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Committee D02 on PETROLEUM PRODUCTS AND LUBRICANTS

August 3rd, 2016

Reply to:
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ASTM D02.B0.03 L-37-1 Surveillance Panel
Members and Guests:

Attached for your review and comment are the unconfirmed minutes of the:

- **May 11th 2016, Surveillance Panel Meeting in Troy, MI**

Please direct any corrections or comments to my attention.

Sincerely,

Matthew Umerley

Matt Umerley, Chairman
L-37-1 Hardware Taskforce Chairman

Report of Meeting
L-37-1 Surveillance Panel Meeting
May 11th, 2016 Meeting

Attendees:
Voting Members in **BOLD**
Bell, Don – Afton
Bubonic, Brad – Lubrizol
Comfort, Allen – US Army
Dharte, John – AAM
Dennis, Mike – Gleason
Dononan, Eric – Afton
Dwornick, Bridget – US Army
Goyal, Arjun – BASF
Marsic, Vera – Lubrizol
Milner, Jeff – Tianhe Chemical
Muransky, Troy – Meritor
Parke, Scott – ASTM TMC
Reardon, Art – Gleason
Smith, Dale – Intertek
Trader, Angela - Intertek
Umerley, Matt – Lubrizol
Venhoff, Wes – Lubrizol
Warden, Rebecca – SwRI

1.0 Call to Order

2.0 Membership Review
T. Muransky to replace B. McGlone

3.0 Approval of Meeting Minutes
L37
20151027
20160125
20160210
20160318

L371
20151104
20151208
20160111
20160210
20160328

R. Warden – Motion
D. Smith – 2nd

4.0 L-37-1 Statistical Analysis

Presentation attached

5.0 L-37-1 Next Steps

Gleason to analyze gears from Afton and Intertek
R. Warden to use Gleason analysis results to create test matrix

6.0 New Business

A.Goyal Motion to adjourn
E.Donovan 2nd

Respectfully Submitted
Matt Umerley

Lubrizol

being essential

L-37-1

May 11th 2016 Automation Alley, MI

Agenda

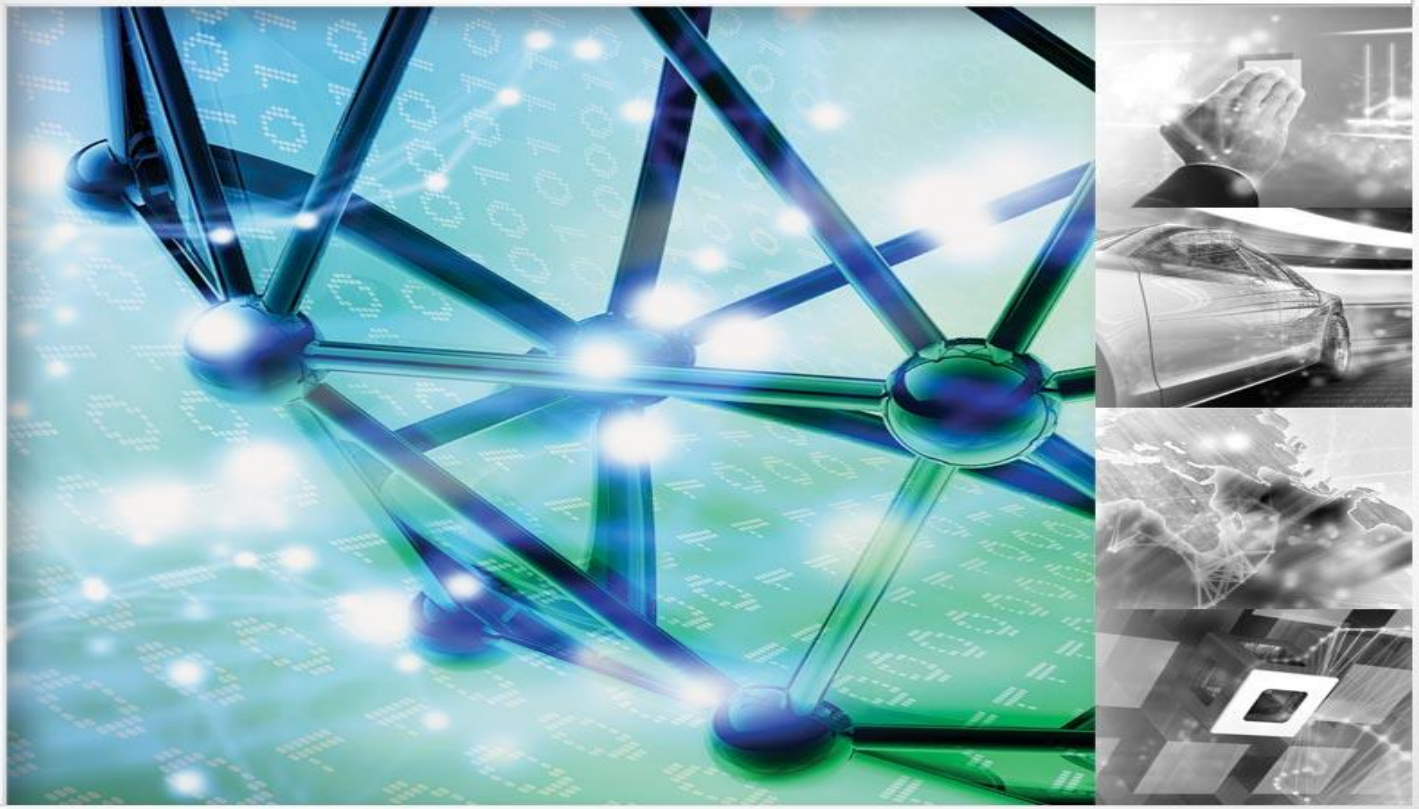
- Membership Review
- Meeting Minutes
- L-37-1 Statistical Analysis
- L-37-1 Next Steps
- New Business

Membership Review – Voting Members

- Rob Banas – ExxonMobil
- Allen Comfort – US Army
- John Dharte – AAM
- Eric Donovan – Afton
- Arjun Goyal – BASF
- Joe Guzikowski – Dana
- Donna Mosher – Eaton
- Troy Muransky – Meritor
- Scott Parke – TMC
- Dale Smith – Intertek
- Matt Umerley – Lubrizol
- Rebecca Warden – SwRI
- Khaled Zreik - GM

Meeting Minutes

- L-37-1
  - 20151104
  - 20151208
  - 20160111
  - 20160210
  - 20160328
- L-37
  - 20151027
  - 20160125
  - 20160210
  - 20160318



L-37 Gleason Hardware Analysis

Pete Sherick

May 2016

Lubrizol

Overview

Mech Test requested an analysis of recent L-37-1 testing with Gleason hardware.
The data consists of 5 oils, tested at 4 different labs from the past year and a half.
Wear, Ridging and Rippling were analyzed, but it was not possible to explain many of the poor results.
It is suspected that parts batches and test procedure differences are playing a significant role.

LTMS Targets

	Pinion				
	Wear	**Rippling**	**Ridging**	**Pitt/Spall**	**Scoring**
TMC134	4 - 8	6 - 10	3 - 9	1 - 7	10
TMC152-2	6 - 8	7 - 10	7 - 10	7 - 10	10
TMC155	6 - 8	6 - 10	7 - 10	5 - 10	10

Ring+Pinion Wear Model

SUCCESS TOGETHER

LABEL	ACTIVITY PROB	EFFECT MEAN	DATA MIN	DATA MAX	# NON-ZERO
CANADIAN PROC	0.16	-0.044	0	1	9
HIGH LOAD	0.11	0.014	0	1	43
ABS(CASEDIFF)*	0.36	-13.417	0	0.033	60
ABS(HARDDIFF)*	0.12	-0.011	0	2	52
SBTFAXTN*	0.51	0.011	0	65.08	43
LAB B	0.98	1.525	0	1	17
LAB D	0.84	-0.815	0	1	15
LAB G	0.85	0.999	0	1	14
OIL 117	1.00	0.292	0	1	15
OIL 155	1.00	0.196	0	1	19
OIL IND	1.00	-0.848	0	1	9
INTERCEPT (LAB A, OIL 152)	.	15.234	.	.	.

Model primarily suggests large lab differences and some test/parts discrepancies.

Robust Bayesian Model Averaging Analysis

Activity Probability gives indication of effect's importance with values closer to 1 more likely to have an effect (>0.35 rule of thumb). OIL terms are forced so always have activity = 1. Effect mean is the average coefficient over many iterations of model fitting via Gibbs sampler.

Oil 134 excluded from model (too dissimilar from pass oils).

*To retain data, missing values were set to zero for these terms.

Pinion Wear Model

LABEL	ACTIVITY PROB	EFFECT MEAN	DATA MIN	DATA MAX	# NON-ZERO
CANADIAN PROC	0.16	-0.022	0	1	9
HIGH LOAD	0.15	0.015	0	1	43
ABS(CASEDIFF)*	0.18	-1.553	0	0.033	60
ABS(HARDDIFF)*	0.15	-0.012	0	2	52
SBTFAXTN*	0.63	0.009	0	65.08	43
LAB B	0.92	0.709	0	1	17
LAB D	0.44	-0.166	0	1	15
LAB G	0.72	0.415	0	1	14
OIL 117	1.00	0.205	0	1	15
OIL 155	1.00	0.051	0	1	19
OIL IND	1.00	-0.363	0	1	9
INTERCEPT (LAB A, OIL 152)	.	7.180	.	.	.

Fairly similar to Pinion+Ring Wear model.

Robust Bayesian Model Averaging Analysis
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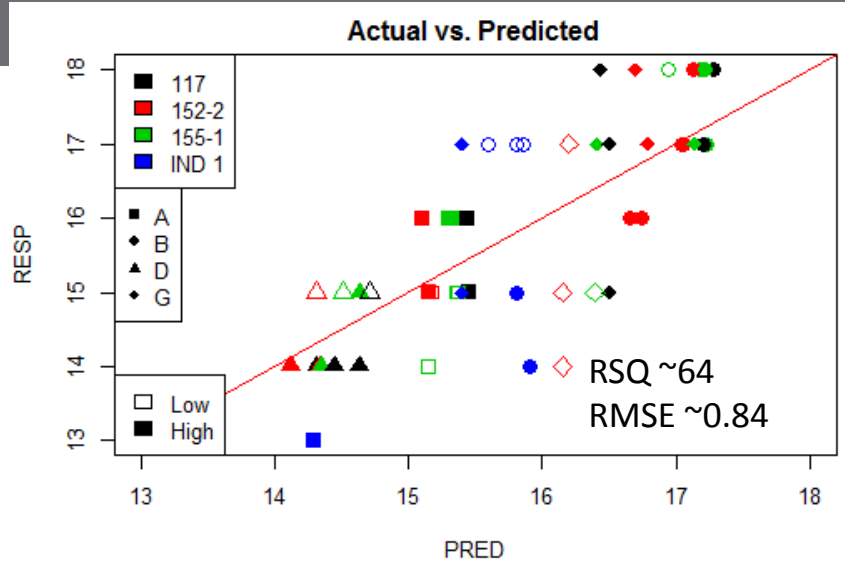
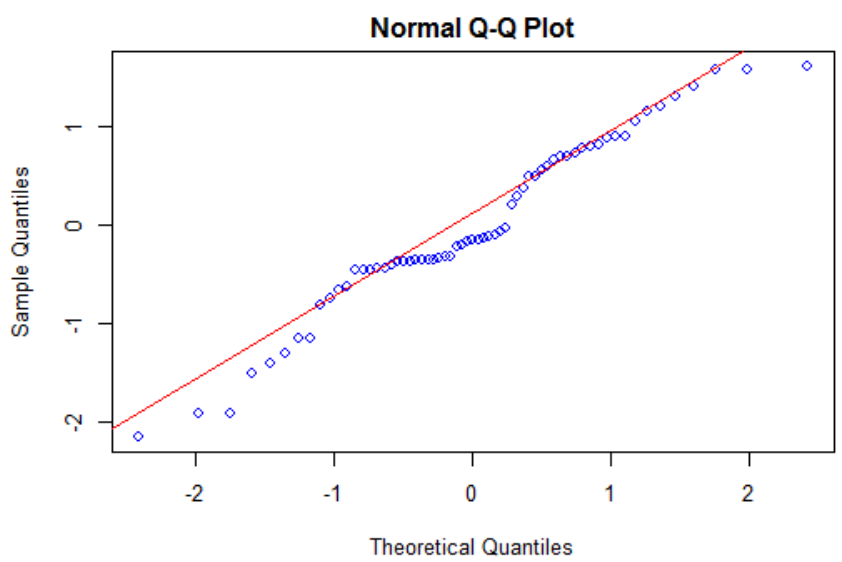
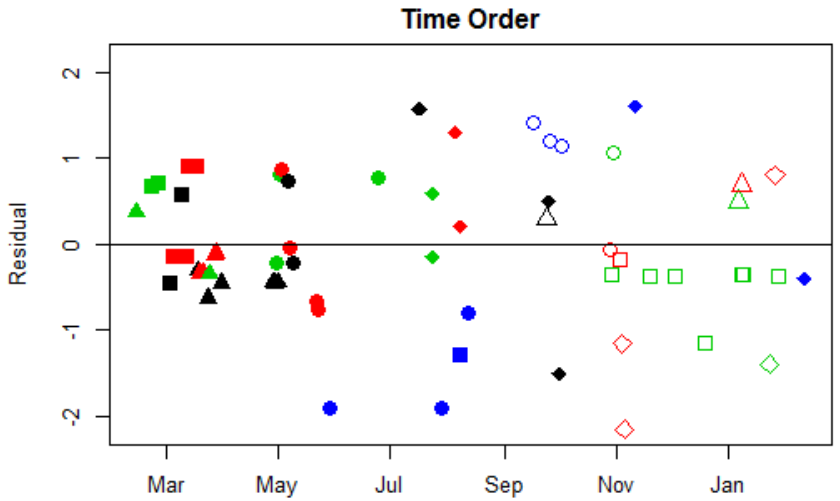
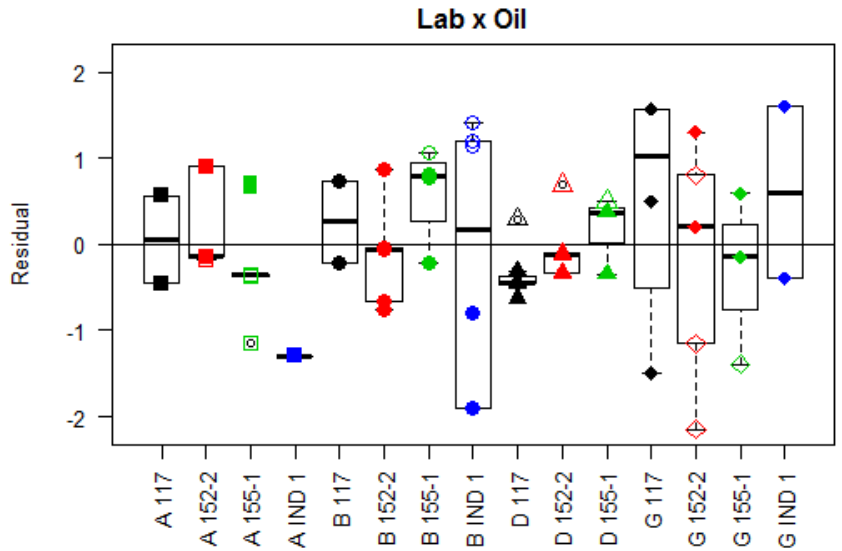
Ring+Pinion Wear Model



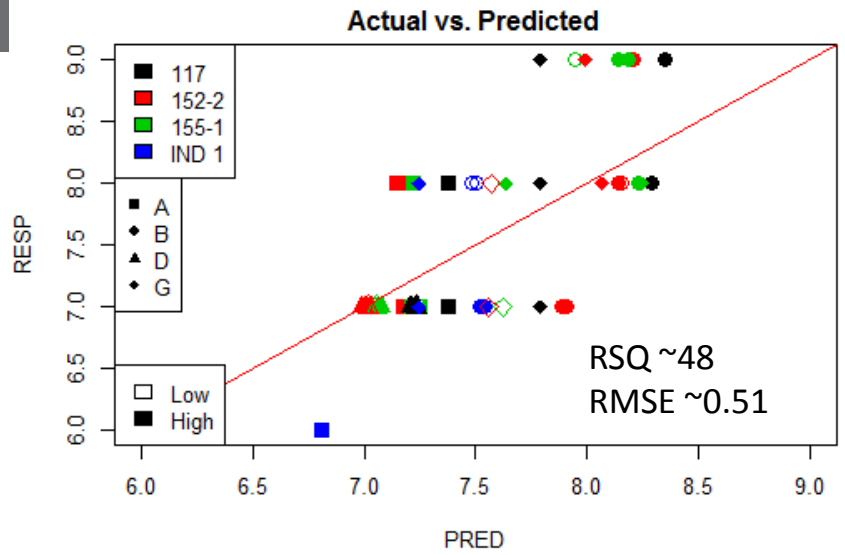


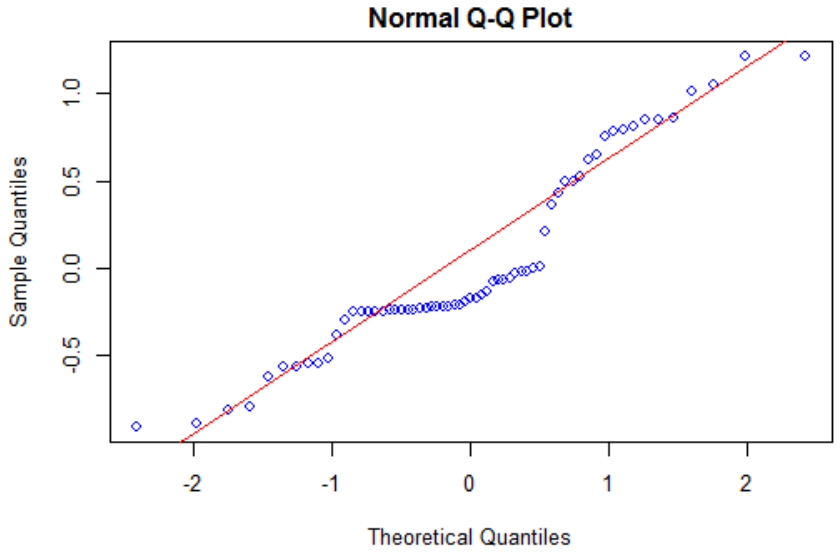


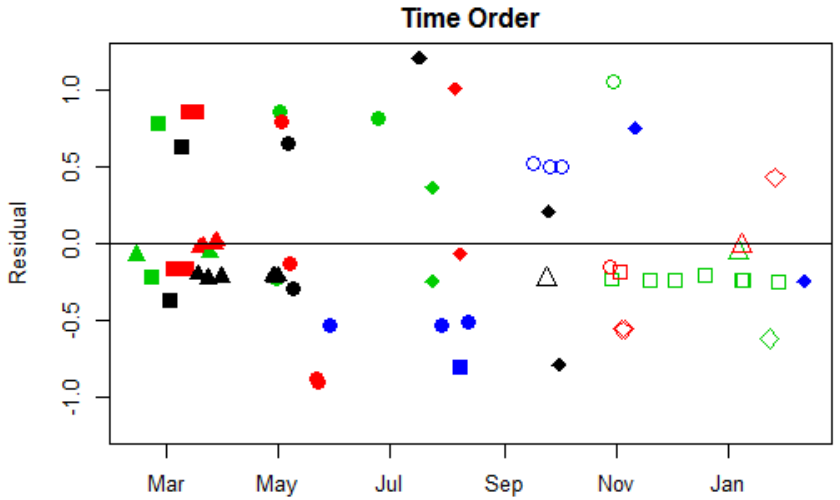


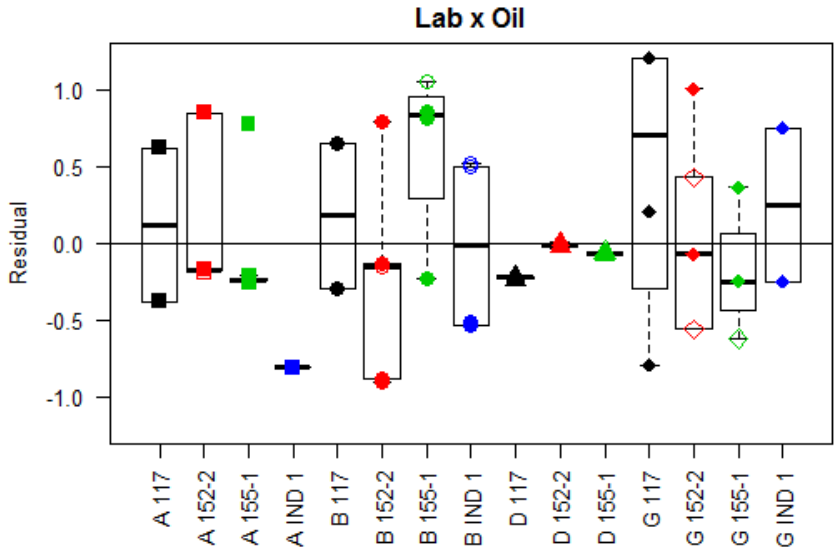
Model predicts reasonably well

Pinion Wear Model









Model predicts ok for discrete response

Ring+Pinion Ridging Model

LABEL	ACTIVITY PROB	EFFECT MEAN	DATA MIN	DATA MAX	# NON-ZERO
CANADIAN PROC	0.16	-0.044	0	1	9
HIGH LOAD	0.30	-0.186	0	1	43
ABS(CASEDIFF)*	0.76	-45.944	0	0.033	60
ABS(HARDDIFF)*	0.13	-0.031	0	2	52
SBTFAXTN*	0.13	-0.001	0	65.08	43
LAB B	0.58	0.481	0	1	17
LAB D	0.27	-0.172	0	1	15
LAB G	0.17	0.026	0	1	14
OIL 117	1.00	-0.668	0	1	15
OIL 155	1.00	0.672	0	1	19
OIL IND	1.00	-0.386	0	1	9
INTERCEPT (LAB A, OIL 152)	.	19.055	.	.	.

Ring/Pinion Batches seem to have an effect. Lowering load slightly helpful.

Robust Bayesian Model Averaging Analysis

Activity Probability gives indication of effect's importance with values closer to 1 more likely to have an effect (>0.35 rule of thumb). OIL terms are forced so always have activity = 1. Effect mean is the average coefficient over many iterations of model fitting via Gibbs sampler.

Oil 134 excluded from model (too dissimilar from pass oils).

*To retain data, missing values were set to zero for these terms.

Pinion Ridging Model

SUCCESS TOGETHER

LABEL	ACTIVITY PROB	EFFECT MEAN	DATA MIN	DATA MAX	# NON-ZERO
CANADIAN PROC	0.14	-0.015	0	1	9
HIGH LOAD	0.51	-0.241	0	1	43
ABS(CASEDIFF)*	0.62	-18.233	0	0.033	60
ABS(HARDDIFF)*	0.13	-0.009	0	2	52
SBTFAXTN*	0.13	0.000	0	65.08	43
LAB B	0.75	0.478	0	1	17
LAB D	0.39	-0.217	0	1	15
LAB G	0.24	0.085	0	1	14
OIL 117	1.00	-0.457	0	1	15
OIL 155	1.00	0.364	0	1	19
OIL IND	1.00	-0.199	0	1	9
INTERCEPT (LAB A, OIL 152)	.	9.312	.	.	.

Ring/Pinion Batches seem to have an effect. Lowering load slightly helpful.

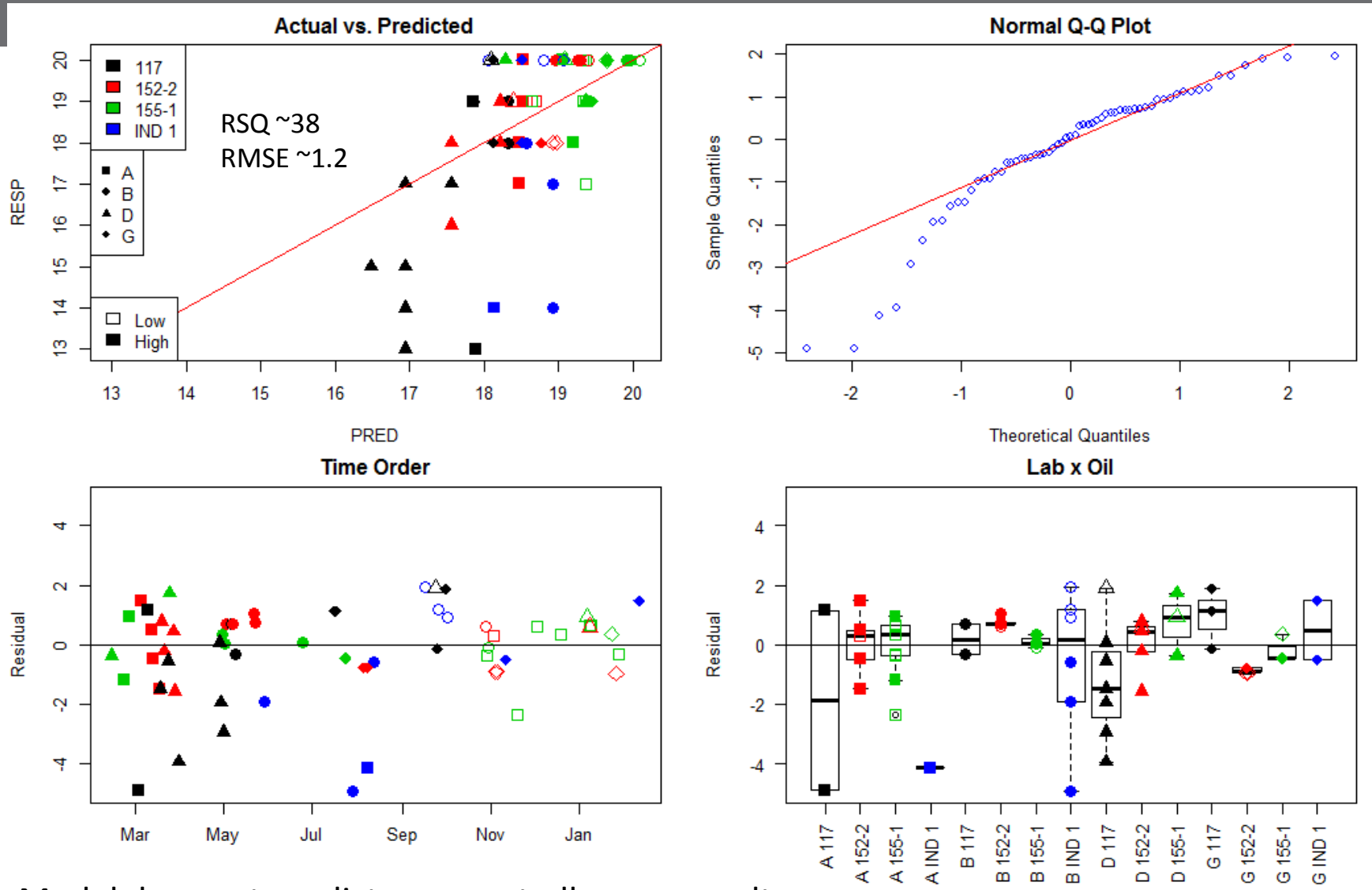
Robust Bayesian Model Averaging Analysis

Activity Probability gives indication of effect's importance with values closer to 1 more likely to have an effect (>0.35 rule of thumb). OIL terms are forced so always have activity = 1. Effect mean is the average coefficient over many iterations of model fitting via Gibbs sampler.

Oil 134 excluded from model (too dissimilar from pass oils).

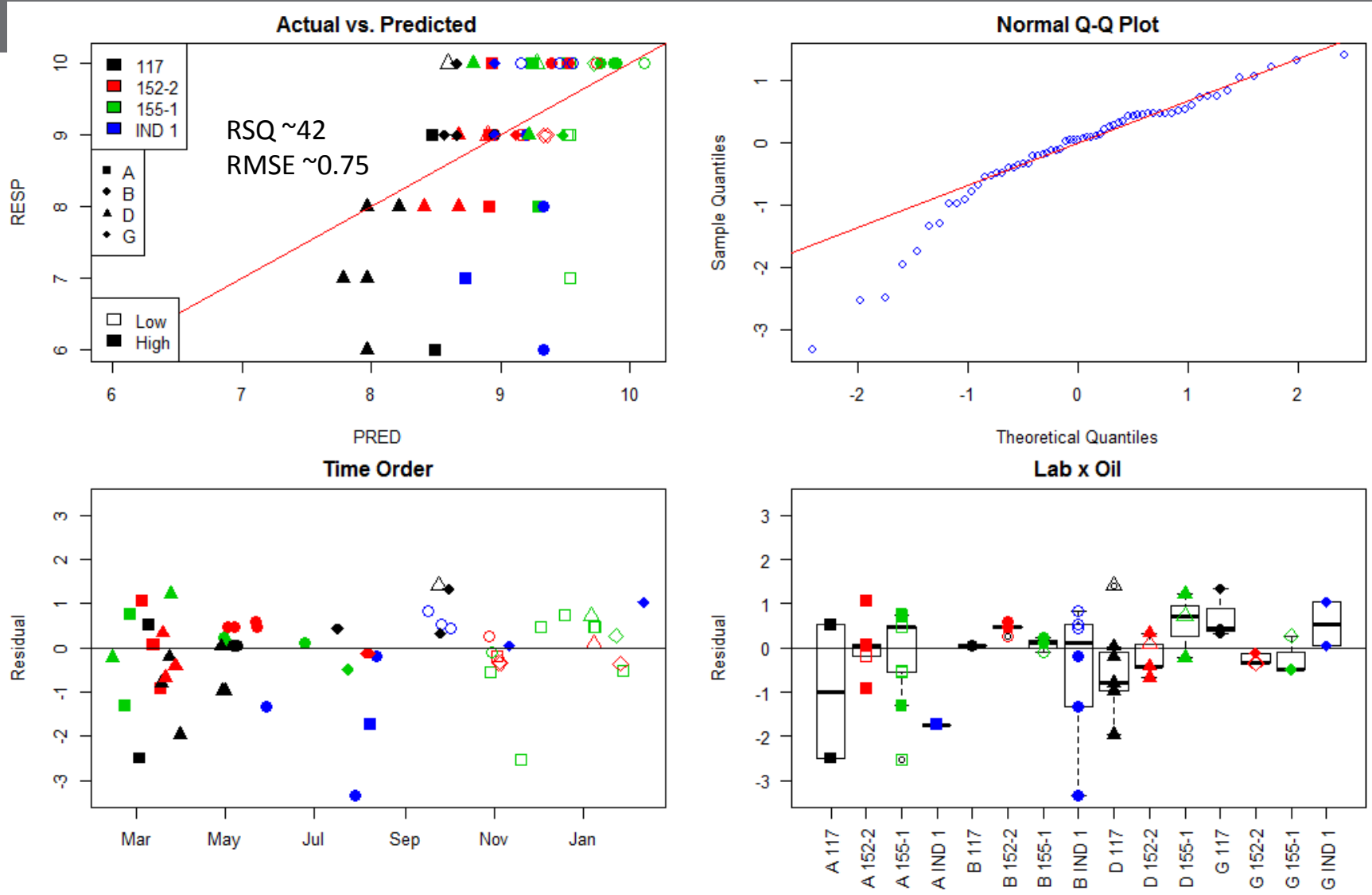
*To retain data, missing values were set to zero for these terms.

Ring+Pinion Ridging Model



Model does not predict unexpectedly poor results

Pinion Ridging Model



Model does not predict unexpectedly poor results, discrete response

Ring+Pinion Ripple Model

SUCCESS TOGETHER

LABEL	ACTIVITY PROB	EFFECT MEAN	DATA MIN	DATA MAX	# NON-ZERO
CANADIAN PROC	0.14	0.026	0	1	9
HIGH LOAD	0.13	-0.006	0	1	43
ABS(CASEDIFF)*	0.14	0.561	0	0.033	60
ABS(HARDDIFF)*	0.17	0.055	0	2	52
SBTFAXTN*	0.15	0.001	0	65.08	43
LAB B	0.94	1.533	0	1	17
LAB D	0.53	0.602	0	1	15
LAB G	0.50	0.575	0	1	14
OIL 117	1	-0.190	0	1	15
OIL 155	1	0.277	0	1	19
OIL IND	1	-1.106	0	1	9
INTERCEPT (LAB A, OIL 152)	.	17.906	.	.	.

Very little going on except for lab differences

Robust Bayesian Model Averaging Analysis
Activity Probability gives indication of effect's importance with values closer to 1 more likely to have an effect (>0.35 rule of thumb). OIL terms are forced so always have activity = 1. Effect mean is the average coefficient over many iterations of model fitting via Gibbs sampler.
Oil 134 excluded from model (too dissimilar from pass oils).
*To retain data, missing values were set to zero for these terms.

Pinion Ripple Model

LABEL	ACTIVITY PROB	EFFECT MEAN	DATA MIN	DATA MAX	# NON-ZERO
CANADIAN PROC	0.15	0.027	0	1	9
HIGH LOAD	0.12	-0.013	0	1	43
ABS(CASEDIFF)*	0.15	-0.329	0	0.033	60
ABS(HARDDIFF)*	0.13	0.013	0	2	52
SBTFAXTN*	0.15	0.001	0	65.08	43
LAB B	0.92	1.396	0	1	17
LAB D	0.54	0.578	0	1	15
LAB G	0.64	0.735	0	1	14
OIL 117	1.00	-0.167	0	1	15
OIL 155	1.00	0.144	0	1	19
OIL IND	1.00	-0.977	0	1	9
INTERCEPT (LAB A, OIL 152)	.	8.169	.	.	.

Very little going on except for lab differences

Robust Bayesian Model Averaging Analysis
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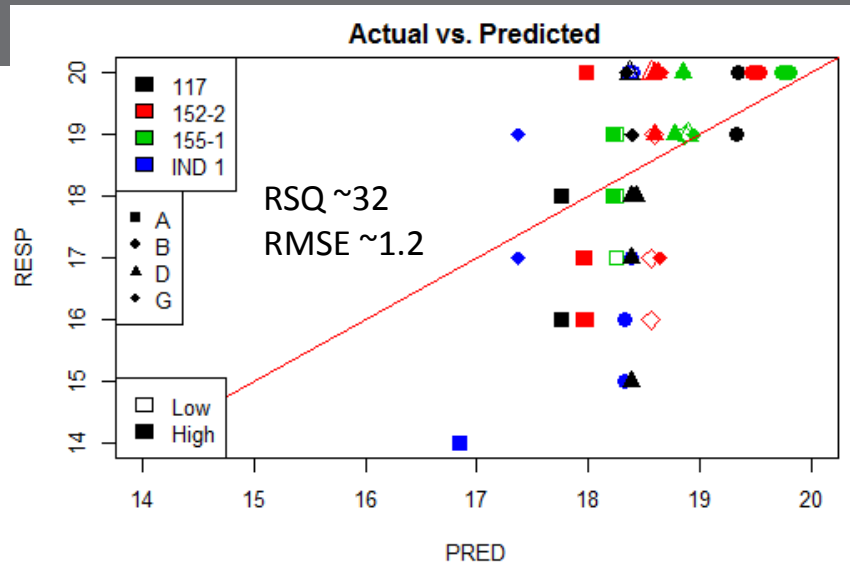
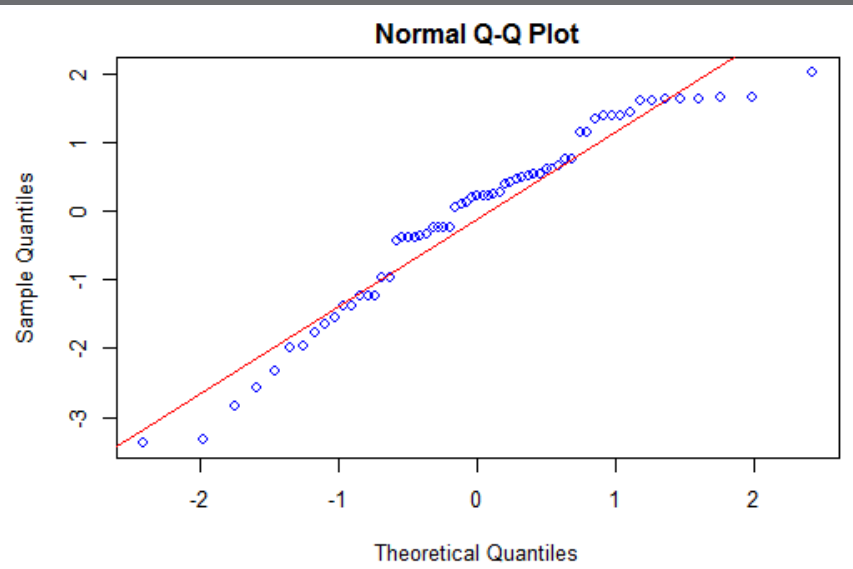
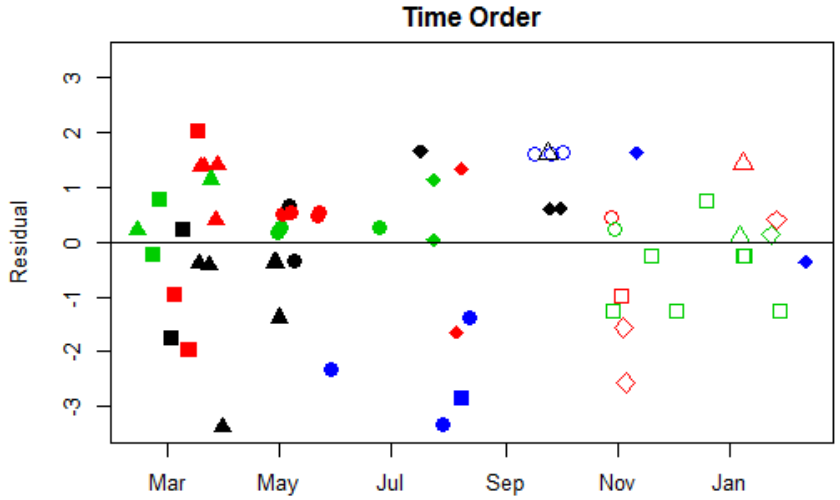
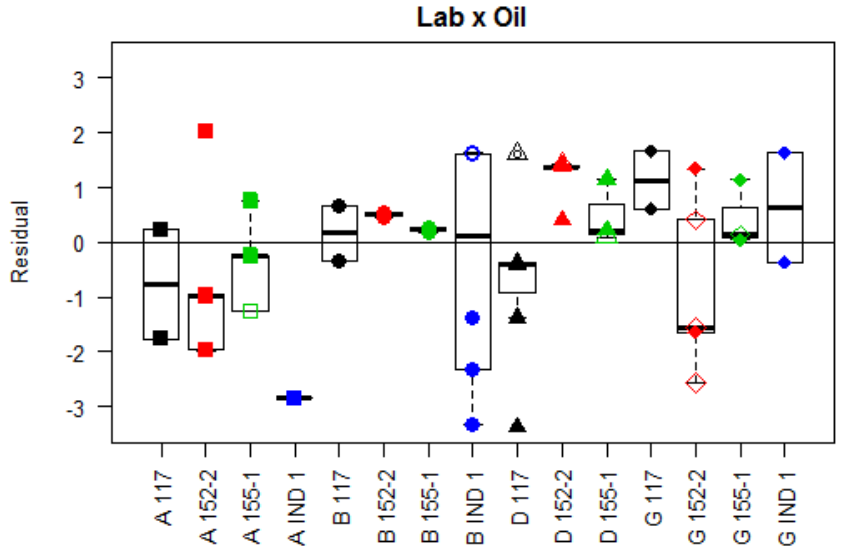
Ring+Pinion Ripple Model



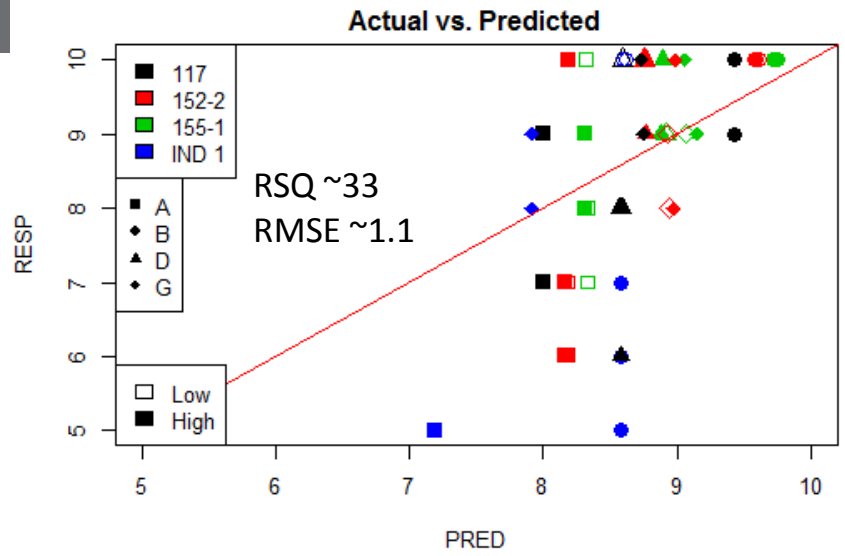


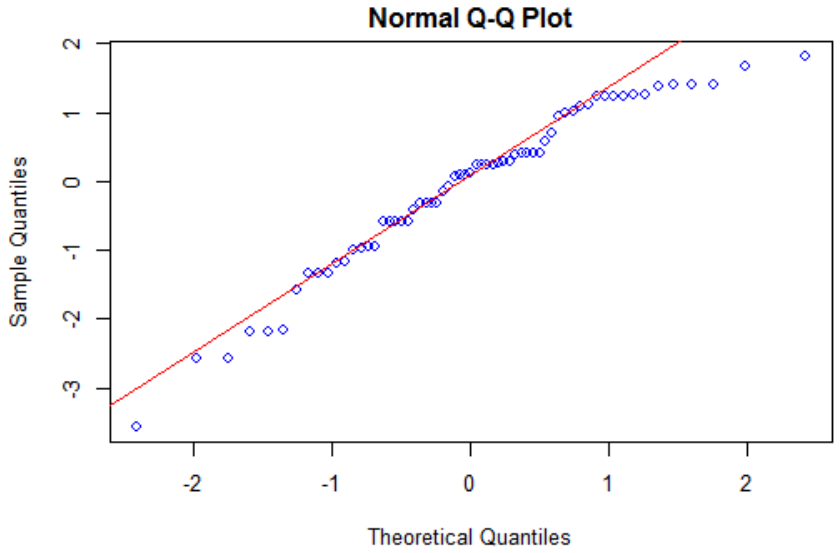


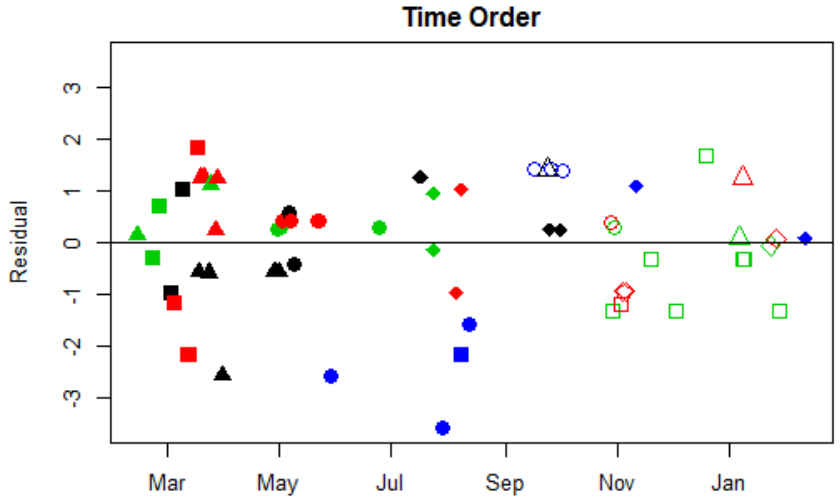


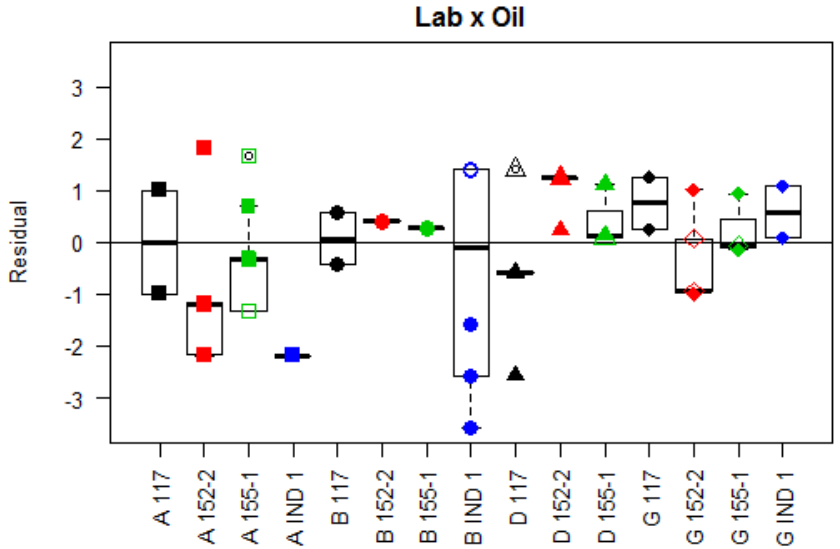
Model does not predict well, questionable parameter repeatability

Pinion Ripple Model









Model does not predict well, questionable parameter repeatability

Ring+Pinion Wear+Ridging+Ripple Model

SUCCESS TOGETHER

NAME	ACTIVITY PROB	EFFECT MEAN	DATA MIN	DATA MAX	# NON-ZERO
CANADIAN PROC	0.15	-0.166	0	1	9
HIGH LOAD	0.12	-0.060	0	1	43
ABS(CASEDIFF)*	0.46	-50.444	0	0.033	60
ABS(HARDDIFF)*	0.12	0.026	0	2	52
SBTFAXTN*	0.14	0.003	0	65.08	43
LAB B	1.00	4.455	0	1	17
LAB D	0.14	-0.032	0	1	15
LAB G	0.70	2.027	0	1	14
OIL 117	1.00	-0.939	0	1	15
OIL 155	1.00	1.229	0	1	19
OIL IND	1.00	-2.091	0	1	9
INTERCEPT (LAB A, OIL 152)	.	51.788	.	.	.

Lab and Parts playing a role

Robust Bayesian Model Averaging Analysis
Activity Probability gives indication of effect's importance with values closer to 1 more likely to have an effect (>0.35 rule of thumb). OIL terms are forced so always have activity = 1. Effect mean is the average coefficient over many iterations of model fitting via Gibbs sampler.
Oil 134 excluded from model (too dissimilar from pass oils).
*To retain data, missing values were set to zero for these terms.

Pinion Wear+Ridging+Ripple Model

SUCCESS TOGETHER

NAME	ACTIVITY PROB	EFFECT MEAN	DATA MIN	DATA MAX	# NON-ZERO
CANADIAN PROC	0.12	-0.023	0	1	9
HIGH LOAD	0.12	-0.034	0	1	43
ABS(CASEDIFF)*	0.16	-4.345	0	0.033	60
ABS(HARDDIFF)*	0.11	-0.004	0	2	52
SBTFAXTN*	0.13	0.001	0	65.08	43
LAB B	1.00	3.294	0	1	17
LAB D	0.15	0.034	0	1	15
LAB G	0.91	1.917	0	1	14
OIL 117	1.00	-0.573	0	1	15
OIL 155	1.00	0.620	0	1	19
OIL IND	1.00	-1.690	0	1	9
INTERCEPT (LAB A, OIL 152)	.	24.225	.	.	.

Lab effects nearly as large as Ring+Pinion model, parts effects diminished

Robust Bayesian Model Averaging Analysis
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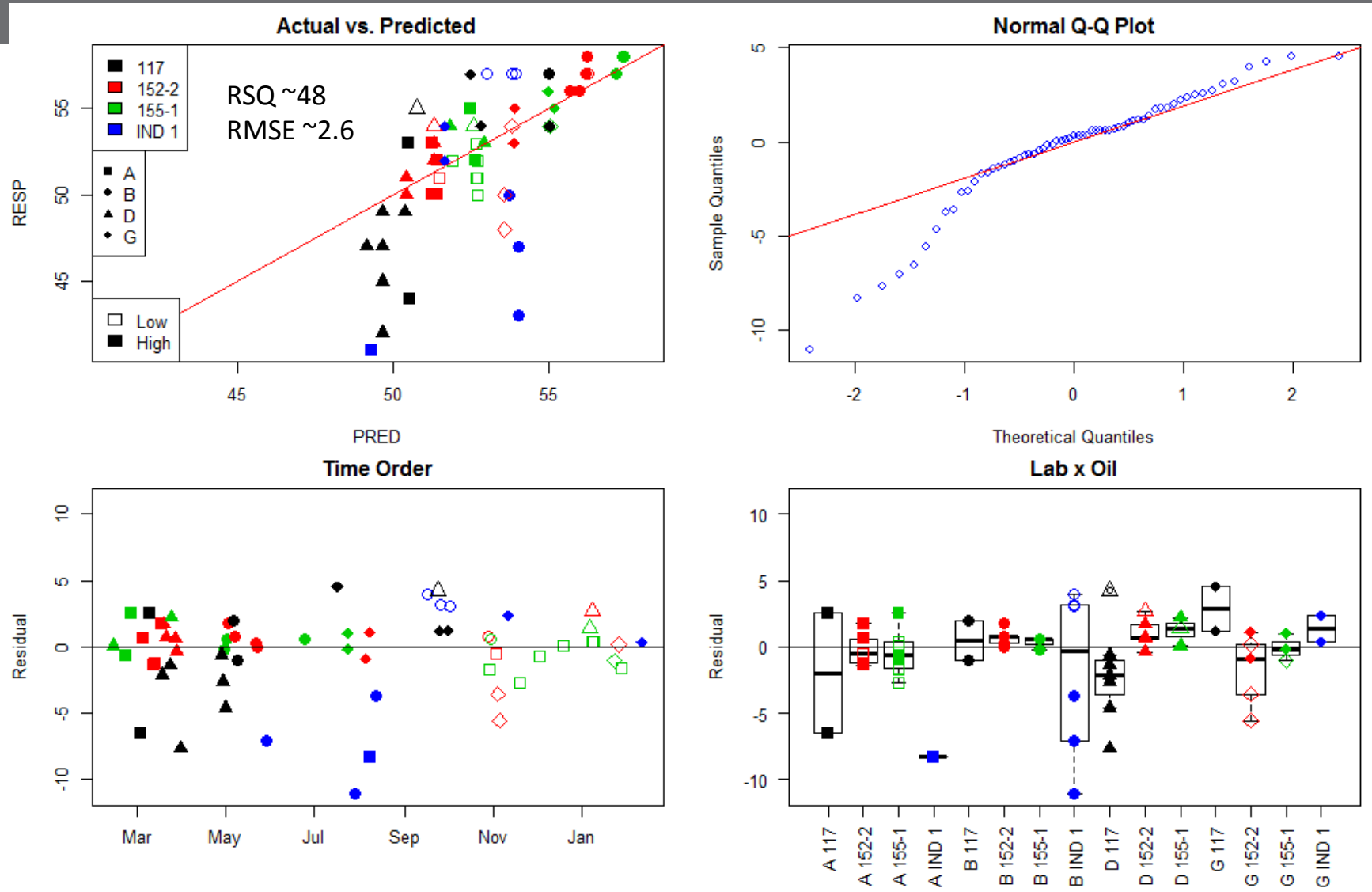
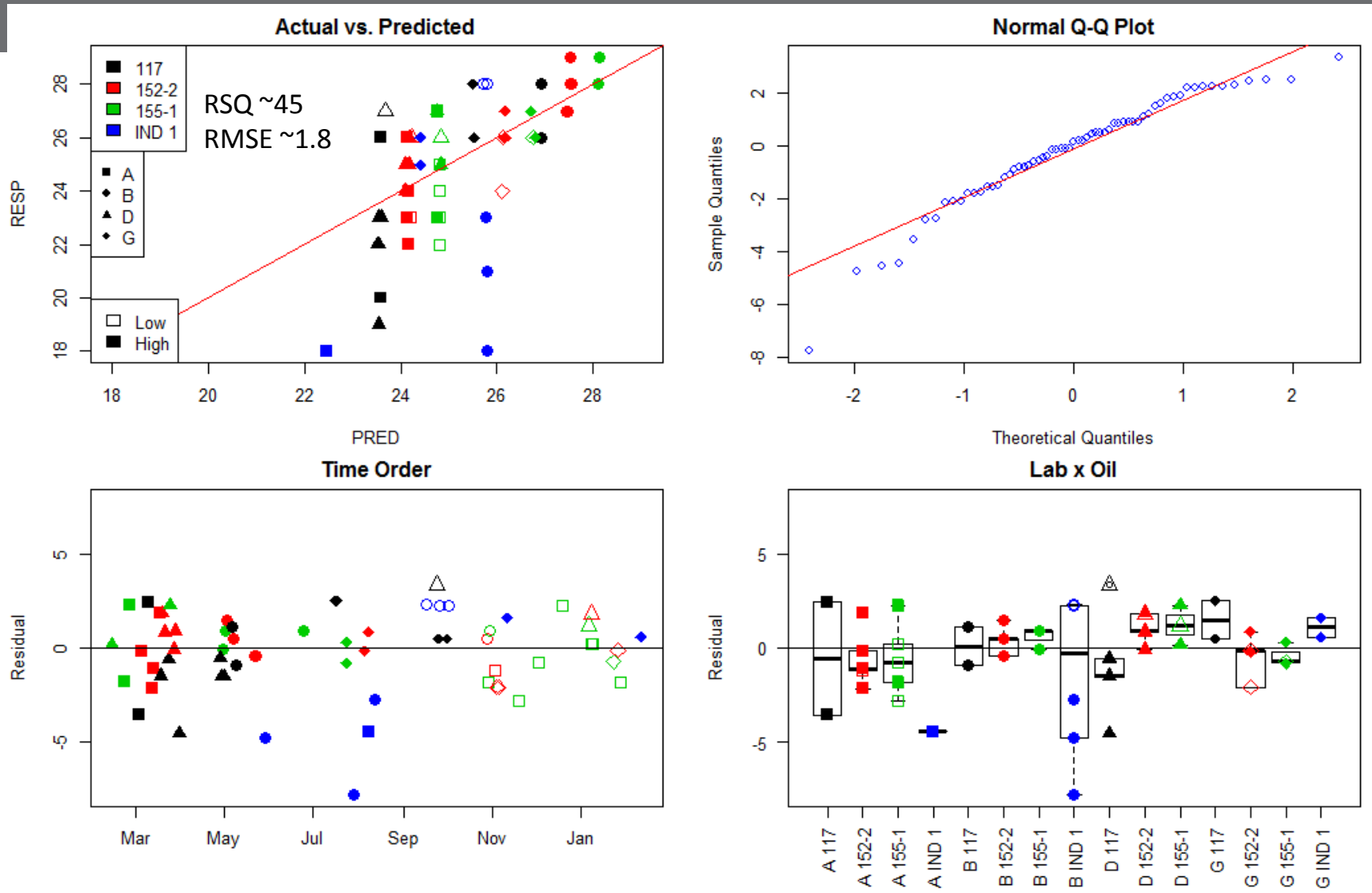
Ring+Pinion Wear+Ridging+Ripple Model

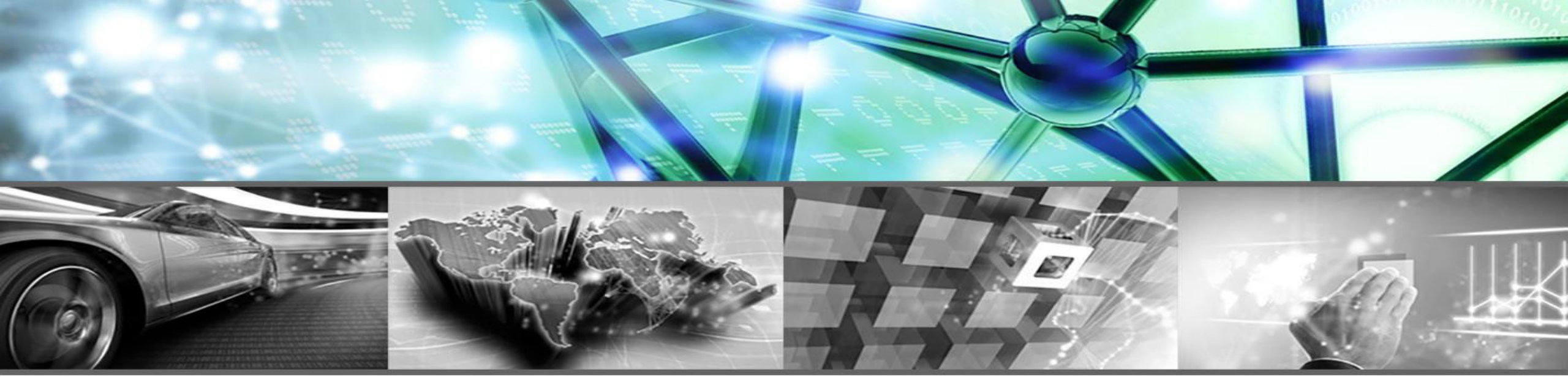


Model predicts ok, poor high-load results unexplained

Pinion Wear+Ridging+Ripple Model



Model predicts ok, poor high-load results unexplained



SUCCESS TOGETHER

Working together, achieving great things

When your company and ours combine energies, great things can happen. You bring ideas, challenges and opportunities. We'll bring powerful additive and market expertise, unmatched testing capabilities, integrated global supply and an independent approach to help you differentiate and succeed.

Lubrizol

Next Steps

- Run variety of gear batches
  - See if we can predict failures based on gear batch
- Order more gears

New Business?

Thanks!