NEW CAR ASSESSMENT PROGRAM (NCAP)
DYNAMIC ROLLOVER RESISTANCE TEST

General Motors LLC

2017 Cadillac XT5 FWD

TEST NUMBER: 17-10

Final Report
17 January 2017

Prepared by:

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Torrance, CA 90501

Prepared for:

National Highway Traffic Safety Administration
Office of Crash Avoidance Standards
1200 New Jersey Avenue S.E.
Washington, DC 20590

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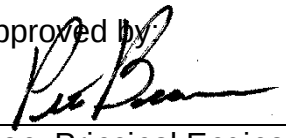
Report Prepared by:

Date: 17 January 2017

John Lenkeit, Program Manager

Report Approved by:



Date: 17 January 2017

Peter Broen, Principal Engineer

Technical Report Documentation Page

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16. Abstract

An NCAP Dynamic Rollover Maneuver (Fishhook) Test was conducted on a 2017 Cadillac XT5 FWD at Dynamic Research, Inc. on November 17, 2016. The vehicle did not experience two-wheel lift. The vehicle's steering angle at 0.3g lateral acceleration at 50 mph was 28.3 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 2017 Cadillac XT5 FWD 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	2017 Cadillac XT5 FWD				
VIN	1GYKNBRS9HZ16xxxx				
Body style	SUV				
Number of doors	4				
Trim level	Luxury				
Seating positions	Front:	2nd row	3rd row	4th row	5th row
	2	3			
Electronic stability control	Yes				
4-Wheel ABS (Yes/No)	No				
Power steering (Yes/No)	Yes				
Major optional equipment	Cue info and media control, Driver awareness package				
Odometer at start of testing	8 miles				
Drivetrain					
Engine cylinder arrangement	V-6				
Engine displacement	3.6 L				
Transmission type	Automatic				
Drive arrangement	FWD				
Chassis					
Track width	F: 64.4 in (1635.8 mm) , R: 64.4 in (1635.8 mm)				
Wheelbase	112.5 in (2857.5 mm)				
Curb weight	4126 lb (1871.5 kg)				
Certification Data from Vehicle's Label					
Vehicle manufactured by	General Motors LLC				
Date of manufacture	09/16				
GVWR	6001 lb (2722 kg)				
GAWR Front	2976 lb (1350 kg)				
GAWR Rear	3196 lb (1450 kg)				

Table 2. Tire Information

Tire Manufacturer	Michelin
Tire Model	Premier LTX
Tire Size	Front: 235/65R18 Rear: 235/65R18
Load rating	Front: 106 Rear: 106
Speed rating	Front: H Rear: H
Treadwear grade	Front: 620 Rear: 620
Traction grade	Front: A Rear: A
Temperature grade	Front: A Rear: A
Location of “Recommended Tire Pressure” label	
Recommended cold tire pressure	Front: 35 psi, (240 kPa) Rear: 35 psi, (240 kPa)
First 8 digits of DOT code	Front: M3MB 7B5X Rear: M3MB 7B5X

Table 3. Vehicle Loading

Water dummy and other loading	3 water dummies in second row
Water dummy weight	lb (kg)
Fuel level	Full
Weight as Tested	
Left front	1456 lb (660.4 kg)
Right front	1392 lb (631.4 kg)
Left rear	1218 lb (552.5 kg)
Right rear	1090 lb (494.4 kg)

D. STEERING CONTROLLER

A programmable steering machine was installed which generates handwheel steering inputs for all test maneuvers. The machine provides at least 35 lb-ft of torque at a handwheel rate of 720 deg/sec, is capable of actuating the vehicle's steering system through its full range, and accepts angular rate sensor feedback input for roll rate-induced steering reversals.

E. INSTRUMENTATION AND DATA COLLECTION

The test vehicle was instrumented with an angle encoder, located in the steering controller; a 3-axis inertial measurement unit to measure roll, pitch, and yaw rates, and longitudinal, lateral, and vertical acceleration; two ultrasonic distance measuring sensors to measure vehicle roll angle; and a radar speed sensor to measure vehicle speed. The brake light circuit was monitored to verify that there was no brake pedal application during any test.

A list of the sensors is given in Table 4. A 3B signal conditioning and power rack was used to provide any necessary sensor power, excitation, gain, and offset. Two pole Butterworth anti-alias filters were used for all analog data channels, using a corner frequency of 20 Hz. Data were collected at 200 samples/sec, using a Measurement Computing Corp. PCI-DAS6402/16 A/D board.

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

Data Measured	Type	Range	Manufacturer	Model Number
Handwheel angle	Encoder	Infinite	Heitz Automotive Testing, Inc.	Angle encoder integral with steering controller
Brake pedal actuation	Tape Switch	On/Off	Vericom Computers	VC3000
Longitudinal, lateral, and vertical acceleration	Multi-axis inertial sensing system	±2 g	BEI Technologies, Inc., Systron Donner Inertial Division	MP-1
Roll, pitch, and yaw rate		±100 deg/s		
Left and right side vehicle ride height (to measure roll angle)	Ultrasonic distance measuring system	50 – 400 mm	Texense	RH550-400
Vehicle speed	Radar speed sensor	0 - 100 mph	Racelogic VBox	VBSS100-V3
Wheel lift (via resolution of two measured distances spaced a known distance apart), used for confirmation tests only	Analog displacement measuring system (Infrared; 880 mm)	13.8 - 33.5 in	Wenglor Sensors, Ltd.	HT 66MGV80

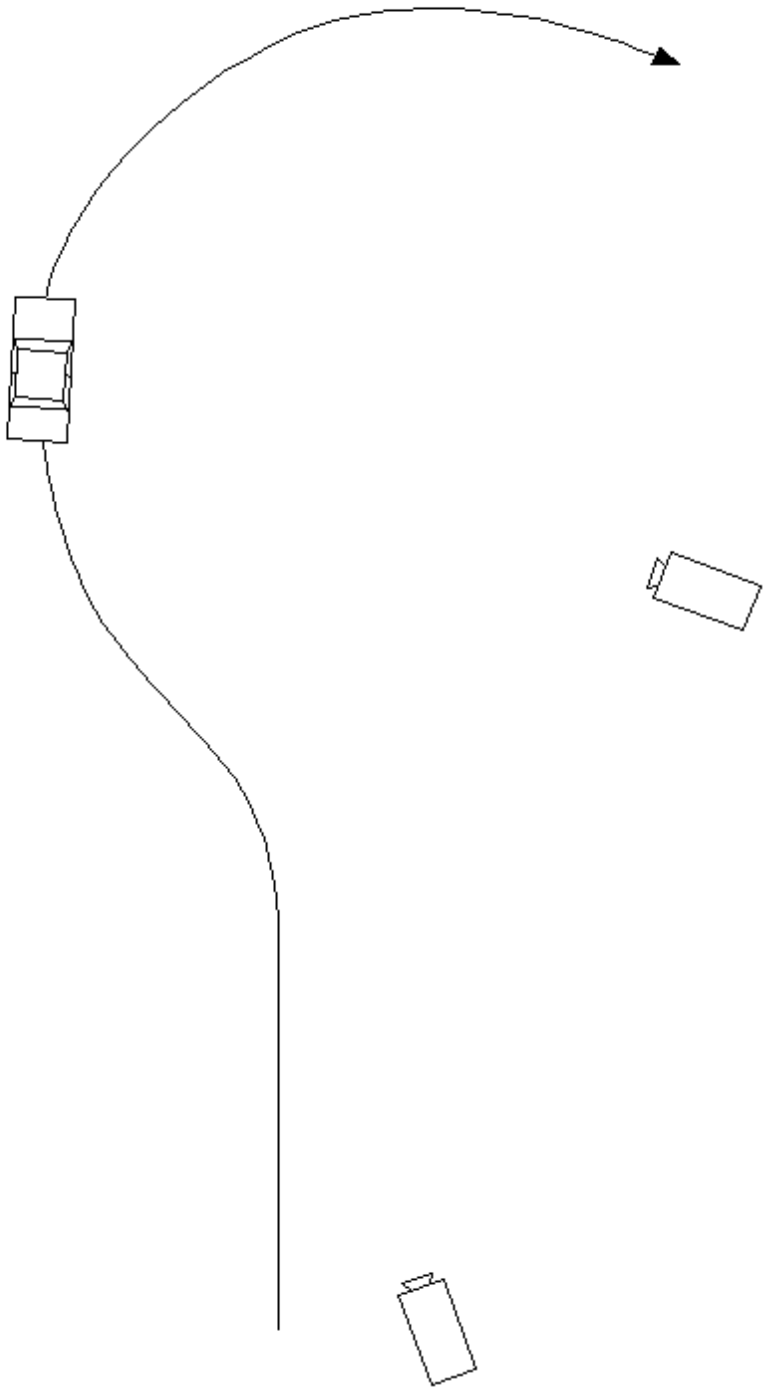

Figure 1. Nominal Position of Video Cameras for Fishhook Tests

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 11/17/2016. 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	11/17/2016
Average normalized lateral force	0.915

2. Fishhook Handwheel Angles

The 0.3g 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

0.3g handwheel angle (from SIS tests at 50 mph)	28.3 º
5.5 scalar handwheel angle for Fishhook Test	156º
6.5 scalar handwheel angle for Fishhook Test	184 º

3. Weather Conditions

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

Table 7. Weather Conditions

Ambient temperature	60 ºF (15.6 ºC)
Wind Speed	0 mph (0 m/s)
Wind Direction	S

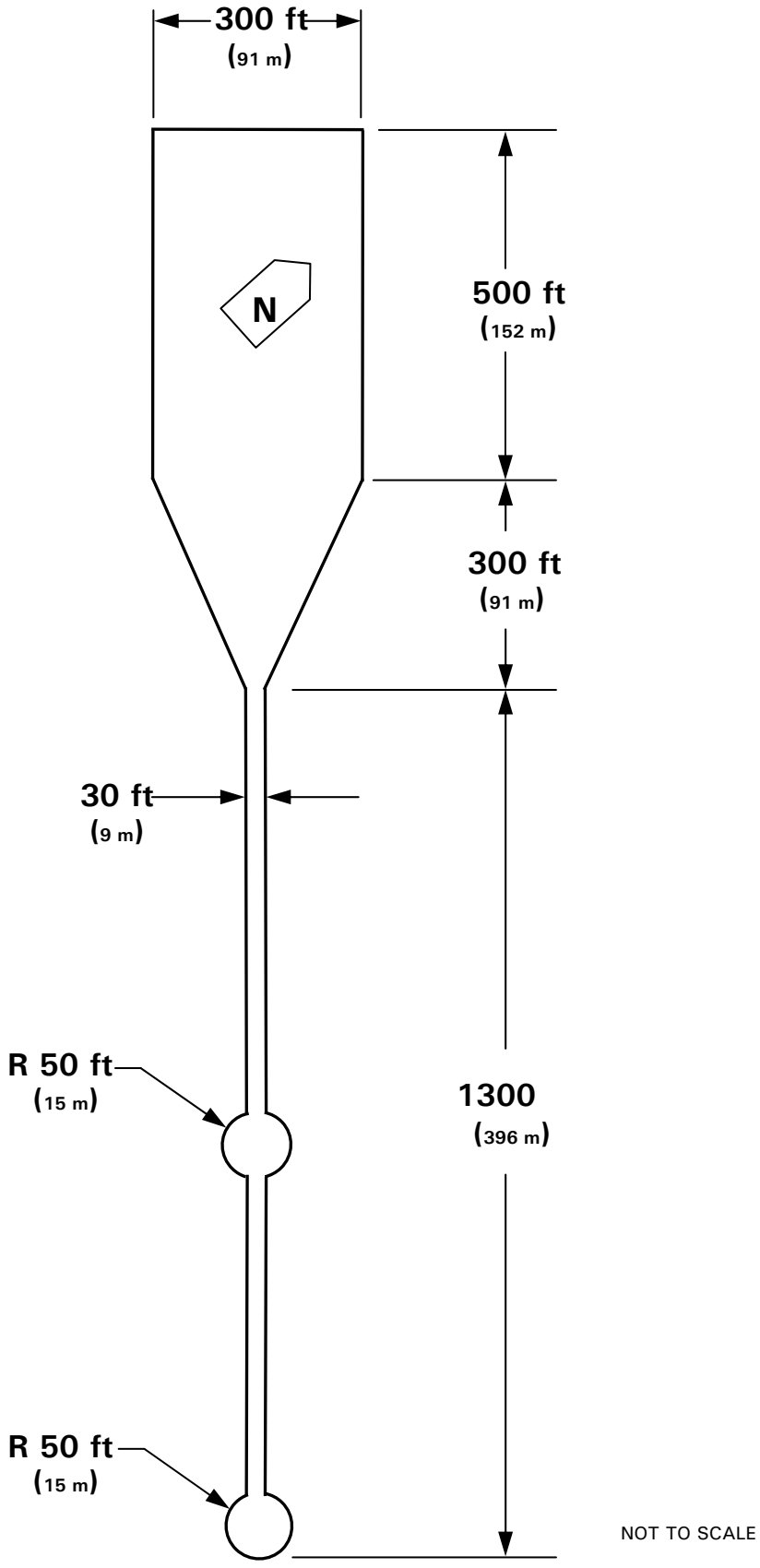

Figure 2. DRI-Minter Vehicle Dynamics Area

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 2017 Cadillac XT5 FWD, there was no two-wheel lift at any test condition.

APPENDIX A

Photographs

LIST OF FIGURES

Cadillac

2017 XT5 LUXURY FWD

EXTERIOR: DARK GRANITE METALLIC
INTERIOR: JET BLACK

ENGINE, 3.6L V6, DI, VVT, W/
TRANSMISSION, 8-SPD AUTOMATIC

Visit us at www.cadillac.com

STANDARD EQUIPMENT

ITEMS FEATURED BELOW ARE INCLUDED AT NO EXTRA CHARGE IN THE STANDARD VEHICLE PRICE SHOWN

CADILLAC OWNER BENEFITS
- 4 YEAR / 50,000 MILE* BUMPER-TO-BUMPER LIMITED WARRANTY
- 4 YEAR / 50,000 MILE* PREMIUM CARE MAINTENANCE
- 6 YEAR / 70,000 MILE* COURTESY TRANSPORTATION
- 6 YEAR / 70,000 MILE* ROADSIDE ASSISTANCE
- 6 YEAR / 70,000 MILE* POWERTRAIN LIMITED WARRANTY
- *WHICHEVER COMES FIRST. SEE DEALER FOR DETAILS.
- ONSTAR(R) INCLUDES 5 YR BASIC PLAN PLUS 1 YR SERVICE W/ AUTOMATIC CRASH RESPONSE, NAVIGATION & MORE (SUBJECT TO TERMS SEE ONSTAR.COM)
- 4G LTE WI-FI(R) HOTSPOT WITH LIMITED DATA TRIAL AND MORE. (SUBJECT TO TERMS SEE ONSTAR.COM)

PERFORMANCE
- ENGINE, 3.6L V6, DI, VVT, W/ AUTOMATIC STOP/START
- TRANSMISSION, 8-SPD AUTOMATIC
- WHEELS, 18" BRIGHT MACHINED FACED W/ LIGHT ARGENT ACCENTS

LUXURY & CONVENIENCE
- LEATHER SEATING SURFACES
- FRONT HEATED SEATS
- PWR SEAT ADJUSTER, FRONT PASSENGER, 8-WAY
- POWER LUMBAR, DRIVER SEAT
- SEAT ADJUSTER, PWR PASSENGER LUMBAR CONTROL
- DRIVER MEMORY PACKAGE
- HEATED STEERING WHEEL
- CLIMATE CONTROL, DUAL-ZONE AUTOMATIC
- CUE(R) INFO & MEDIA CONTROL AM/FM STEREO WITH 8" COLOR DIAGONAL DISPLAY APPLE CARPLAY(R) CAPABILITY PROVIDED BY APPLE(R) AVAIL. WITH COMPATIBLE SMARTPHONES
- XM RADIO + SERVICE SUBSCRIPTION SOLD SEPARATELY BY SIRIUSXM(R) AFTER 3 MONTHS
- AUD. SYSTEM BOSE(R) 8 SPEAKER
- INSIDE REARVIEW MIRROR, AUTO DIMMING
- MIRRORS, OUTSIDE HEATED, POWER, FOLDING,DRIVER SIDE AUTO DIMMING
- ULTRAVIEW(R) SUNROOF WITH POWER SUNSHADE
- UNIVERSAL HOME REMOTE
- LIFTGATE, REAR POWER WITH MEMORY HEIGHT
- WIRELESS DEVICE CHARGING
- EZ KEY PASSIVE ENTRY SYSTEM
- STEERING COLUMN, POWER TILT & TELESCOPIC

SAFETY & SECURITY
- AIR BAGS, DRIVER AND FRONT PASSENGER (DUAL STAGE PASS) FRONT AND REAR HEAD CURTAIN, DRIVER SIDE KNEE
- REAR VISION CAMERA
- SIDE BLIND ZONE ALERT LANE CHANGE ALERT
- REAR CROSS TRAFFIC ALERT
- FRONT & REAR PARKING ASSIST

OPTIONS & PRICING

MANUFACTURER'S SUGGESTED RETAIL PRICE

STANDARD VEHICLE PRICE	$44,895.00

OPTIONS INSTALLED BY THE MANUFACTURER (MAY REPLACE STANDARD EQUIPMENT SHOWN)

CUE(R) INFO & MEDIA CONTROL W/ EMBEDDED NAVIGATION, AM/FM STEREO WITH 8" COLOR DIAGONAL DISPLAY, APPLE CARPLAY(R) CAPABILITY BY APPLE(R)	1,025.00
AVAILABLE WITH COMPATIBLE SMARTPHONES	
• BOSE(R) SURROUND SOUND SYSTEM 14 SPEAKERS	
DRIVER AWARENESS PACKAGE:	770.00
• SAFETY ALERT SEAT	
• FORWARD COLLISION ALERT	
• FOLLOWING DISTANCE INDICATOR	
• LANE KEEP ASSIST WITH LANE DEPARTURE WARNING	
• FRONT PEDESTRIAN DETECTION	
• INTELLIBEAM(R) HEADLAMPS	
• FRONT AUTOMATIC BRAKING, LOW SPEED	
DARK GRANITE METALLIC	495.00
TIRE, COMPACT SPARE	350.00
• CARGO NET, LATERAL MESH	
PREMIUM CARPET CARGO MAT (DEALER INSTALLED)	190.00
CARGO TIE DOWNS (DEALER INSTALLED)	130.00
REAR FASCIA CLOSEOUT (DEALER INSTALLED)	70.00

TOTAL OPTIONS	$3,030.00
TOTAL VEHICLE & OPTIONS	$47,925.00
DESTINATION CHARGE	995.00
TOTAL VEHICLE PRICE*	**$48,920.00**

EPA DOT Fuel Economy and Environment

These estimates reflect new EPA methods beginning with 2017 models

Gasoline Vehicle

Fuel Economy
22 MPG
combined city/hwy
19 city
27 highway
4.5 gallons per 100 miles

Small SUVs range from 18 to 33 MPG. The best vehicle rates 119 MPGe.

You spend $1,250 more in fuel costs over 5 years compared to the average new vehicle.

GAA

Annual fuel cost $1,650

Fuel Economy & Greenhouse Gas Rating (tailpipe only): 5 (1 – 10 Best)

Smog Rating (tailpipe only): 5 (1 – 10 Best)

This vehicle emits 395 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 26 MPG and costs $7,000 to fuel over 5 years. Cost estimates are based on 15,000 miles per year at $2.45 per gallon. MPGe is miles per gasoline gallon equivalent. Vehicle emissions are a significant cause of climate change and smog.

fueleconomy.gov
Calculate personalized estimates and compare vehicles

Smartphone QR Code*

GOVERNMENT 5-STAR SAFETY RATINGS

This vehicle has not been rated by the government for overall vehicle score, frontal crash, side crash or rollover risk.

Source: National Highway Traffic Safety Administration (NHTSA)
www.safercar.gov or 1-888-327-4236

PARTS CONTENT INFORMATION

FOR VEHICLES IN THIS CARLINE:
U.S./CANADIAN PARTS CONTENT: 65%

NOTE: PARTS CONTENT DOES NOT INCLUDE FINAL ASSEMBLY, DISTRIBUTION, OR OTHER NON-PARTS COSTS.

FOR THIS VEHICLE:
FINAL ASSEMBLY POINT:
SPRING HILL, TN U.S.A.
COUNTRY OF ORIGIN:
ENGINE: UNITED STATES
TRANSMISSION: JAPAN

This label has been applied pursuant to Federal law – Do not remove prior to delivery to the ultimate purchaser. "Includes Manufacturer's Recommended Pre-Delivery Service. Does not include dealer installed options and accessories not listed above, local taxes or license fees.

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ORDER NO. TRPHW SALES CODE E
SALES MODEL CODE 6NH06
DEALER NO. 36501
FINAL ASSEMBLY:
SPRING HILL, TN U.S.A.
VIN 1GYKNBRS9HZ16
DEALER (IF KNOWN DELIVERED)

LM

On 4GLTE Wi-Fi

Equipped with the safety and connectivity of OnStar.*
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onstar.com/privacy

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

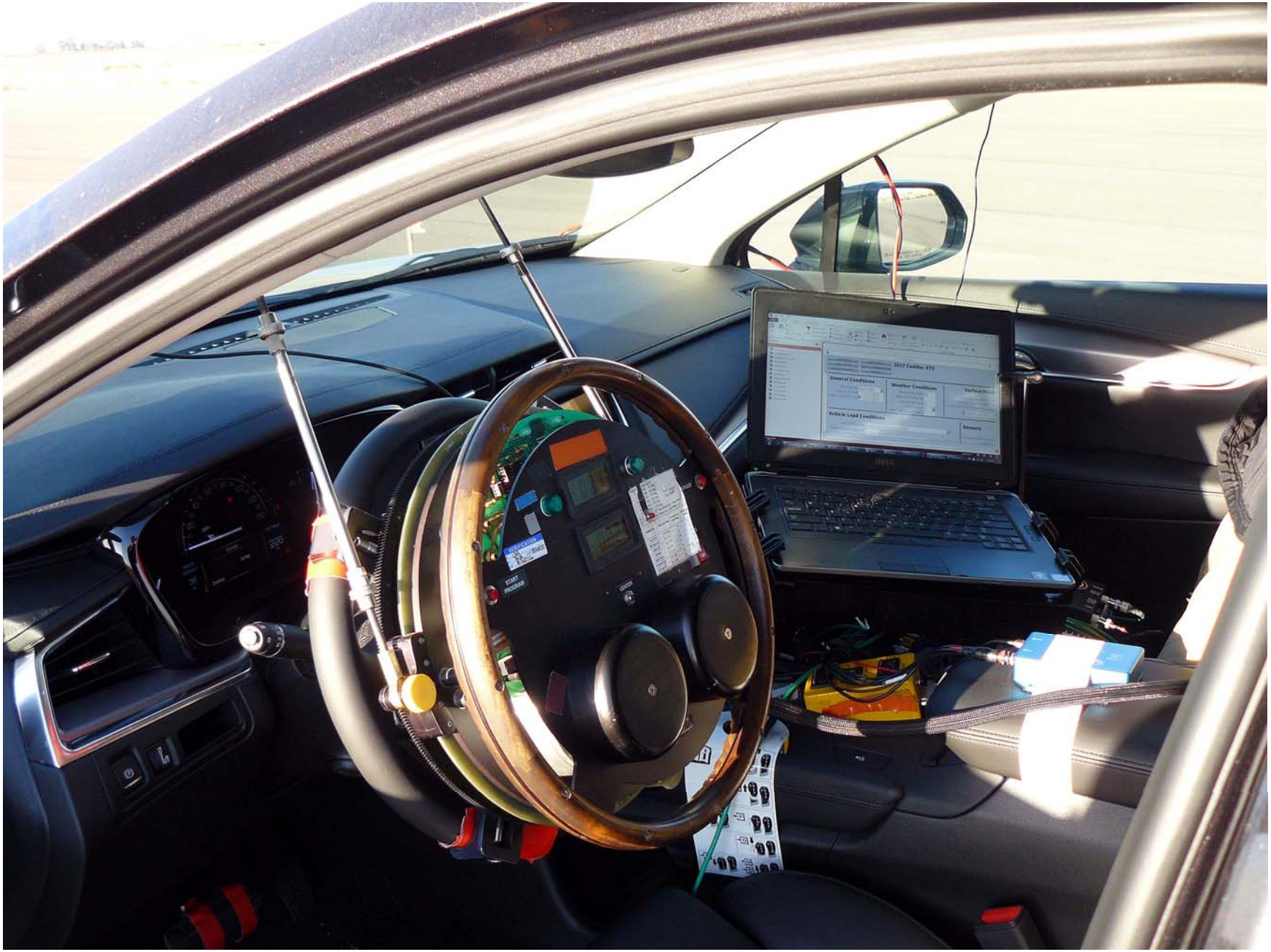

Figure A6. Instrumentation in Test Vehicle

Figure A7. Ballast Condition

APPENDIX B

Test Run Log

Vehicle: **2017 Cadillac XT5 FWD** Driver: **Peter Broen** Date: **11/17/2016**

Run Number	Test Type	Speed (mph)	Handwheel Angle (deg)	Dir. of First Steer	2 Wheel Lift	Notes
1	Tire Warm-Up	35	80	Left	NA	
2			80		NA	
3			80		NA	
4						2x SWA last cycle
5	Static	0	0			
6	Steady State	50	0			
7	Slowly Increasing Steer	50	50	Left	NA	Resulted in ay = 0.60g
8				Left	NA	
9				Left	NA	ng
10				Right	NA	
11				Right	NA	
12				Right	NA	
13	Fishhook	35	184	Left	No	6.5x Scalar
14	Fishhook	40	184	Left	No	
15	Fishhook	45	184	Left	No	
16	Fishhook	47.5	184	Left	No	
17	Fishhook	50	184	Left	No	
18	Fishhook	35	184	Right	No	
19	Fishhook	40			No	
20	Fishhook	45			No	
21	Fishhook	47.5			No	
22	Fishhook	50			No	

Vehicle: **2017 Cadillac XT5 FWD** Driver: **Peter Broen** Date: **11/17/2016**

Run Number	Test Type	Speed (mph)	Handwheel Angle (deg)	Dir. of First Steer	2 Wheel Lift	Notes
23	Fishhook	45	156	Right	No	5.5x Scalar
24	Fishhook	47.5	156	Right	No	
25	Fishhook	50	156	Right	No	
26	Fishhook	45	156	Left	No	
27	Fishhook	47.5	156	Left	No	
28	Fishhook	50	156	Left	No	

APPENDIX C

Slowly Increasing Steer Test Worksheet

NCAP, 2017 Cadillac XT5 FWD , Multi-Passenger Load, Test Date: 11/17/2016

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	1	49.9	6.3	87.4	917	-28.1	-0.305	-182.9	-0.254	-154.8	-0.2149	0.9930	301	500
8	1	49.7	3.4	93.2	927	-28.5	-0.293	-185.4	-0.2575	-156.9	-0.2179	0.9956	300	500
9	1	49.6	3.9	92.1	916	-28.2	-0.320	-183.4	-0.2548	-155.2	-0.2156	0.9810	300	500
10	0	49.8	3.5	92.9	923	28.5	0.300	185.1	0.2570	156.6	0.2175	0.986	300	500
11	0	50,0	2.5	95,0	918	28.4	0.303	184.5	0.2562	156.1	0.2168	0.9937	300	500
12	0	49.9	2.7	94.5	920	28.2	0.306	183.3	0.2546	155.1	0.2154	0.9881	300	500
					Mean:	28.3	0.305	184	0.256	156	0.216			

Steering Controller Input Values

Scalar 6.5 values:

Initial HW angle:	184	deg
Initial time:	0.256	s
Reversal HW angle:	-184	deg
Reversal time:	0.511	s

Scalar 5.5 values:

Initial HW angle:	156	deg
Initial time:	0.216	s
Reversal HW angle:	-156	deg
Reversal time:	0.433	s

APPENDIX D

Time History Plots

LIST OF FIGURES

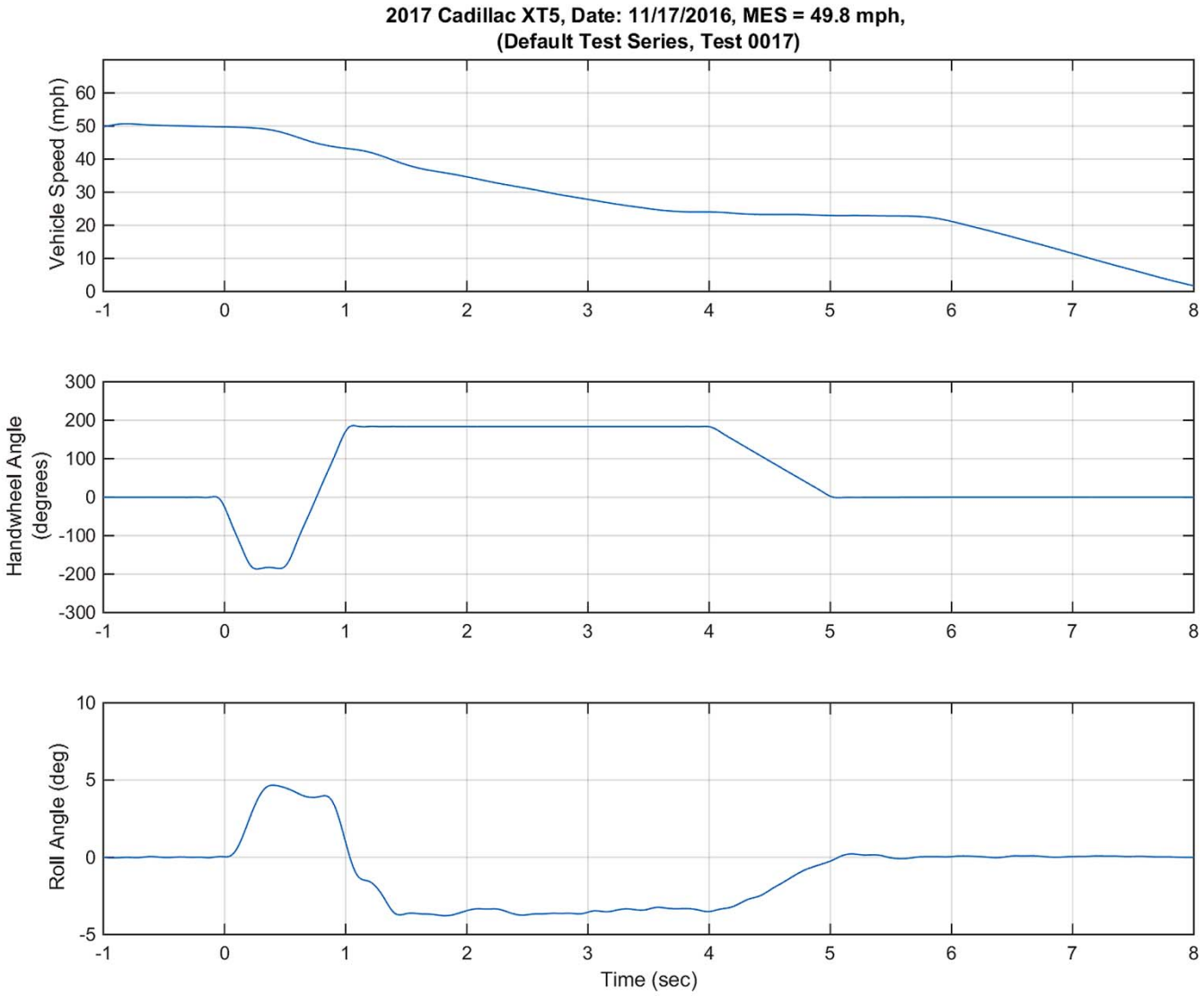

Figure D1. Vehicle Speed, Handwheel Angle, and Roll Angle Time History Plots for Default Test Series, L-R, 50 mph

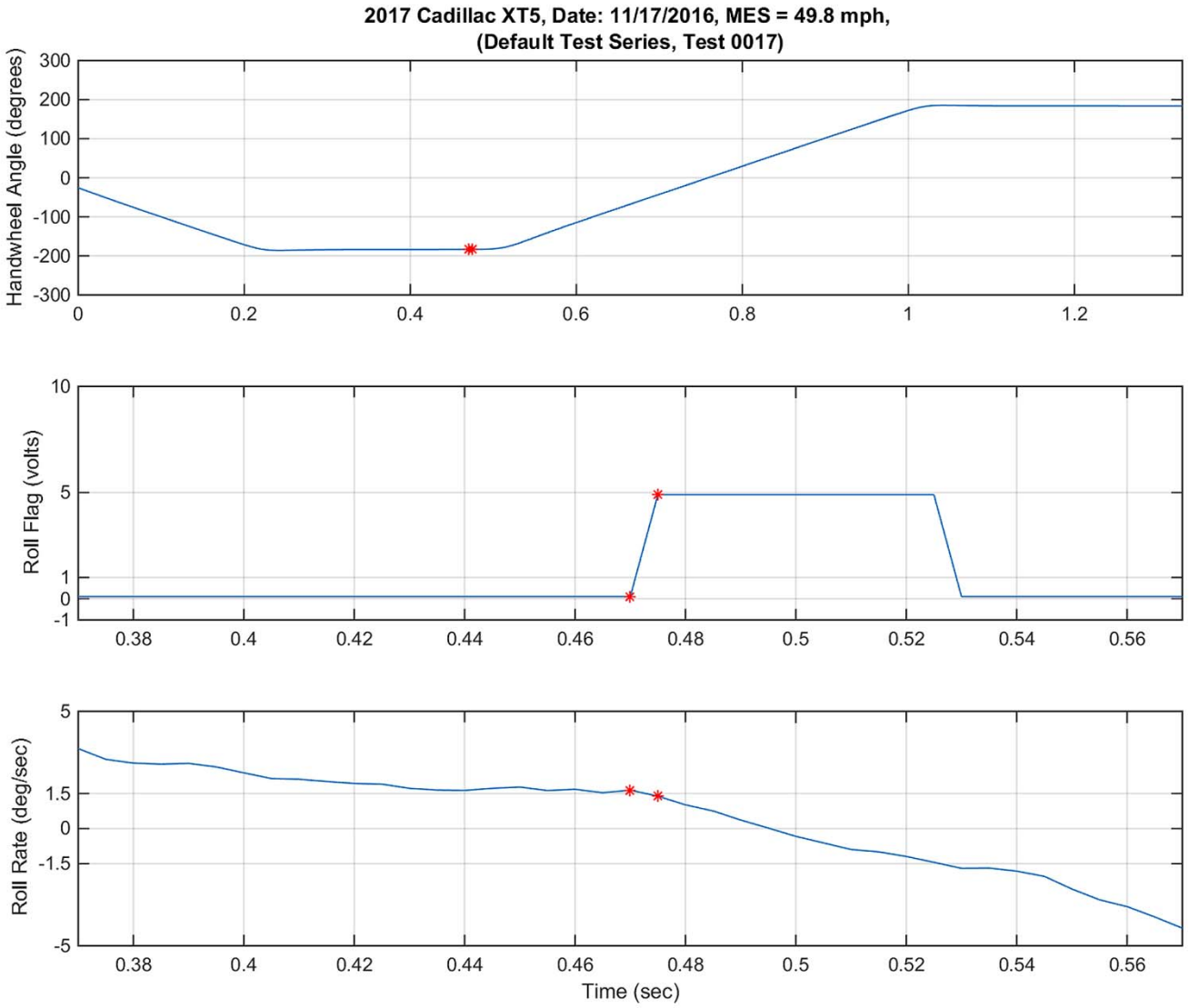

Figure D2. Steering Machine Operation Time History Plots for Default Test Series, L-R, 50 mph

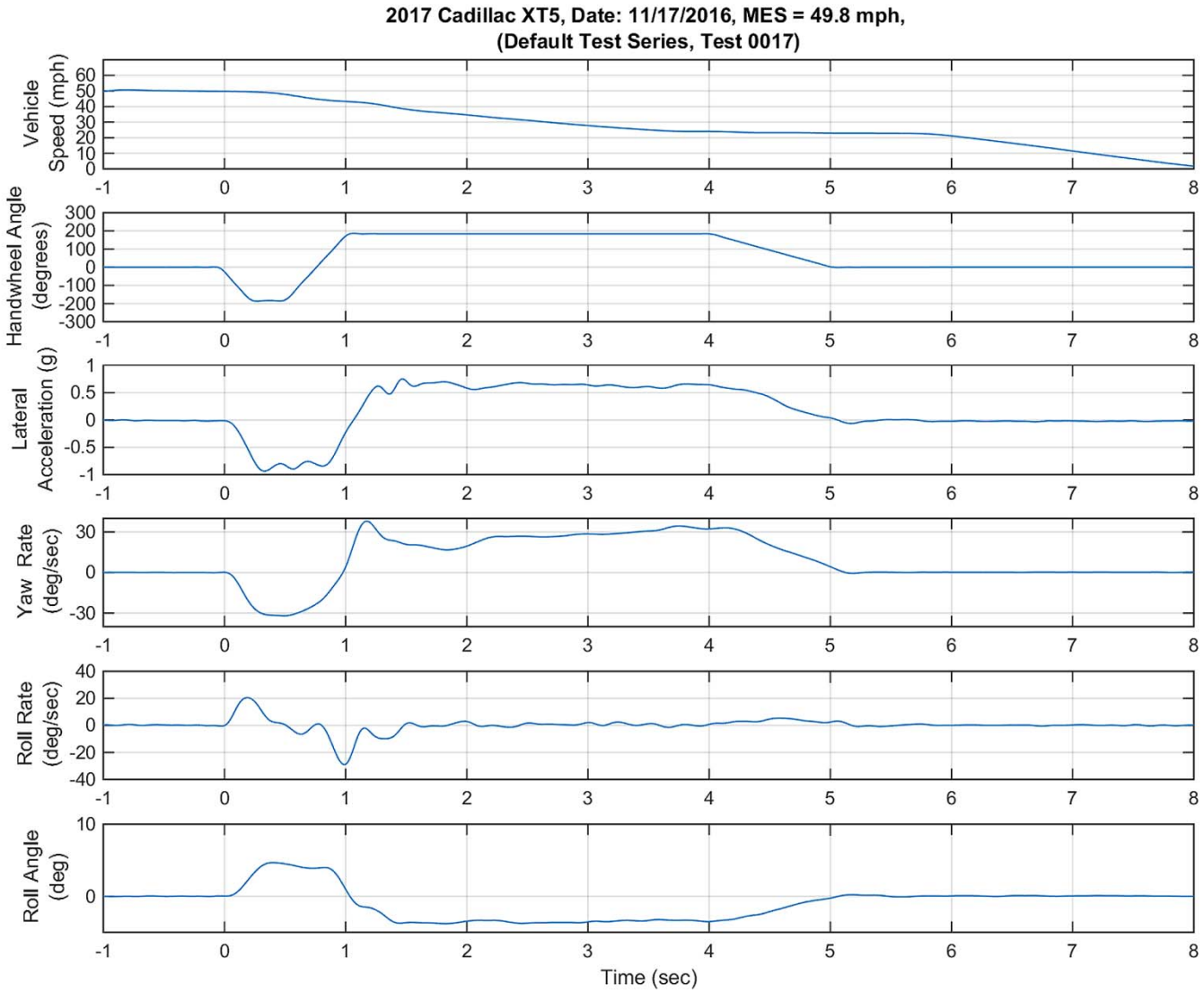

Figure D3. Yaw Rate, Roll Rate, and Lateral Acceleration Time History Plots For Default Test Series, L-R, 50 mph

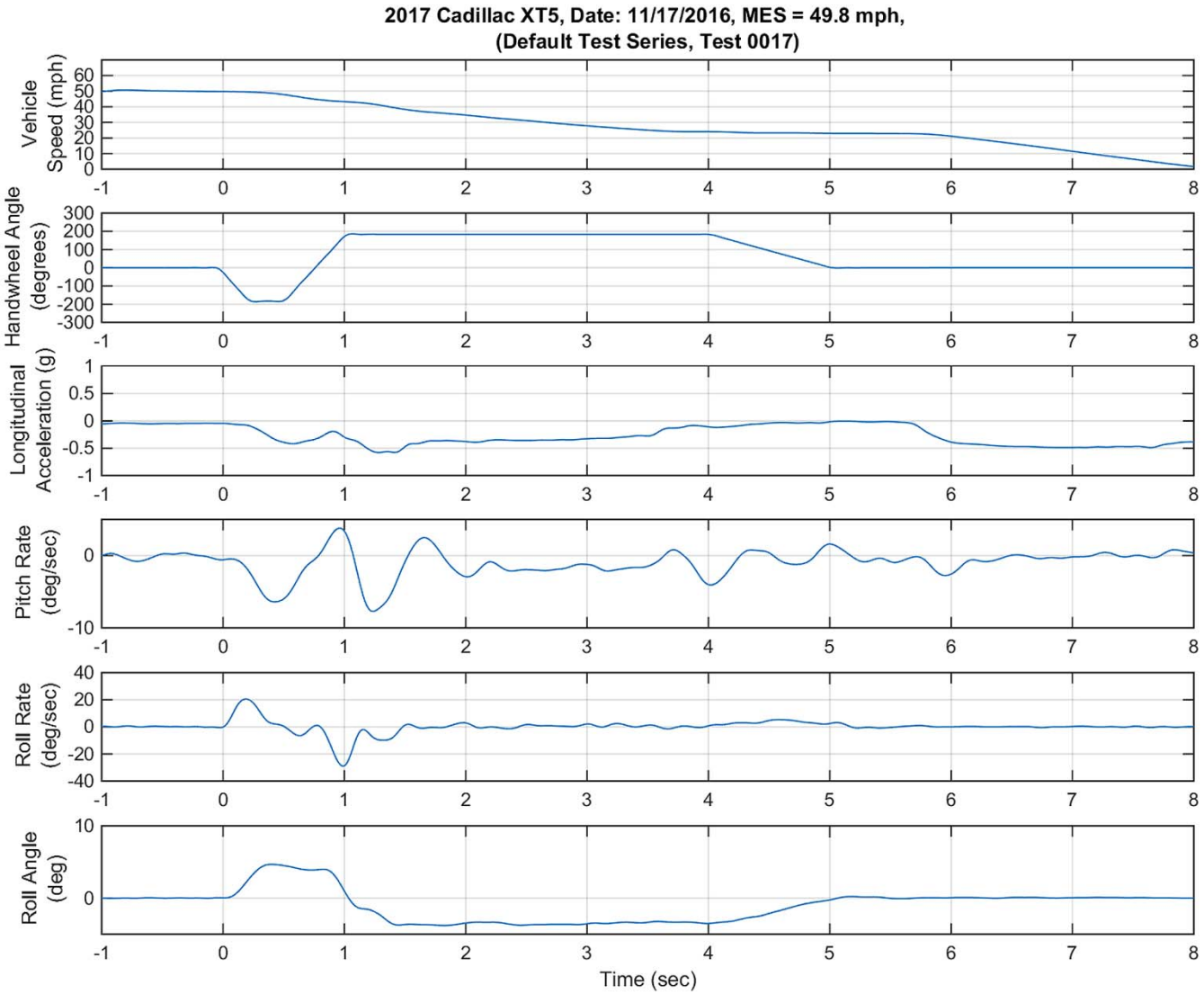

Figure D4. Pitch Rate and Longitudinal Acceleration Time History Plots for Default Test Series, L-R, 50 mph

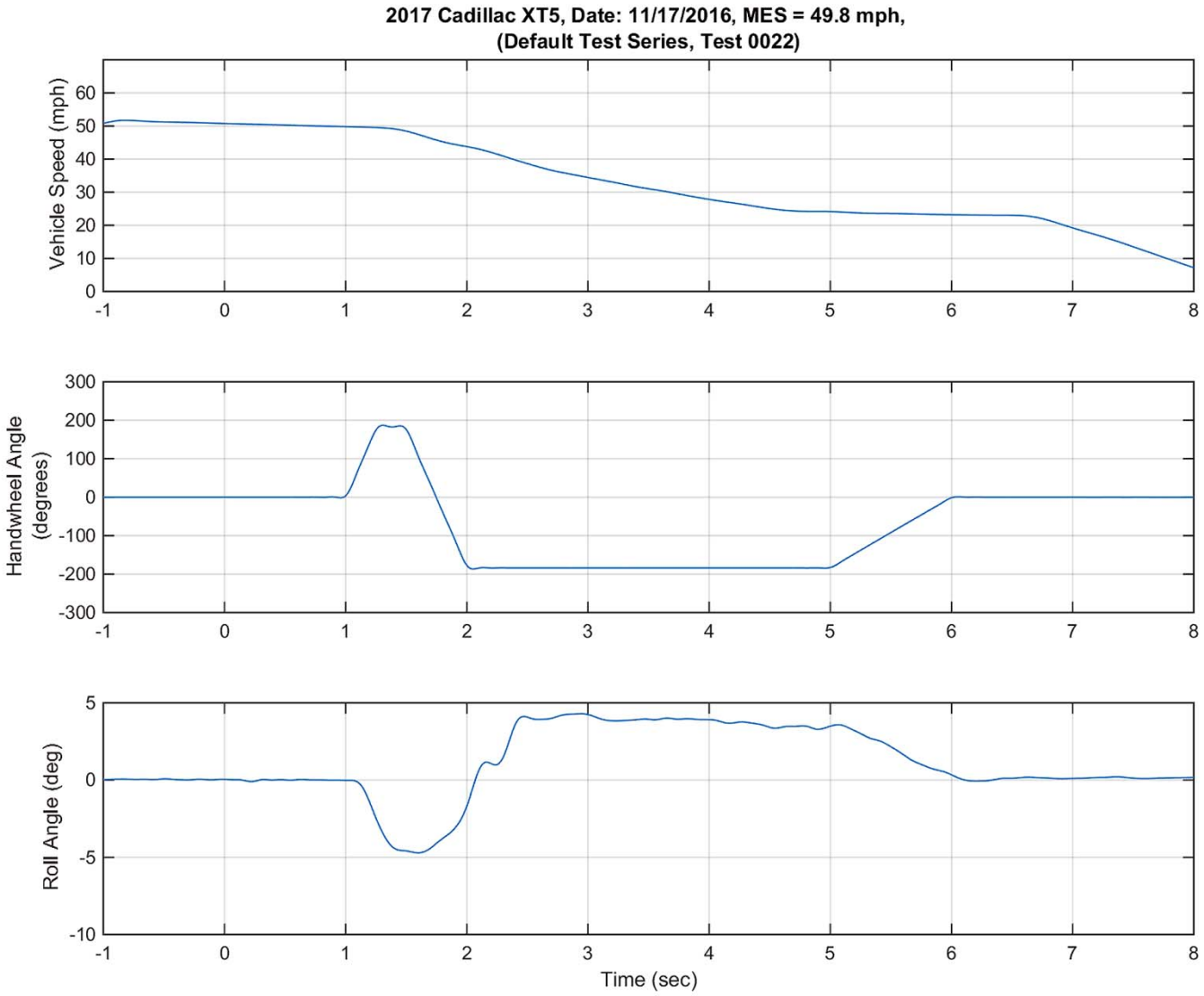

Figure D5. Vehicle Speed, Handwheel Angle, and Roll Angle Time History Plots for Default Test Series, R-L, 50 mph

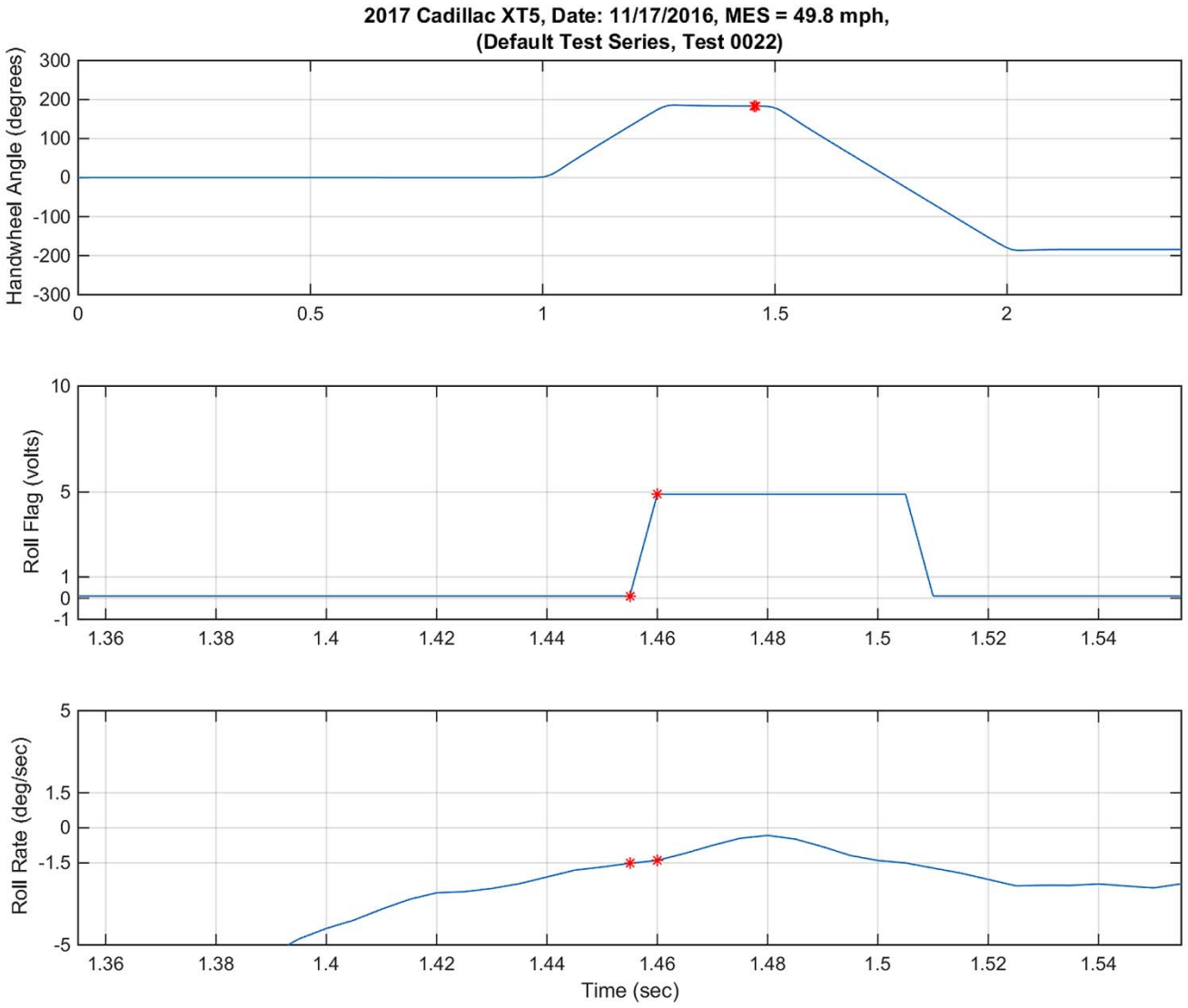

Figure D6. Steering Machine Operation Time History Plots for Default Test Series, R-L, 50 mph

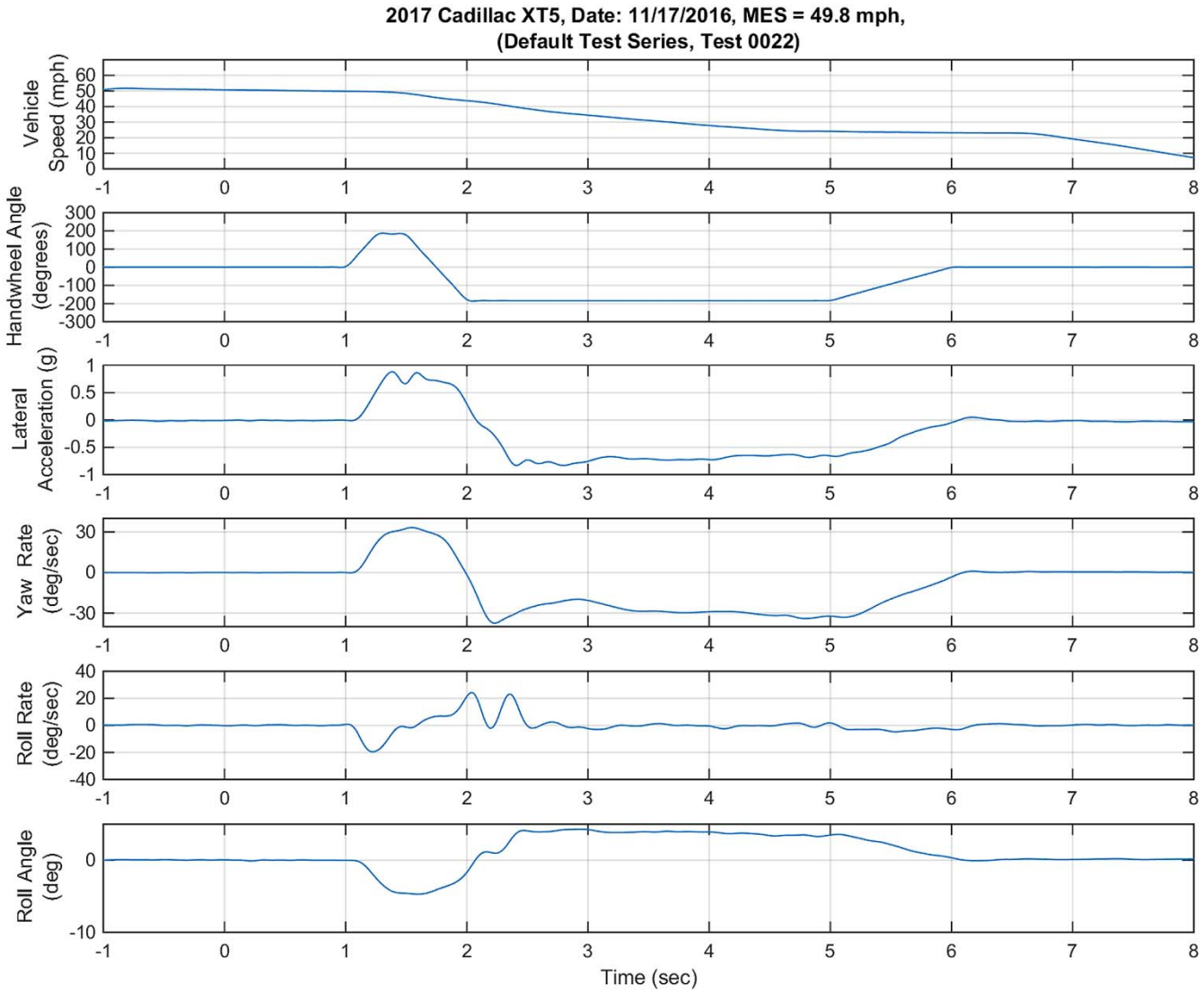

Figure D7. Yaw Rate, Roll Rate, and Lateral Acceleration Time History Plots for Default Test Series, R-L, 50 mph

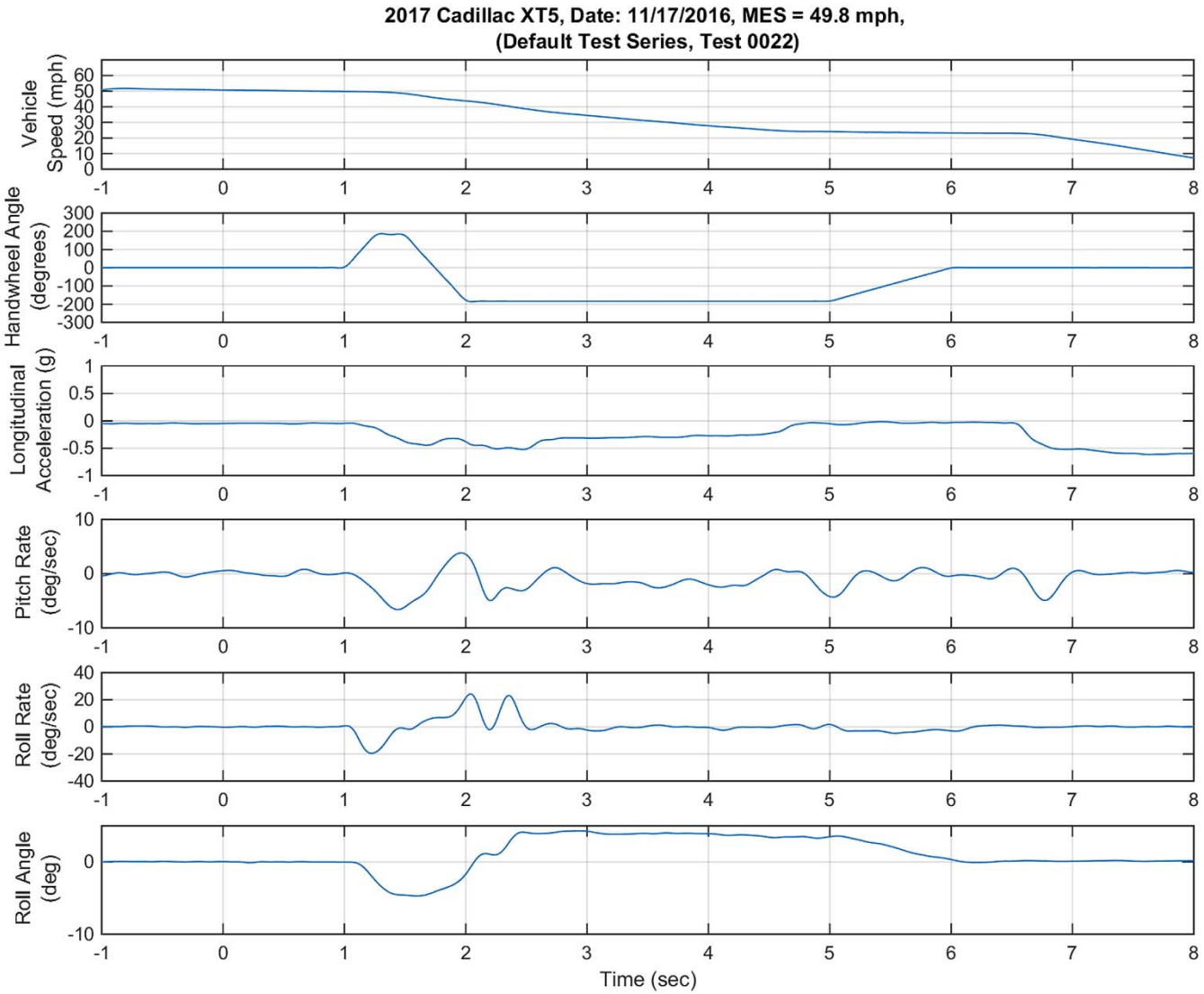

Figure D8. Pitch Rate and Longitudinal Acceleration Time History Plots or Default Test Series, R-L, 50 mph

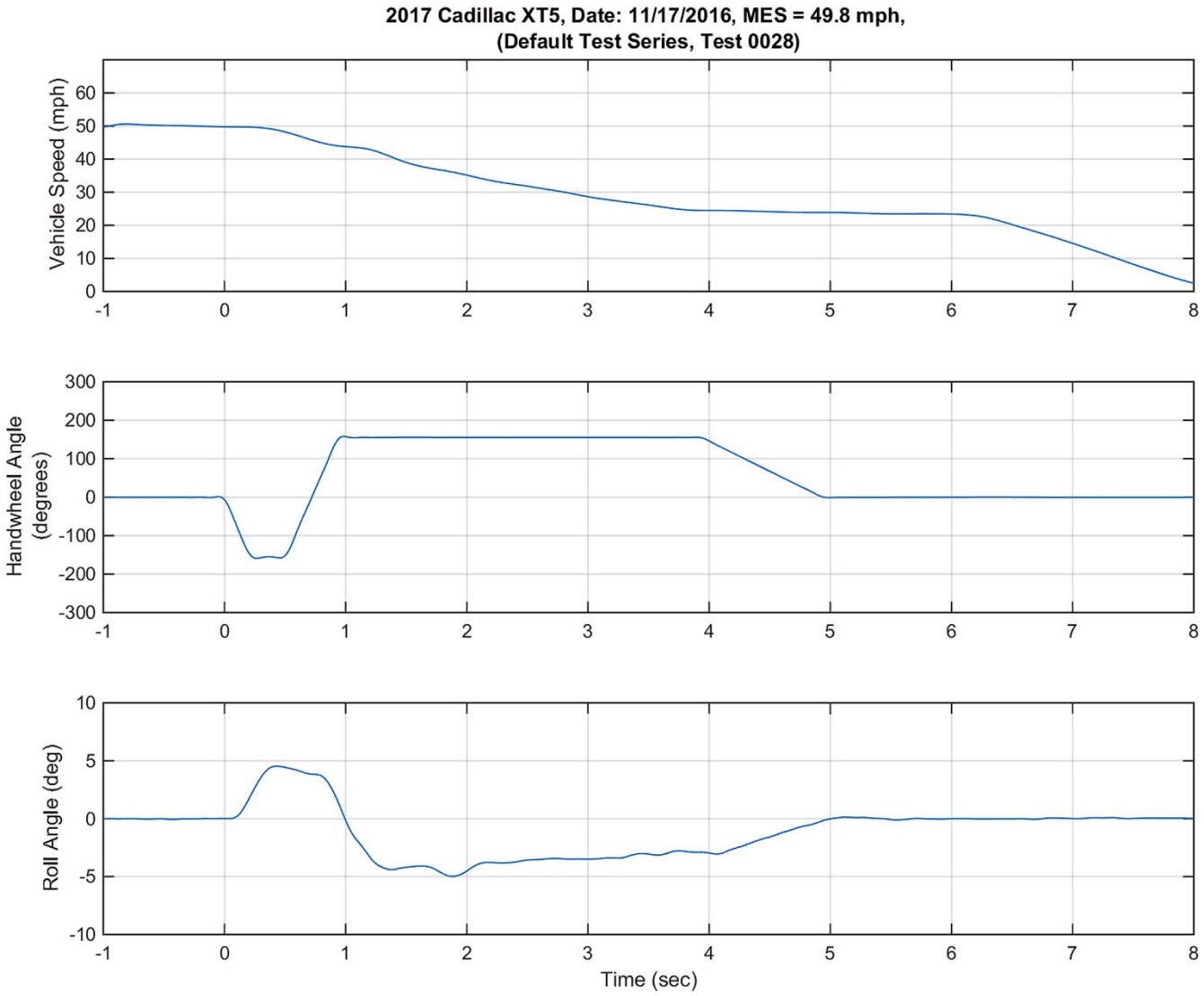

Figure D9. Vehicle Speed, Handwheel Angle, and Roll Angle Time History Plots for Supplemental 2 Test Series, L-R, 50 mph

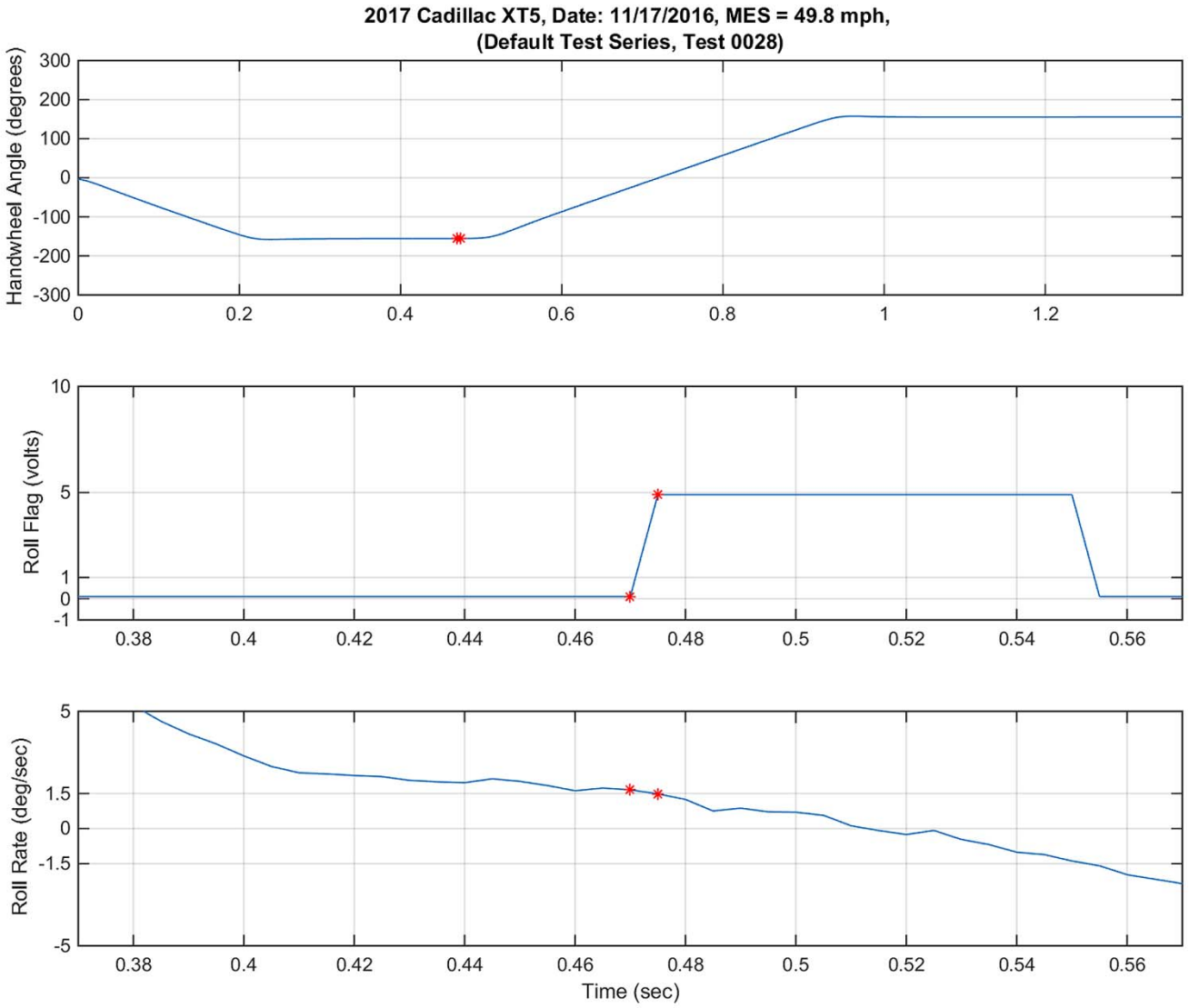

Figure D10. Steering Machine Operation Time History Plots for Supplemental 2 Test Series, L-R, 50 mph

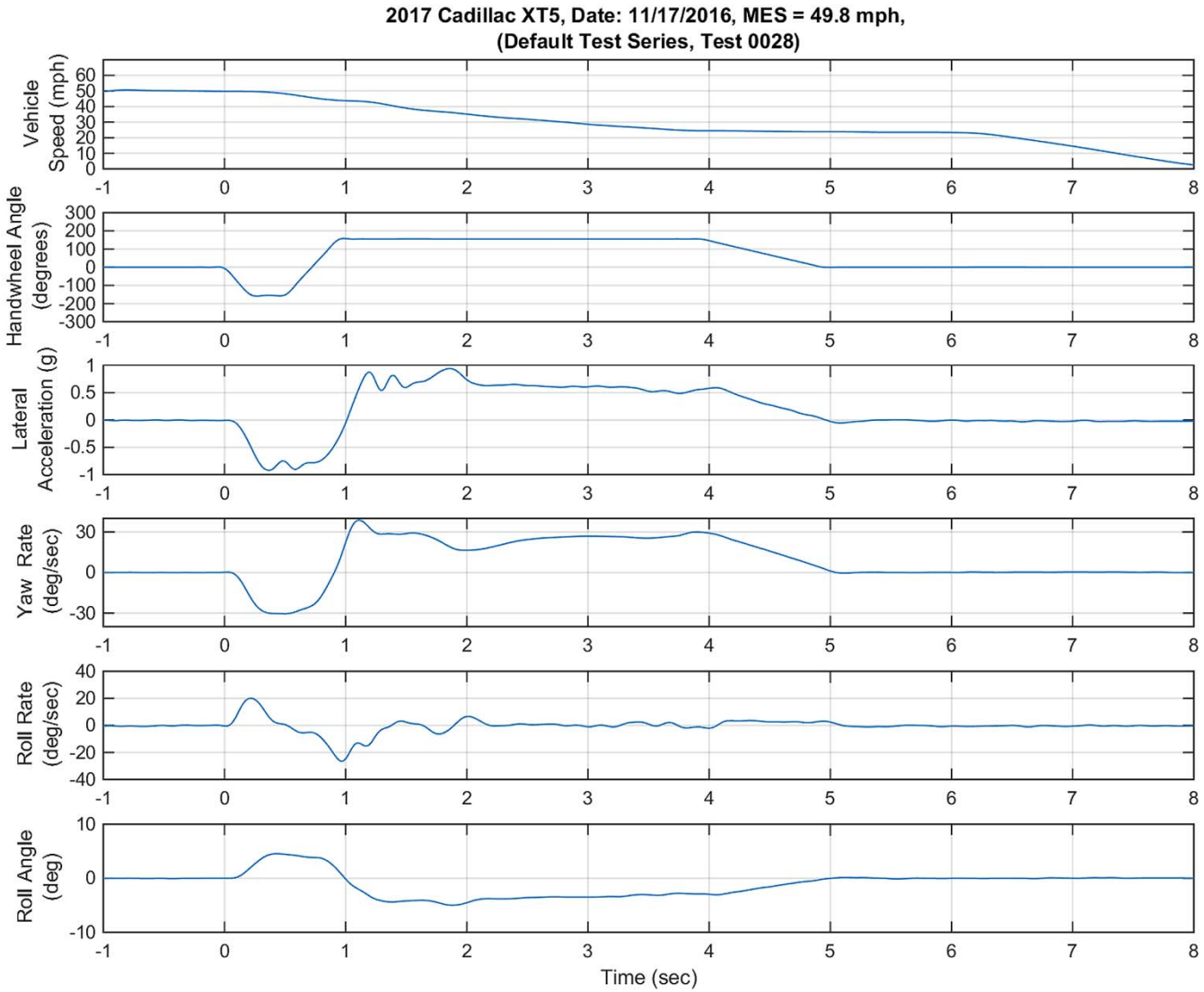

Figure D11. Yaw Rate, Roll Rate, and Lateral Acceleration Time History Plots for Supplemental 2 Test Series, L-R, 50 mph

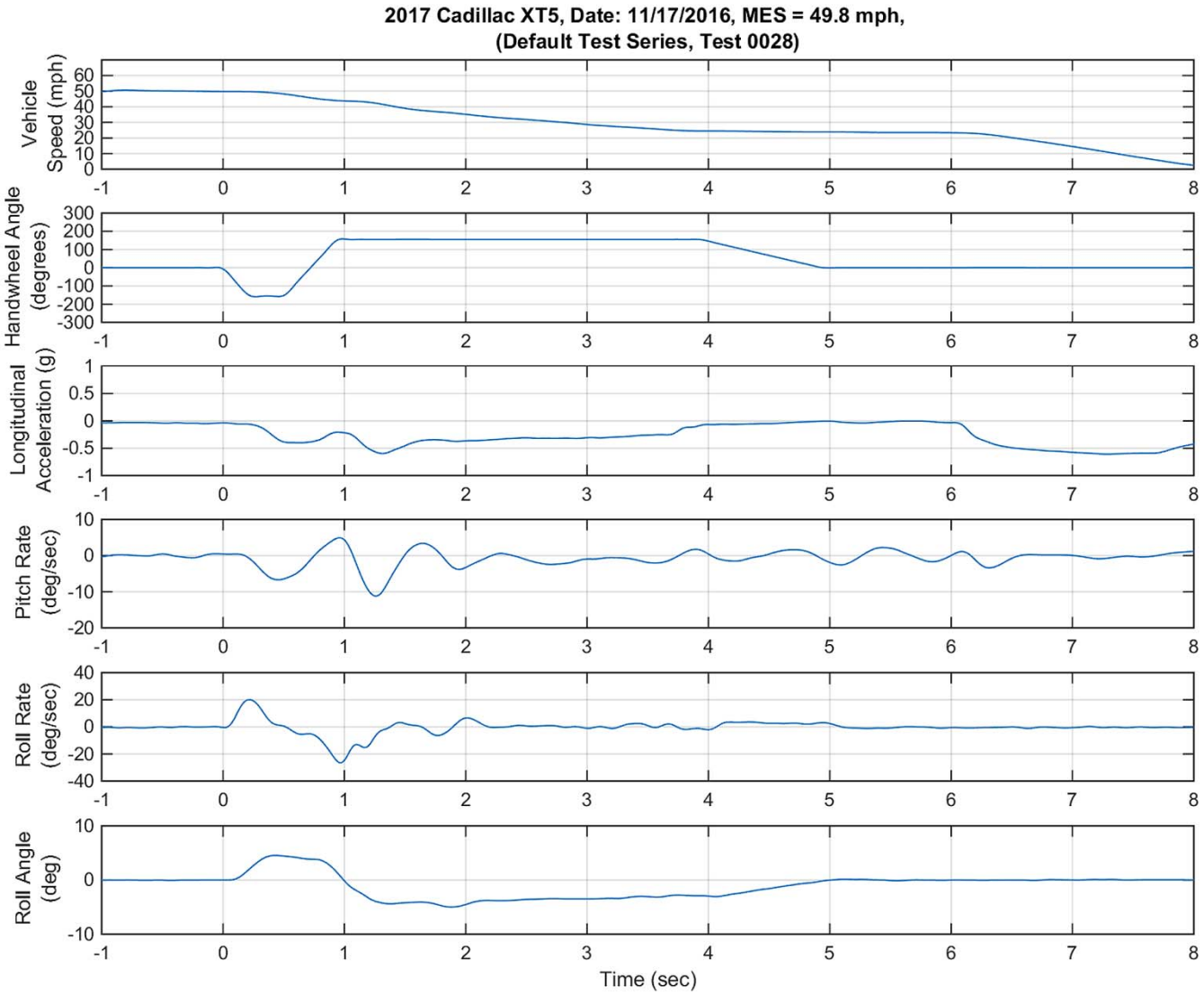

Figure D12. Pitch Rate and Longitudinal Acceleration Time History Plots for Supplemental 2 Test Series, L-R, 50 mph

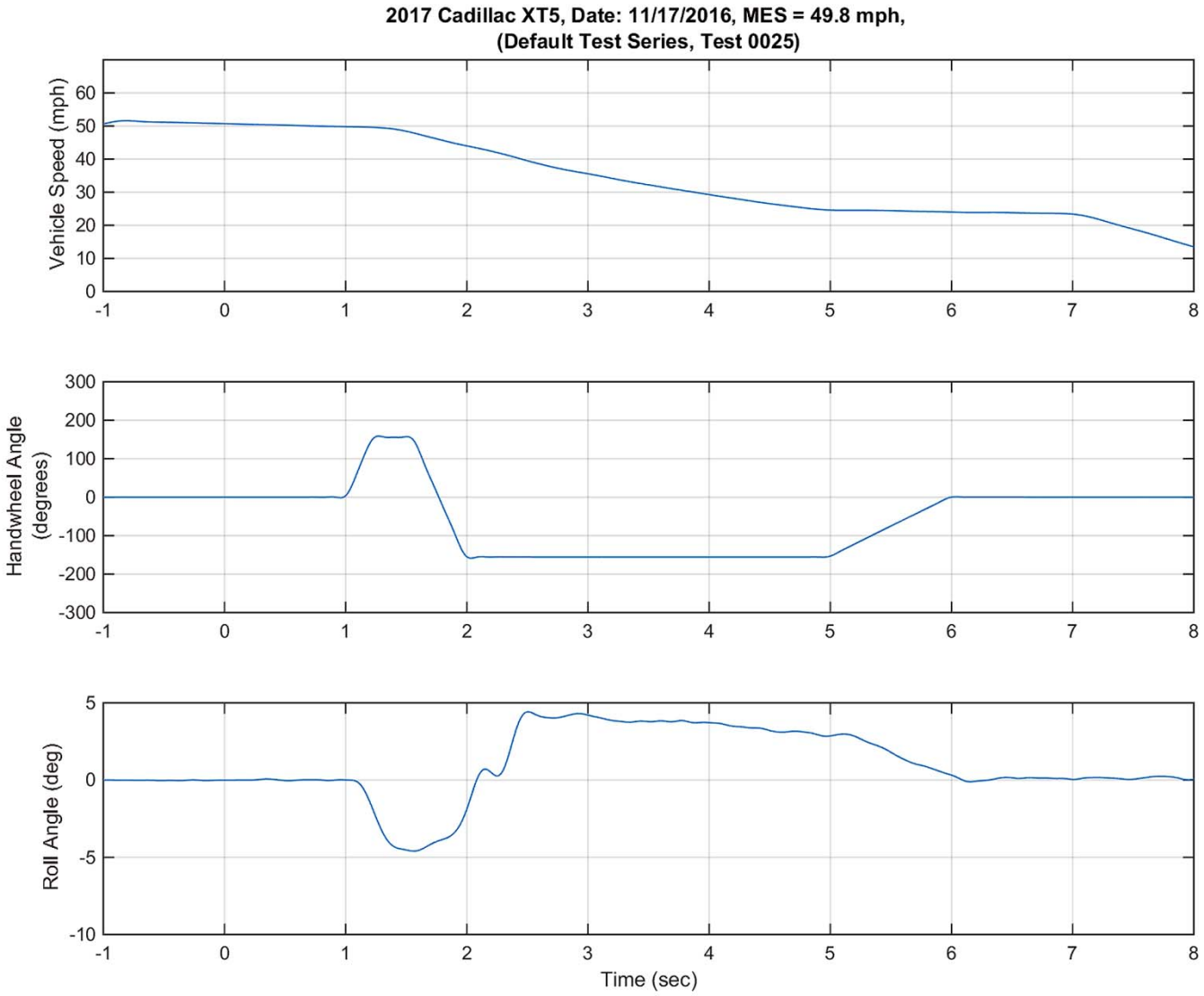

Figure D13. Vehicle Speed, Handwheel Angle, and Roll Angle Time History Plots for Supplemental 2 Test Series, R-L, 50 mph

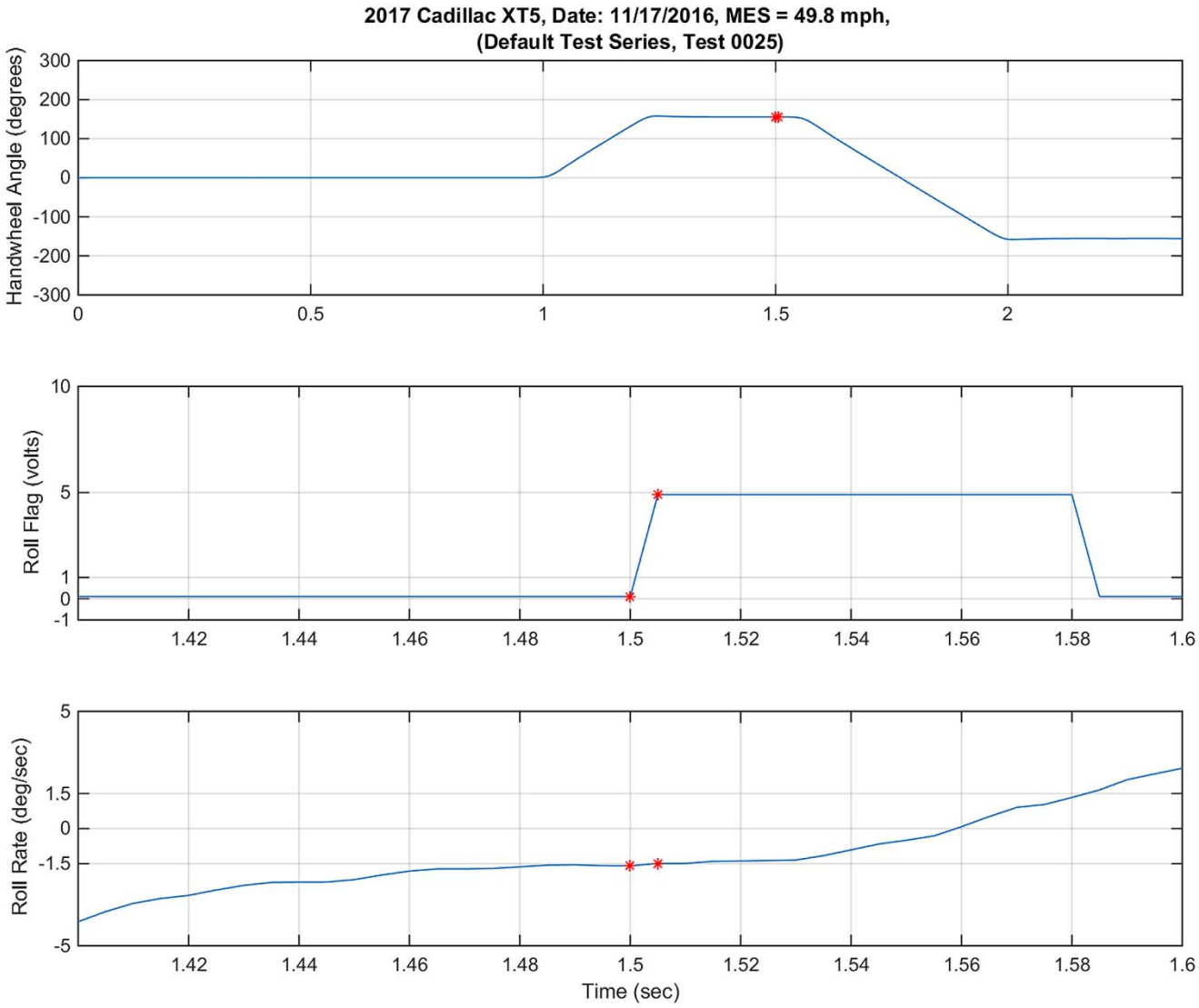

Figure D14. Steering Machine Operation Time History Plots for Supplemental 2 Test Series, R-L, 50 mph

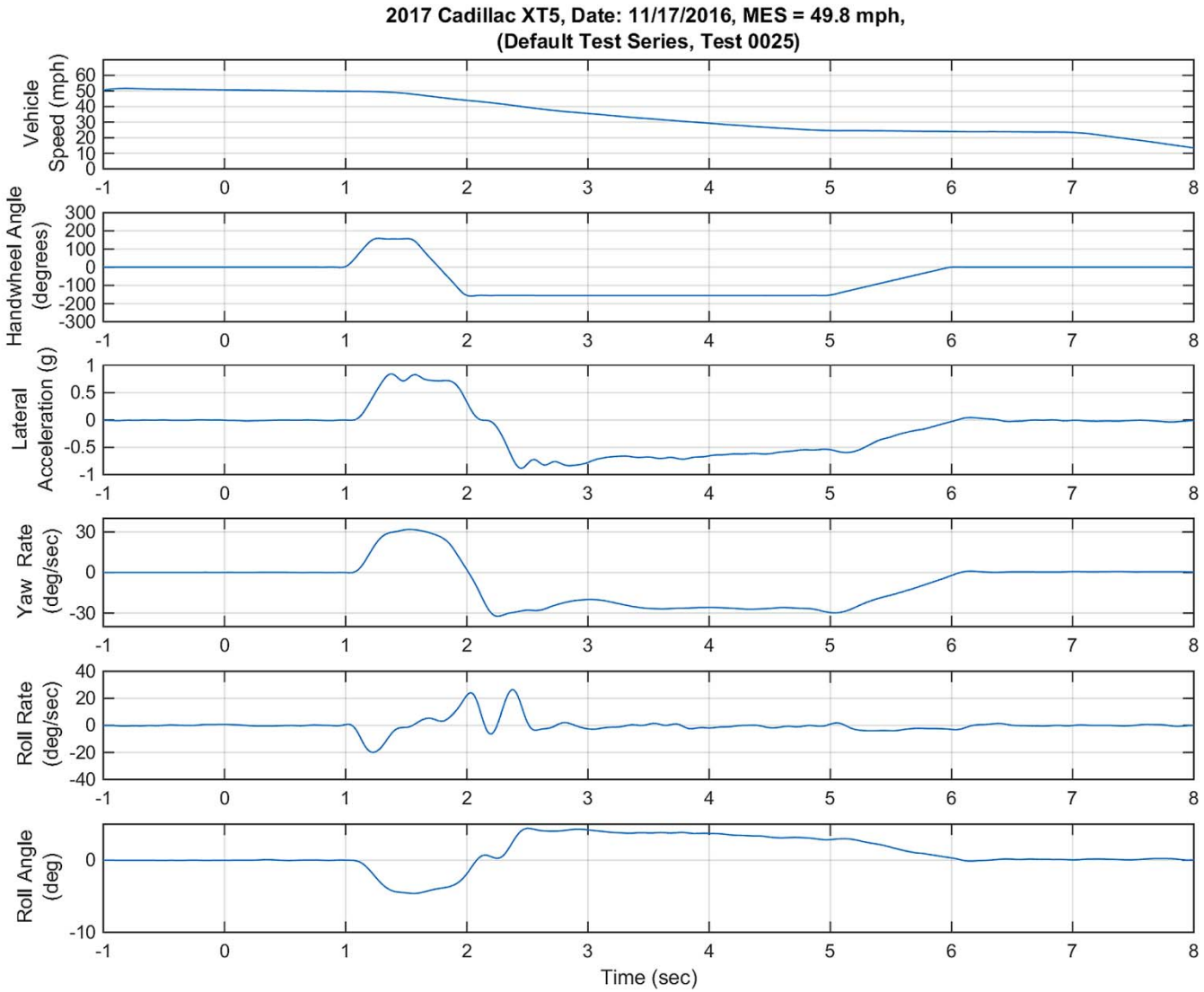

Figure D15. Yaw Rate, Roll Rate, and Lateral Acceleration Time History Plots for Supplemental 2 Test Series, R-L, 50 mph

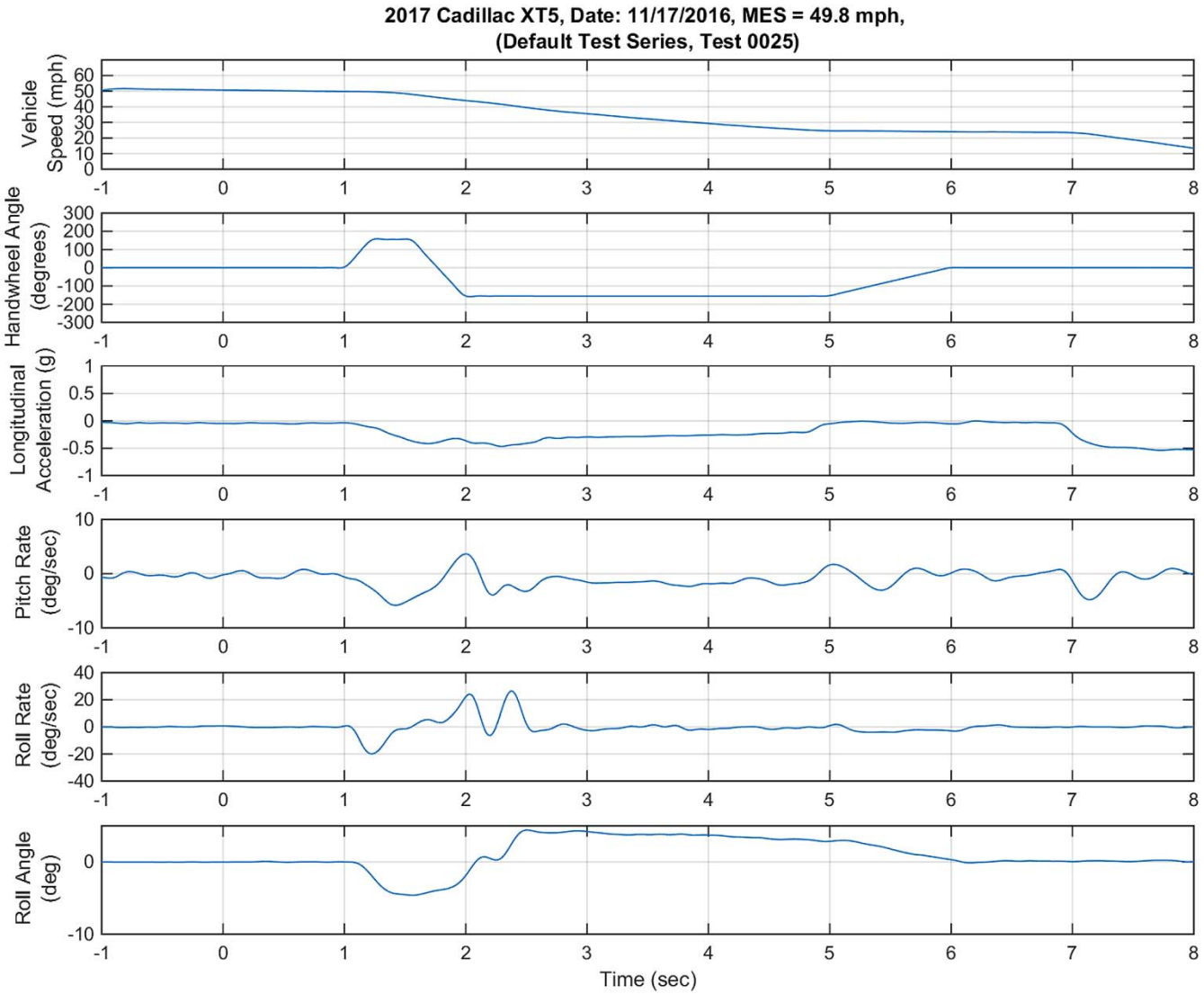

Figure D16. Pitch Rate and Longitudinal Acceleration Time History Plots for Supplemental 2 Test Series, R-L, 50 mph