NEW CAR ASSESSMENT PROGRAM (NCAP)
DYNAMIC ROLLOVER RESISTANCE TEST

Ford Motor Co

2018 Ford Expedition RWD

TEST NUMBER: 18-03

Final Report
1 May 2018

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Prepared for:

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1200 New Jersey Avenue S.E.
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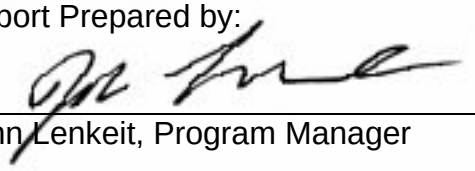
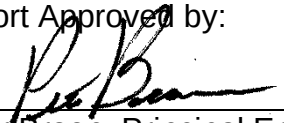


Date: 1 May 2018

John Lenkeit, Program Manager

Report Approved by:



Date: 1 May 2018

Peter Broen, Principal Engineer

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16. Abstract

An NCAP Dynamic Rollover Maneuver (Fishhook) Test was conducted on a 2018 Ford Expedition RWD at Dynamic Research, Inc. on March 14, 2018. The vehicle did not experience two-wheel lift. The vehicle's steering angle at 0.3 g lateral acceleration at 50 mph was 32 degrees.

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Section I
INTRODUCTION

Beginning with the 2006 fiscal year, the National Highway Traffic Safety Administration (NHTSA) has engaged Dynamic Research, Inc. (DRI) of Torrance, CA to conduct dynamic rollover testing and gather data from that testing as part of NHTSA's New Car Assessment Program (NCAP).

The purpose of the testing reported herein was to determine if a typical 2018 Ford Expedition RWD would experience tip-up, defined as simultaneous two-wheel lift of two inches or more at an entry speed of 50 mph or less in the Fishhook Procedure developed by NHTSA. This procedure may be found at www.regulations.gov, docket item NHTSA-2006-26555-0136.

The testing reported herein was accomplished under contract DTNH22-14-D-00332. The task order is entitled, "New Car Assessment Program (NCAP) Non-Destructive Vehicle Testing and Data Gathering."

Section II
VEHICLE PREPARATION

A. TEST VEHICLE

The test vehicle was new or in as-new condition, meaning the vehicle had been driven no more than 500 miles prior to the start of dynamic rollover testing. It was acquired through a commercial rental/leasing company. Details of the test vehicle are given in Table 1.

B. TIRES

All tires used were new, and of the same make, model, size, and DOT specification of those installed on the vehicle when purchased new. Tire inflation pressures were in accordance with the recommendations indicated on each vehicle's identification placard. To reduce the possibility of tire debeading during Fishhook testing, an appropriately sized inner tube was installed in each tire. To further reduce the possibility of tire debeading, the tires were mounted to the rims without the use of tire mounting lubricant. Tire specifications are listed in Table 2.

C. VEHICLE LOADING

The multi-passenger load, described in the Fishhook Procedure, was used for all tests. The load and positioning of the load in the vehicle are listed in Table 3.

In addition to water dummies, the loading included instrumentation, a steering machine, and outriggers. Test vehicle bumper assemblies were removed for outrigger installation. The reduction in vehicle weight due to the removal of the bumpers was offset by the additional weight of the outriggers and their mounting system. The outrigger system typically outweighs the bumper assemblies.

Table 1. Test Vehicle Data

General Data					
Model year, make, model	2018 Ford Expedition RWD				
VIN	1FMJU1HT3JEA0xxxx				
Body style	SUV				
Number of doors	4				
Trim level	XLT				
Seating positions	Front:	2nd row	3rd row	4th row	5th row
	2	3	3		
Electronic stability control	Yes				
4-Wheel ABS (Yes/No)	Yes				
Power steering (Yes/No)	Yes				
Major optional equipment	Equipment Group 200A				
Odometer at start of testing	19 miles				
Drivetrain					
Engine cylinder arrangement	V-6				
Engine displacement	3.5 L				
Transmission type	Automatic				
Drive arrangement	RWD				
Chassis					
Track width	F: 68 in (1727.2 mm) , R: 67 in (1701.8 mm)				
Wheelbase	123 in (3124.2 mm)				
Curb weight	5420 lb (2458.5 kg)				
Certification Data from Vehicle's Label					
Vehicle manufactured by	Ford Motor Co				
Date of manufacture	11/17				
GVWR	7225 lb (3277 kg)				
GAWR Front	3175 lb (1440 kg)				
GAWR Rear	4380 lb (1987 kg)				

Table 2. Tire Information

Tire Manufacturer	Hankook
Tire Model	Dynapro HT
Tire Size	Front: 275/65R18 Rear: 275/65R18
Load rating	Front: 116 Rear: 116
Speed rating	Front: H Rear: H
Treadwear grade	Front: 700 Rear: 700
Traction grade	Front: B Rear: B
Temperature grade	Front: A Rear: A
Location of “Recommended Tire Pressure” label	Driver’s door jamb
Recommended cold tire pressure	Front: 35 psi, (240 kPa) Rear: 35 psi, (240 kPa)
First 8 digits of DOT code	Front: T7DU HU H Rear: T7DU HU H

Table 3. Vehicle Loading

Water dummy and other loading	3 water dummies in second row
Water dummy weight	175 lb (79.4 kg)
Fuel level	Full
Weight as Tested	
Left front	1543 lb (699.9 kg)
Right front	1462 lb (663.2 kg)
Left rear	1688 lb (765.7 kg)
Right rear	1741 lb (789.7 kg)

D. STEERING CONTROLLER

Precise controlled steering is accomplished using a steering machine designed and constructed by DRI. DRI has used its Automated Vehicle Controller (AVC) steering machine for many vehicle tests including FMVSS 126 tests. It can provide up to 65 ft-lb torque and rates over 1300 deg/sec. The integrated angle encoder has an unlimited range with a resolution of 0.045 degrees and an accuracy of ±0.045 degrees. The steering motor is controlled by a MicroAutoBox II from dSPACE which also acts as the data acquisition system.

E. REAL-TIME CONTROLLER AND DATA ACQUISITION

Data acquisition is achieved using a MicroAutoBox II from dSPACE which also serves as the real-time system for the steering controller. Data from the Oxford IMU, including Longitudinal, Lateral, and Vertical Acceleration, Roll, Yaw, and Pitch Rate, Forward and Lateral Velocity, Roll and Pitch Angle are sent over Ethernet to the Micro AutoBox. The Oxford IMUs are calibrated per the manufacturer's recommended schedule (Table 4). The MicroAutoBox II specifications are:

Model: D-Space Micro-Autobox II 1401/1513
Base Board SN 549068
I/O Board SN 588523

A list of the sensors is given in Table 4.

Two video cameras were used to record the Fishhook runs. They were positioned nominally as shown in Figure 1. The recorded videotapes were reviewed after the Fishhook runs to check for any two wheel lift. If any two wheel lift was observed, eight infrared distance measuring sensors for measurement of wheel lift (two sensors at each wheel) were then mounted for use in subsequent confirmation Fishhook tests.

F. OTHER VEHICLE PREPARATION

In addition to installation and preparation discussed above, the test vehicle was prepared as follows:

- Front and rear bumpers were removed
- Outrigger mounts were installed in the bumper locations and titanium outriggers were fastened to these mounts

- A five point safety harness was installed.
- Airbags were removed or otherwise disabled

Photographs of the vehicle tested are given in Appendix A.

Table 4. Sensors

Measured Variable	Sensor	Range	Resolution	Accuracy	Specifics	Serial Number	Calibration
Vehicle Tire Pressure	Tire Pressure Gauge	0-100 psi 0-690 kPa	0.01 psi 6.89 kPa	< 1% error between 20 and 100 psi	Omega DPG8001	17042707002	By: DRI Date: 6/8/2017 Due: 6/8/2018
Vehicle Total, Wheel, and Axle Load	Platform Scales (Minter)	1200 lb/platform 5338 N/platform	1 lb 4.4 N	0.5% of applied load	Intercomp SWI	1110M206352	By: DRI Date: 12/12/2017 Due: 12/12/2018
	Platform Scales (Torrance)	7000 lb 31.1 kN 31.1 kN	0.5 lb 2.2 N 2.2 N	±0.1% of applied load	Proform 67644	VS800W16-00455	By: DRI Date: 6/1/2017 Due: 6/1/2018
Handwheel Angle	Steering Angle Encoder (Automated Steering Controller)	±800 deg	0.25 deg	±0.25 deg	DRI Automatic Vehicle Controller using D-Space Micro-Autobox II	NA	Verified by DRI at installation[1]
Longitudinal, Lateral, and Vertical Acceleration Roll, Yaw, and Pitch Rate, Forward and Lateral Velocity, Roll and Pitch Angle	Multi-Axis Inertial Sensing System	Accels ± 5 g, Angular Rate ±300 deg/s, Angle >45 deg, Velocity >200 km/h	Accels .001 g, Angular Rate 0.01 deg/s, Angle 0.05 deg, Velocity 0.1 km/h	Accels .001g, Angular Rate 0.01 deg/s, Angle 0.05 deg, Velocity 0.1 km/h	Oxford xNav 550	015386	By: Oxford Technical Solutions Date: 6/21/2017 Due: 6/21/2019

1 . The steering encoder is checked prior to beginning tests to verify that there are no faults. The steering controller is installed in the vehicle and the steering wheel is turned through two complete revolutions while recording data. The data are then reviewed for any dropouts or other nonlinearities that would indicate dust intrusion or faulty sectors.

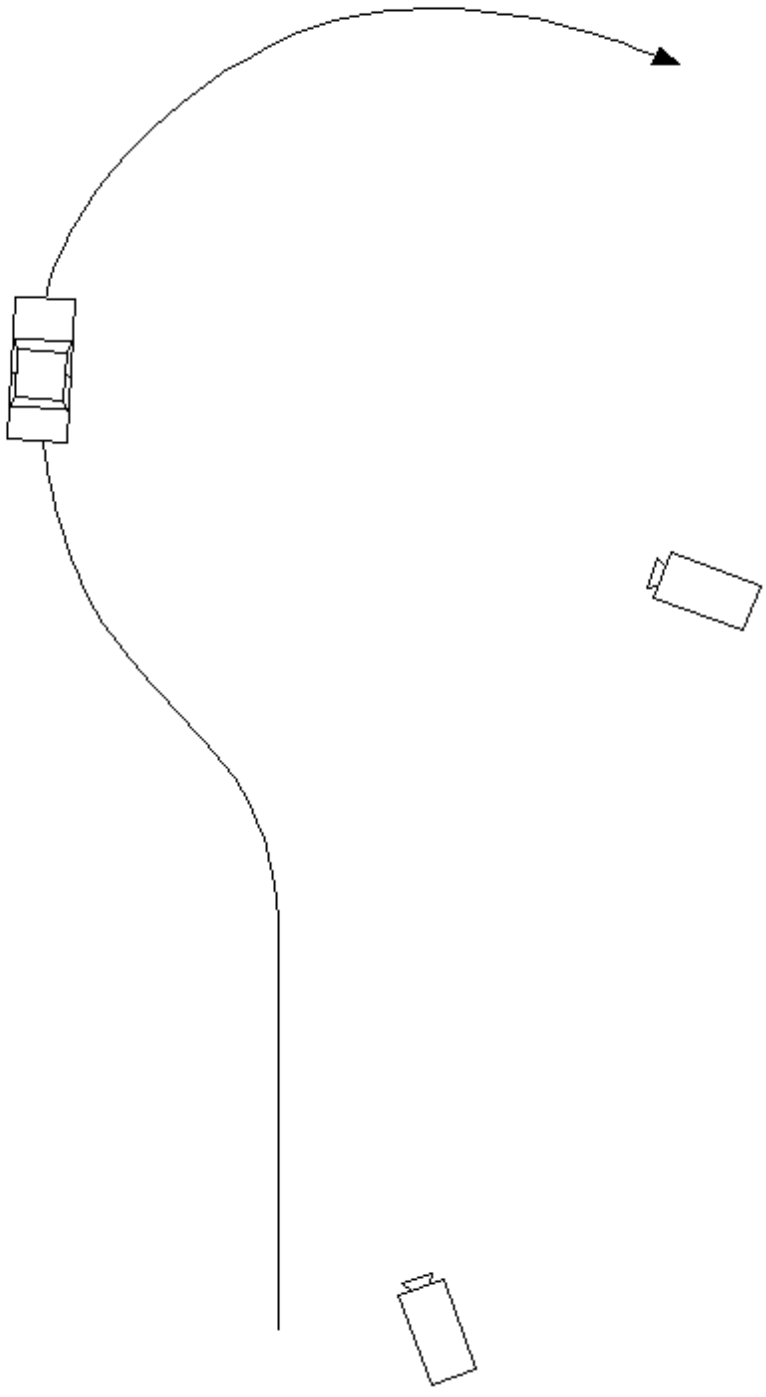


Figure 1. Nominal Position of Video Cameras for Fishhook Tests

Section III
TEST PROCEDURES

This section includes a general overview of the test procedures and details of the particular test.

A. TEST PROCEDURE OVERVIEW

This test was conducted in accordance with NHTSA's NCAP Rollover Resistance Test Procedure (Fishhook) as described in the Federal Register (68 FR 59250). Detailed descriptions of the test procedure, pass/fail criteria, and data acquisition specifications may be found at docket NHTSA-2001-9663.

There are two major components of the test procedure, the Slowly Increasing Steer (SIS) pre-test and the Fishhook test.

The Slowly Increasing Steer (SIS) maneuver was used to characterize the steady state lateral dynamics of each vehicle, and is based on the "Constant Speed, Variable Steer" test defined in SAE J266. The maneuver is used to determine the handwheel angle that produces a lateral acceleration of 0.3 g at 50 mph. This handwheel angle is then used to determine the magnitude of steering to be used for the NHTSA Fishhook maneuver.

SIS tests were performed at a constant speed of 50 mph. Handwheel angle was input at a rate of 13.5 deg/sec, from 0 to an angle that provided at least 0.55 g. Three tests were conducted in each direction, and the data for the six runs were averaged to obtain the handwheel angle that produced 0.3 g at 50 mph.

The Fishhook test is a programmed steering maneuver that is implemented via the steering controller. The vehicle was initially steered in one direction and then the steering was reversed. The timing, magnitude and rate of the steering were prescribed by the Fishhook Procedure.

To begin the maneuver, the vehicle was driven in a straight line at a speed slightly greater than the desired entrance speed. The driver then released the throttle. When the vehicle was at the target speed, the steering controller automatically initiated the steering maneuver. Following completion of the steering reversal the handwheel position was maintained for three seconds, and then returned to zero angle in 1 second.

The tests were conducted in both left-right and right-left directions. The “Default” test series used a handwheel angle equal to 6.5 times the handwheel angle that produced 0.3 g at 50 mph in the SIS tests, and initial vehicle speeds beginning at 35 mph and concluding up to 50 mph (if no two-wheel lift occurs). Supplemental tests were also done, as specified in the Fishhook Procedure.

B. TEST CONDITIONS

1. Test Surface

The tests were conducted on the Vehicle Dynamics Area at DRI’s Minter Field facility, located near Bakersfield, California, on 3/14/2018. The VDA has a smooth, flat (slope less than 0.5% throughout) asphaltic concrete surface. Its dimensions are as shown in Figure 2. It was built in the spring of 2005.

VDA surface friction measurements were accomplished using the DRI Mobile Tire Tester. Three runs were done, one at each of three previously determined locations. Each run provided for a minimum of 3 seconds of tire friction at constant normal load, slip angle, and speed in a free rolling condition. The test was accomplished using an ASTM E1136 tire with an inflation pressure of 35 (±0.5) psi at a test speed of 40 (±0.5) mph. The net slip angle of the test tire for each test run was 7.5 deg. The test tire was no older than 6 months from the date of manufacture. The surface friction measurement results are shown in Table 5.

Table 5. Surface Friction

Date of surface friction measurements	3/15/2018
Average normalized lateral force	0.823

2. Fishhook Handwheel Angles

The 0.3 g handwheel angle obtained from the SIS tests and the handwheel angles used in the Fishhook tests are shown in Table 6.

Table 6. Handwheel Angles

0.3 g handwheel angle (from SIS tests at 50 mph)	32 º
5.5 scalar handwheel angle for Fishhook Test	176º
6.5 scalar handwheel angle for Fishhook Test	208 º

3. Weather Conditions

The weather conditions, recorded at the end of testing, are shown in Table 7.

Table 7. Weather Conditions

Ambient temperature	62.6 ºF (17 ºC)
Wind Speed	3 mph (1.3 m/s)
Wind Direction	SE

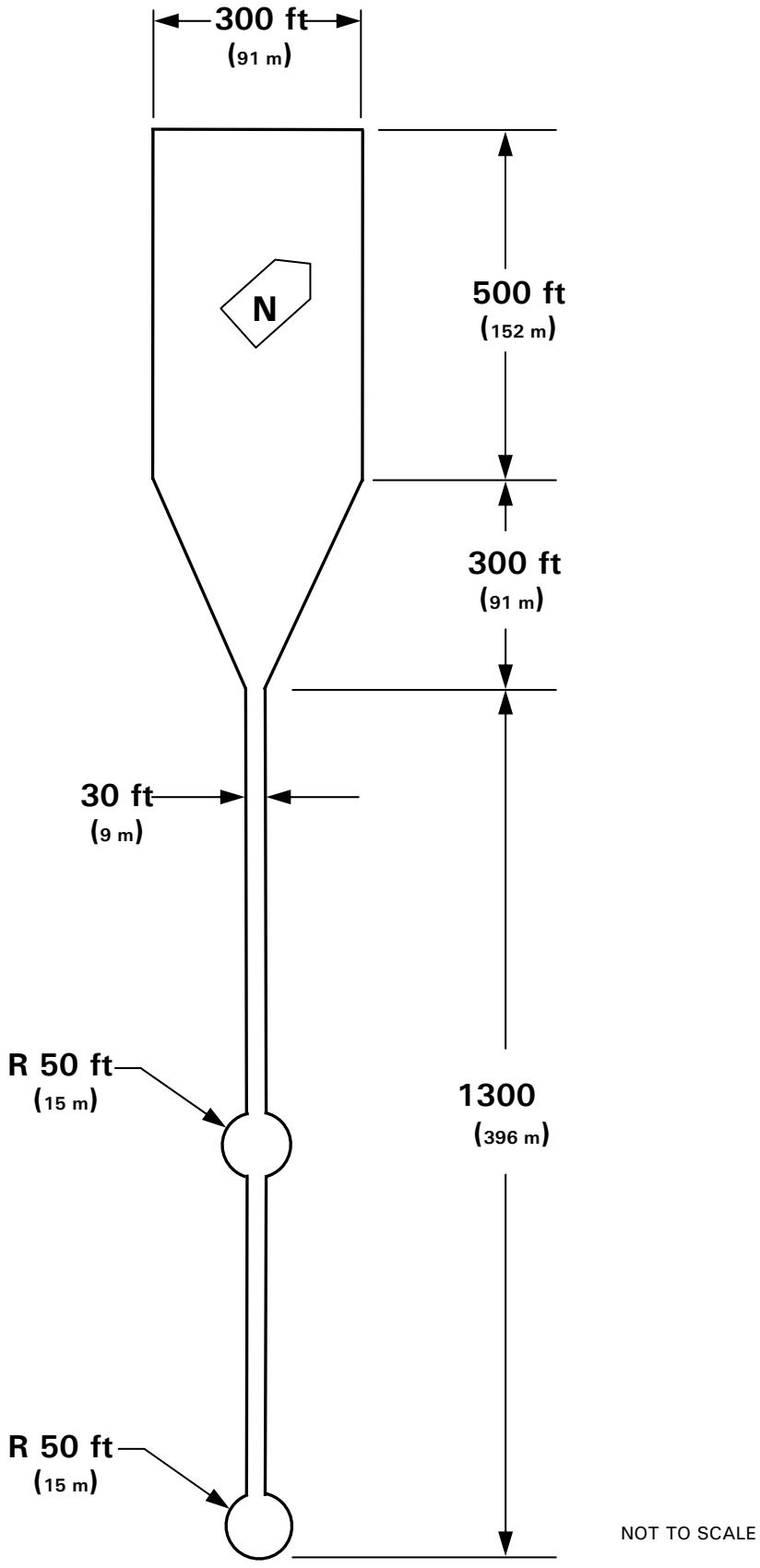


Figure 2. DRI-Minter Vehicle Dynamics Area

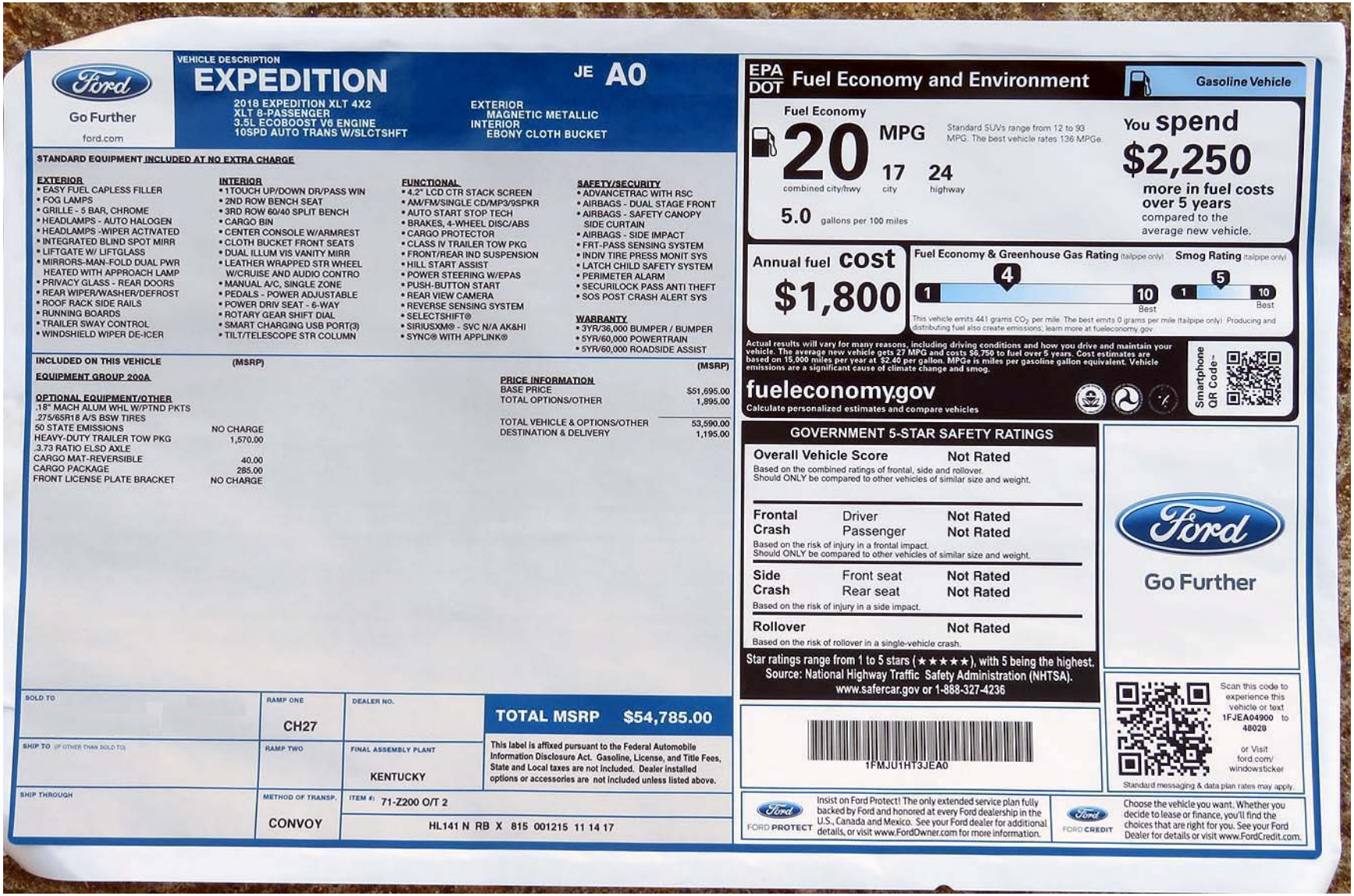
Section IV
RESULTS

The test run log is given in Appendix B. The Slowly Increasing Steer Test Worksheet is given in Appendix C. Appendix D contains time history plots for the 50 mph runs and any runs which resulted in two-wheel lift. For the 2018 Ford Expedition RWD, there was no two-wheel lift at any test condition.

APPENDIX A

Photographs

LIST OF FIGURES



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VEHICLE DESCRIPTION
EXPEDITION JE A0
2018 EXPEDITION XLT 4X2
XLT 8-PASSENGER
3.5L ECOBOOST V6 ENGINE
10SPD AUTO TRANS W/SLCTSHFT
EXTERIOR
MAGNETIC METALLIC
INTERIOR
EBONY CLOTH BUCKET

STANDARD EQUIPMENT INCLUDED AT NO EXTRA CHARGE

EXTERIOR
- EASY FUEL CAPLESS FILLER
- FOG LAMPS
- GRILLE - 5 BAR, CHROME
- HEADLAMPS - AUTO HALOGEN
- HEADLAMPS -WIPER ACTIVATED
- INTEGRATED BLIND SPOT MIRR
- LIFTGATE W/ LIFTGLASS
- MIRRORS-MAN-FOLD DUAL PWR HEATED WITH APPROACH LAMP
- PRIVACY GLASS - REAR DOORS
- REAR WIPER/WASHER/DEFROST
- ROOF RACK SIDE RAILS
- RUNNING BOARDS
- TRAILER SWAY CONTROL
- WINDSHIELD WIPER DE-ICER

INTERIOR
- 1TOUCH UP/DOWN DR/PASS WIN
- 2ND ROW BENCH SEAT
- 3RD ROW 60/40 SPLIT BENCH
- CARGO BIN
- CENTER CONSOLE W/ARMREST
- CLOTH BUCKET FRONT SEATS
- DUAL ILLUM VIS VANITY MIRR
- LEATHER WRAPPED STR WHEEL W/CRUISE AND AUDIO CONTRO
- MANUAL A/C, SINGLE ZONE
- PEDALS - POWER ADJUSTABLE
- POWER DRIV SEAT - 6-WAY
- ROTARY GEAR SHIFT DIAL
- SMART CHARGING USB PORT(3)
- TILT/TELESCOPE STR COLUMN

FUNCTIONAL
- 4.2" LCD CTR STACK SCREEN
- AM/FM/SINGLE CD/MP3/9SPKR
- AUTO START STOP TECH
- BRAKES, 4-WHEEL DISC/ABS
- CARGO PROTECTOR
- CLASS IV TRAILER TOW PKG
- FRONT/REAR IND SUSPENSION
- HILL START ASSIST
- POWER STEERING W/EPAS
- PUSH-BUTTON START
- REAR VIEW CAMERA
- REVERSE SENSING SYSTEM
- SELECTSHIFT®
- SIRIUSXM® - SVC N/A AK&HI
- SYNC® WITH APPLINK®

SAFETY/SECURITY
- ADVANCETRAC WITH RSC
- AIRBAGS - DUAL STAGE FRONT
- AIRBAGS - SAFETY CANOPY SIDE CURTAIN
- AIRBAGS - SIDE IMPACT
- FRT-PASS SENSING SYSTEM
- INDIV TIRE PRESS MONIT SYS
- LATCH CHILD SAFETY SYSTEM
- PERIMETER ALARM
- SECURILOCK PASS ANTI THEFT
- SOS POST CRASH ALERT SYS

WARRANTY
- 3YR/36,000 BUMPER / BUMPER
- 5YR/60,000 POWERTRAIN
- 5YR/60,000 ROADSIDE ASSIST

INCLUDED ON THIS VEHICLE	(MSRP)
EQUIPMENT GROUP 200A	
OPTIONAL EQUIPMENT/OTHER	
.18" MACH ALUM WHL W/PTND PKTS	
275/65R18 A/S BSW TIRES	
50 STATE EMISSIONS	NO CHARGE
HEAVY-DUTY TRAILER TOW PKG	1,570.00
3.73 RATIO ELSD AXLE	
CARGO MAT-REVERSIBLE	40.00
CARGO PACKAGE	285.00
FRONT LICENSE PLATE BRACKET	NO CHARGE

PRICE INFORMATION	(MSRP)
BASE PRICE	$51,695.00
TOTAL OPTIONS/OTHER	1,895.00
TOTAL VEHICLE & OPTIONS/OTHER	53,590.00
DESTINATION & DELIVERY	1,195.00

SOLD TO	RAMP ONE	DEALER NO.	**TOTAL MSRP $54,785.00**
	CH27		
SHIP TO (IF OTHER THAN SOLD TO)	RAMP TWO	FINAL ASSEMBLY PLANT	This label is affixed pursuant to the Federal Automobile Information Disclosure Act. Gasoline, License, and Title Fees, State and Local taxes are not included. Dealer installed options or accessories are not included unless listed above.
		KENTUCKY	
SHIP THROUGH	METHOD OF TRANSP.	ITEM #: 71-Z200 O/T 2	
	CONVOY	HL141 N RB X 815 001215 11 14 17	

EPA DOT Fuel Economy and Environment — Gasoline Vehicle

Fuel Economy
20 MPG
combined city/hwy — 17 city — 24 highway
5.0 gallons per 100 miles

Standard SUVs range from 12 to 93 MPG. The best vehicle rates 136 MPGe.

You **spend** **$2,250** more in fuel costs over 5 years compared to the average new vehicle.

Annual fuel **cost** **$1,800**

Fuel Economy & Greenhouse Gas Rating (tailpipe only): 4 (1 – 10, Best)
Smog Rating (tailpipe only): 5 (1 – 10, Best)
This vehicle emits 441 grams CO_2 per mile. The best emits 0 grams per mile (tailpipe only). Producing and distributing fuel also create emissions; learn more at fueleconomy.gov

Actual results will vary for many reasons, including driving conditions and how you drive and maintain your vehicle. The average new vehicle gets 27 MPG and costs $6,750 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $2.40 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

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GOVERNMENT 5-STAR SAFETY RATINGS

Overall Vehicle Score		Not Rated
Based on the combined ratings of frontal, side and rollover. Should ONLY be compared to other vehicles of similar size and weight.		
Frontal Crash	Driver	Not Rated
	Passenger	Not Rated
Based on the risk of injury in a frontal impact. Should ONLY be compared to other vehicles of similar size and weight.		
Side Crash	Front seat	Not Rated
	Rear seat	Not Rated
Based on the risk of injury in a side impact.		
Rollover		Not Rated
Based on the risk of rollover in a single-vehicle crash.		

Star ratings range from 1 to 5 stars (★★★★★), with 5 being the highest. Source: National Highway Traffic Safety Administration (NHTSA). www.safercar.gov or 1-888-327-4236

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Figure A1. Window Sticker

Figure A2. Front View, Test Vehicle as Delivered

Figure A3. Rear View, Test Vehicle as Delivered

Figure A4. Front View, Test Vehicle in Test Condition

Figure A5. Rear View, Test Vehicle in Test Condition

Figure A6. Instrumentation in Test Vehicle

Figure A7. Steering Controller and Computer

Figure A8. Ballast Condition

APPENDIX B

Test Run Log

Vehicle: **2018 Ford Expedition RWD** Driver: **John Partridge** Date: **3/14/2018**

Run Number	Test Type	Speed (mph)	Handwheel Angle (deg)	Dir. of First Steer	2 Wheel Lift	Notes
1	Tire Warm-Up	35	40	Right	5P	Resulted in ay = 0.36g
2			60			Resulted in ay = 0.50g
3						
4						
5						
6						2x SWA last cycle
7	Static	0	0			
8	Steady State	50	0			
9	Slowly Increasing Steer	50	50	Left	NA	Resulted in ay =53g
10				Left	NA	
11				Left	NA	
12				Right	NA	
13				Right	NA	
14				Right	NA	
15	Fishhook 6.5 Scalar	35	208	Left	No	
16	Fishhook 6.5 Scalar	40			No	
17	Fishhook 6.5 Scalar	45			No	
18	Fishhook 6.5 Scalar	47.5			No	
19	Fishhook 6.5 Scalar	50			No	
20	Fishhook 5.5 Scalar	45	176	Left	No	
21	Fishhook 5.5 Scalar	47.5			No	
22	Fishhook 5.5 Scalar	50			No	

Vehicle: **2018 Ford Expedition RWD** Driver: **John Partridge** Date: **3/14/2018**

Run Number	Test Type	Speed (mph)	Handwheel Angle (deg)	Dir. of First Steer	2 Wheel Lift	Notes
23	Fishhook 6.5 Scalar	35	208	Right	No	
24	Fishhook 6.5 Scalar	40			No	
25	Fishhook 6.5 Scalar	45			No	
26	Fishhook 6.5 Scalar	47.5			No	
27	Fishhook 6.5 Scalar	50			No	
28	Fishhook 5.5 Scalar	45	176	Right	No	
29	Fishhook 5.5 Scalar	47.5			No	
30	Fishhook 5.5 Scalar	50			No	

APPENDIX C

Slowly Increasing Steer Test Worksheet

NCAP, 2018 Ford Expedition RWD , Multi-Passenger Load, Test Date: 3/14/2018

SIS_out_v2

Run	Dir of Steer	Start Speed (mph)	End Speed (mph)	Speed Red. (%)	Index of ay @ 0.3g	HW Angle (deg) at 0.3g	ay (g) @ 0.3g index	6.5x HW Angle (deg)	Ramp Time (sec) at 6.5x	5.5x HW Angle (deg)	Ramp Time (sec) at 5.5x	R2	Zero Begin Index	Zero End Index
7	L	50.8	0.0	100.0	1116	-29.9	-0.299	-194.1	-0.2696	-164.3	-0.2282	0.9975	475	675
8	L	49.4	0.0	100.0	1138	-32.1	-0.313	-208.4	-0.2894	-176.3	-0.2449	0.9955	505	705
9	L	50.7	-0.1	100.1	1116	-29.7	-0.301	-192.8	-0.2678	-163.2	-0.2266	0.9962	505	705
10	R	50.1	0.9	98.2	1148	30.8	0.301	200.1	0.2779	169.3	0.2352	0.9977	480	680
11	R	50.2	-0.1	100.1	1155	32.8	0.302	213.2	0.2961	180.4	0.2505	0.9970	512	712
12	R	50.4	0.6	98.8	1136	30.1	0.297	195.9	0.2721	165.8	0.2303	0.9966	491	691
					Mean:	30.9	0.302	201	0.279	170	0.236			

Steering Controller Input Values

Scalar 6.5 values:

Initial HW angle:	201	deg
Initial time:	0.279	s
Reversal HW angle:	-201	deg
Reversal time:	0.558	s

Scalar 5.5 values:

Initial HW angle:	170	deg
Initial time:	0.236	s
Reversal HW angle:	-170	deg
Reversal time:	0.472	s

APPENDIX D

Time History Plots

LIST OF FIGURES

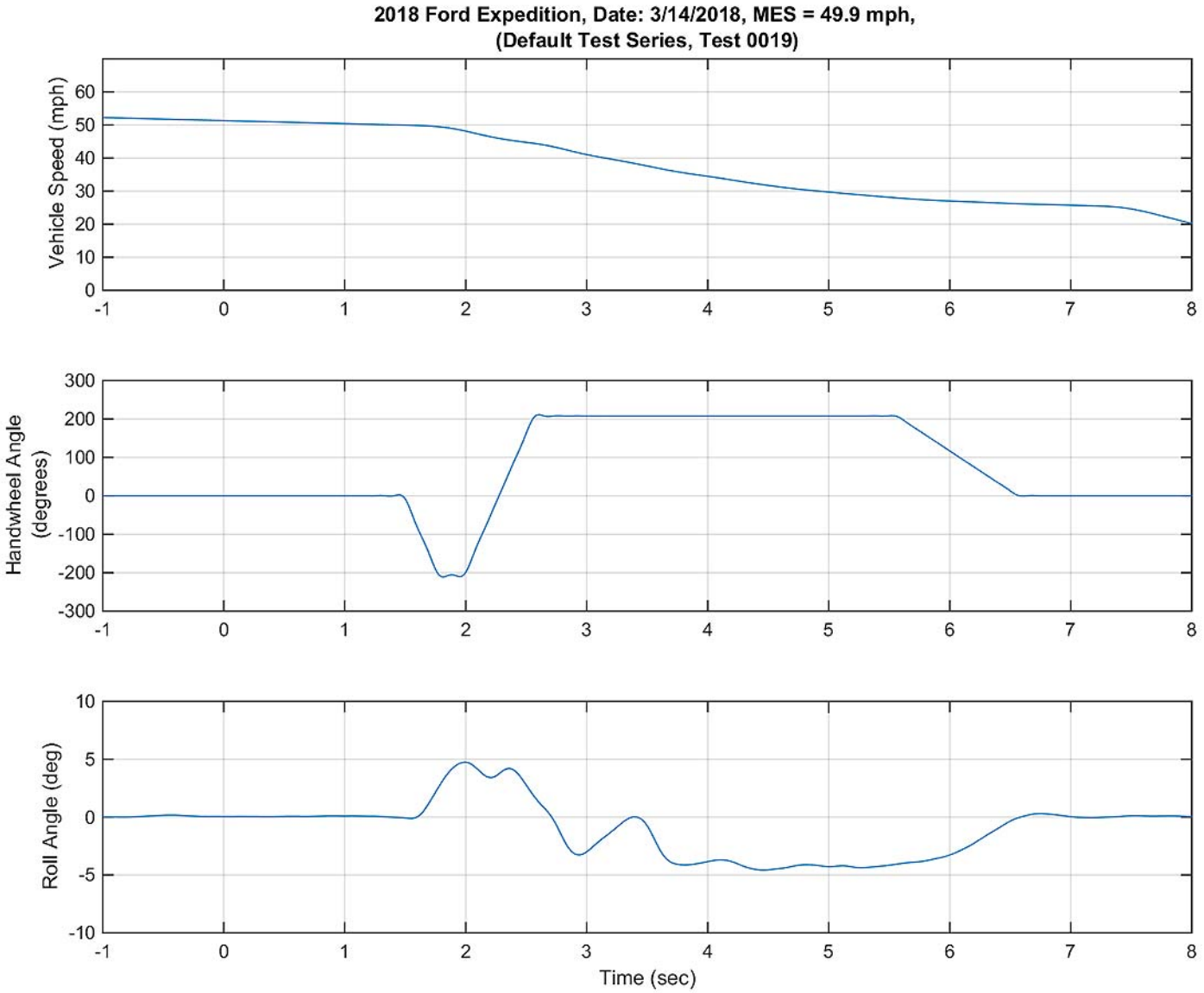
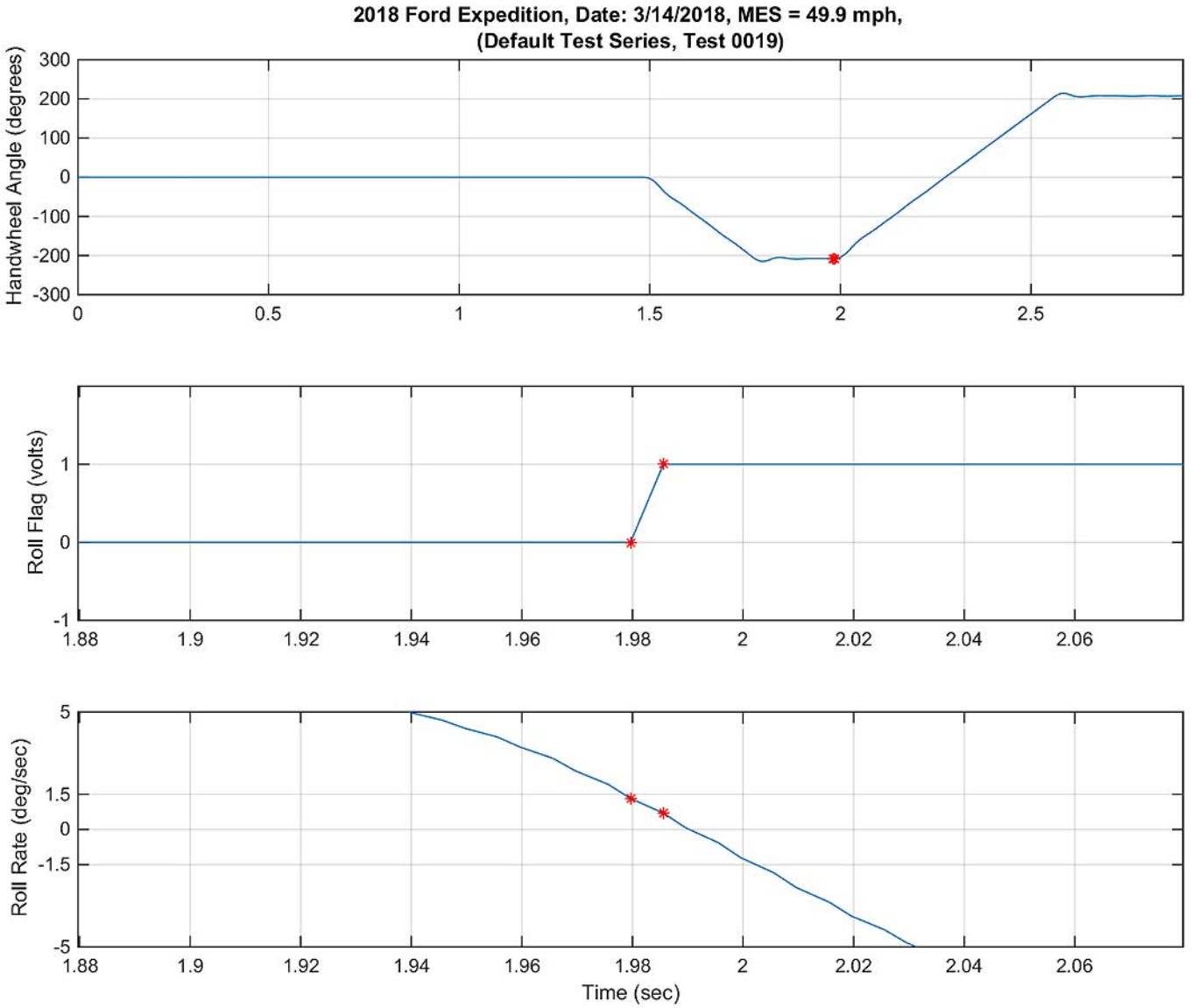


Figure D1. Vehicle Speed, Handwheel Angle, and Roll Angle Time History Plots for Default Test Series, L-R, 50 mph



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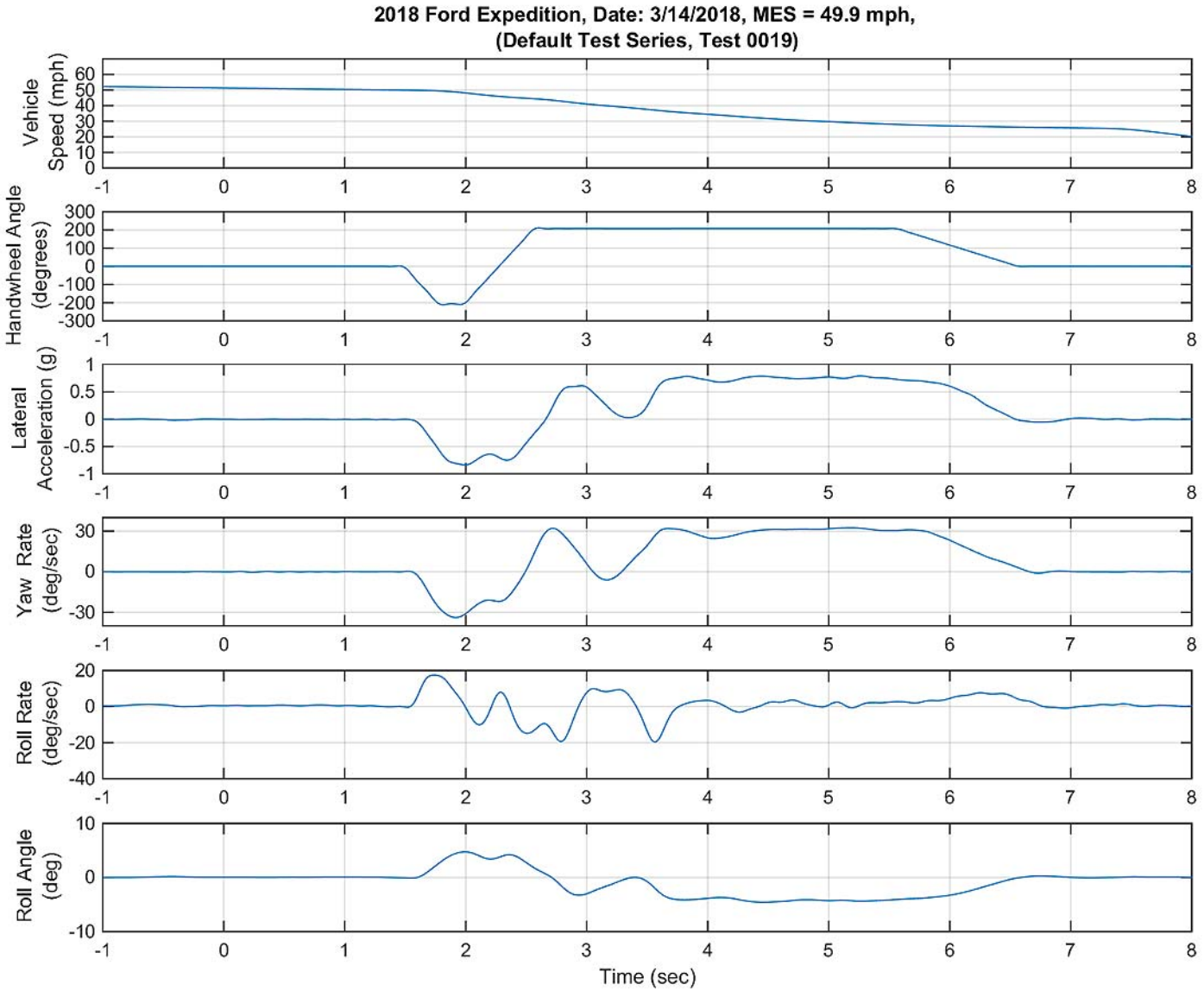

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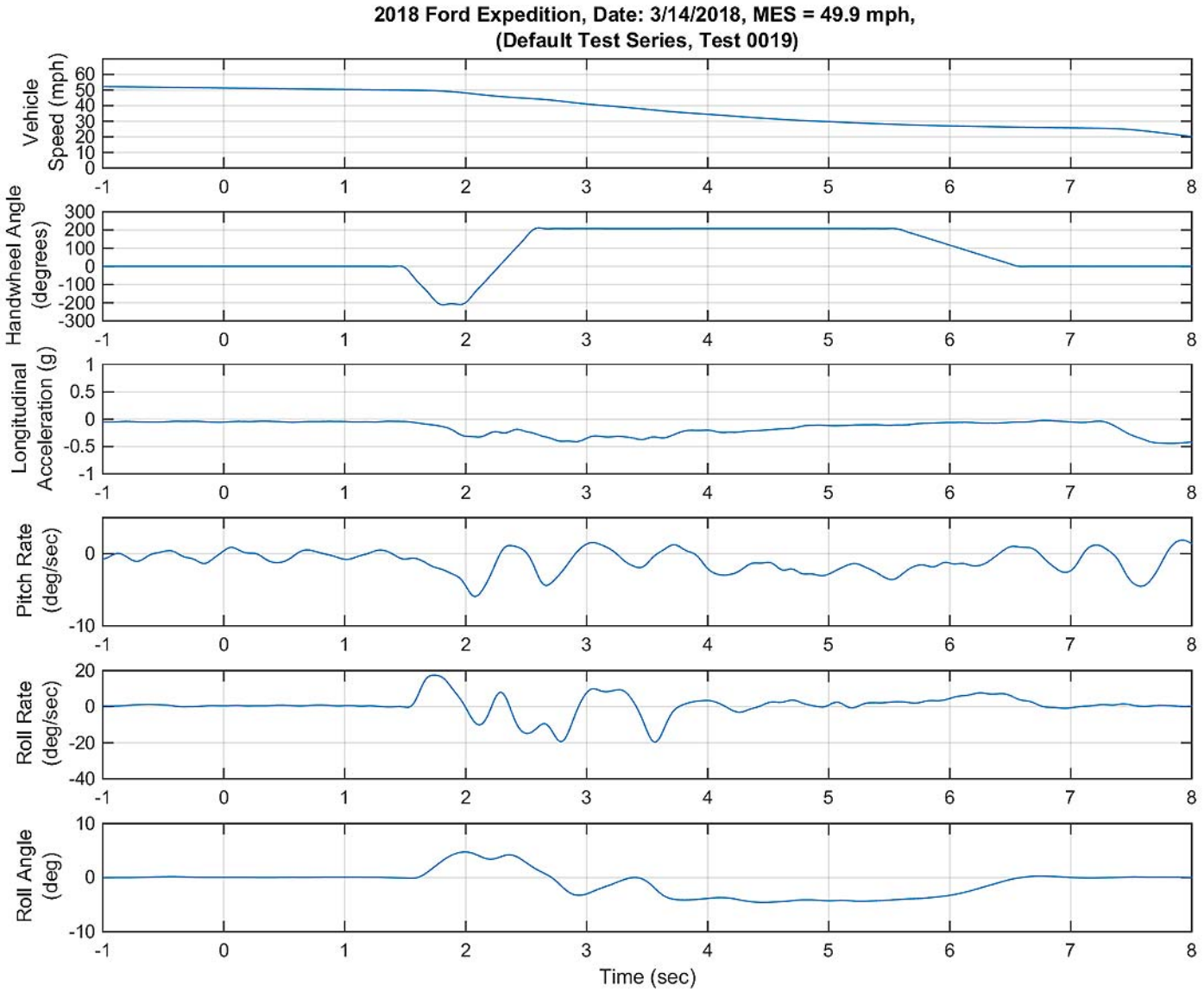

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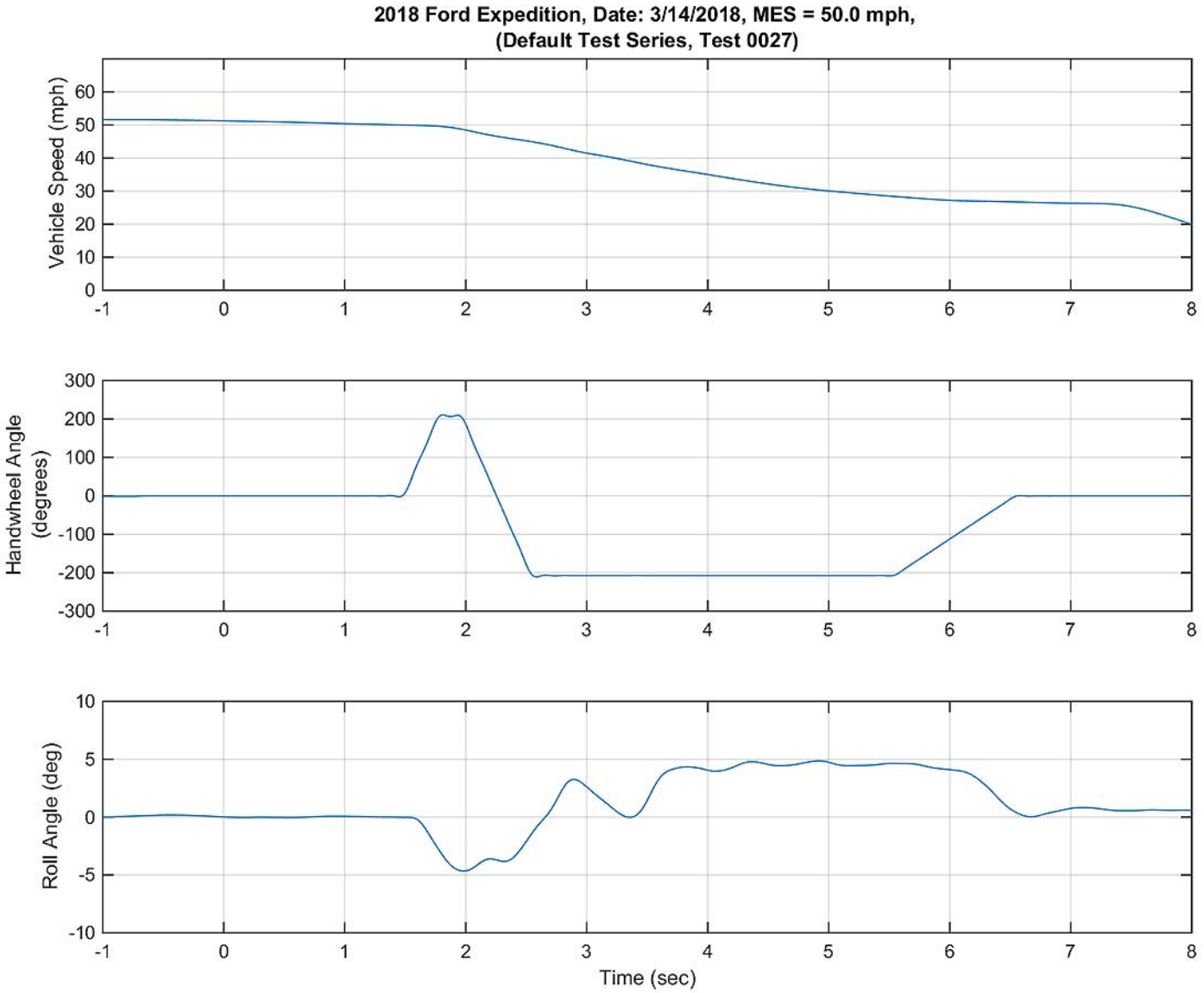


Figure D5. Vehicle Speed, Handwheel Angle, and Roll Angle Time History Plots for Default Test Series, R-L, 50 mph

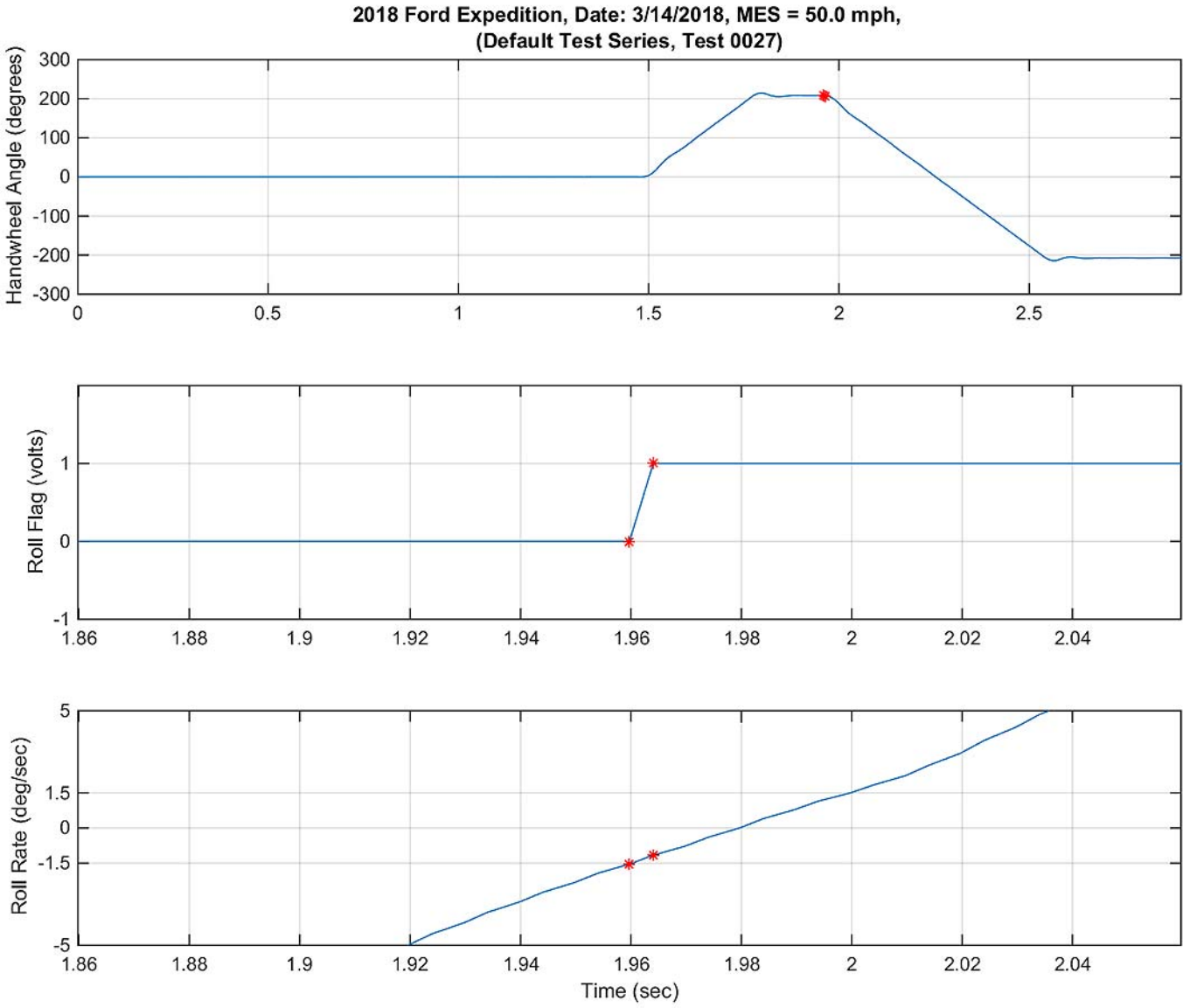


Figure D6. Steering Machine Operation Time History Plots for Default Test Series, R-L, 50 mph

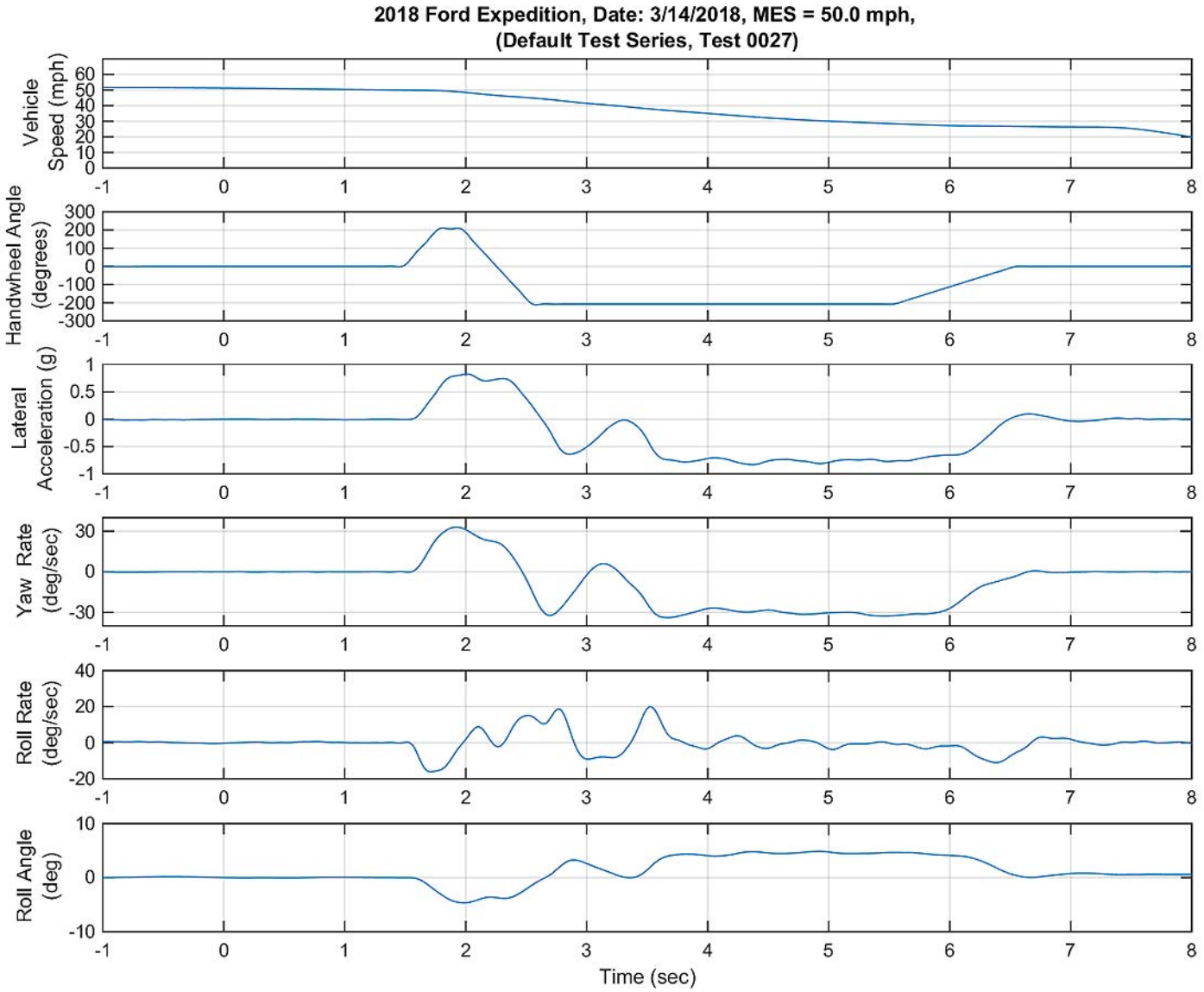


Figure D7. Yaw Rate, Roll Rate, and Lateral Acceleration Time History Plots for Default Test Series, R-L, 50 mph

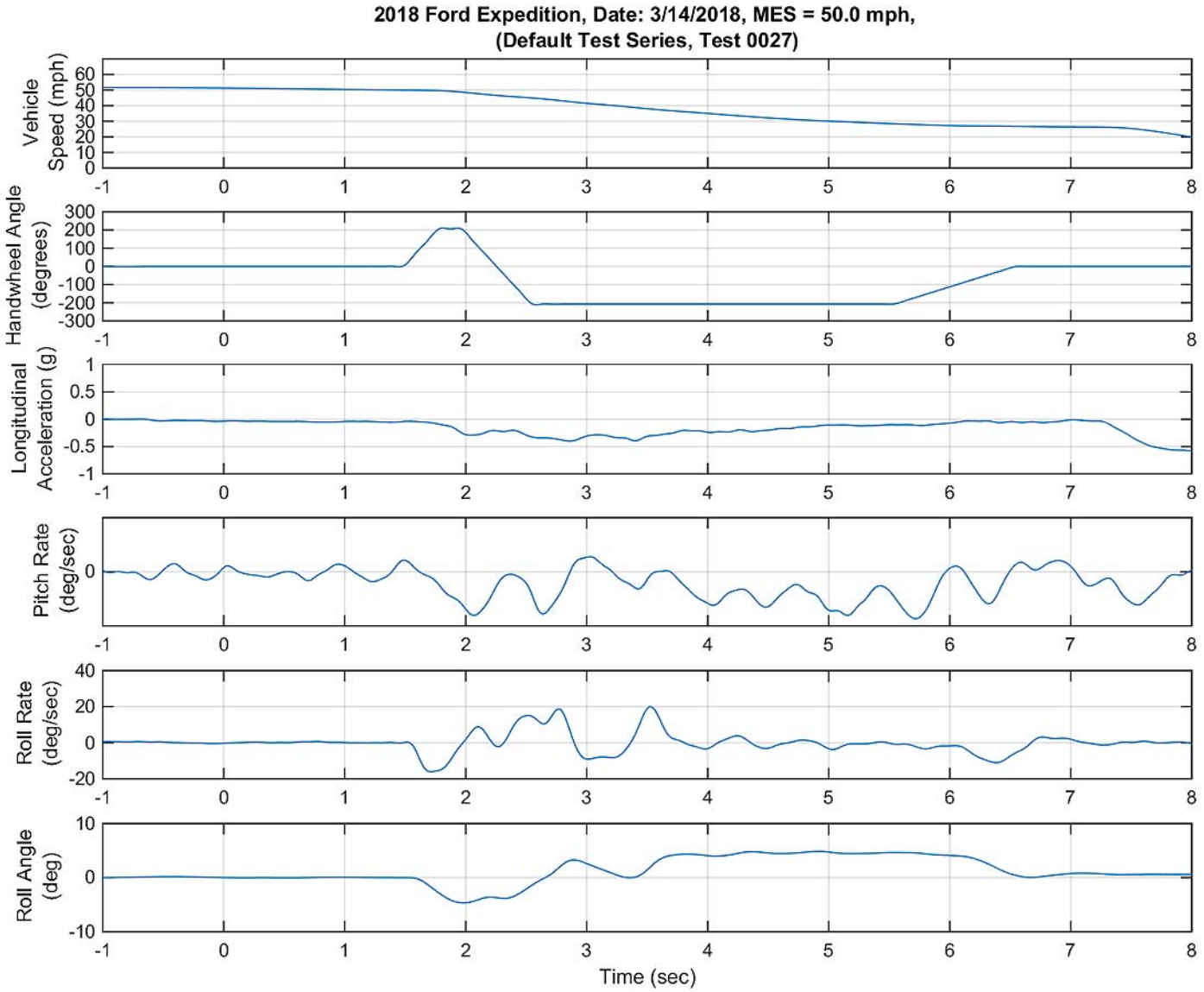


Figure D8. Pitch Rate and Longitudinal Acceleration Time History Plots or Default Test Series, R-L, 50 mph

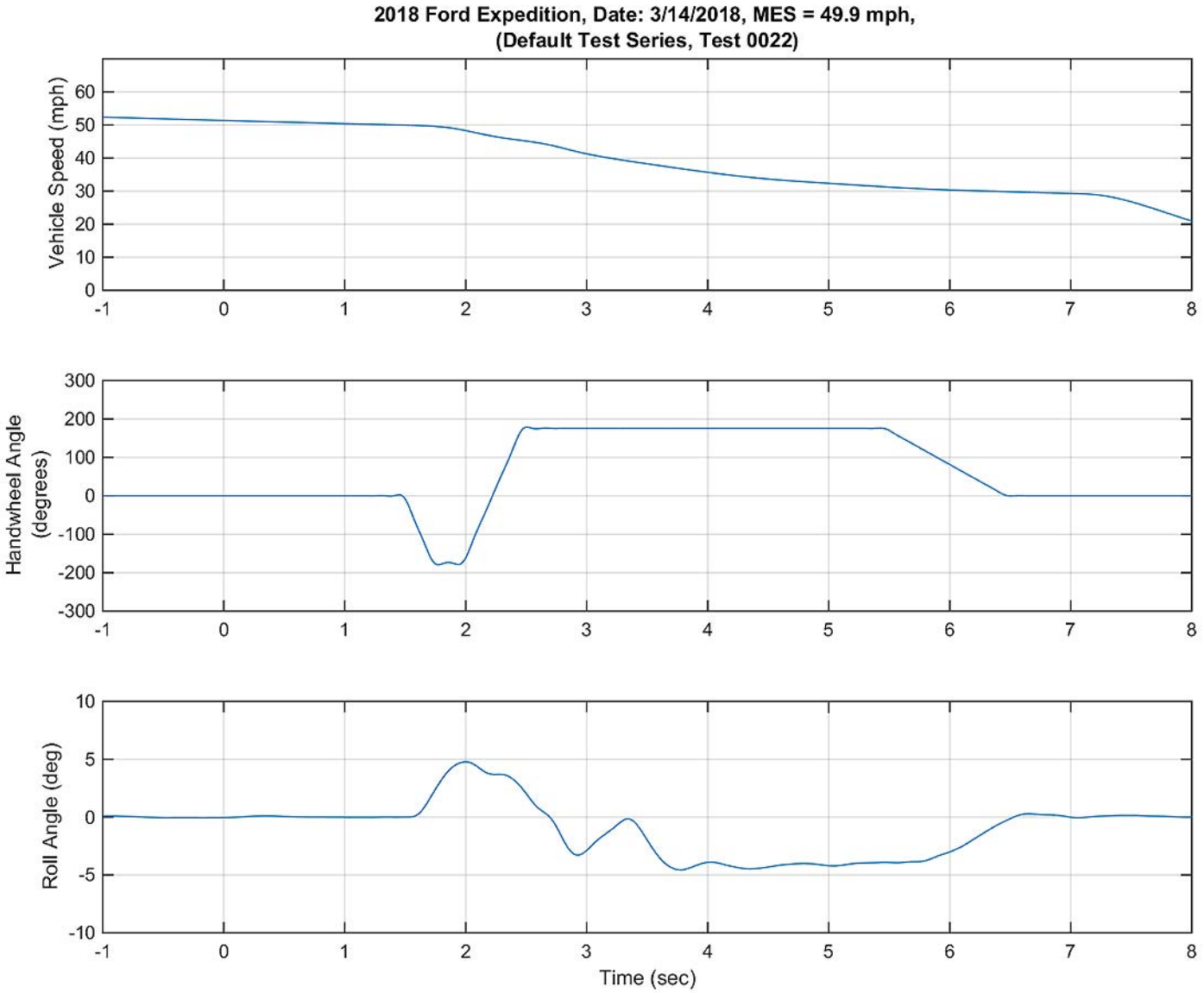
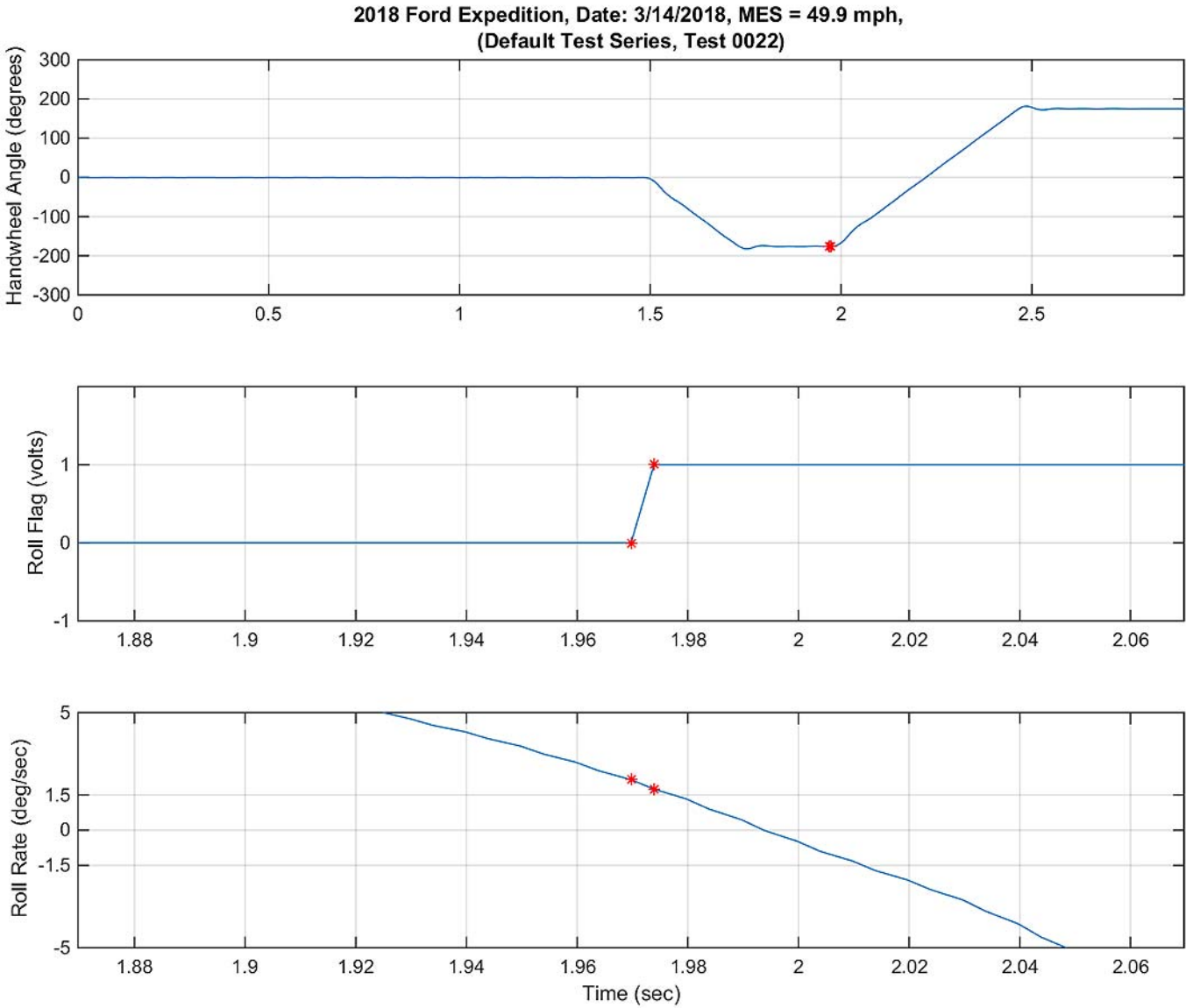


Figure D9. Vehicle Speed, Handwheel Angle, and Roll Angle Time History Plots for Supplemental 2 Test Series, L-R, 50 mph



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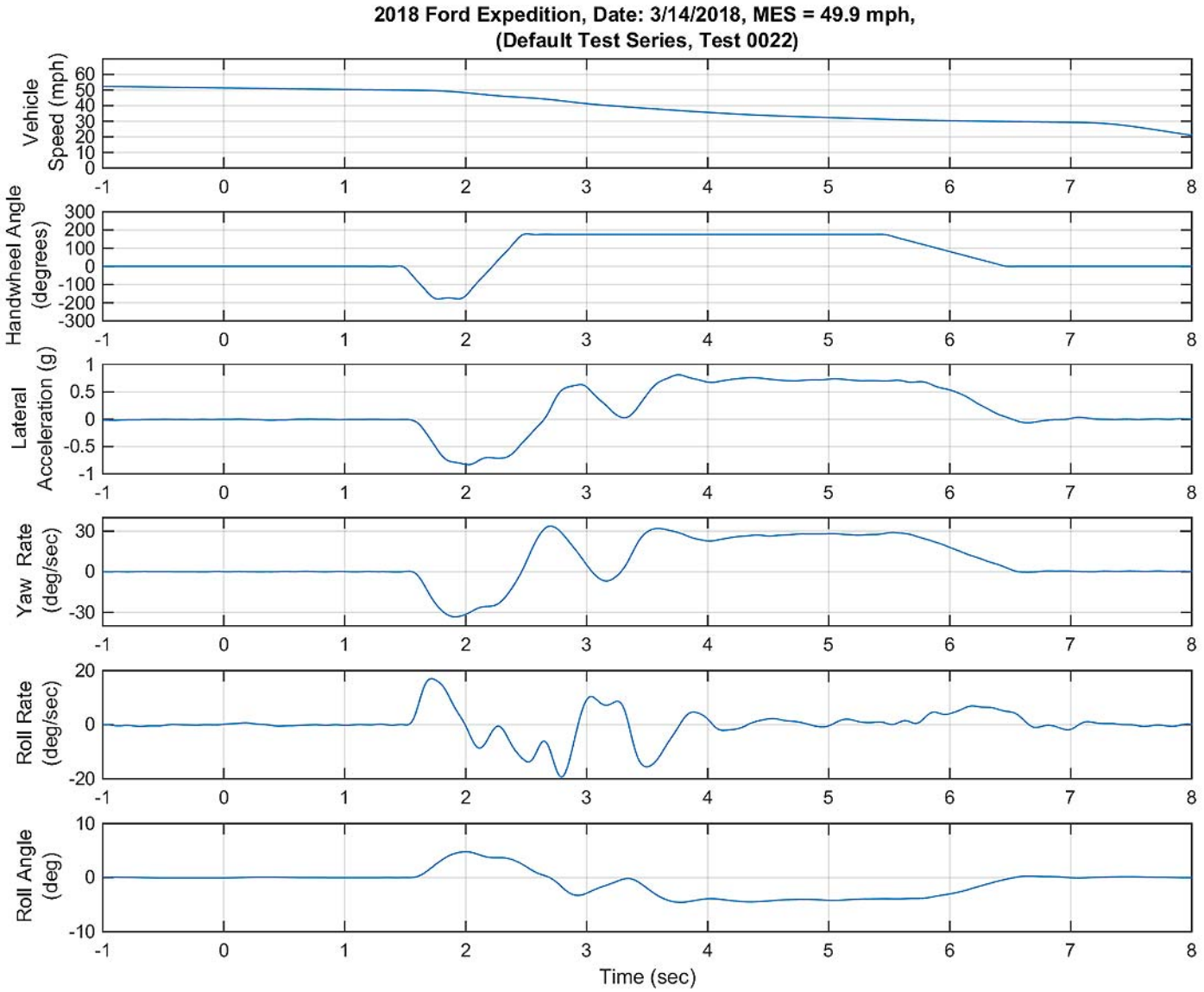

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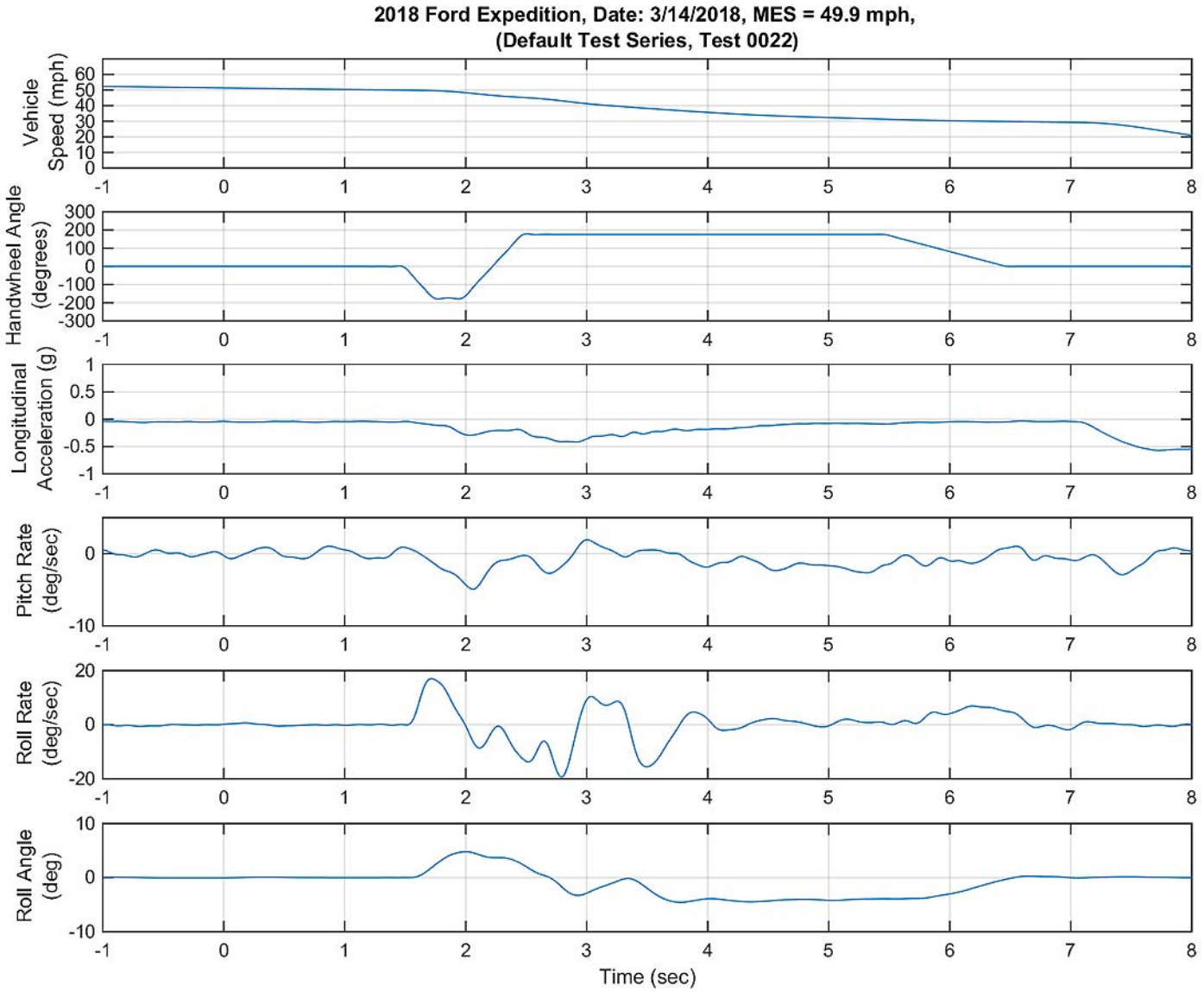

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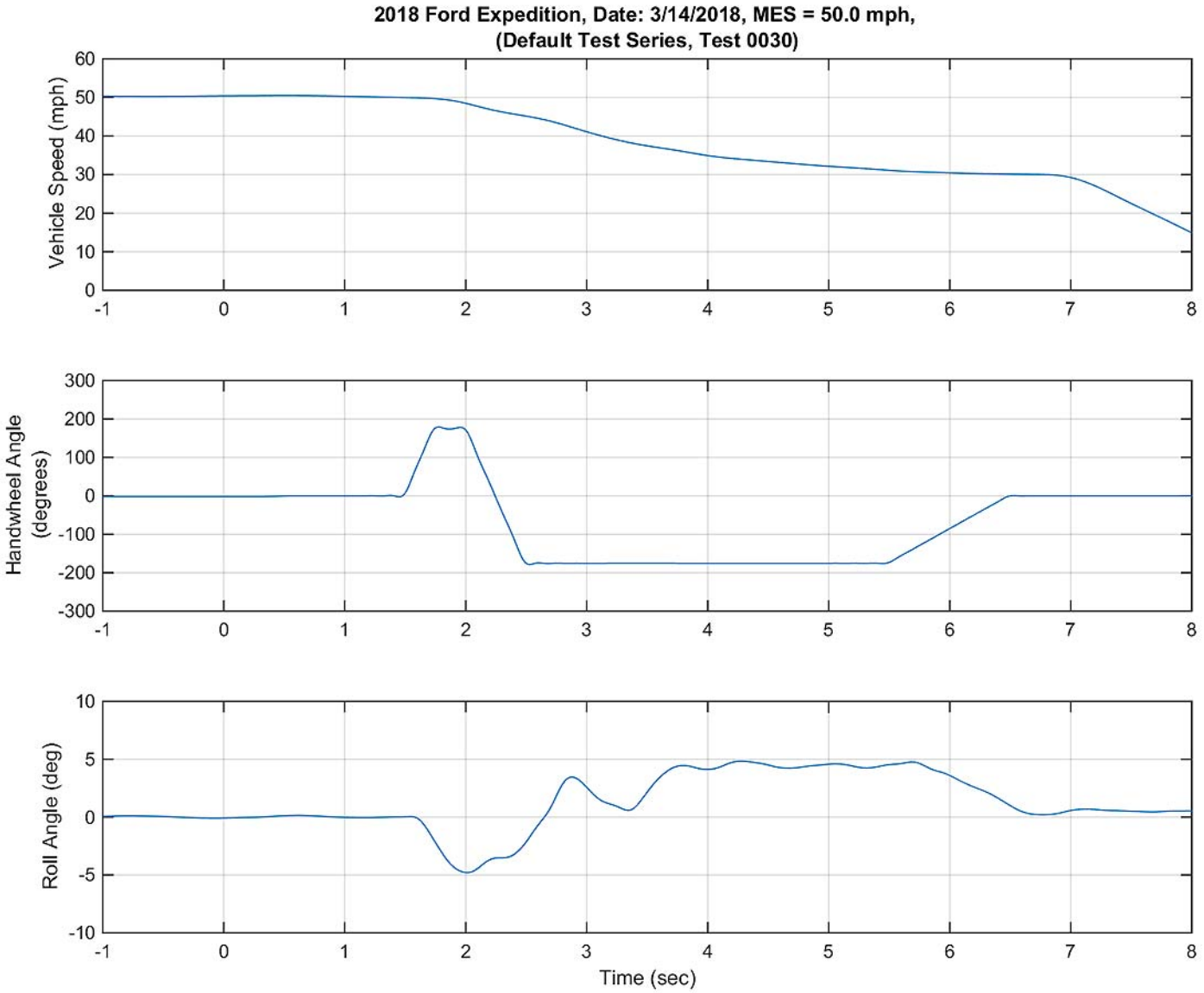


Figure D13. Vehicle Speed, Handwheel Angle, and Roll Angle Time History Plots for Supplemental 2 Test Series, R-L, 50 mph

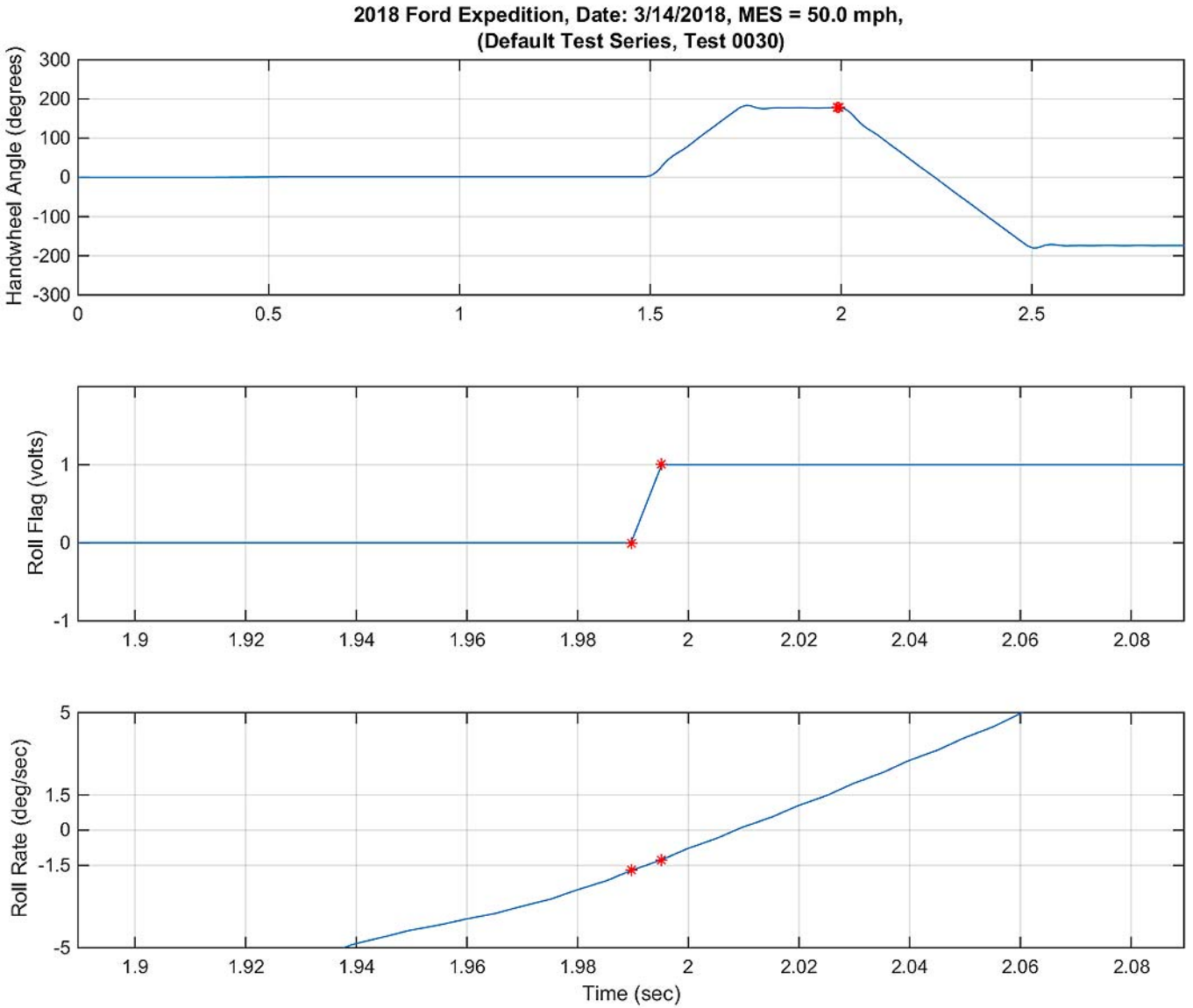
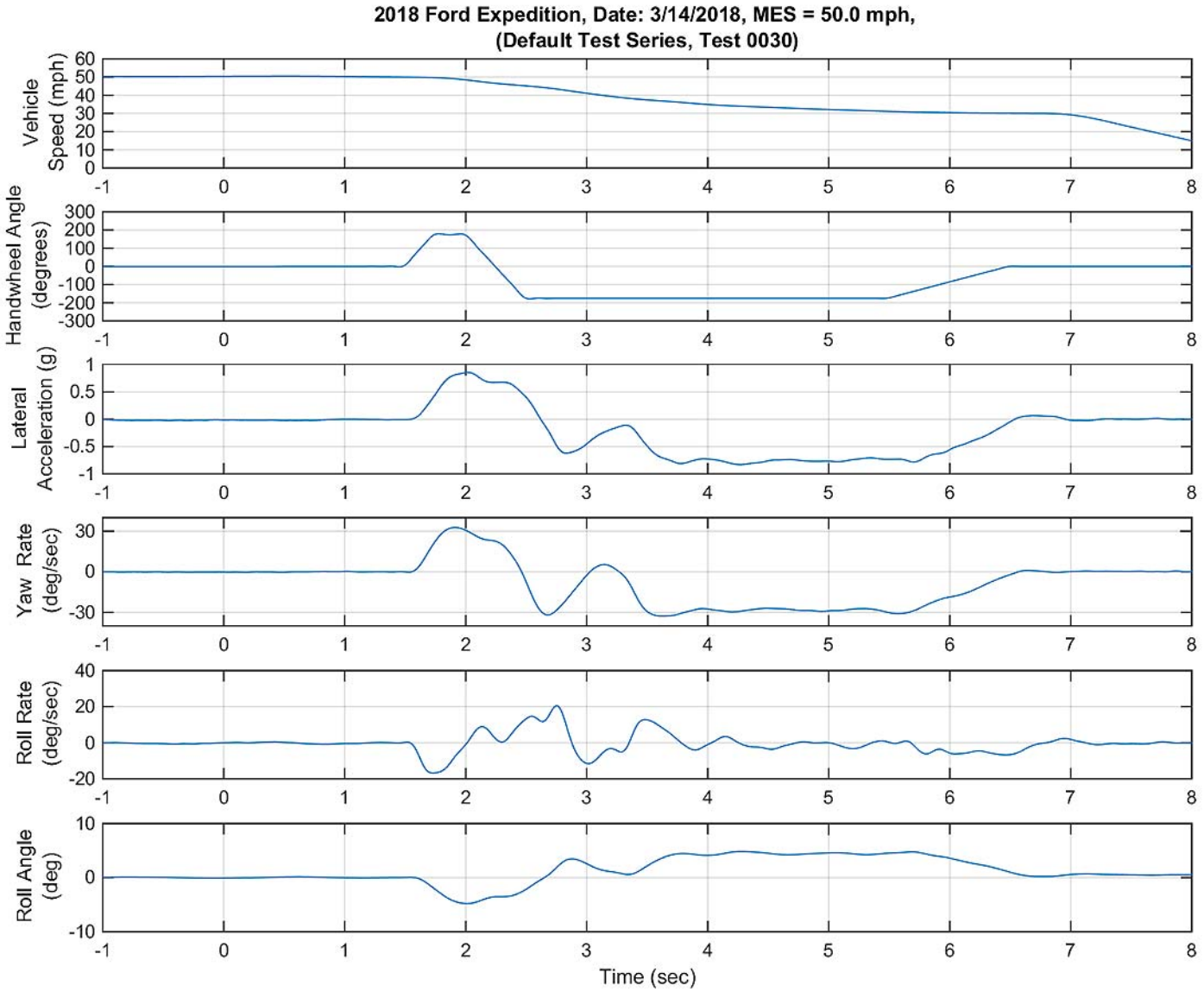


Figure D14. Steering Machine Operation Time History Plots for Supplemental 2 Test Series, R-L, 50 mph



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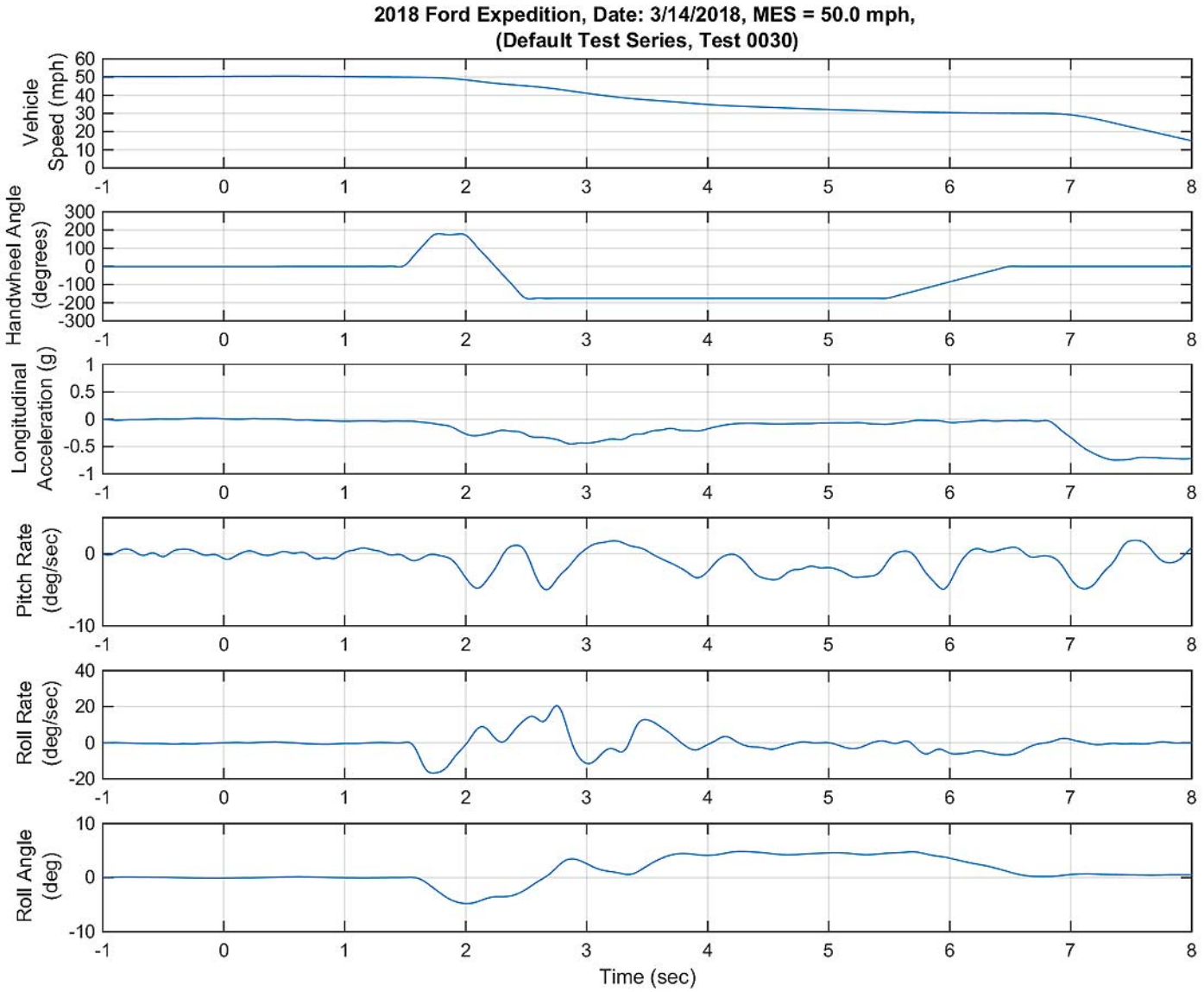

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