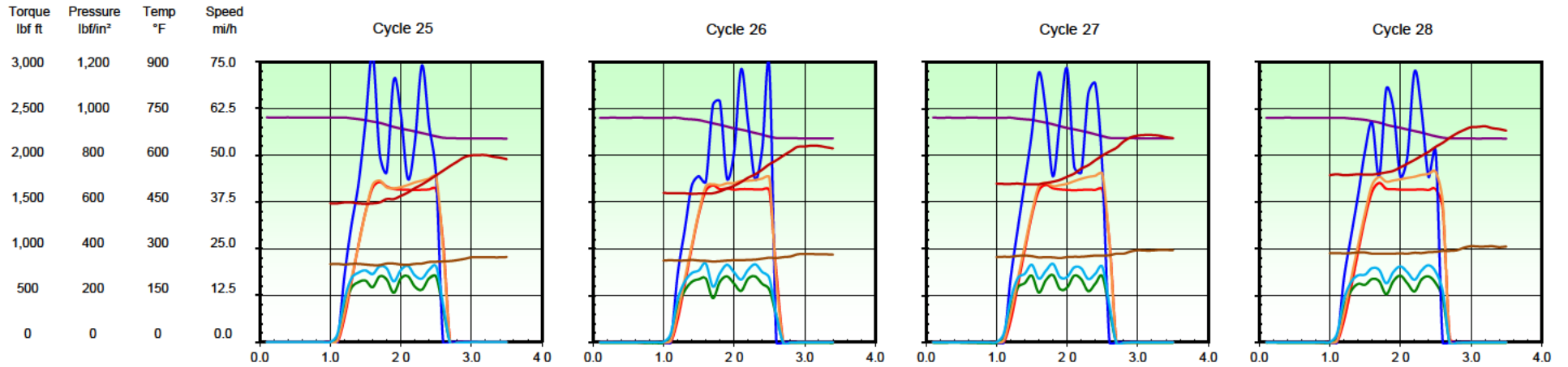
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Test Report Date: 21 March 2020

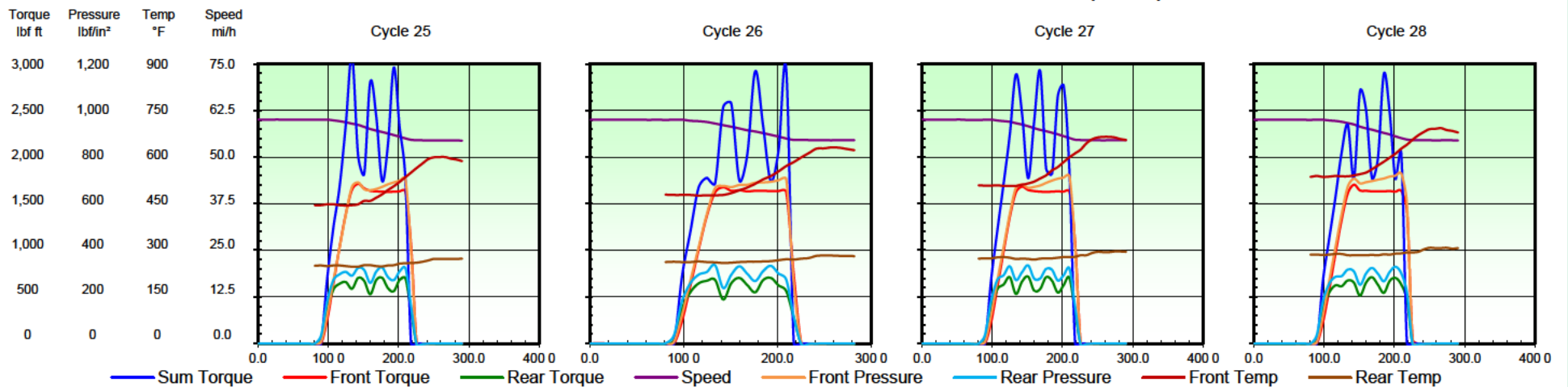
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

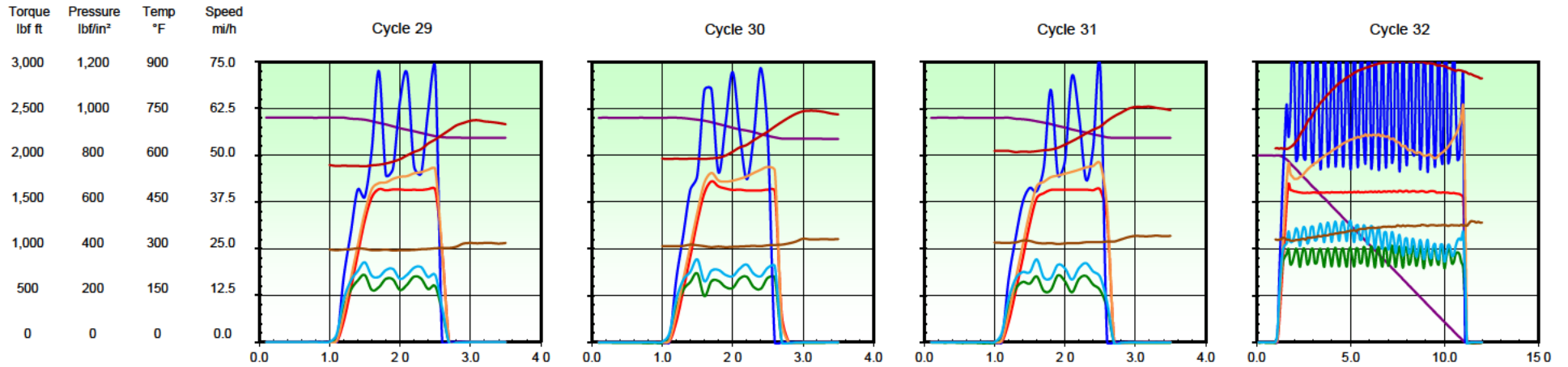
Report Number: 203145-5

Test Report Date: 21 March 2020

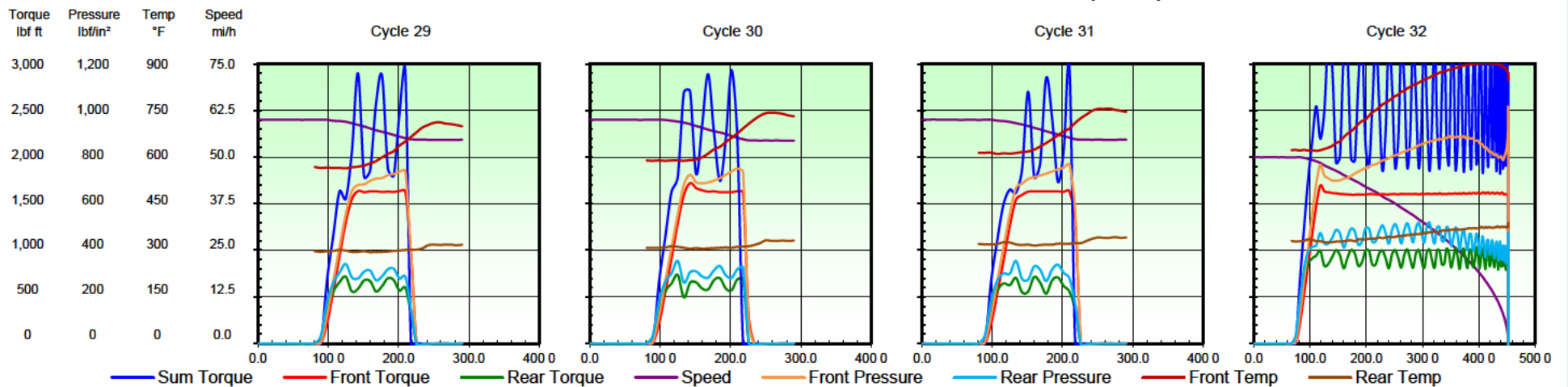
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

GRADE SIMULATION CYCLES IN-STOP DATA vs. TIME (SECONDS)



GRADE SIMULATION CYCLES IN-STOP DATA vs. DISTANCE (FEET)



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

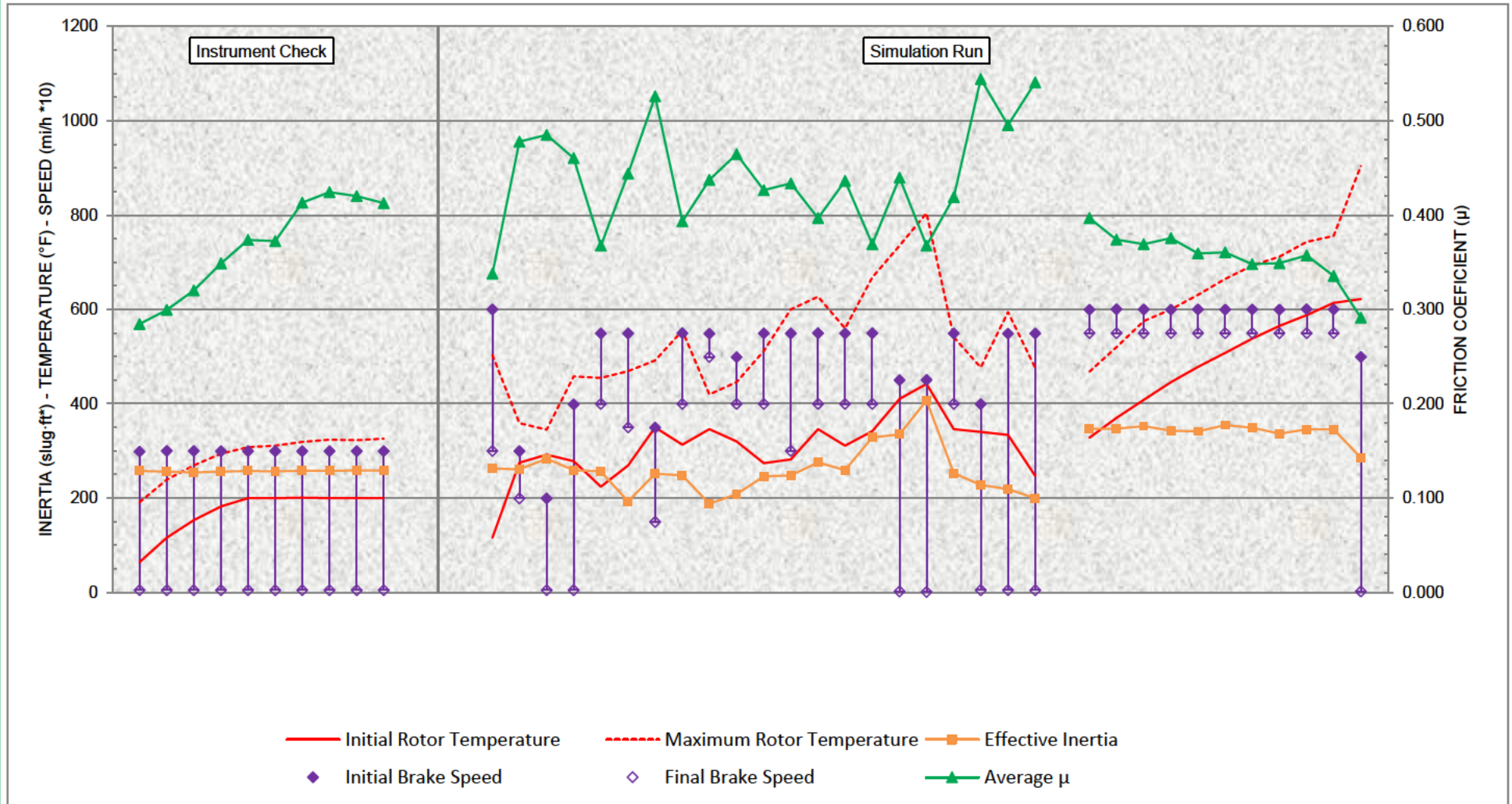
Report Number: 203145-5

Test Report Date: 21 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

TEST PERFORMANCE PROFILE - FRONT BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

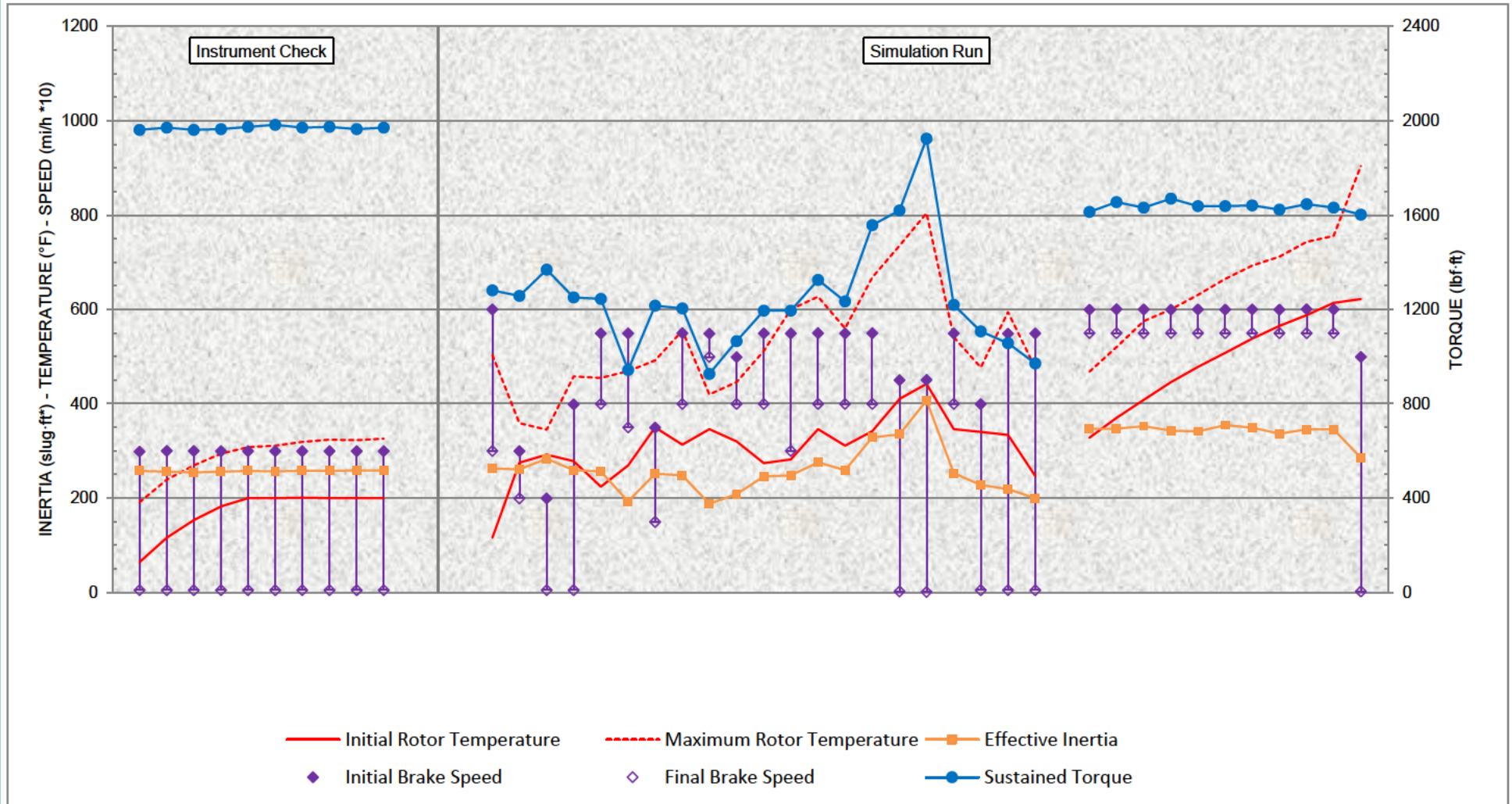
Report Number: 203145-5

Test Report Date: 21 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

TEST PERFORMANCE PROFILE - FRONT BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

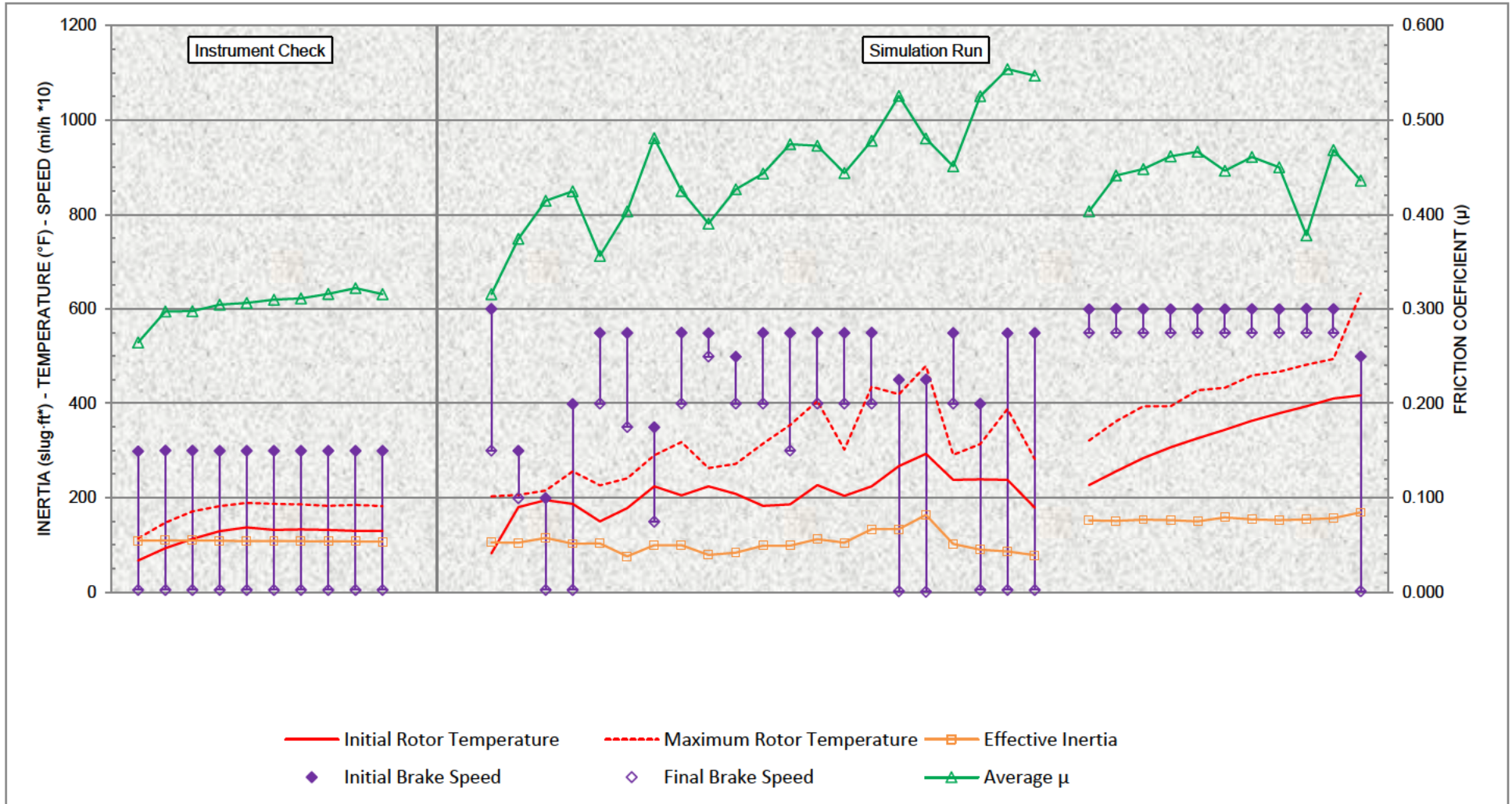
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Test Report Date: 21 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

TEST PERFORMANCE PROFILE - REAR BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

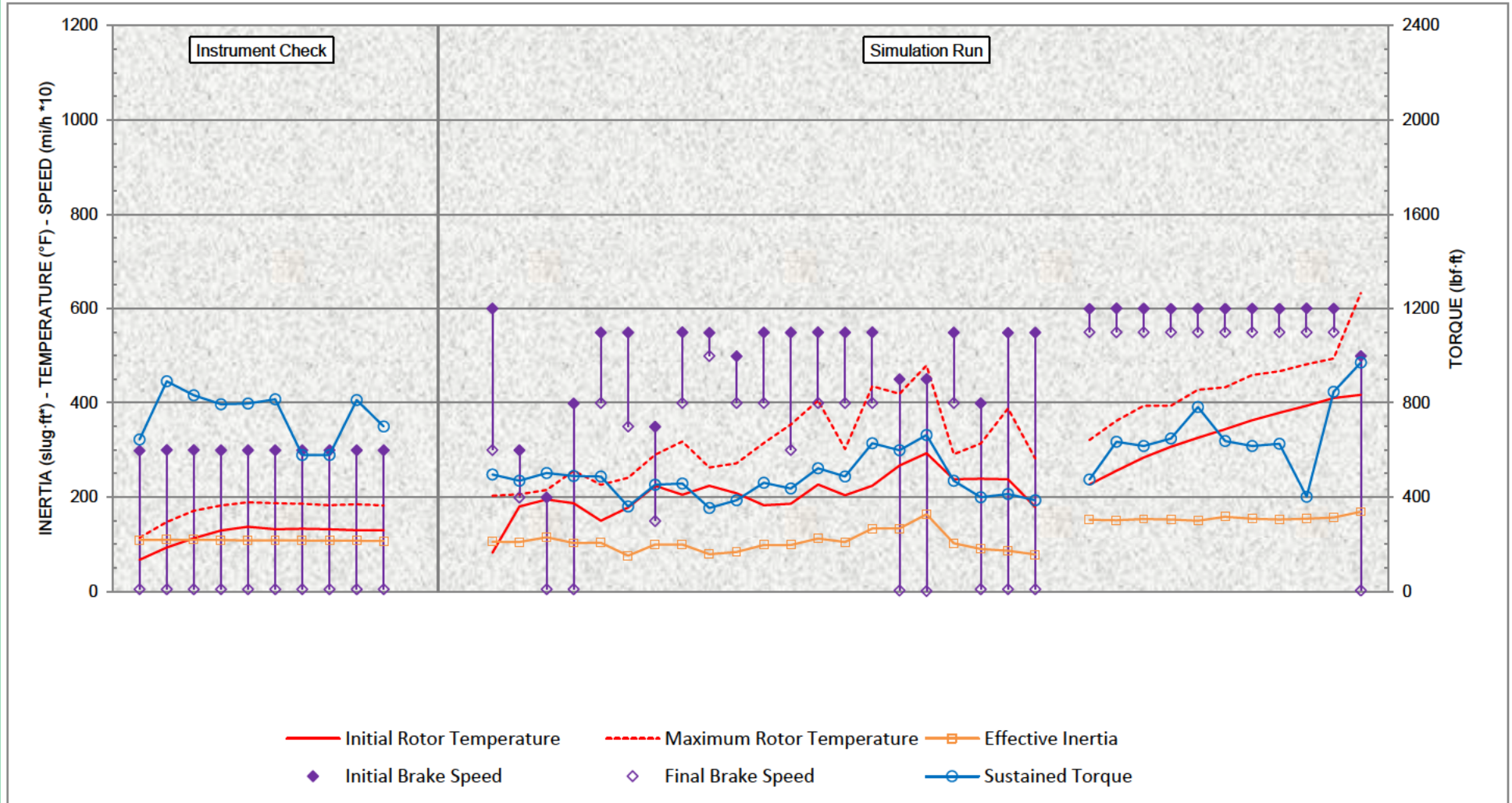
Report Number: 203145-5

Test Report Date: 21 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

TEST PERFORMANCE PROFILE - REAR BRAKE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

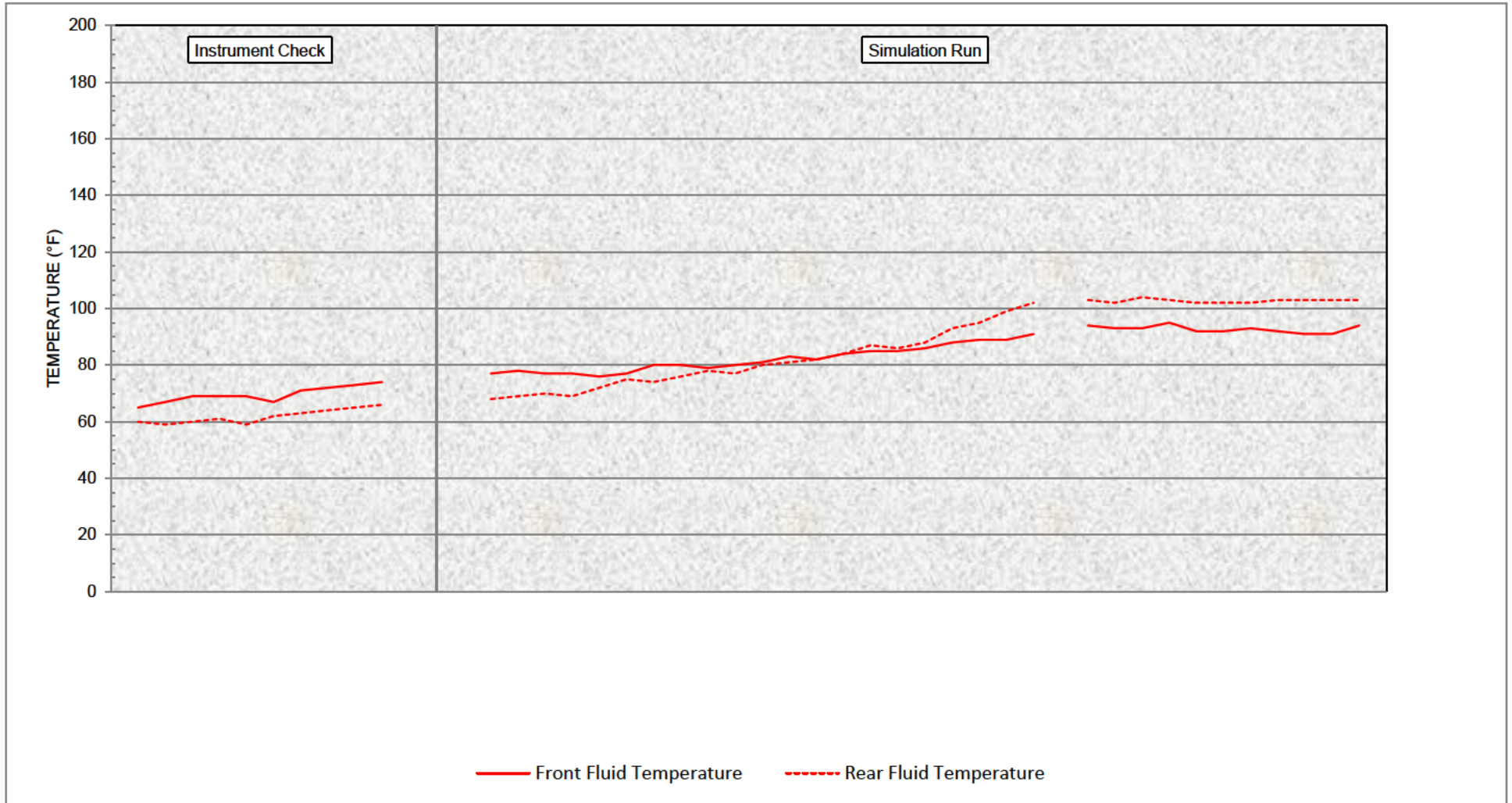
Report Number: 203145-5

Test Report Date: 21 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

BRAKE FLUID TEMPERATURE



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

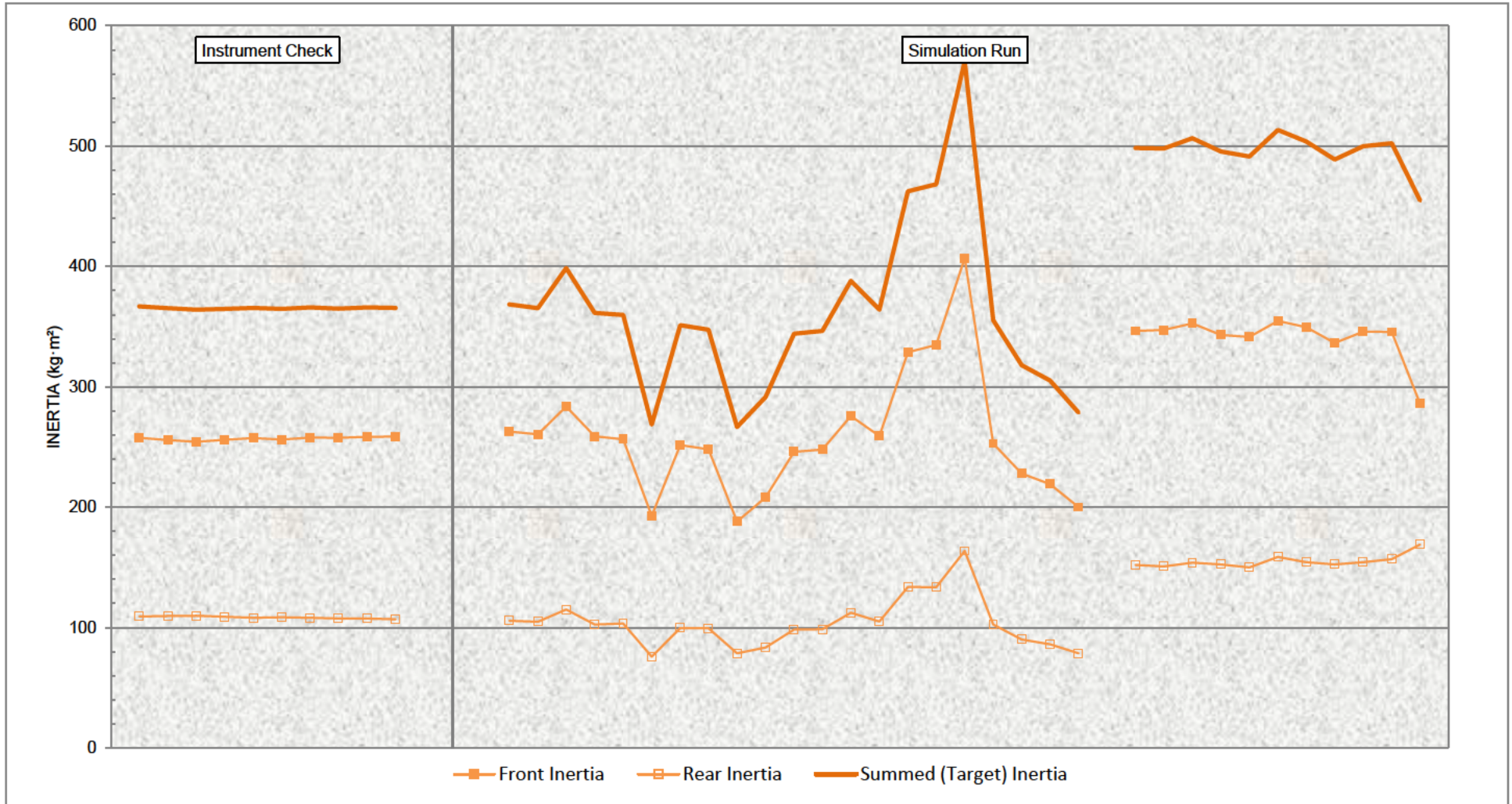
Report Number: 203145-5

Test Report Date: 21 March 2020

NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW - 1 FAILED REAR CALIPER

INERTIA DISTRIBUTION



Client: NTSB Acquisition and Lease Management Division

Test Numbers: M20-064-10

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

Report Number: 203145-5

Test Report Date: 21 March 2020

Test Numbers: M20-064-10

Report Number: 203145-5

Lining Edge Codes: MPV 2000-EE Front / MPV 2000-EE Rear

NTSB

Rotor Part Numbers: Ford 1G3Z-1V102-AB Front / Ford YC3Z-2C026-BB Rear

CYCLE NO.	SPEED		TIME		DISTANCE		DECEL		PRESSURE				TORQUE						TEMPERATURE						FLUID DISPLACE.		FRICTION COEFF.		INERTIA												
	INIT	FNL	STOP	REPT	STOP	REPT	AVG	AVERAGE	SUSTAINED	MAXIMUM	AVERAGE	SUSTAINED	MAXIMUM	ROTOR	FRONT		REAR		ROTOR	I/B	O/B	FLUID	ROTOR	I/B	O/B	FLUID	MAXIMUM	SUSTAINED	FRONT	REAR											
	mi/h		s		ft		ft/s ²	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	FRONT	REAR	FRONT	REAR	FRONT	REAR		
INSTRUMENT CHECK																																									
30 mi/h - 0.31g Deceleration Rate - 200°F Initial Rotor Temperature																																									
1	29.8	0.5	4.52	0.0	105	0	9.08	901	513	1041	513	1186	787	2482	1743	739	2606	1962	644	1998	1080	64	191	66	171	65	93	65	67	114	62	108	65	106	60	1.66	1.74	0.28	0.26	257.6	109.2
2	30.0	0.5	4.63	57.9	111	58	8.71	711	503	993	631	1163	984	2370	1660	711	2862	1971	891	1998	1387	116	239	105	216	81	106	67	93	147	80	137	87	131	59	0.85	0.42	0.30	0.30	255.8	109.5
3	30.0	0.5	4.62	60.0	110	60	8.78	878	583	925	589	1125	948	2383	1665	718	2794	1962	832	2033	1387	153	269	143	254	95	119	69	113	171	96	157	104	149	60	0.61	0.33	0.32	0.30	254.4	109.7
4	30.0	0.5	4.61	60.1	110	60	8.78	836	544	850	549	1009	958	2388	1675	713	2759	1965	794	2004	1464	182	294	174	284	109	133	69	129	182	110	169	117	161	61	0.57	0.31	0.35	0.30	255.9	108.8
5	30.0	0.5	4.59	64.5	110	65	8.81	785	544	797	548	982	932	2399	1689	710	2771	1974	797	2030	1461	200	308	194	305	121	145	69	137	189	121	175	127	168	59	0.55	0.30	0.37	0.31	257.3	108.1
6	30.0	0.5	4.58	86.2	109	86	8.89	632	428	804	554	893	916	2415	1697	718	2798	1983	815	2009	1490	200	311	202	308	127	152	67	132	187	123	169	127	168	62	0.52	0.30	0.37	0.31	256.2	108.4
7	29.9	0.5	4.56	85.2	109	85	8.87	696	388	720	392	857	899	2419	1705	714	2550	1971	579	2004	1487	201	319	208	314	133	153	71	133	186	123	170	126	168	63	0.51	0.29	0.41	0.31	257.9	108.1
8	30.0	0.5	4.56	89.3	108	89	8.93	684	383	702	386	881	904	2430	1715	715	2553	1974	579	2045	1484	200	324	208	316	134	156	72	132	183	123	171	126	168	64	0.51	0.29	0.42	0.32	257.6	107.4
9	29.9	0.5	4.55	91.3	108	91	8.93	696	527	706	531	913	890	2436	1720	715	2777	1965	812	2139	1484	200	323	208	318	134	156	73	130	185	123	168	126	167	65	0.52	0.29	0.42	0.32	258.6	107.5
10	29.9	0.5	4.57	91.8	108	92	8.93	701	463	721	467	905	883	2434	1723	711	2671	1971	700	2142	1473	200	326	210	319	136	158	74	130	182	122	170	126	166	66	0.51	0.28	0.41	0.32	258.7	106.8

CYCLE	SPEED		TIME		DISTANCE		DECEL	PRESSURE						TORQUE						TEMPERATURE						FLUID DISPLACEMENT		FRICTION COEFF.		INERTIA											
	NO.		STOP		STOP			AVG	AVERAGE		SUSTAINED		MAXIMUM		AVERAGE		SUSTAINED		MAXIMUM		FRONT		REAR		MAXIMUM		SUSTAINED		FRONT		REAR										
	INIT	FNL	STOP	REPT	STOP	REPT	DIST	FRONT	REAR	FRONT	REAR	FRONT	REAR	SUM	FRONT	REAR	SUM	FRONT	REAR	FRONT	REAR	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	INT	MAX	FRONT	REAR	FRONT	REAR	FRONT	REAR		
		m/h		s		ft		ft/s ²		lbf/in ²						lbf ft						F						in ³		μ		slug ft ²									
DOWNHILL SIMULATION TEST																																									
0.20g Deceleration Rate																																									
1	60.0	30.0	6.94	606.3	468	50940	6.20	561	329	572	331	735	430	1704	1216	488	1777	1281	496	1384	582	116	503	117	497	94	183	77	82	203	84	240	89	172	68	0.45	0.21	0.34	0.32	262.9	105.6
2	29.9	19.9	2.38	48.8	90	2330	5.96	323	249	397	264	509	309	1624	1158	466	1726	1257	469	1428	564	275	359	273	369	145	162	78	180	206	141	172	147	179	69	0.36	0.17	0.48	0.37	260.5	104.8
3	19.9	0.5	4.57	23.5	71	712	6.05	371	247	426	255	505	328	1796	1278	518	1871	1369	502	1549	626	292	345	298	368	158	173	77	195	215	156	186	166	194	70	0.35	0.16	0.49	0.41	283.6	115.0
4	39.9	0.5	9.07	56.7	275	2631	6.22	406	242	410	243	595	380	1677	1201	476	1741	1251	490	1440	579	278	458	271	479	161	206	77	187	256	163	233	170	236	69	0.38	0.18	0.46	0.42	258.9	102.6
5	54.9	39.9	3.52	214.1	251	16090	6.09	468	285	511	288	638	375	1633	1164	469	1732	1245	487	1414	558	224	455	232	439	155	205	76	150	226	159	206	159	206	72	0.40	0.18	0.37	0.36	256.5	103.3
6	54.9	35.0	4.55	71.0	306	5620	6.31	316	187	321	188	456	235	1263	907	356	1304	944	360	1175	434	269	469	272	491	170	216	77	178	241	175	218	175	226	75	0.33	0.15	0.44	0.40	192.8	75.8
7	34.9	14.9	4.62	20.0	173	1106	6.20	344	197	349	198	467	263	1624	1164	460	1668	1216	452	1414	558	350	492	374	529	198	233	80	224	290	202	244	211	264	74	0.33	0.14	0.53	0.48	251.6	99.5
8	55.0	39.9	3.52	93.5	249	6887	6.17	448	225	462	227	515	293	1598	1141	457	1662	1204	458	1349	561	313	555	315	534	192	251	80	205	318	200	247	201	274	76	0.36	0.16	0.39	0.42	248.1	99.4
9	54.9	49.9	1.19	57.6	96	4527	5.81	293	186	320	191	337	226	1154	814	340	1281	927	354	968	461	346	420	347	424	211	219	79	224	263	215	228	214	246	78	0.28	0.14	0.44	0.39	188.0	78.6
10	49.9	39.9	2.30	56.5	155	4177	6.17	337	190	346	191	447	226	1340	957	383	1452	1065	387	1260	496	320	446	325	463	202	228	80	208	272	209	231	208	257	77	0.33	0.14	0.46	0.43	208.1	83.4
11	54.9	39.9	3.49	113.8	248	9104	6.18	414	218	423	219	484	279	1585	1133	453	1656	1195	461	1349	567	274	512	285	511	186	248	81	183	315	193	230	191	274	80	0.34	0.16	0.43	0.44	245.9	98.3
12	54.9	30.0	5.77	101.4	366	8091	6.21	411	194	416	194	438	286	1604	1148	456	1632	1195	437	1228	596	282	600	289	597	188	277	83	186	354	194	270	192	312	81	0.32	0.16	0.43	0.47	247.9	98.5
13	54.9	39.9	3.55	64.4	252	4890	6.07	492	231	504	233	550	282	1754	1247	507	1848	1325	523	1363	641	346	627	347	594	212	283	82	227	405	220	269	218	344	82	0.36	0.16	0.40	0.47	275.8	112.2
14	54.9	39.9	3.52	128.6	251	10310	6.09	418	230	427	231	458	282	1653	1176	477	1721	1234	487	1290	608	311	560	319	548	205	274	84	204	302	215	256	211	287	84	0.34	0.16	0.44	0.44	259.0	105.1
15	54.9	39.9	3.61	62.2	258	4903	5.94	613	274	637	277	687	333	2048	1456	592	2187	1558	629	1726	750	342	668	345	612	216	293	85	224	435	226	290	221	369	87	0.41	0.17	0.37	0.48	328.7	133.7
16	45.0	0.2	10.36	42.0	352	2780	6.19	550	239	556	240	766	425	2160	1544	616	2219	1620	599	1676	1080	410	735	408	688	242	311	85	267	419	253	369	251	393	86	0.42	0.19	0.44	0.53	334.8	133.5
17	45.1	0.1	10.57	86.4	362	4795	6.03	777	290	790	291	1178	687	2564	1828	735	2588	1924	664	2074	1532	442	804	439	770	264	341	86	293	479	285	415	279	443	88	0.58	0.25	0.37	0.48	406.9	163.7
18	54.9	39.9	3.52	210.3	251	15760	6.09	427	218	439	219	499	306	1613	1148	465	1688	1219	469	1278	608	346	541	365	568	235	268	88	238	291	266	285	254	285	93	0.37	0.18	0.42	0.45	252.9	102.4
19	39.9	0.5	9.01	94.2	271	5612	6.32	294	160	307	160	499	310	1497	1073	424	1506	1107	399	1378	894	340	477	349	515	231	248	89	239	314	257	284	247	311	95	0.36	0.19	0.54	0.53	227.9	90.0
20	54.9	0.5	12.42	92.1	512	6169	6.32	320	156	322	157	496	250	1438	1032	406	1470	1057	413	1316	593	334	594	343	636	219	269	89	238	388	254	312	244	364	99	0.35	0.16	0.50	0.55	219.1	86.1
21	54.9	0.5	12.41	262.5	511	20010	6.34	270	149	271	149	370	213	1315	944	371	1358	971	387	1012	511	247	476	265	547	182	223	91	179	282	209	256	200	275	102	0.31	0.16	0.54	0.55	200.0	78.5
2 MINUTE STOP WITH VEHICLE IN PARK																																									
22	60.0	55.0	1.35	38.2	118	1866	5.20	561	246	614	248	663	579	1933	1344	590	2089	1614	475	1655	1331	328	468	322	449	212	233	94	227	321	232	266	228	285	103	0.42	0.23	0.40	0.40	346.5	152.0
23	60.0	55.0	1.34	14.4	118	1243	5.30	554	288	668	303	738	577	1965	1370	595	2290	1655	635	1800	1349	370	520	391	523	225	248	93	256	362	257	300	253	311	102	0.42	0.22	0.37	0.44	347.2	150.8
24	60.0	55.0	1.37	14.5	120	1250	5.18	447	284	667	290	724	579	1955	1361	594	2249	1632	617	1750	1366	408	575	433	570	237	263	93	284	394	276	328	274	339	104	0.41	0.22	0.37	0.45	352.7	153.9
25	60.0	55.0	1.36	14.5	117	1250	5.26	627	292	671	296	730	613	1942	1345	597	2319	1670	649	1747	1408	446	600	466	601	251	273	95	307	394	295	347	292	347	103	0.42	0.22	0.38	0.46	343.1	152.4
26	60.0	55.0	1.34	14.5	118	1249	5.25	578	346	688	353	748	581	1923	1336	587	2420	1638	782	1815	1363	478	631	497	624	263	283	92	326	428	314	363	308	367	102	0.42	0.22	0.36	0.47	341.4	149.9
27	60.0	55.0	1.39	14.5	122	1250	5.06	572	285	686	301	732	577	1936	1338	598	2276	1638	638	1762	1378	508	665	525	657	274	296	92	344	433	328	380	323	380	102	0.43	0.22	0.36	0.45	354.8	158.6
28	60.0	55.0	1.37	14.5	121	1250	5.12	641	277	712	282	754	613	1921	1333	588	2258	1641	617	1776	1434	538	693	551	690	286	308	93	363	459	344	399	338	397	102	0.43	0.22	0.35	0.46	349.5	154.3
29	60.0	55.0	1.36	14.5	118	1249	5.22	473	286	702	293	741	599	1901	1308	592	2249	1623	626	1691	1369	565	712	579	717	296	318	92	379	467	359	410	351	406	103	0.44	0.22	0.35	0.45	336.4	152.4
30	60.1	55.0	1.40	14.5	122	1251	5.15	630	225	696	224	761	617	1917	1326	591	2049	1647	402	1756	1396	588	743	601	756	308	332	91	394	482	373	431	367	424	103	0.45	0.22	0.36	0.38	345.7	154.2
31	60.0	55.0	1.39	14.5	123	1249	5.08	660	368	734	381	771	631	1900	1308	593	2479	1632	847	1653	1399	614	756	627	776	319	342	91	410	494	387	440	381	435	103	0.45	0.22	0.34	0.47	345.6	156.7
32	50.0	0.2	9.90	18.6																																					



**Brake Performance Study Attachment 7: Dynamometer Testing Report: Example Cooling
Curve Calibration for Simulations**

Schoharie, NY

HWY19H001

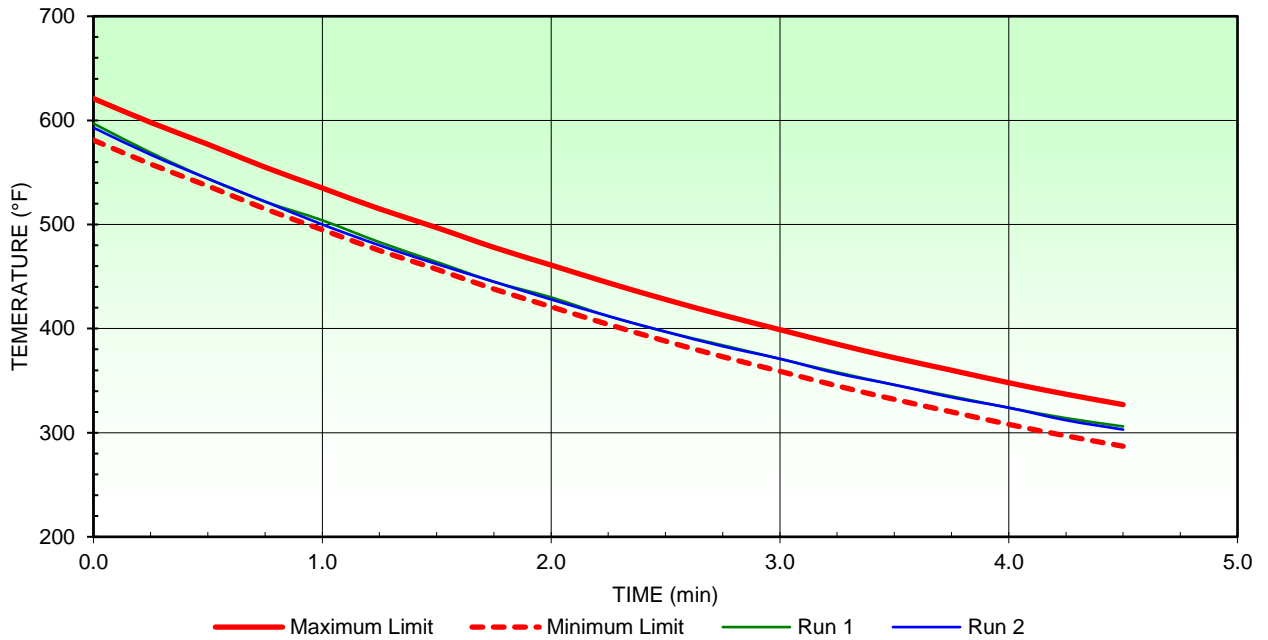
NTSB - SCHOHARIE, NY BRAKING SIMULATION TEST

2001 FORD EXCURSION WITH LIMOUSINE CONVERSION - USED PARTS 13,565 LB GVW

50 mi/h BRAKE COOLING CURVES

(LIMITS DERIVED FROM VEHICLE DATA MEASURED BY NATIONAL AUTOMOTIVE TEST CENTER)

FRONT BRAKE COOLING CURVE



REAR BRAKE COOLING CURVE

