

L-42 Surveillance Panel Meeting Minutes

PRI Headquarters, Warrendale, PA and Virtual Meeting – Microsoft Teams

August 7, 2024

Attendees: voting members in **bold**, * indicates virtual attendance

N. Ariemma (Lubrizol)	H. Catania (Cummins)	C. Mueller (SwRI)
R. Banas (Exxon Mobil)	J. Clark (TMC)	T. Muransky (AAM)*
D. Beck (TMC)	A. Comfort (US Army)	M. Sangpeal (Afton/C)
D. Bell (Afton)	A. Goyal (BASF)	E. Sattler (US Army)
T. Bender (Fuchs)	A. Jackson (Chevron Oronite)	N. Schaup (LZ)
M. Burgman (Fuchs)*	A. Lange (Intertek)	C. Thomas (SwRI)
B. Campbell (Afton)*	M. M-Pouv (Tribodens)	D. Uy (Shell)
M. Caridi (BASF)	J. Morris (Navistar)	R. Warden (Chevron Oronite)
J. Carowick (Cummins)	D. Mosher (BASF)	A. Zyski (Dana)

Call to Order

Review of Agenda

The meeting agenda is attached.

Review of Membership

No changes required.

Approval of Meeting Minutes

Meeting minutes for approval:

- ▲ “20240508_SP” → May 8, 2024 – Surveillance Panel Meeting – Plymouth, MI

A motion was made to approve the meeting minutes as presented.

Motion: A. Zyski

Second: A. Goyal

All in favor, no objections, no abstentions.

Next Hardware Batch Order

Labs are preparing to place an order for the next batch of test hardware from Dana. All four labs will participate. A call with the Dana sales rep and the lab engineers will be setup to discuss terms and past issues.

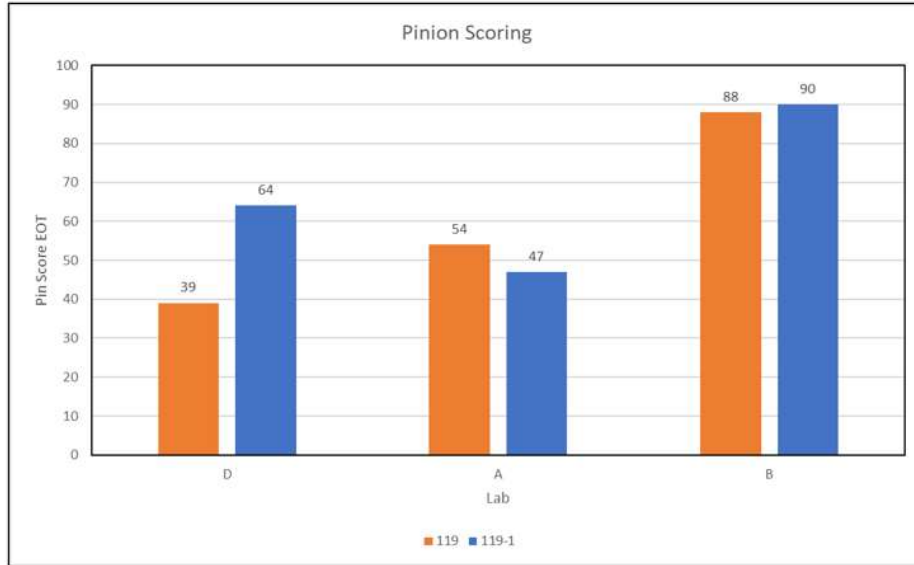
Specific issues to address:

1. Severe under-delivery from past two orders
2. Quality issues (one lab has two axles with zero back-lash)
3. Confirm if simplification is possible (Dana mentioned that not all features on housings may be needed)

Action Item: M. Sangpeal to set up call with Dana, lab engineers, and A. Zyski within two weeks.

TMC 119-1 Reference Oil

3 of 4 labs completed acceptance testing of TMC 119-1. Results are as follows:



Lab	CMIR	Oil	Hardware	Pin Score EOT	Ring Score EOT	S1 Score Ring	S1 Tq [ft-lb]	S2 Tq [ft-lb]
D	184769	119	MSPLO/P2AD01	39	29	0	-75.1	-353.2
D	188628	119-1	MSPLO/P2AD01	64	47	0	-77.1	-356.9
A	183550	119	MSPLO/P2AD01	54	45	35	-102.7	-407.7
A	188630	119-1	MSPLO/P2AD01	47	37	25	-98.5	-411
B	158148	119	C1L446/P8AD132	88	67	0	-81.2	-344.9
B	188624	119-1	C1L446/P8AD132	90	75	0	-98.3	-374.5

Avg Pin Score 119	Avg Ring Score 119
60	47
Avg Pin Score 119-1	Avg Ring Score 119-1
67	53

No concerns with the results were noted. Lab G committed to submitting data within two weeks. A conference call will be setup to review the data when it becomes available.

L-42-1 Development

Labs with electric test stands shared detailed specs of their motors and drives.

M. Sangpeal shared results of reducing peak torque in Shock 2. ~50 ft-lb less peak torque resulted in EOT scoring of 18 Pinion, 10 Ring. The data suggests that peak torque in Shock 2 is a primary driver of scoring severity.

Shock 2 pinion torque traces for the Fired Engine + Eddy Current, Electric + Eddy Current, and Electric Motor rigs were compared. All three are unique.

Additional details can be found in the attached presentation.

Actions Items:

1. SwRI will run additional testing with increased Shock 2 torque, Cond. 4 and Shock 2 repetitions as defined in D7452, and rigid axle mounts.
2. IAR to donate three axles from MSPLO/P2AD01 batch to SwRI for development efforts.
3. IAR to investigate installing L-42 axle on their Efficiency T-Rig.

LOTO During Gear Inspections

One lab recently went through a safety audit of their L-42 test stand. The auditor pointed out that the engine is not shut down / locked out during mid-test ring gear inspections. The test procedure states that the engine is to be idling and the transmission is to be in Neutral. Proximity to rotating equipment and removal of guarding while the test stand is not locked out are the primary concerns.

The panel decided to make the inspections after Conditioning 4 and Shock 1 optional, but highly recommended.

Motion: Inspections 1 and 2 are optional, but highly recommended, effective immediately.

Motion: M. Sangpeal

Second: N. Schaup

New/Open Issues

None.

Adjournment

A motion was made to adjourn.

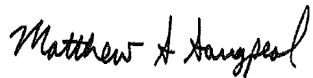
Motion: M. Sangpeal

Second: A. Lange

All in favor, no objections, no abstentions.

Meeting adjourned.

Respectfully submitted,



Matt Sangpeal

L-42 Surveillance Panel Chairman



L-42 Surveillance Panel Meeting

ASTM D7452

PRI Headquarters

Warrendale, PA

August 7, 2024


1:30 – 2:30 PM EST

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Agenda

- ▲ **Call to Order**
- ▲ **Agenda**
- ▲ **Membership Review & Update**
- ▲ **Approval of Meeting Minutes**
 - ▲ “20240508 SP” – Intertek PSI, Plymouth, MI
- ▲ **Next Hardware Batch Order**
- ▲ **TMC 119-1 Reference Oil**
- ▲ **LOTO / PPE During Gear Inspections**
- ▲ **L-42-1 Development Updates**
- ▲ **New Issues**
- ▲ **Adjournment**

L-42 SP Voting Members

 Rob Banas:	Exxon Mobil
 Dylan Beck:	TMC
 Allen Comfort:	US Army
 Arjun Goyal:	BASF
 Troy Muransky:	AAM
 Jessica Carowick:	Cummins- Meritor
 Matt Sangpeal:	Afton Chemical (Chair)
 Nick Schaup:	Lubrizol
 Anthony Lange:	Intertek
 Caroline Mueller:	SwRI
 Amy Zyski:	Dana
 Rebecca Warden:	Chevron-Oronite

Approval of Meeting Minutes

SP Meeting Minutes

- ▲ “20240508 SP” → May 8, 2024 – Surveillance Panel Meeting - Intertek PSI, Plymouth, MI and Virtual Meeting via Microsoft Teams

Next Hardware Batch Order

- 📌 **November SP meeting is due date with Dana for next order**
 - ▲ SwRI: 300
 - ▲ IAR: 250
 - ▲ Afton: 200
 - ▲ Lubrizol: 100
- 📌 **Last two orders were severely under-filled due to loss**
 - ▲ Need to determine if batch will be on-target
- 📌 **Dana requested pictures of the axle in the test stand**
 - ▲ Afton sent pictures
 - ▲ May be able to reduce cost / complexity
 - ▲ No response to date
- 📌 **Dana sales rep will be contacted prior to Nov. meeting**

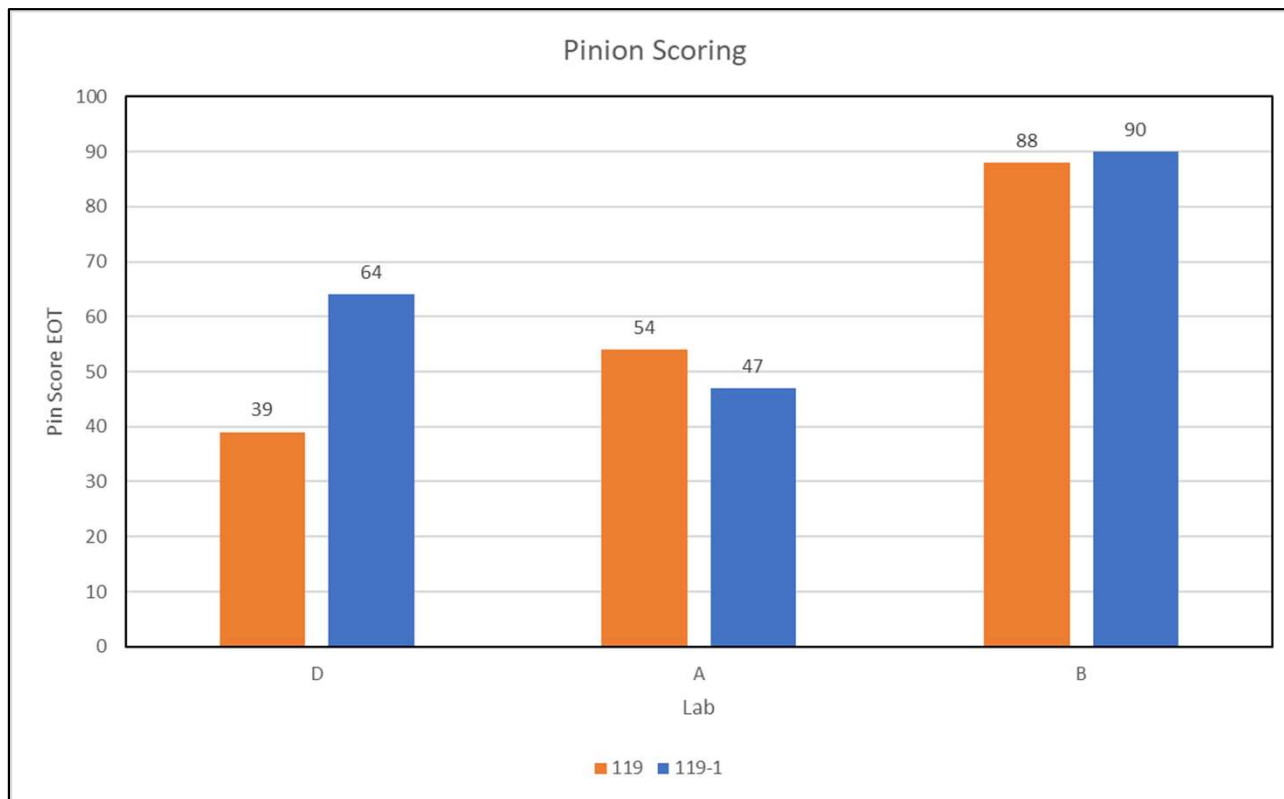
TMC 119-1 Reference Oil Approval - Process

Approval Process

- ▲ Each lab will run one test with 119 and one test with 119-1 back-to-back on a referenced stand
- ▲ Labs have two choices on how the tests will be recorded:
 - Two tests will be added to the 20-test reference period
 - One test with 119 will be used as the low reference run in a four-test calibration sequence and one test will be added to the 20-test reference period (for the 119-1 test run)
- ▲ Due date to submit data: August SP meeting (August 7, 2024)

 **3 of 4 labs have completed testing to date**

TMC 119-1 Reference Oil Approval - Results



Lab	CMIR	Oil	Hardware	Pin Score EOT	Ring Score EOT	S1 Score Ring	S1 Tq [ft-lb]	S2 Tq [ft-lb]
D	184769	119	MSPLO/P2AD01	39	29	0	-75.1	-353.2
D	188628	119-1	MSPLO/P2AD01	64	47	0	-77.1	-356.9
A	183550	119	MSPLO/P2AD01	54	45	35	-102.7	-407.7
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Avg Pin Score 119	Avg Ring Score 119
60	47
Avg Pin Score 119-1	Avg Ring Score 119-1
67	53



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LOTO / PPE During Gear Inspections

- ▲ **Safety Audit raised concern over mid-test gear inspections**
 - ▲ Engine must be idling (per ASTM D7452)
- ▲ **What PPE are labs using while performing inspections?**
 - ▲ Afton: Safety Glasses, Leather Gloves
- ▲ **Are mid-test inspections necessary?**



L-42-1 Development Update

Rig Specs

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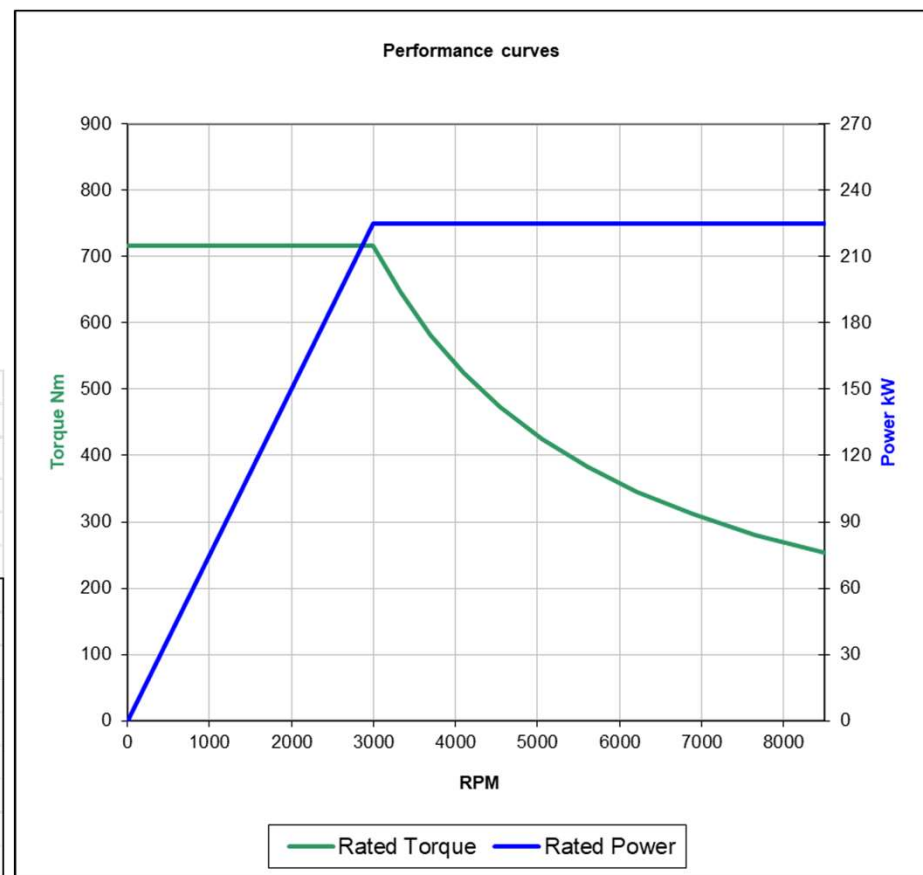
Electric Motor T-Rig Input Motor Specs



AC Dynamometer (INPUT)

ADS 225.3000-8500

Frame	ARSD	250.3-4	Rated Power	225 kW	-	302 HP
Base speed	3000	rpm	Max. Power	270 kW	-	362 HP
Max. speed	8500	rpm	Rated Torque	717 Nm	-	529 lb.ft
			Max. Torque	860 Nm	-	634 lb.ft
Inertia	1.60	kg.m2				
Max. Accel.	5135	rpm/s				



📈 L-42 Max Input Speed is ~4300 RPM

📈 ~1/2 Acceleration Rate Needed for Shock 1

Electric Motor T-Rig Output Motor Specs



AC Dynamometer (Outputs)

ADS 230.1000-3000

Frame	ARSD 250.3-4	Rated Power	180 kW	-	241 HP
Base speed	1000 rpm	Max. Power	250 kW	-	335 HP
Max. speed	3000 rpm				
		Rated Torque	1720 Nm	-	1268 lb.ft
		Max. Torque	2389 Nm	-	1762 lb.ft
Inertia	1.60 kg.m ²				
Max. Accel.	14263 rpm/s				



 L-42 requires ~150 ft-lb on each wheel

Electric Motor T-Rig Drive Specs

Siemens Drive Modules

- ▶ Capable of power regen
 - Not required for L-42 conditions



Eddy Current Rig Input Motor Specs

 **Power: 250 HP**

 **Base Speed: 3575 RPM**

 **Drive: Toshiba G9 250 HP, Braking Resistor**

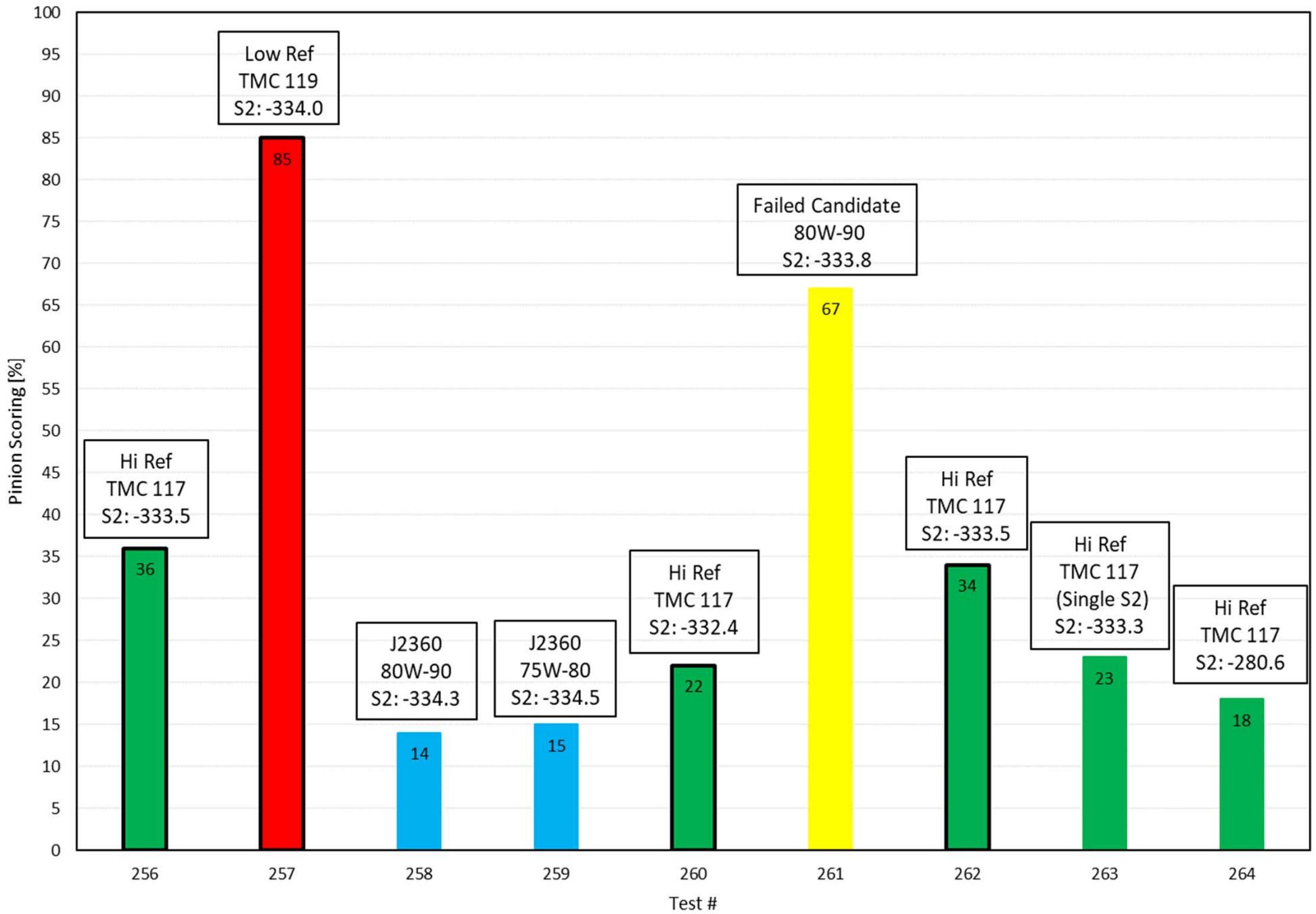


L-42-1 Development Update

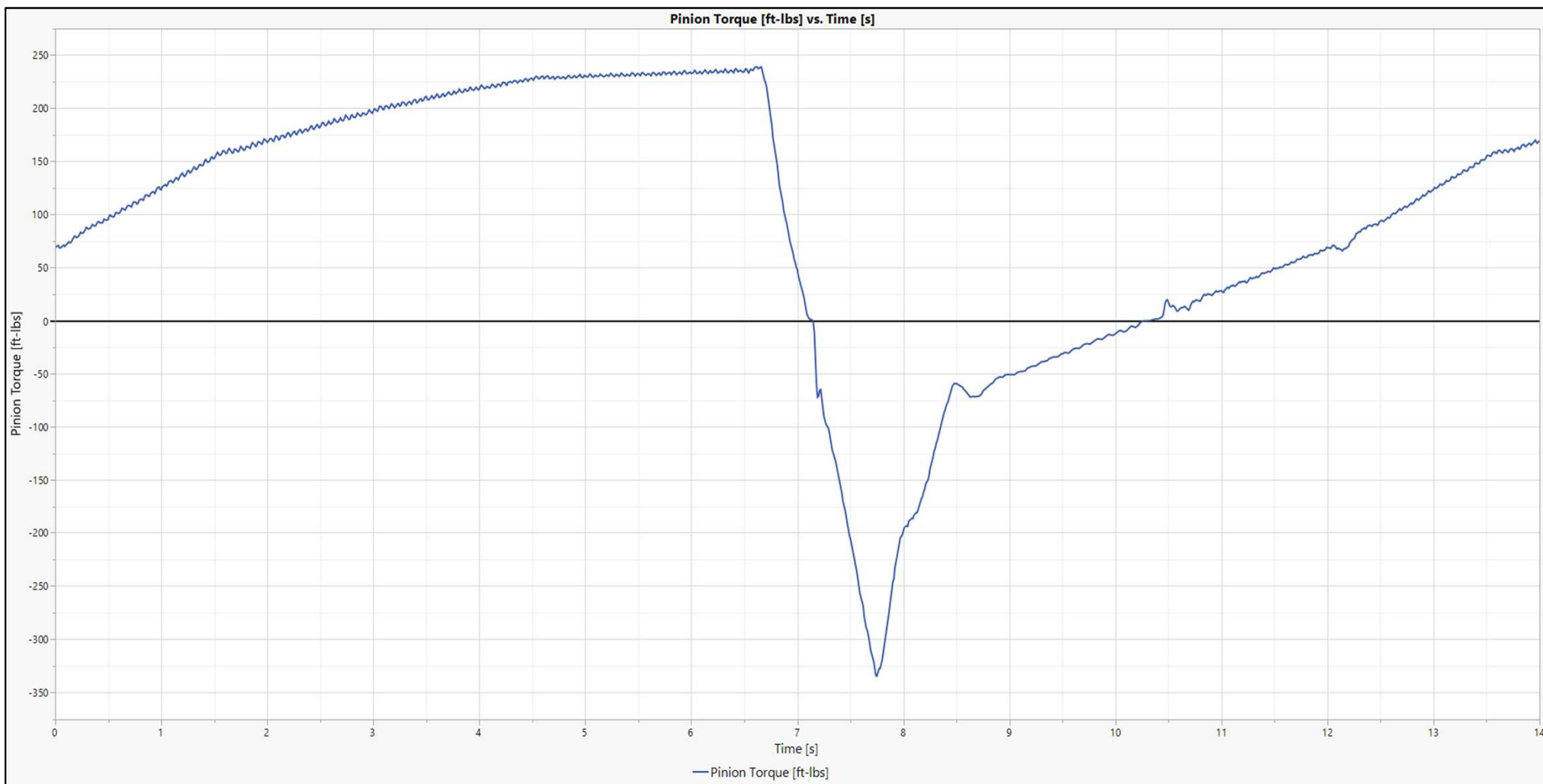
Electric Motor T-Rig Reduced Shock 2 Peak Torque

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Testing Summary



Shock 2 Peak Torque Reduction



▲ Min peak torque setpoint lowered ~50 ft-lb

▲ All other parameters un-changed

Ratings

TMC 117 Oil (Reduced S2 Torque)								
Test Date Started	Test Date Completed	Drive Side Scoring (%)		Coast Side Scoring (%)			Coast Side Torque (lbf-ft)	
		EOT Pinion	EOT Ring	EOT Pinion	EOT Ring	Shock Series 1 Ring	Shock Series 1 (Average)	Shock Series 2 (Average)
20240722	20240722	0	0	18	10	0.0	-74.5	-280.6
Conditioning 2 Test Time: 3		Conditioning 4 Test Time: 2		End of Test Time: 13:04		Total Test Minutes: 64		
Ring Batch: P2AD01	Pinion Batch: MSPLO	Latest Information Letter Run Against:				N/A		

Targets:

Mean = 23.0

Std Dev = 5.49

U. L. = 32

L. L. = 13

Electric Motor T-Rig:

Eddy Current Rig:

	Coast Side Scoring (%)			Coast Side Torque (lbf-ft)	
	EOT Pinion	EOT Ring	Shock Series 1 Ring	Shock Series 1 (Average)	Shock Series 2 (Average)
Passing Reference Oil Test Average	31	21	0	-74.1	-333.1
Passing Reference Oil Test Average	15	10	0	-66.3	-231.2

- 2023 Hardware (MSPLO / P2AD01)
- Correction factors applied to all 117 tests (6 pinion, 4 ring)

Pinion Comparison (TMC 117)



Scoring = 18
Avg Tq = -280.6 ft-lb
Run # 264

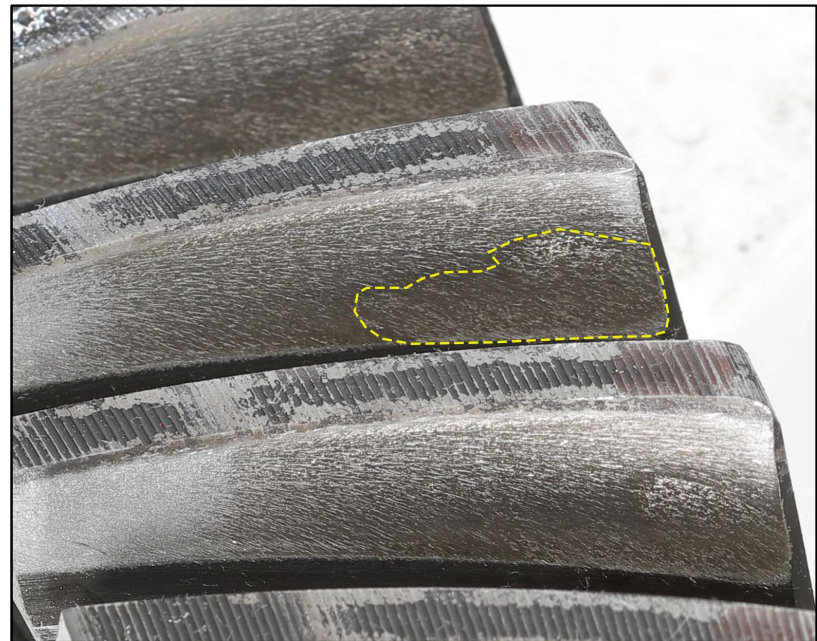


Scoring = 36
Avg Tq = -333.5 ft-lb
Run # 256

Ring Comparison (TMC 117)



Scoring = 10
Avg Tq = -280.6 ft-lb
Run # 264



Scoring = 24
Avg Tq = -333.5 ft-lb
Run # 256

*Scoring Severity Follows
Shock II Peak Torque

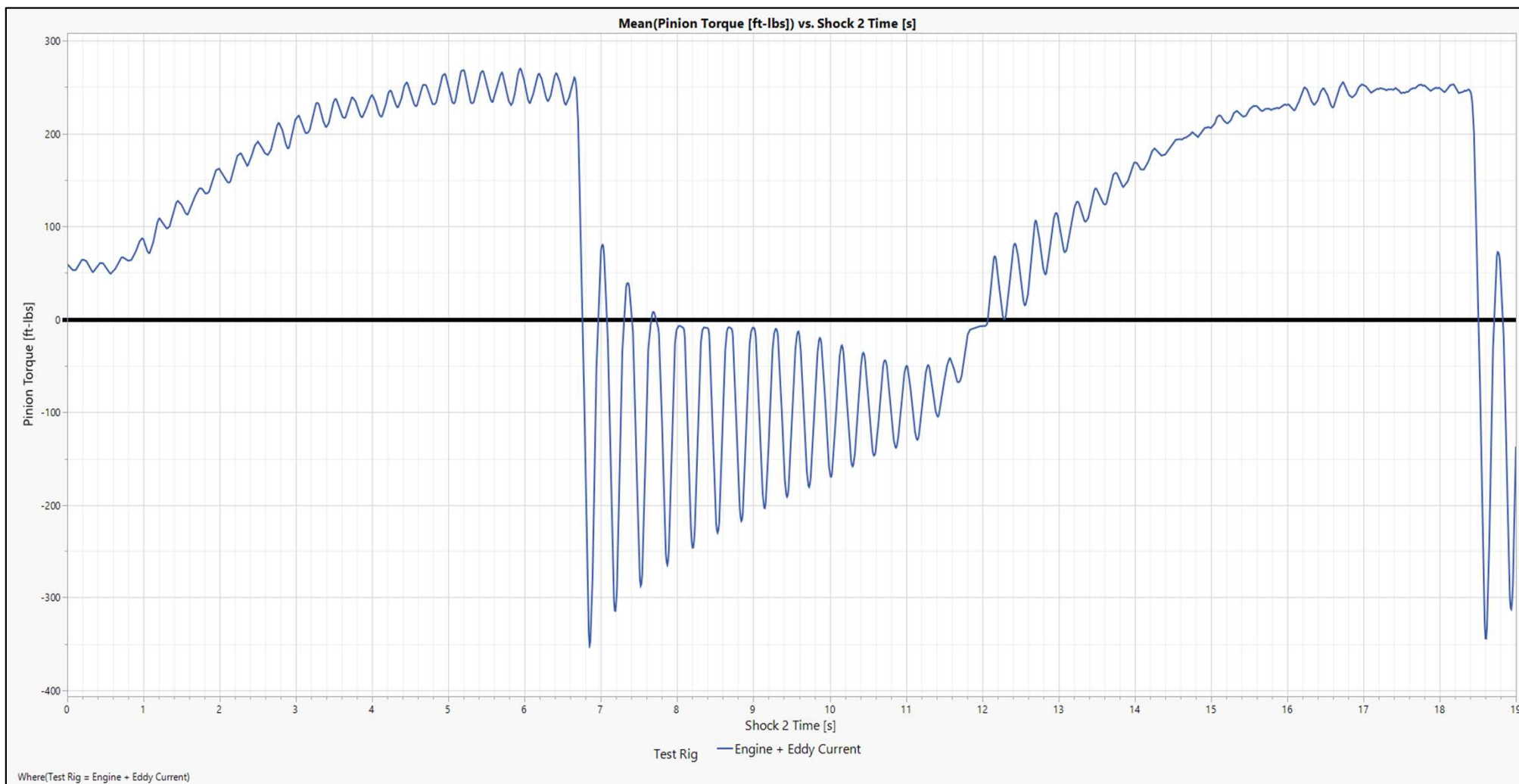


Operational Data Comparison

Shock 2 Torque Curves

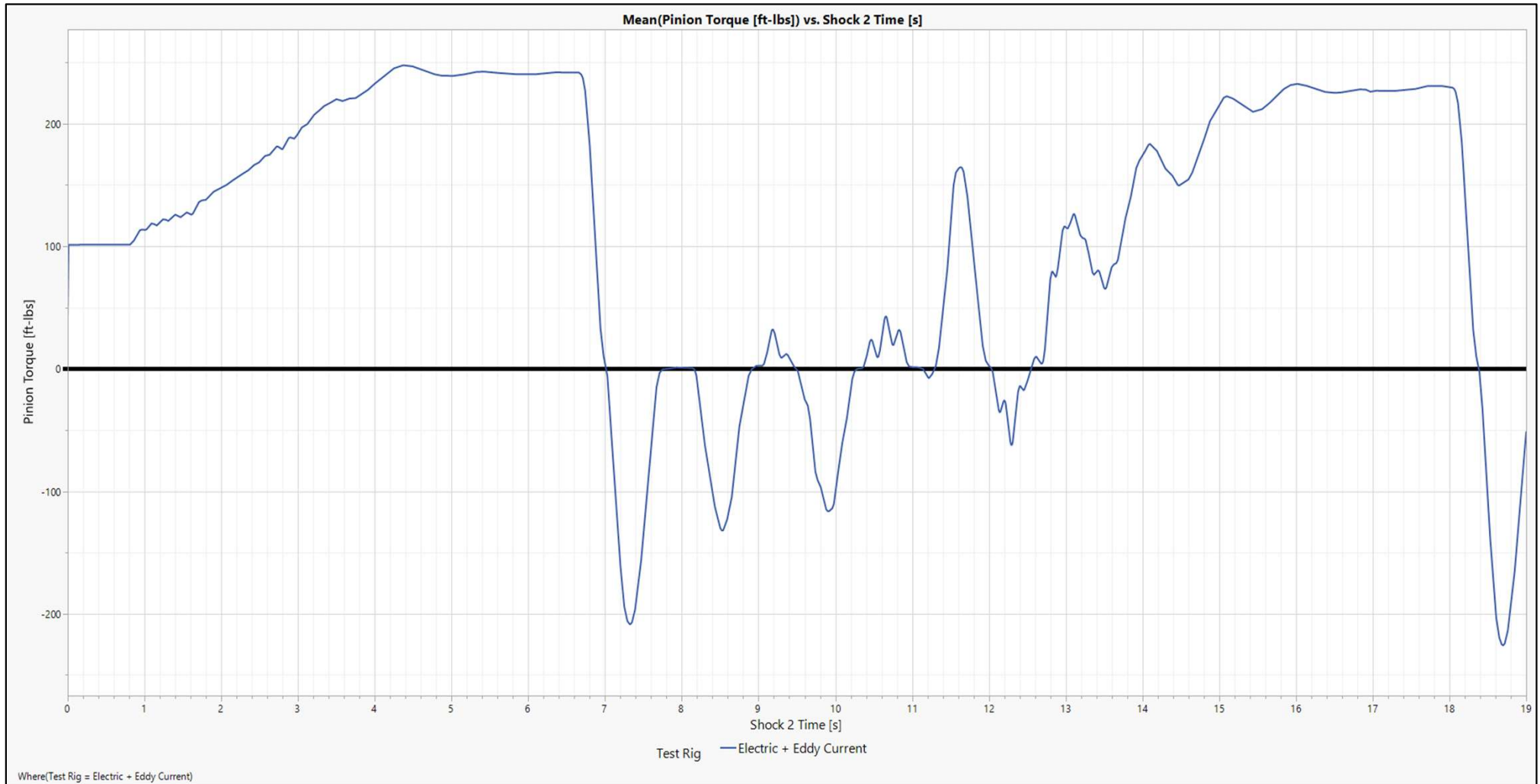
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Shock 2: Engine + Eddy Current Dynos



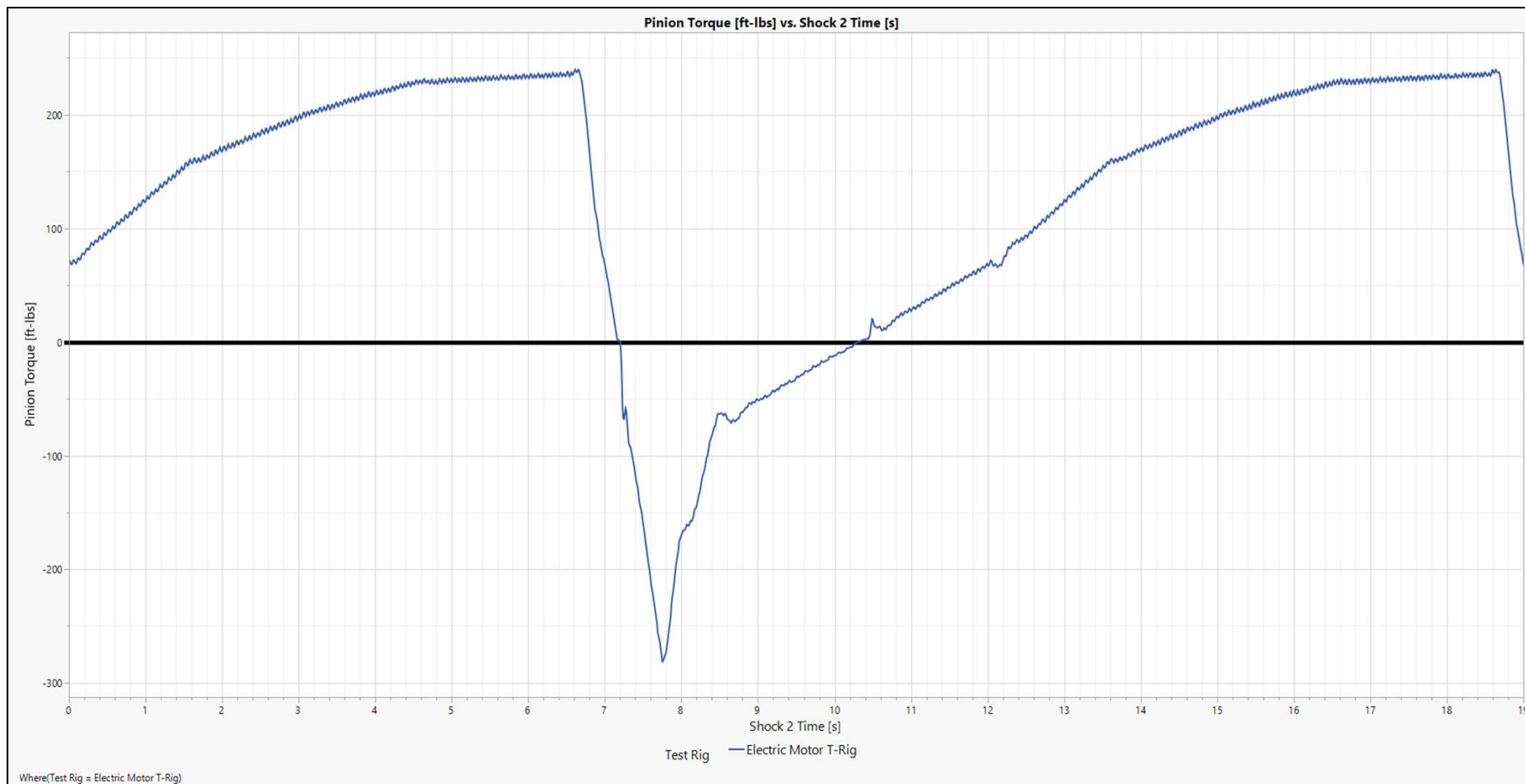
*100 Hz data collection rate

Shock 2: Electric Motor + Eddy Current Dynos



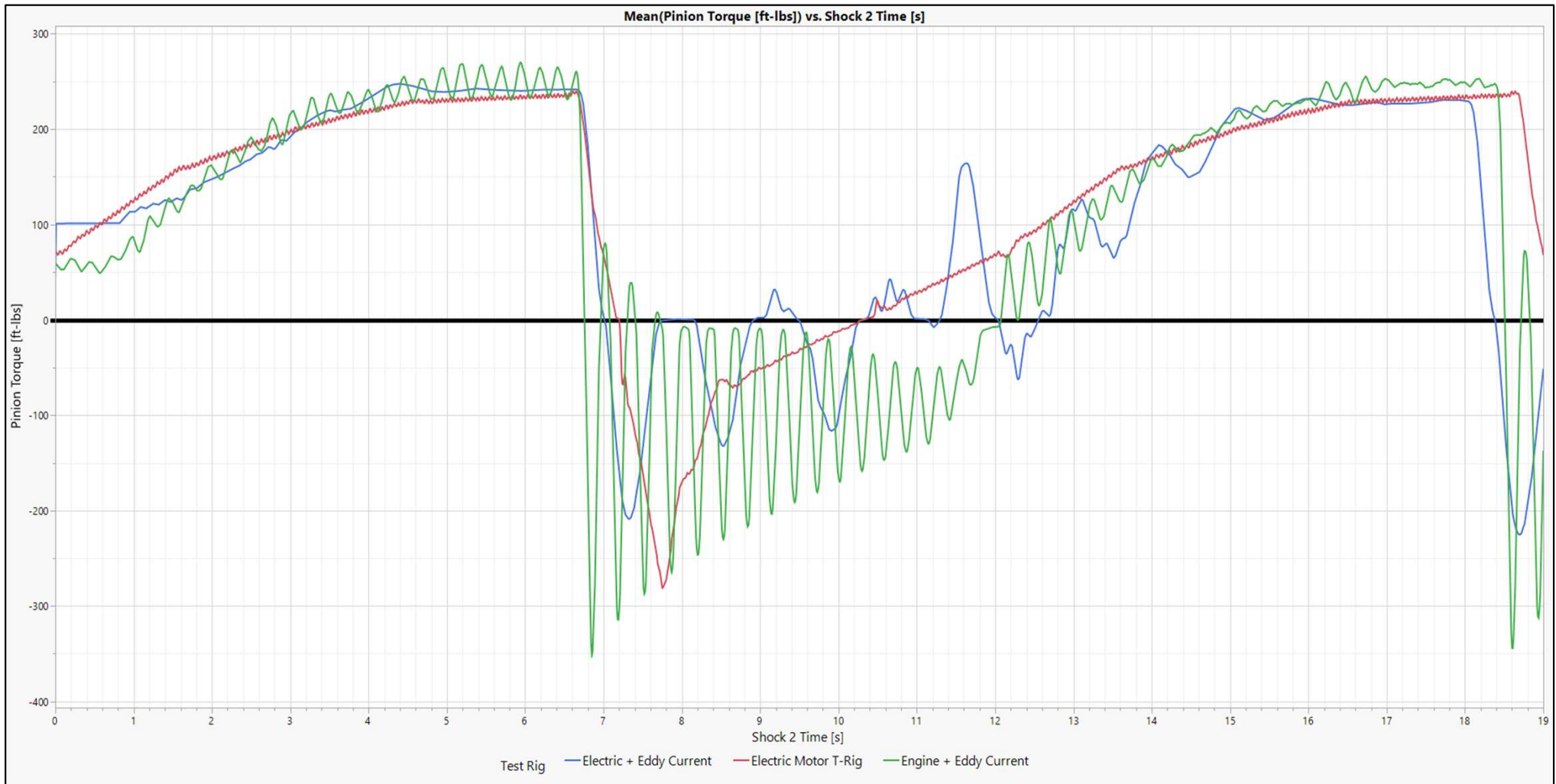
*100 Hz data collection rate

Shock 2: Electric Motor T-Rig



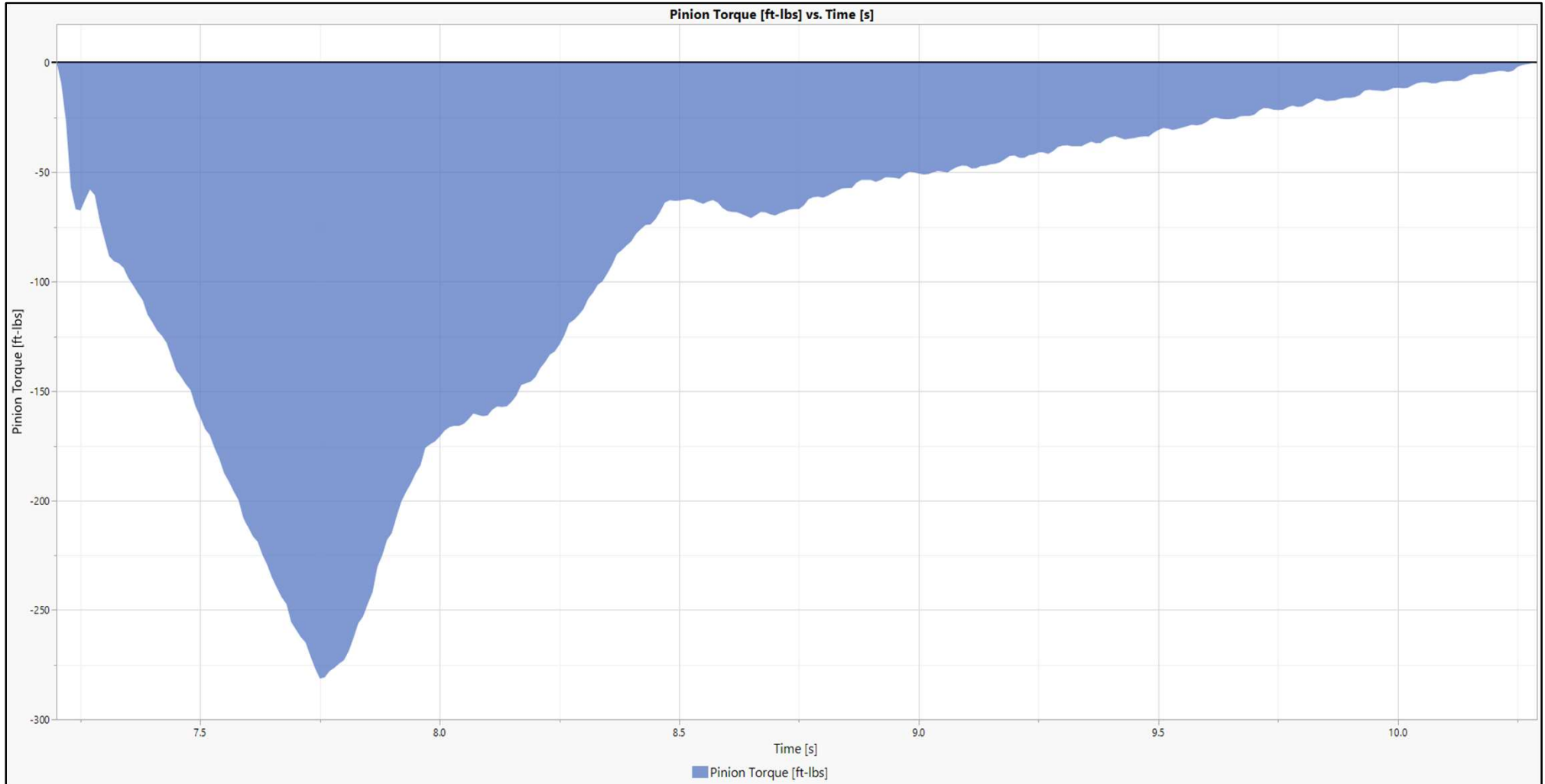
*100 Hz data collection rate

Shock 2 Overlay



*100 Hz data collection rate

Shock 2 Integral Approximation of Coast-Side Torque



Electric Motor T-Rig

Area: -266.7 ft-lb*s

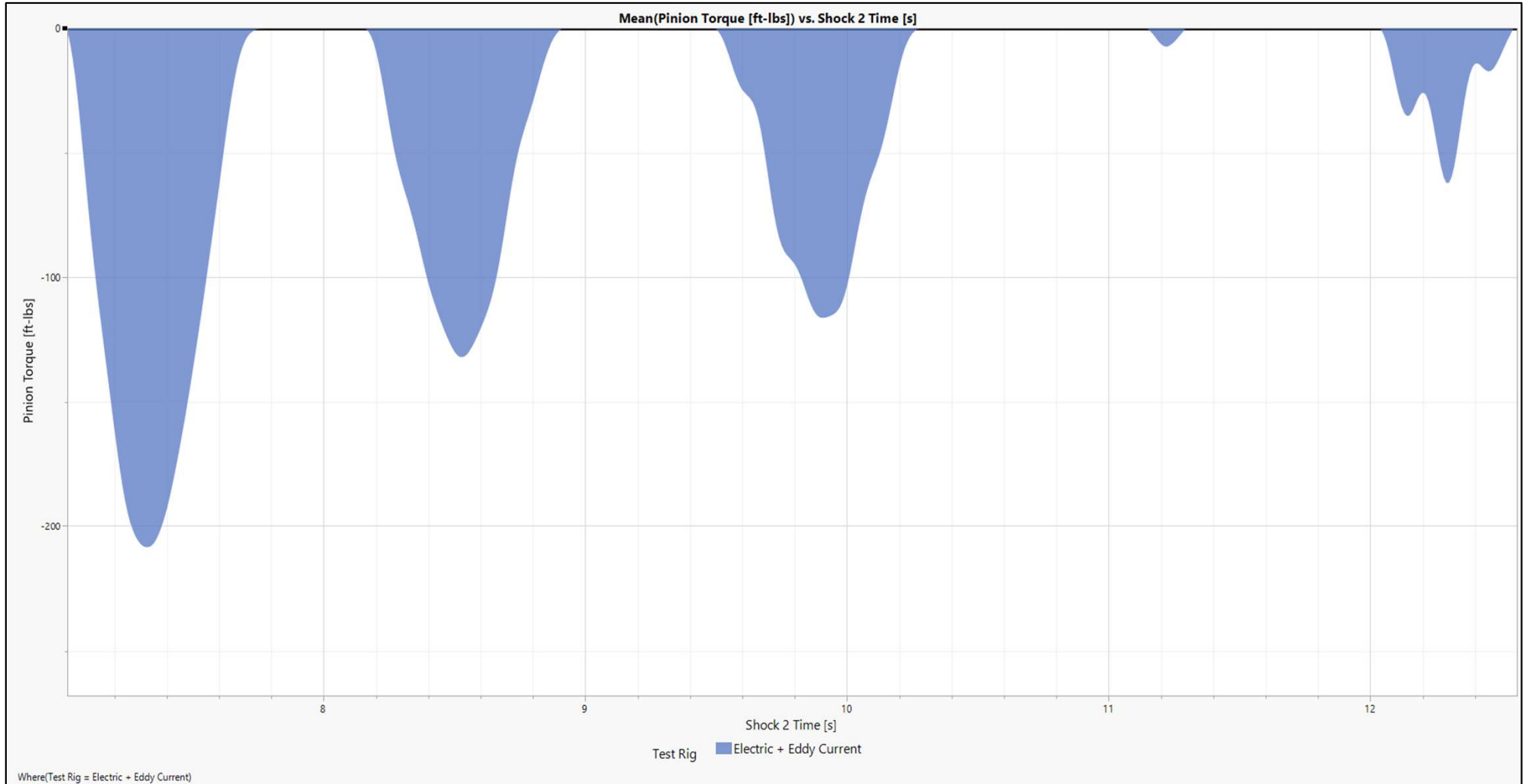
Peak: -281.4 ft-lb

Score P: 18



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Shock 2 Integral Approximation of Coast-Side Torque



Electric + Eddy Current

Area: -118.8 ft-lb*s

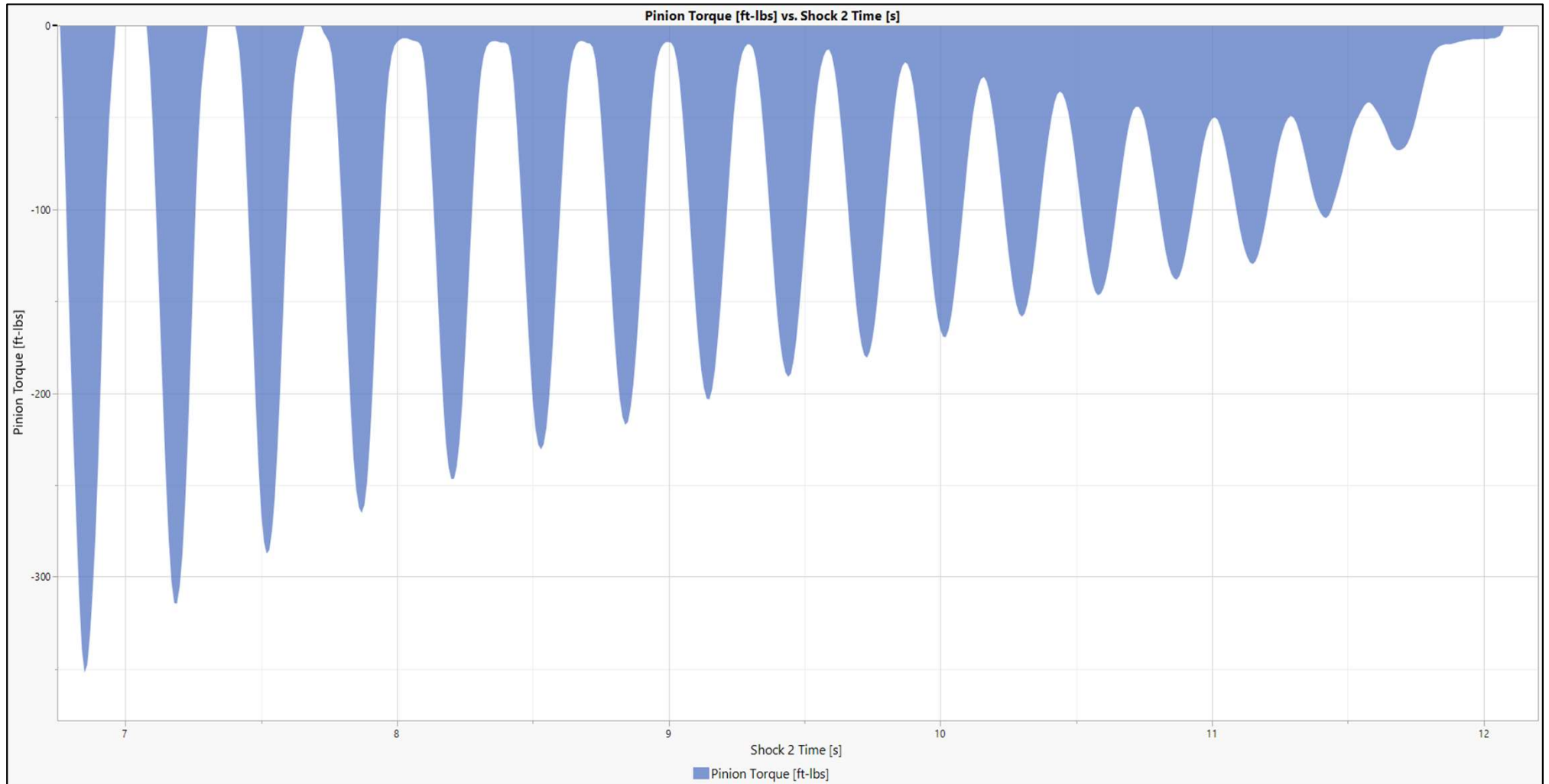
Peak: -208.5 ft-lb

Score P: 15



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Shock 2 Integral Approximation of Coast-Side Torque



Fired Engine + Eddy Current

Area: -491.6 ft-lb*s

Peak: -351.9 ft-lb

Score P: 18



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Summary / Conclusions / Next Steps

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Summary / Conclusions

Primary Objectives of L-42-1 Development:

- ▲ Eliminate Gas Engine on L-42 test
- ▲ Maintain current test severity and discrimination

Primary Driver of EOT Scoring:

- ▲ **Shock 2 Peak Torque**
 - Severity can be dialed in by changing torque setpoint

Parameters with Minimal Impact on EOT Scoring:

- ▲ Spring Plate 'Ringing'
- ▲ Time on Coast Side
- ▲ Repetitions of Shock 2

2 Types of Electric Rigs Produce similar Scoring Severity

- ▲ Simulated vs. Physical Inertia

Primary Concerns

Unequal loading of axle between Electric Motors and Eddy Current Dynos

- ▲ Physical vs. Simulated Inertia

Cost of Installing Full-Electric T-Rig is High

- ▲ Many options of varying cost available

Next Steps

Generate Reference Data on Electric + Eddy Current Rig

- ▲ ~280 ft-lbs Shock 2 Torque
- ▲ Repetitions of each phase – keep the same as current D7452
- ▲ Rigid Mounts?
- ▲ Hardware Donation?

Other Ideas?

New Issues



Thanks!



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Appendix

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Summary

Run #	Description	CMIR	TMC Oil Code	Note	Axle Batch	Profile	Pinion Scoring [%]	Ring Scoring [%]	Shock I Avg Tq [lbf-ft]	Shock II Avg Tq [lbf-ft]
256	Reference	176820	117	Pass Oil	MSPLO/P2AD01 (2023)	Ramp Rate / Torque Setpoints	36	24	-74.5	-333.5
257	Reference	184767	119	Disc. Oil	MSPLO/P2AD01 (2023)	Ramp Rate / Torque Setpoints	85	55	-74.3	-334.0
258	80W-90	-	-	J2360	MSPLO/P2AD01 (2023)	Ramp Rate / Torque Setpoints	14	7	-74.8	-333.3
259	75W-80	-	-	J2360	MSPLO/P2AD01 (2023)	Ramp Rate / Torque Setpoints	15	9	-74.1	-333.5
260	Reference	184759	117	Pass Oil	MSPLO/P2AD01 (2023)	Ramp Rate / Torque Setpoints	22	14	-73.5	-332.4
261	80W-90	-	-	Poor Perf.	MSPLO/P2AD01 (2023)	Ramp Rate / Torque Setpoints	67	61	-74.1	-333.8
262	Reference	184761	117	Pass Oil	MSPLO/P2AD01 (2023)	Ramp Rate / Torque Setpoints	34	25	-74.2	-333.5
263	Reference	184763	117	Pass Oil	MSPLO/P2AD01 (2023)	Single Shock 2	23	15	-74.3	-333.3
264	Reference	184765	117	Pass Oil	MSPLO/P2AD01 (2023)	Reduced Shock 2 Peak Torque	18	10	-74.5	-280.6

Gear Loading Data

TMC 117 Oil (Reduced S2 Torque)				
Operational Data				
	Conditioning 1		Conditioning 3	
	Wheel Speed (r/min)	Torques (lbf-ft)	Wheel Speed (r/min)	Torques (lbf-ft)
Maximum	576	62	816	74
Minimum	574	58	814	66
Average	575	60	815	70

TMC 117 Oil (Reduced S2 Torque)					
Operational Data					
		Conditioning 2		Conditioning 4	
		Wheel Speed (r/min)	Torques (lbf-ft)	Wheel Speed (r/min)	Torques (lbf-ft)
Drive Side	Maximum	576	126	815	125
	Minimum	574	125	815	124
	Average	575	125	815	124
Coast Side	Maximum	386	-75	670	-75
	Minimum	385	-77	670	-77
	Average	385	-76	670	-76

TMC 117 Oil (Reduced S2 Torque)				
Lubricant Temperature Data				
Phase	Specification	Average	Minimum	Maximum
Gear Conditioning (After reaching 215°F)	225 ± 10°F	225.5	215.1	230

TMC 117 Oil (Reduced S2 Torque)					
Gear Loading Data					
Gear Side		Shock Series 1		Shock Series 2	
		Wheel Speed (r/min)	Torques (lbf-ft)	Wheel Speed (r/min)	Torques (lbf-ft)
Drive	Maximum	1049	228	632	241
	Minimum	1048	228	631	240
	Average	1048	228	631	240
Coast	Maximum	530	-74	530	-279
	Minimum	529	-75	530	-281
	Average	530	-74	530	-281

TMC 117 Oil (Reduced S2 Torque)			
Lubricant Temperature Data			
Phase	Specification	Start Value	Maximum
Shock Series 1	200 ± 5 °F	196	274
Shock Series 2	< 280 °F	254	277

 Run 264

 Afton[®]
CHEMICAL

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Present	Name	Voting Non-Voting	Company Name Company Address	Contact information	
	Aguirre, Nancy	NV	Intertek Automotive Research	Phone:	
			5404 Bandera Rd. San Antonio, TX 78238	E-mail:	nancy.aguirre@intertek.com
NA	Ariemma, Nick	NV	The Lubrizol Corporation	Phone:	
			29400 Lakeland Boulevard Wickliffe, OH 44092	E-mail:	Nick.Ariemma@Lubrizol.com
REP	Banas, Rob	V	ExxonMobil Product Solutions	Phone:	770-833-5920
			535 Thomas Lane Waleska, GA 30183	E-mail:	rob.a.banas@exxonmobil.com
DB	Beck, Dylan	V	ASTM Test Monitoring Center	Phone:	724-355-1854
			203 Armstrong Drive Freeport, PA 16229	E-mail:	djb@astmtmc.org
DB	Bell, Don	NV	Afton Chemical	Phone:	804-788-6332
			500 Spring St. Richmond, VA 23219	E-mail:	don.bell@aftonchemical.com


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Present	Name	Voting Non-Voting	Company Name Company Address	Contact information	
TBS	Bender, Tobias	NV	Fuchs Lubricants	Phone:	708-737-1681
			17050 Lathrop Ave Harvey, IL 60426	E-mail:	Tobias.Bender@fuchs.com
Virtual	Burgman, Maxim	NV	Fuchs Lubricants	Phone:	248-846-3120
			17050 Lathrop Ave Harvey, IL 60426	E-mail:	maxim.burgman@fuchs.com
Virtual	Campbell, Bob	NV	Afton Chemical	Phone:	804-788-5340
			500 Spring St. Richmond, VA 23219	E-mail:	Bob.Campbell@aftonchemical.com
MC	Caridi, Margaret	NV	BASF	Phone:	914-785-2336
			500 White Plains Rd Tarrytown, NY 10591	E-mail:	margaret.caridi@basf.com
JFC	Carowick, Jessica	V	Cummins-Mentor	Phone:	248-872-3055
			2135 W. Maple Rd Troy, MI 48084	E-mail:	Jessica.LaBond@cummins.com


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Present	Name	Voting Non-Voting	Company Name Company Address	Contact information	
HC	Catania, Hailey	NV	Cummins- Meritor	Phone:	248-821-9862
			2135 W. Maple Rd Troy, MI 48084	E-mail:	Hailey.Catania@cummins.com
	Cereghino, Brian	NV	IPAC Inc.	Phone:	
				E-mail:	bcereghino@ipac-inc.com
	Charron, Michael	NV	Southwest Research Institute	Phone:	832-444-2180
			6220 Culebra Rd. San Antonio, TX 78238	E-mail:	michael.charron@swri.org
JAC	Clark, Jeff	NV	ASTM Test Monitoring Center	Phone:	412-365-1032
			203 Armstrong Drive Freeport, PA 16229	E-mail:	jac@astmtmc.org
AIC	Comfort, Allen	V	US Army DEVCOM	Phone:	586-282-4225
				E-mail:	allen.s.comfort.civ@army.mil




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	Fry, Enia	NV	Daimler Truck	Phone:	313-802-2835
				E-mail:	enia.fry@daimlertruck.com
	Gingerich, Jason	NV	The Lubrizol Corporation	Phone:	440-391-0101
			29400 Lakeland Boulevard Wickliffe, OH 44092	E-mail:	Jason.Gingerich@lubrizol.com
	Goyal, Arjun	V	BASF	Phone:	914-785-2083
			500 White Plains Rd Tarrytown, NY 10591	E-mail:	arjun.goyal@basf.com
	Grundza, Rich	NV	ASTM Test Monitoring Center	Phone:	412-365-1031
			203 Armstrong Drive Freeport, PA 16229	E-mail:	reg@astmtmc.org
	Hahn, Hyeok	NV	Chevron Oronite	Phone:	408-507-2848
				E-mail:	hyeok.hahn@chevron.com

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	Haynes, Troy	NV	IPAC Inc.	Phone:	
				E-mail:	thaynes@ipac-inc.com
	Horvath, Dan	NV	Afton Chemical	Phone:	248-514-2551
			2000 Town Center, Suite 1160 Southfield, MI 48075	E-mail:	dan.horvath@aftonchemical.com
	Jackson, Alexander	NV	Chevron Oronite	Phone:	510-367-7541
			4502 Centerview, Suite 210 San Antonio, TX 78228	E-mail:	alexmjack@chevron.com
	Jordan, Brad	NV	Shell	Phone:	804-516-1238
			2084 Ditchley Rd VA 22482	E-mail:	Kilmarnock, brad.jordan@shell.com
	Joy, Tisha	NV	BASF	Phone:	914-785-2206
				E-mail:	tisha.joy@basf.com

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Present	Name	Voting Non-Voting	Company Name Company Address	Contact information	
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