Sequence X

ASTM D8729

Ford Chain Wear Test Surveillance Panel Meeting

April 8th, 2021

Prepared By: Alfonso Lopez, S.P. Chairman

- Attendance roster attached below
- Meeting minutes from 12/03/20 were approved
- Lab Calibration status
  - A – 1 stand through 05/01/21
  - B – 1 Stand through 08/11/21
  - D – 1 Stand through 09/20/21
  - G – 1 Stand through 09/23/21
- API letter for test unavailability has been put on hold considering the calibration status of the independent labs.

Meeting Minutes

- Travis presented the operational data review. Attached
  - Data from before the mild shift was compared to current data.
  - No differences were noted in the operational review.
  - A fuel correlation is seen in slide 14 but that may be coincidental. Additional review of fuel certificates is ongoing.
  - Slides 12 and 13 show the reference oil chain stretch data in untransformed and transformed units. The task force came to the realization that the Ln transform was affecting oil 271 results more than oils 270 and 1011. Travis pointed out the transform characteristics and how the transformed values begin to drop to infinity very quickly as raw results approach zero. Slide 13.
  - This problem with the transform, as results approach zero, is generating oil 271 reference results that are -4 sigma mild. Labs are not able to calibrate. Severity adjustments do not represent true engineering results.

Meeting Minutes Continued

- A motion was made to suspend oil 271 for two months. Motion passed with no negatives.
- The suspension of oil 271 is a short-term solution. It gives the statisticians and task force more time to find root cause of the mild shift.
  - A task force meeting is scheduled for April 13th.
  - The stats group will meet to review the transform and formulate a “fix” to the infinity problem that it has.
  - Analysis of the fuel will evolve to other properties not seen in the CoA.
- Calibration tests that follow a 271 test failing result are generating severity adjustments that are not correct. There is an undo-influence calculation that will minimize the problem but candidate results will see severity adjustments that are too large.

Meeting Minutes Continued

- Options to resolve the severity adjustment problem were discussed.
  - Option 1 – continue to run reference tests on oils 1011 and 270 knowing that stands affected by 271 will have a control chart skew and inaccurate severity adjustment.
  - Option 2 – Remove recent 271 data form control charts.
  - Option 3 – Apply an industry correction factor
  - Option 4 – Declare the test not fit for purpose and stop testing until the severity shift is resolved.
- After much debate it was decided not to remove data from control charts. The test labs all agreed to live with the influence of previous 271 data.
- Consumers of the test were polled and there was no objection to having severity adjustments that were larger than they should be.

Meeting Minutes Continued

- Lab D has already run a reference test after a failing 271 test. That lab is generating candidate data. This was a major consideration to have all labs do the same.
- Another topic of discussion was the transform application to candidate data. At near zero the transform is generating test results that are extremely low. There was no clear answer to this issue and the statisticians have this as an action item.
- The ln log transformation was based on the precision matrix data. For test results that are now falling below the levels of matrix data ranges, the transformed results have become detached from engineering reality. This will be looked into by the stats group.

Motion List 4/7/21

- Motion 1: Approval of the SP Meeting minutes from 12/3/20
  - Motioned: Andy Ritchie
  - Second: Christian Porter
  - Passed - unanimous
- Motion 2: Suspend reference oil 271 for two months. Effective 04/07/21 – 06/07/21
  - Motioned: Al Lopez
  - Second: Michael Deegan
  - Passed – 8 approve, 5 waives, zero negatives

Attendance List

Sequence X Surveillance Panel Meeting		
April 7, 2021		
	Attendance	Voting Member
Porter, Christian <Christian.Porter@AftonChemical.com>	x	Afton
Todd Dvorak <Todd.Dvorak@AftonChemical.com>	x	
Martin Chadwick Intertek <martin.chadwick@intertek.com>		
Dan Lanctot <DLanctot@tei-net.com>		TEI
Jason Bowden <jhbowden@OHTech.com>	x	OHT
'Rich Grundza' (reg@astmtmc.cmu.edu)	x	TMC
Jason Soto Intertek <jason.soto@intertek.com>	x	IAR
doyle.boese@infineum.com	x	
Martinez, Jo G. (jogm) <JoMartinez@chevron.com>		Chevron
J.Hsu@shell.com		Shell
Gleason, Joseph <Joseph.Gleason@lubrizol.com>	x	
Kostan, Travis G. <travis.kostan@swri.org>		
ptumati@jhaltermann.com	x	Haltermann
Khaled , Zreik Khaled.zreik@gm.com		GM
Chiappelli, Maria <Maria.Chiappelli@Infineum.com>		Infineum
Montufar, Ashley <ashley.montufar@exxonmobil.com>	x	ExxonMobil
Charlie Leverett <charlie.leverett@yahoo.com>		
Amol C Savant <ACSavant@valvoline.com>	x	Valvoline
Eickstead, Christine M. <christine.eickstead@swri.org>	x	SWRI
Brys, Jerome <Jerome.Brys@lubrizol.com>		Lubrizol
'Bob.Campbell@aftonchemical.com'		
Patrick M. Lang <patrick.lang@swri.org>	x	SWRI
Stockwell, Robert T (Robert.Stockwell@chevron.com)		Chevron
Bill Buscher Intertek <william.buscher@intertek.com>		
Ritchie, Andrew <Andrew.Ritchie@Infineum.com>	x	
Rais, Khaled <khaled.rais@swri.org>		
Stevens, Andrew <Andrew.Stevens@Lubrizol.com>		
Matthews, Tim <Tim.Matthews@uk.bp.com>	x	BP
Lopez, Alfonso <al.lopez@intertek.com>	x	Intertek
Deegan, Michael (M.D.) <mdeegan@ford.com>	x	Ford
Lochte, Michael D. <michael.lochte@swri.org>		
joshua cooley valvoline		
George Szappanos	x	LZ
Timothy Cushing <timothy.cushing@gm.com>		GM
Wingert, Dean (D.) <dwingert@ford.com>		
Michael Luhard		Afton
Ben Maddock		Afton

Sequence X Severity Review

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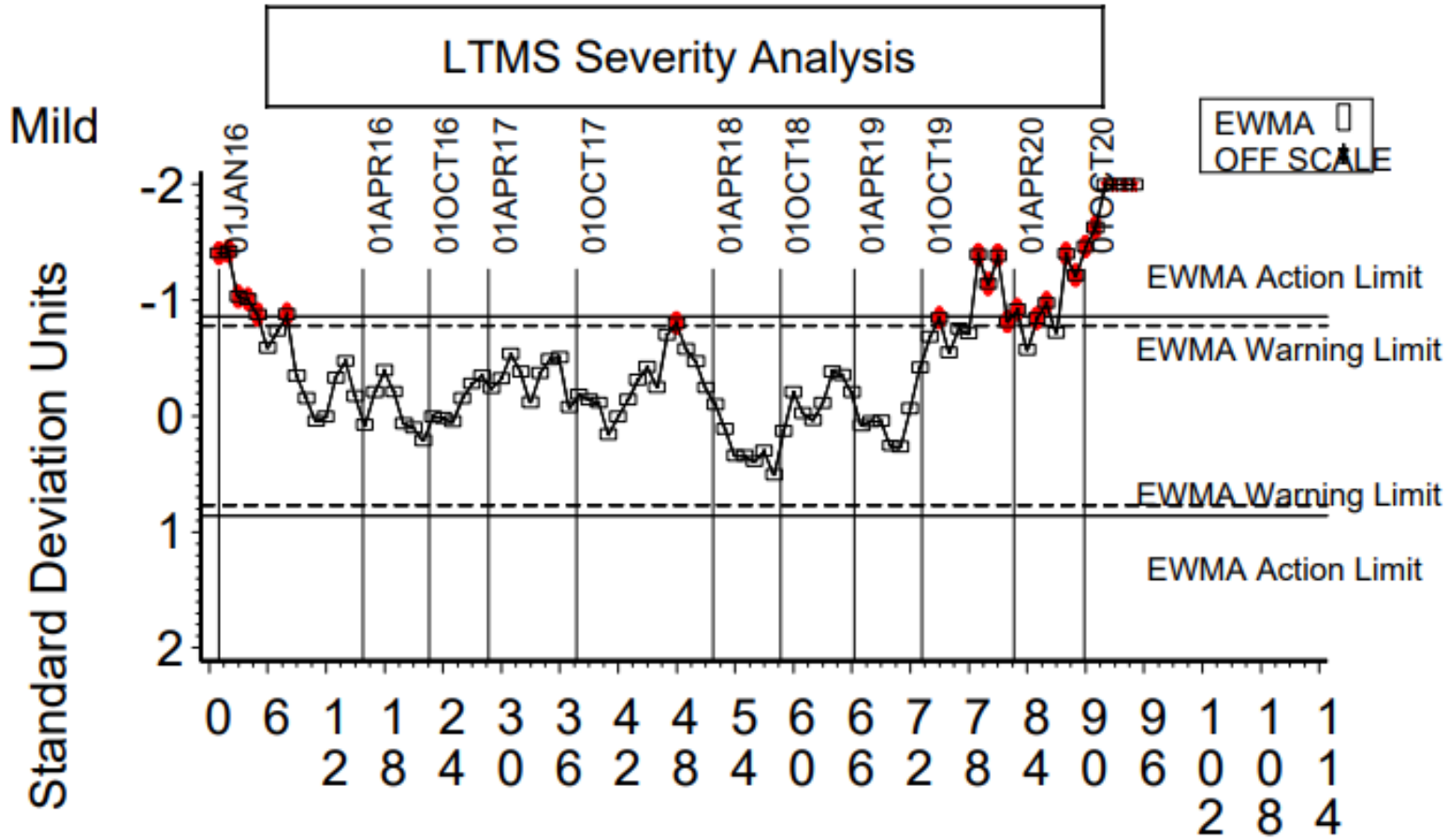
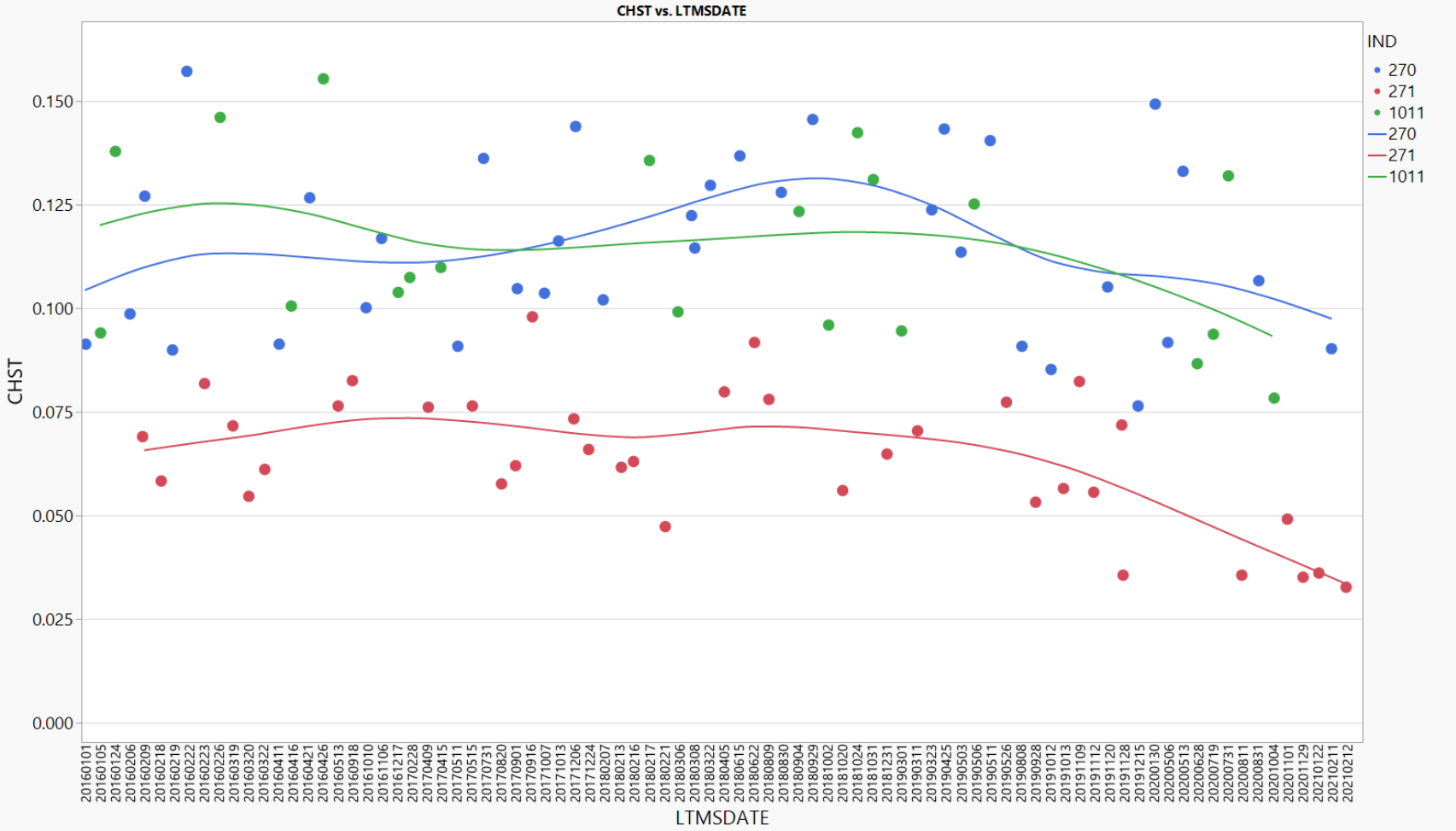
Background

The industry is currently mild for chain stretch and beyond the EWMA action limit. It appears the trend began somewhere around October of 2019.



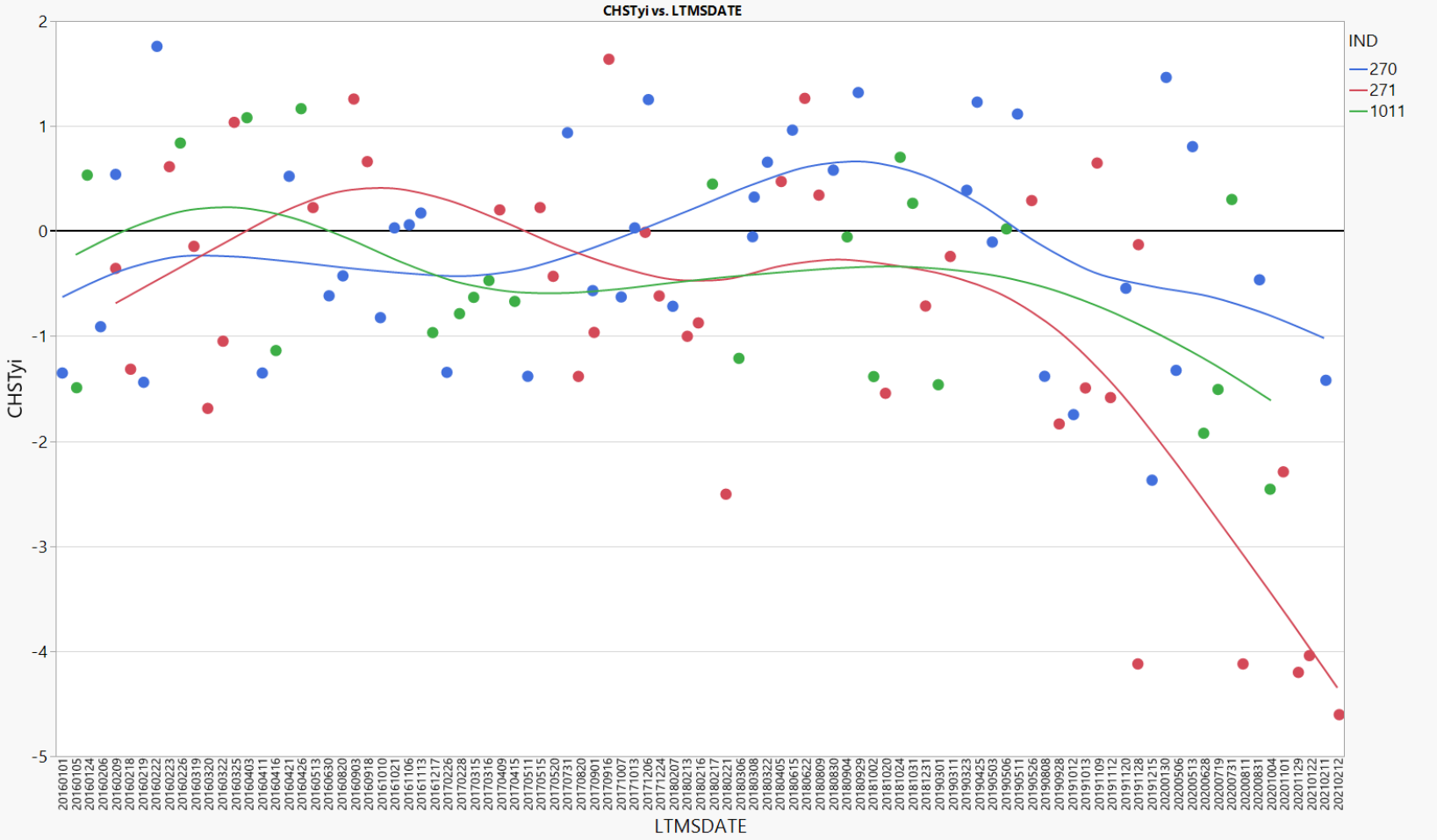
Oil Severity Differences – Untransformed

In untransformed units, the three oils appear to have all shifted by a similar magnitude.

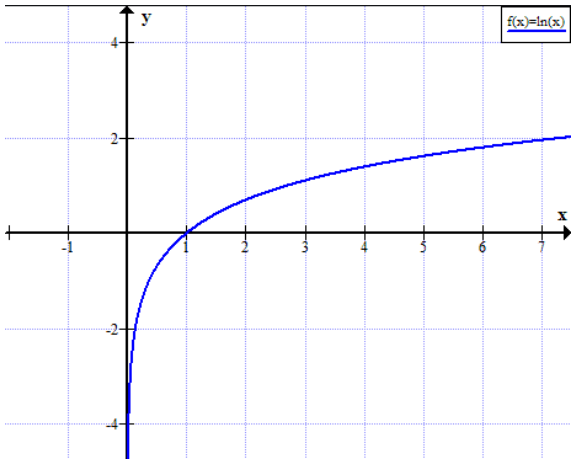


Oil Severity Differences – Ln(Chst.) Yi

In transformed units, the shift is having a major impact on the mild reference oil due to the shape of the natural log curve.

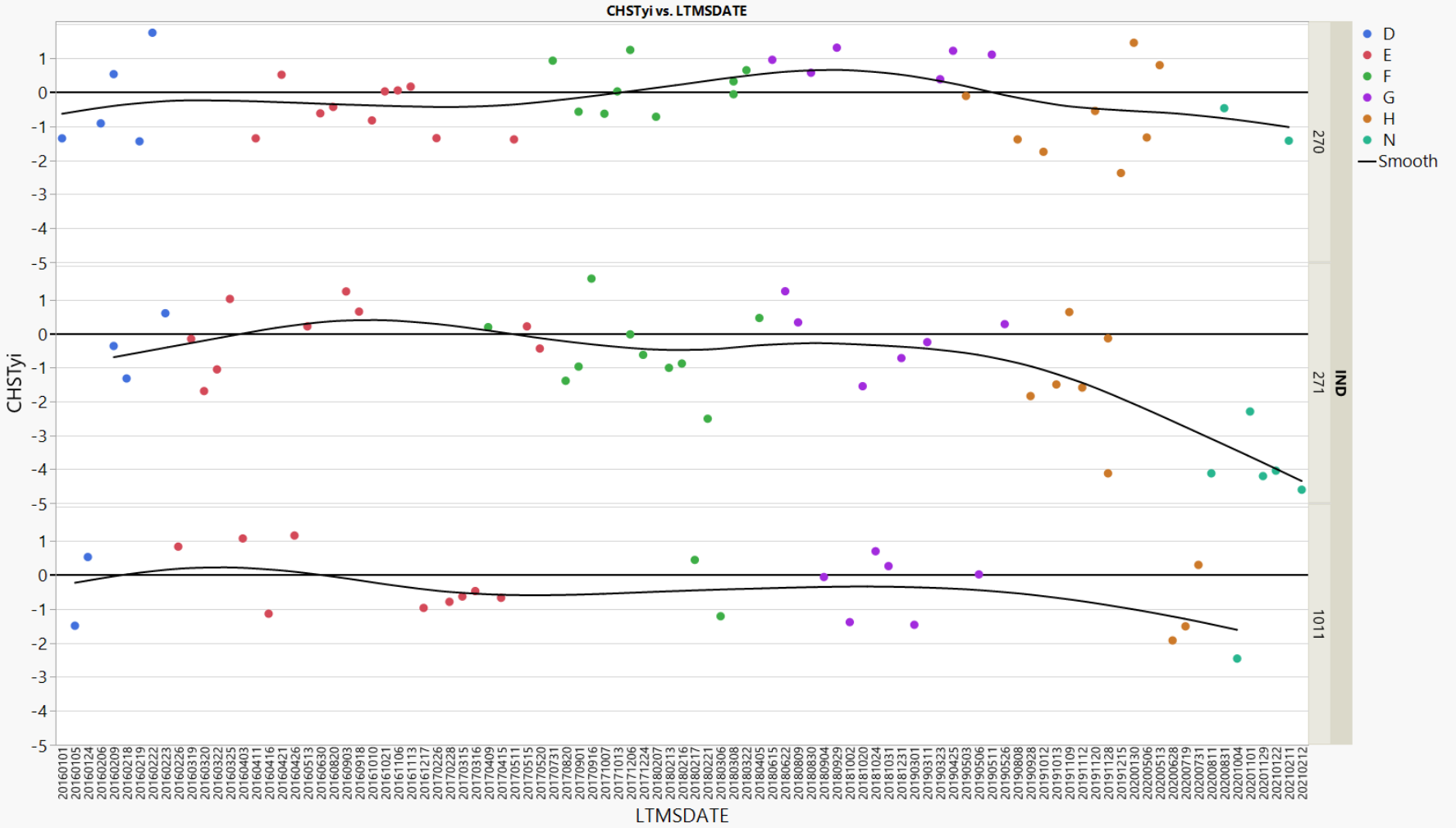


Ln(X) goes very quickly to negative infinite the closer you get to zero.



Fuel Batch

Some mild results have occurred with H batch of fuel, but most extreme mild results are with “N” batch (not sure about “N” designation).



TESTFUEL	FUELBTID	Fuel Bat.
INDOLENE(EEE)	GD2021NX10	G
HF-0003EEE	GD2021NX10	G
HF-0003EEE	GD2021NX10	G
HF-0003EEE	GD2021NX10	G
HF-0003EEE	GD2021NX10	G
INDOLENE(EEE)	GD2021NX10	G
EEE	GJ0221LT10	G
INDOLENEEEE	GK1221NX10	G
EEE	GJ0221LT10	G
INDOLENEEEE	GK1221NX10	G
INDOLENEEEE	GK1221NX10	G
HF-0003EEE	GK1221NX10	G
EEE	HA3021LT10	H
HF-0003EEE	GK1221NX10	G
INDOLENEEEE	GK1221NX10	G
HF-0003EEE	GK1221NX10	G
INDOLENE(EEE)	HE0221NX10	H
INDOLENE(EEE)	HE0221NX10	H
INDOLENE(EEE)	HE0221NX10	H
INDOLENE(EEE)	HE0221NX10	H
EEE	HE0221NX10	H
HF-0003EEE	HE0221NX10	H
EEE	HF1021LT20	H
HF-0003EEE	HI3021NX10	H
INDOLENE(EEE)	HI3021NX10	H
HF-0003EEE	HI3021NX10	H
INDOLENE(EEE)	HI3021NX10	H
INDOLENE(EEE)	HL2321LT10	H
HF-0003EEE	HI3021NX10	H
INDOLENE(EEE)	HL2321LT10	H
EEE	HL2321LT10	H
EEE	HI3021NX10	H
INDOLENE(EEE)	N-000001	N
INDOLENE(EEE)	N-000001	N
INDOLENE(EEE)	N-000001	N
HF-0003EEE	N-000001	N
INDOLENE(EEE)	N-000001	N
INDOLENE(EEE)	N-000003	N
EEE	N-000003	N
EEE	N000003	N

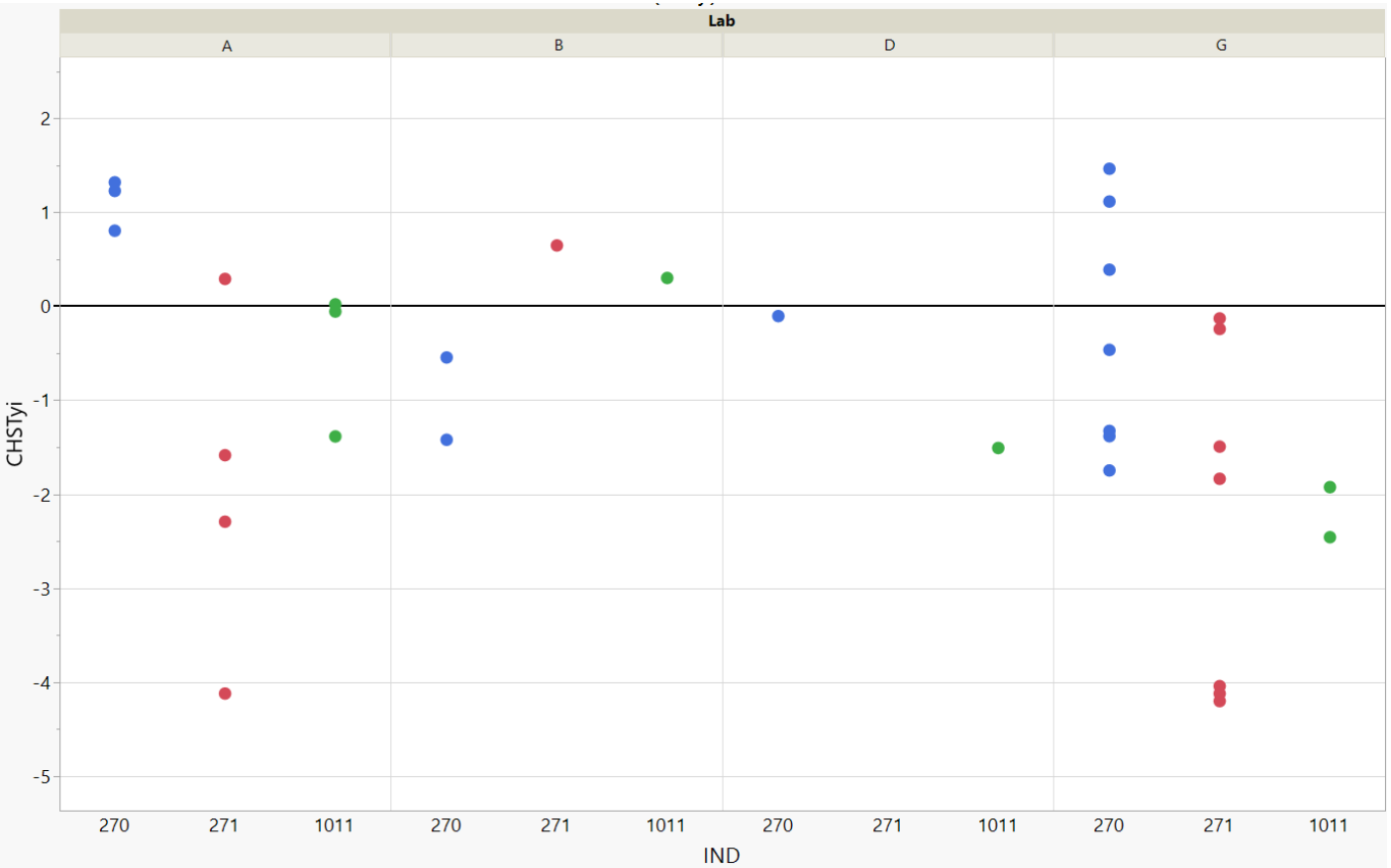
Operational Data Review

The Data Set

- Based on the EWMA, labs asked to submit tests both before and after the severity shift, going back to 09/01/2018
- 32 tests were collected for the analysis
  - Lab A, 10 tests (4 test missing CAN data)
  - Lab B, 4 tests (only reported a single ramp for Phase 1-2 Ramp and Phase 2-1 Ramp)
  - Lab D, 2 tests
  - Lab G, 16 tests (Reported every 6th ramp for the Phase 2-1 Ramp)

Chainstretch Yi

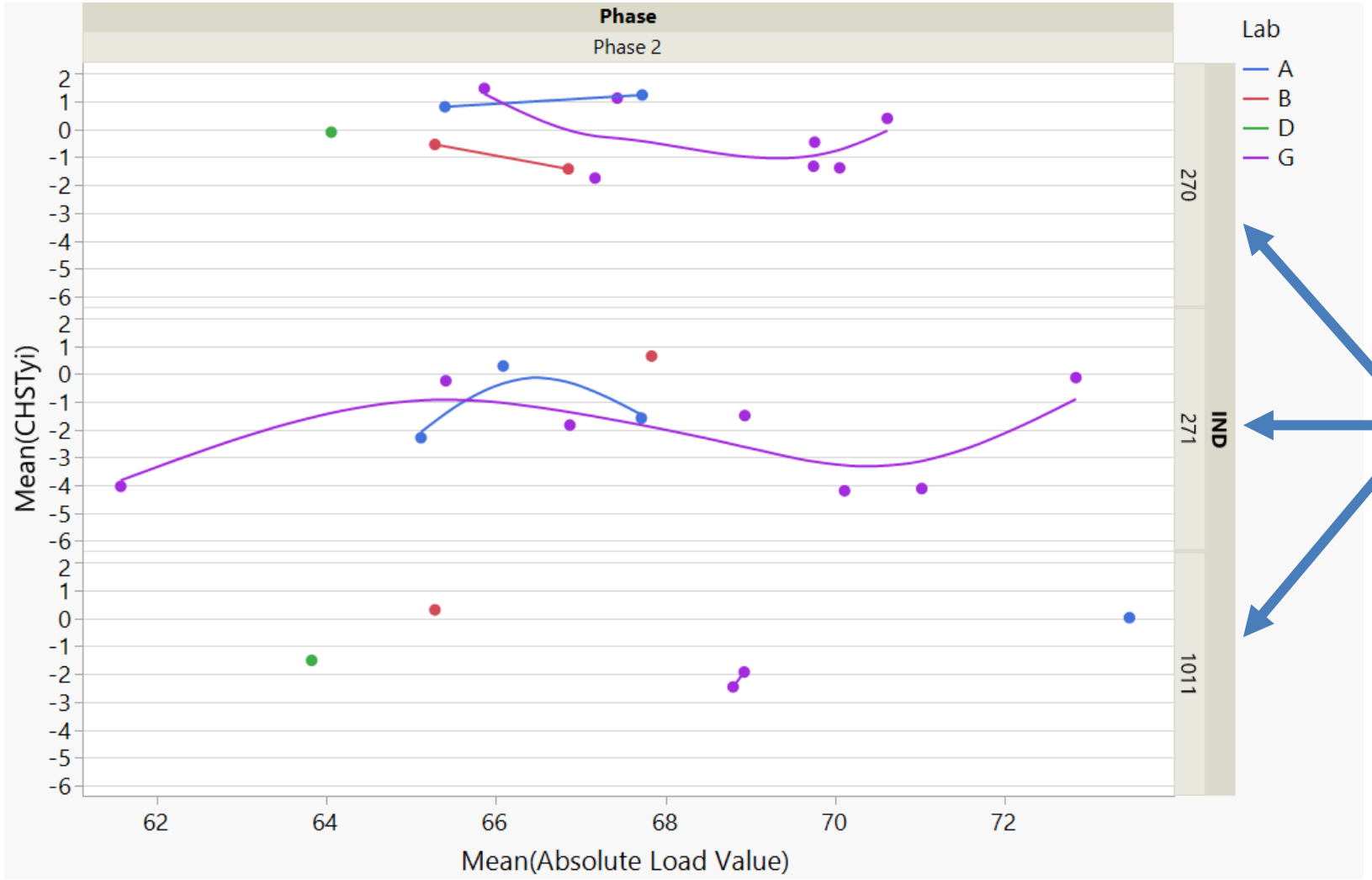
A plot of Chainstretch Yi is shown below for the tests in the analysis.



Plots Layout

Phase

Colored by Lab



EOT Chainstretch Yi

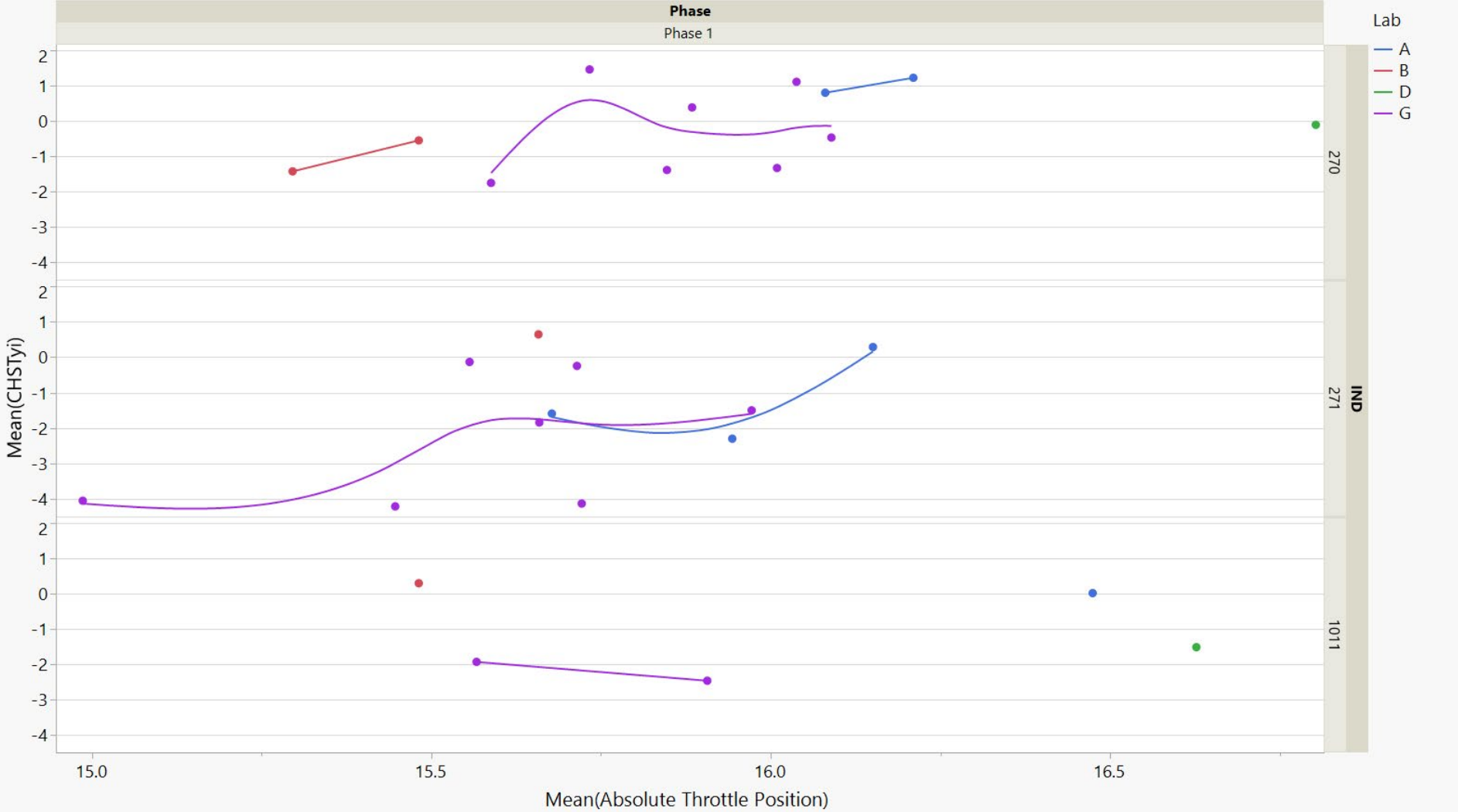
(Not actually an average. EOT CHST Yi was replicated on every row of each file.)

Ref. Oil (Not all plots have this breakout)

Parameter of Interest

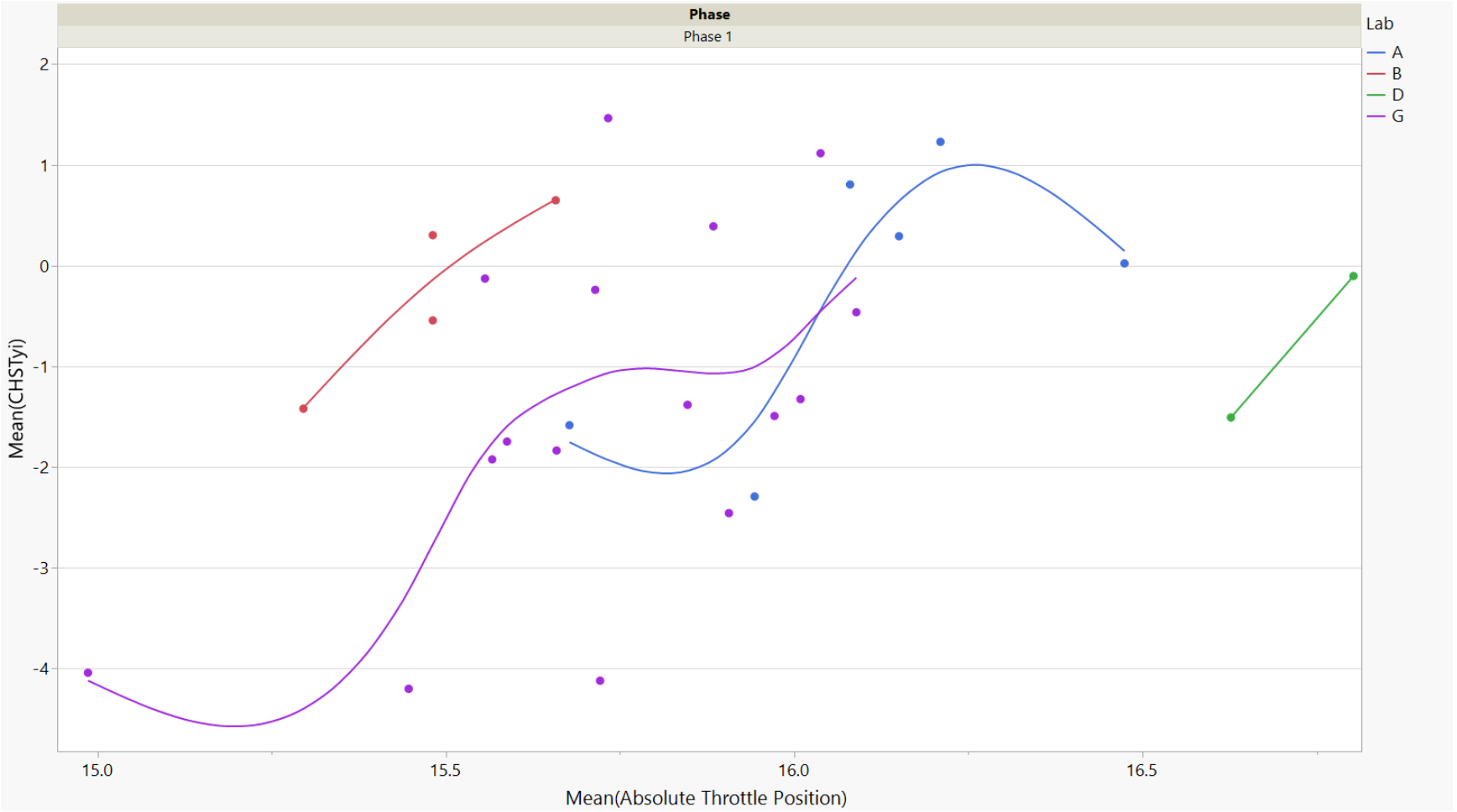
Phase I - All Data

Chst. Vs. Absolute Throttle Position



Chst. Vs. Absolute Throttle Position

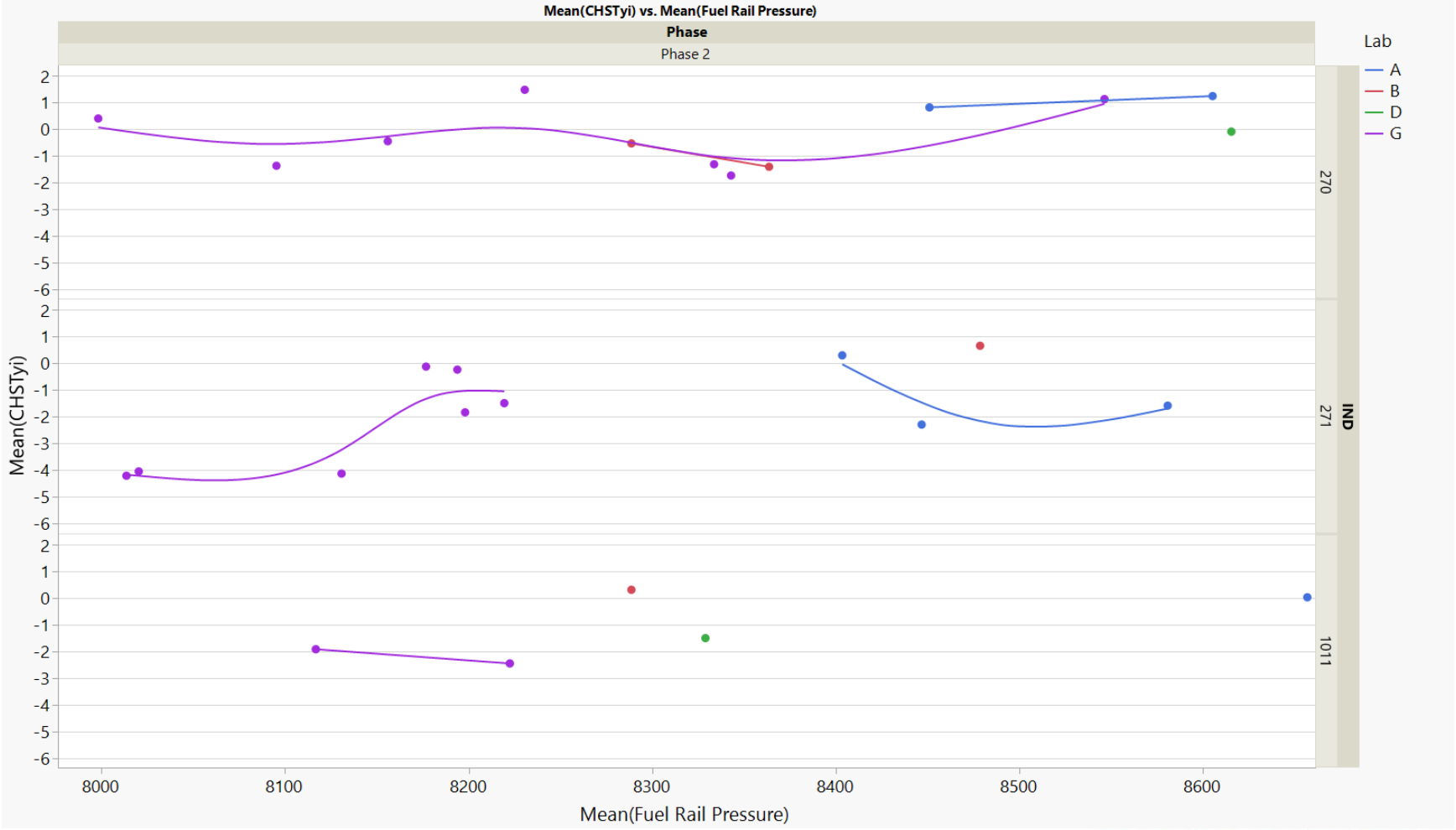
Potential relationship with Absolute Throttle Position and Chainstretch.



Phase 2 - All Data

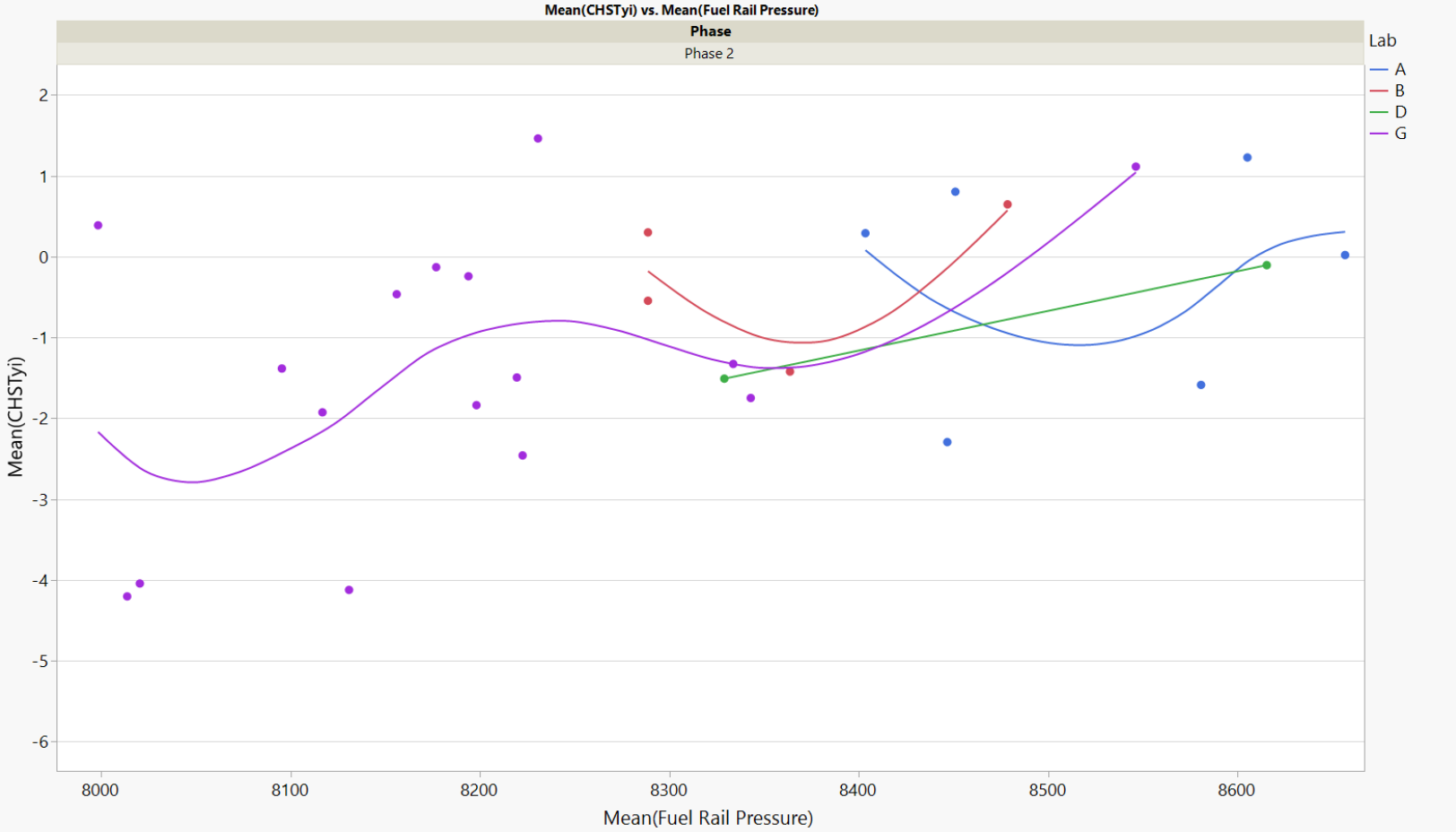
Chst.Vs. Fuel Rail Pressure

Potential relationship with Fuel Rail Pressure and Chainstretch.



Chst. Vs. Fuel Rail Pressure

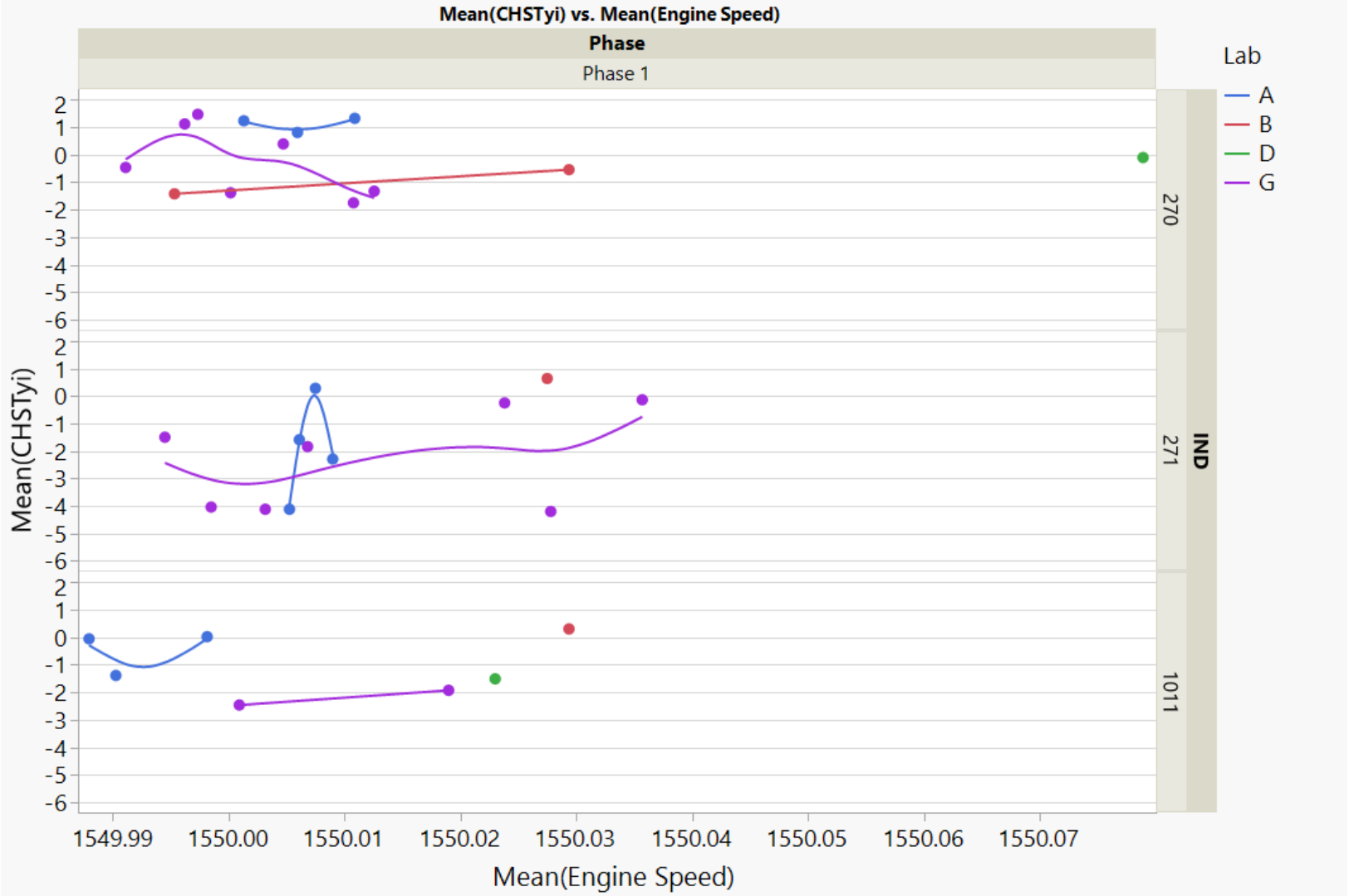
Potential relationship with Fuel Rail Pressure and Chainstretch.



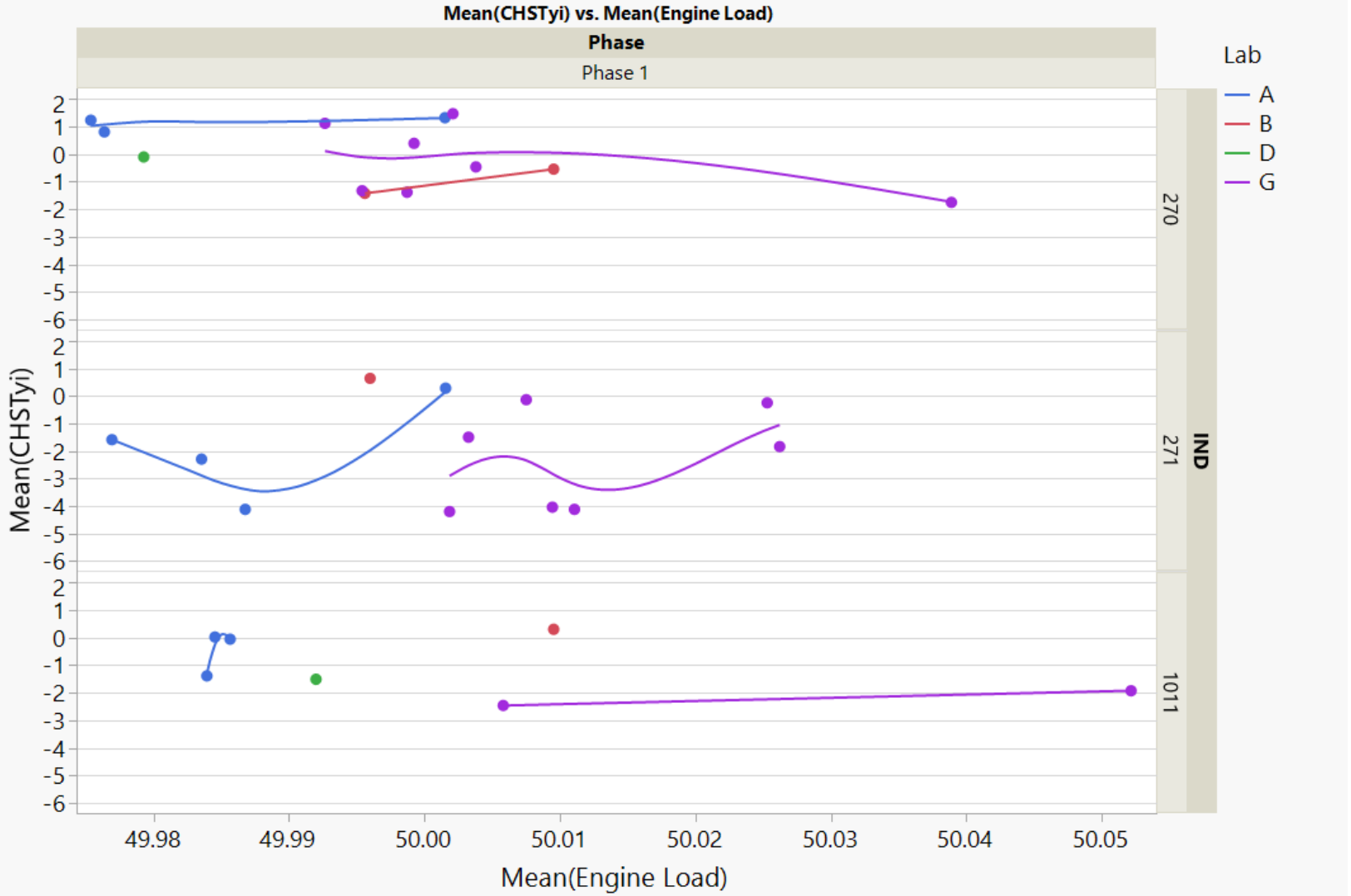
Appendix I

Phase I Average Plots

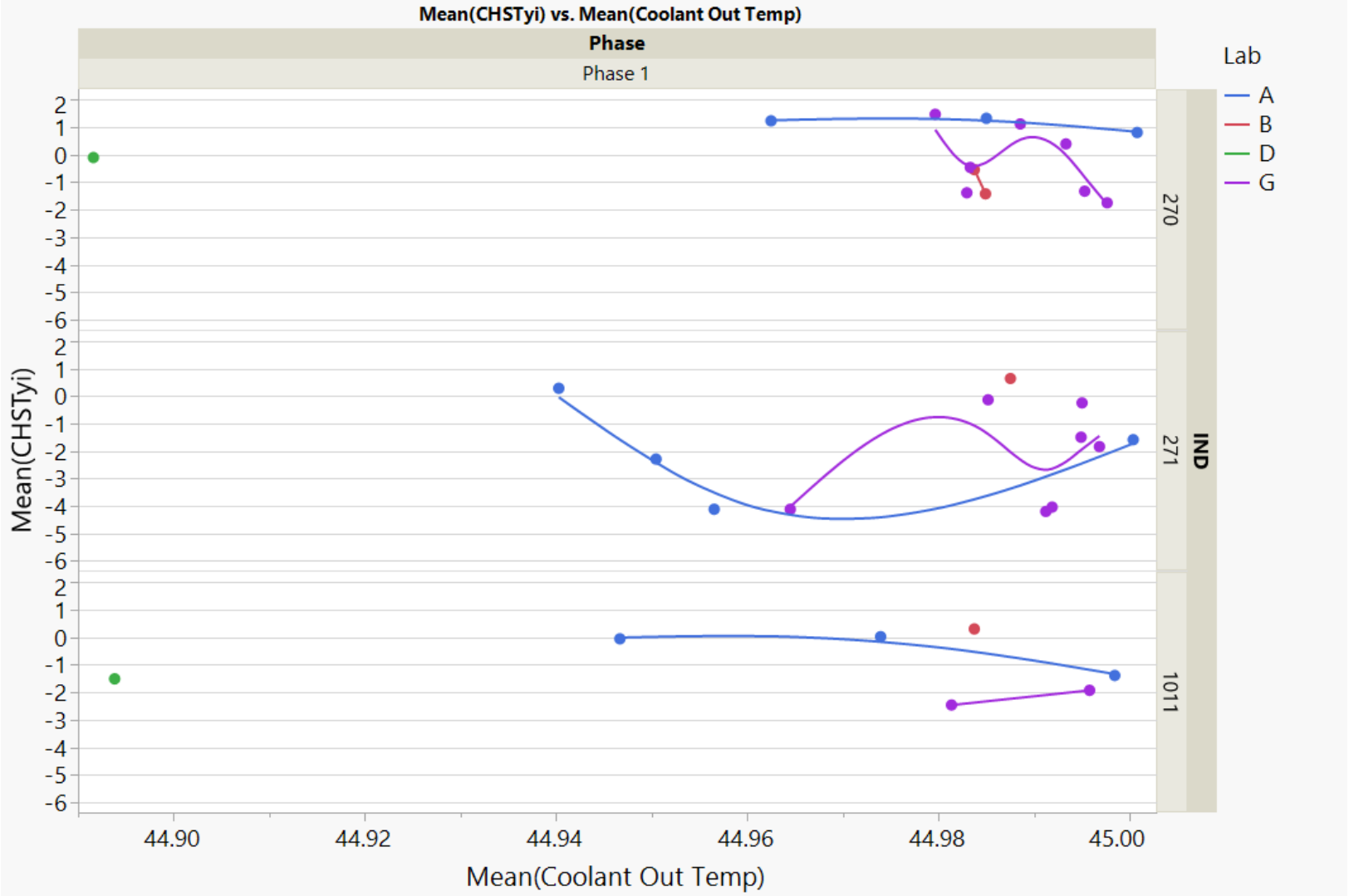
Chst. Vs. Engine Speed



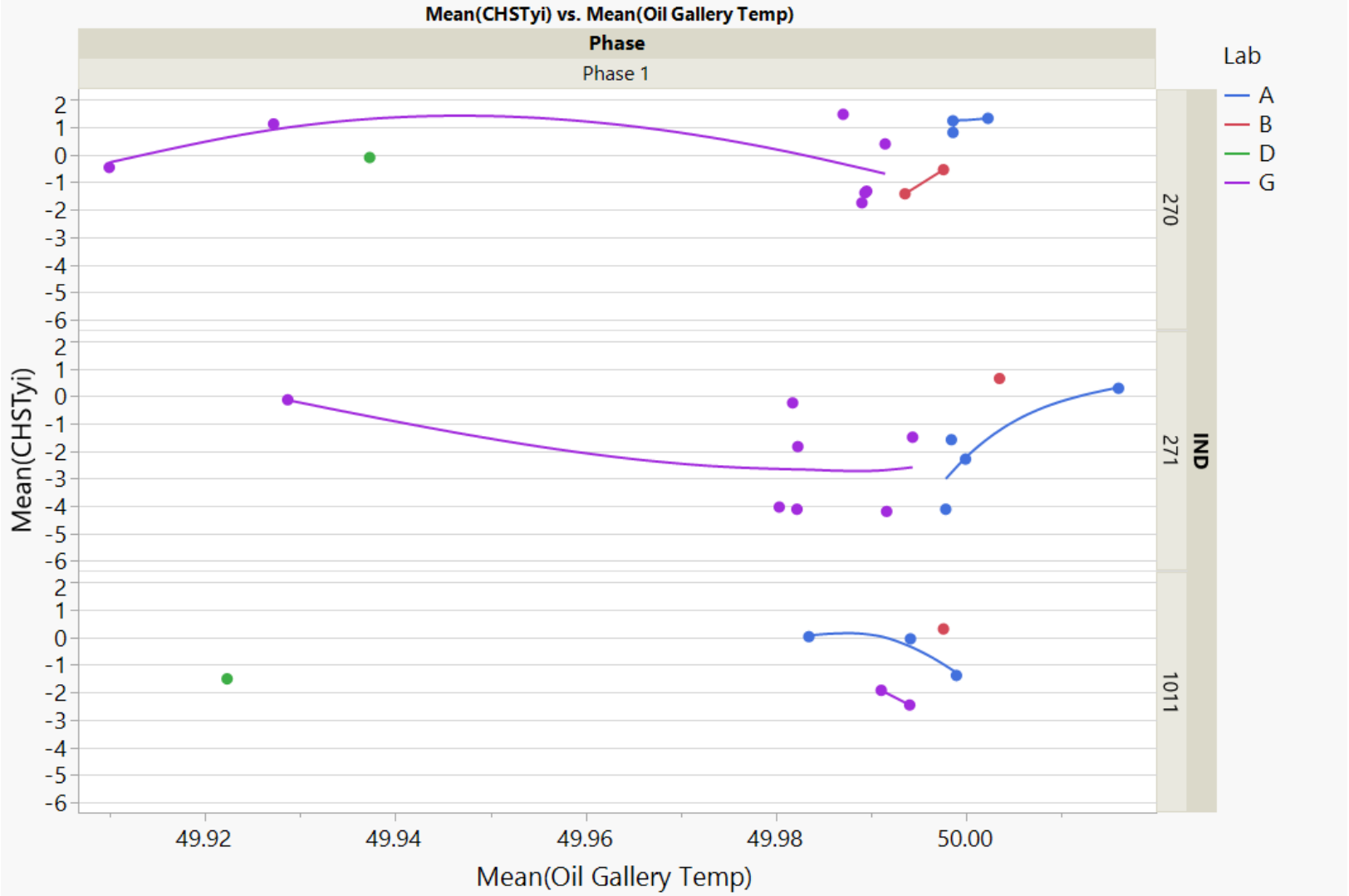
Chst. Vs. Engine Load



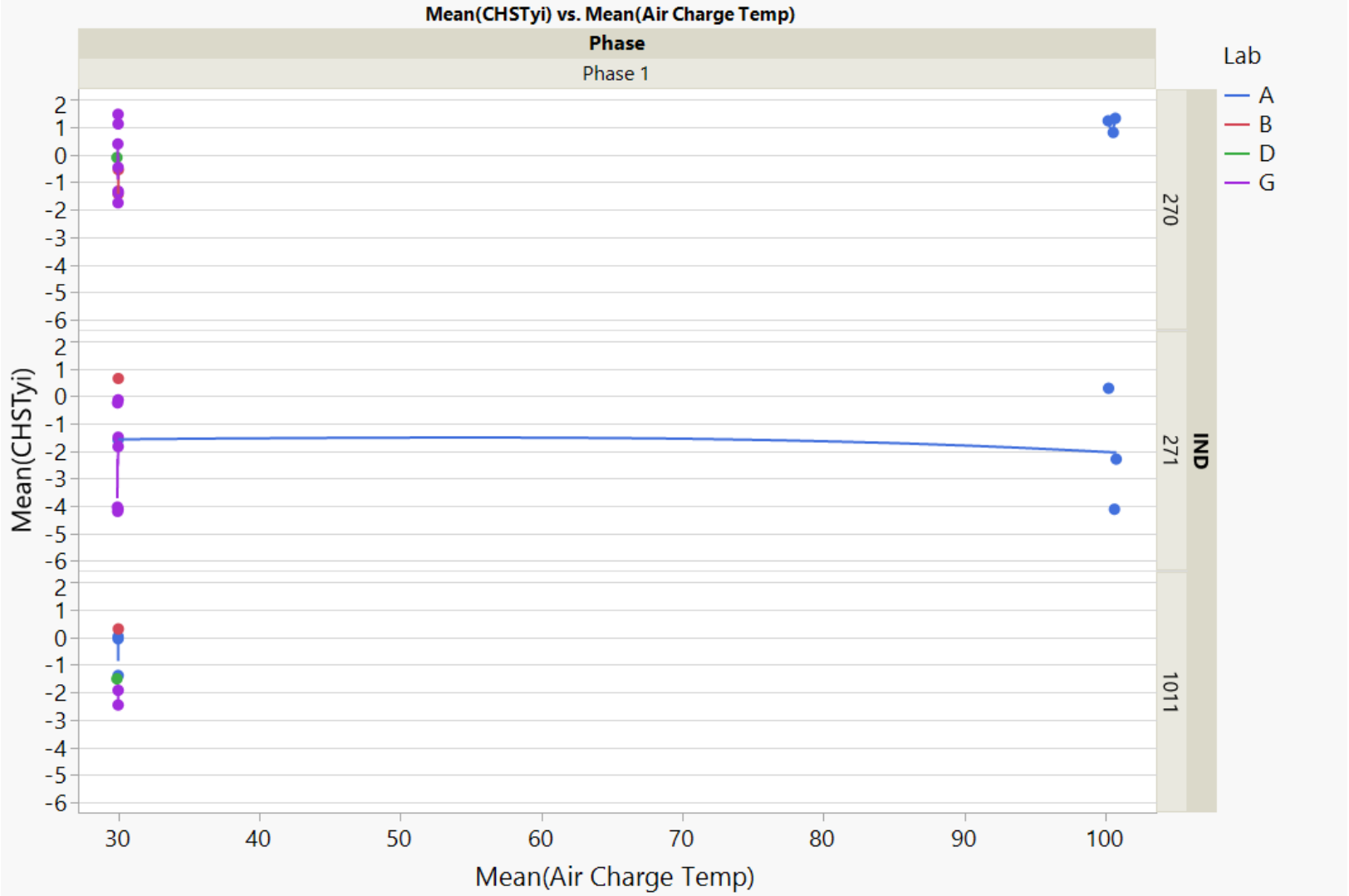
Chst. Vs. Coolant Out Temp



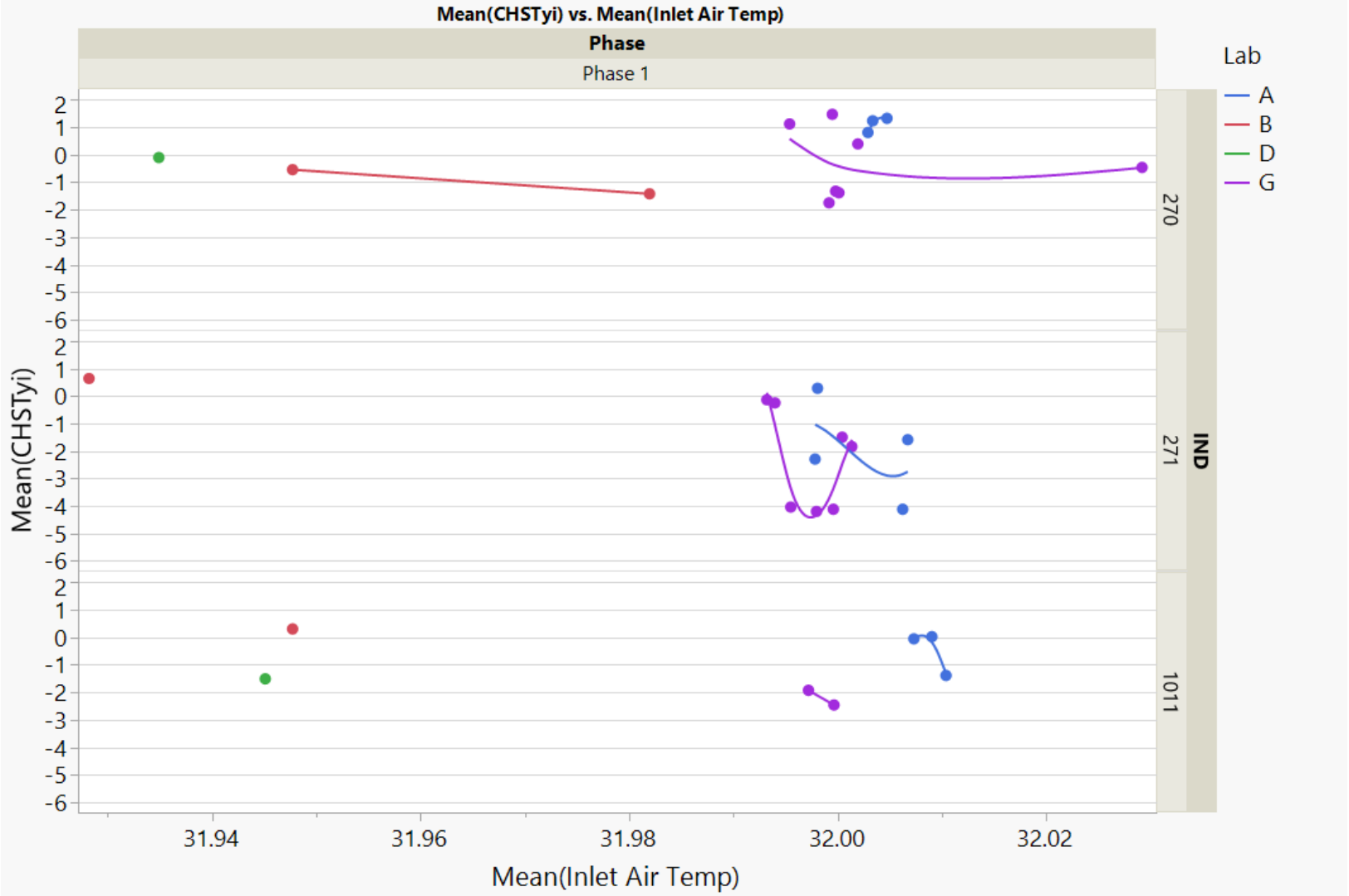
Chst. Vs. Oil Gallery Temp



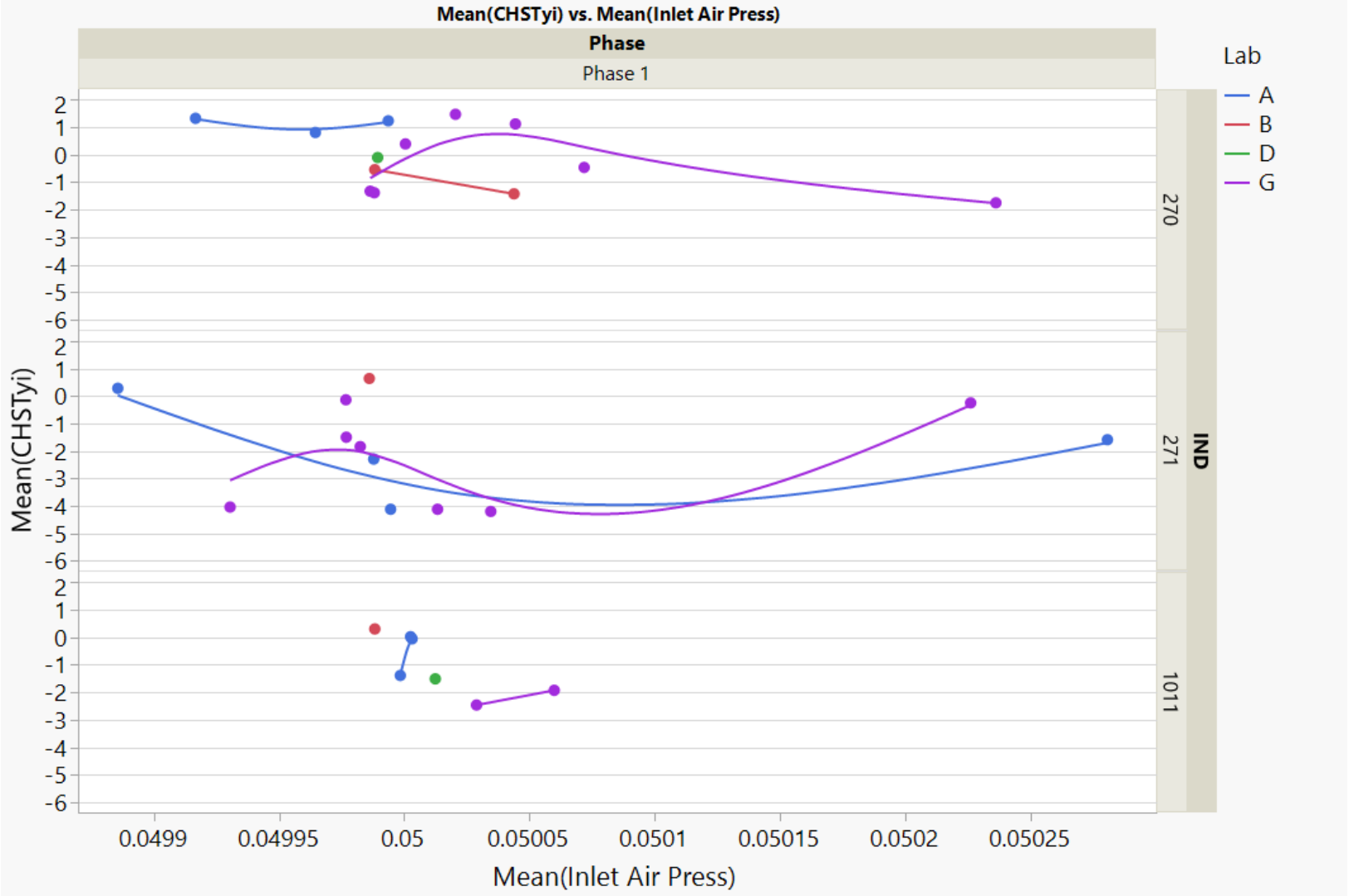
Chst. Vs. Air Charge Temp



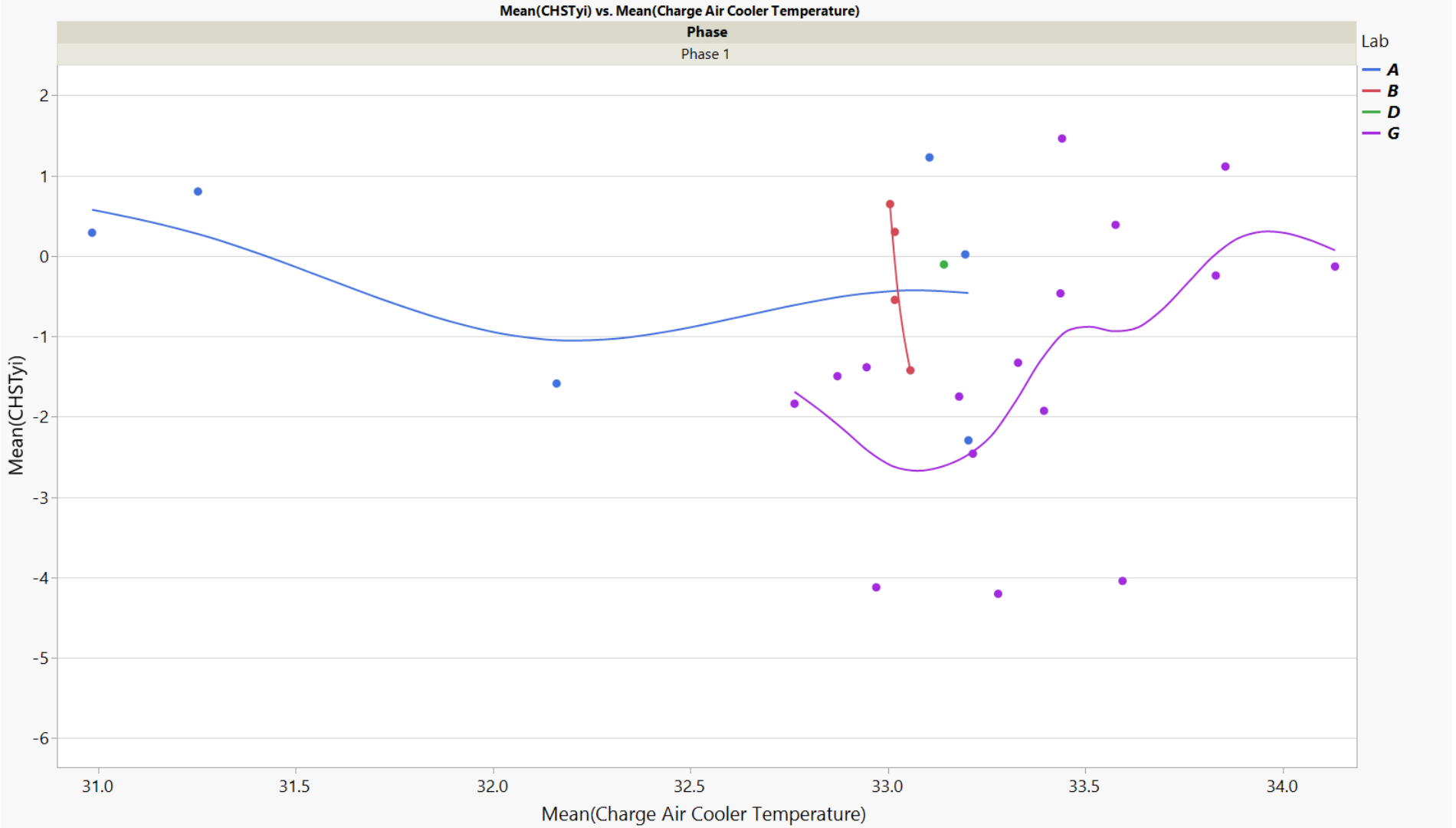
Chst. Vs. Inlet Air Temp



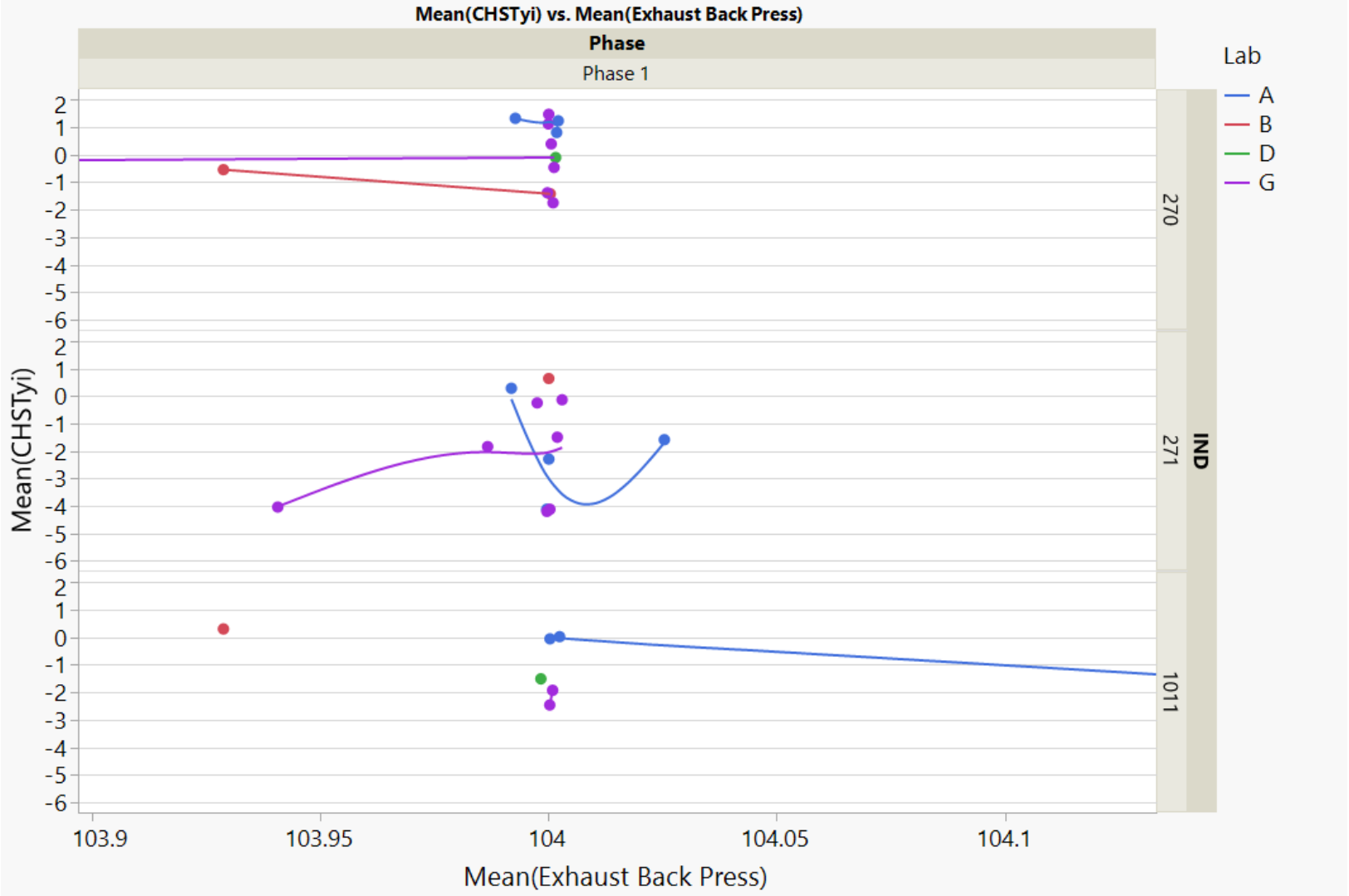
Chst. Vs. Inlet Air Pressure



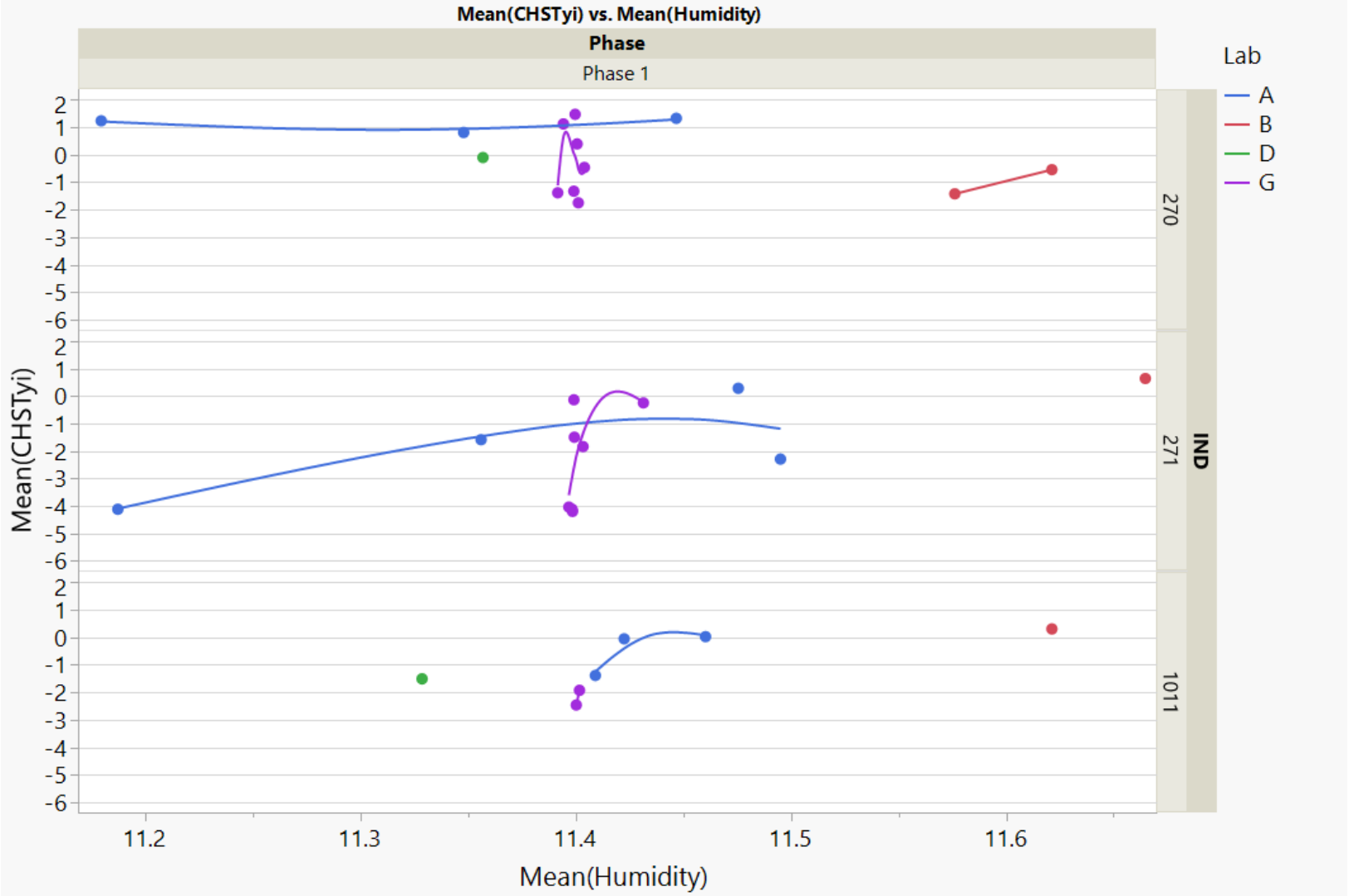
Chst. Vs. Charge Air Cooler Temp



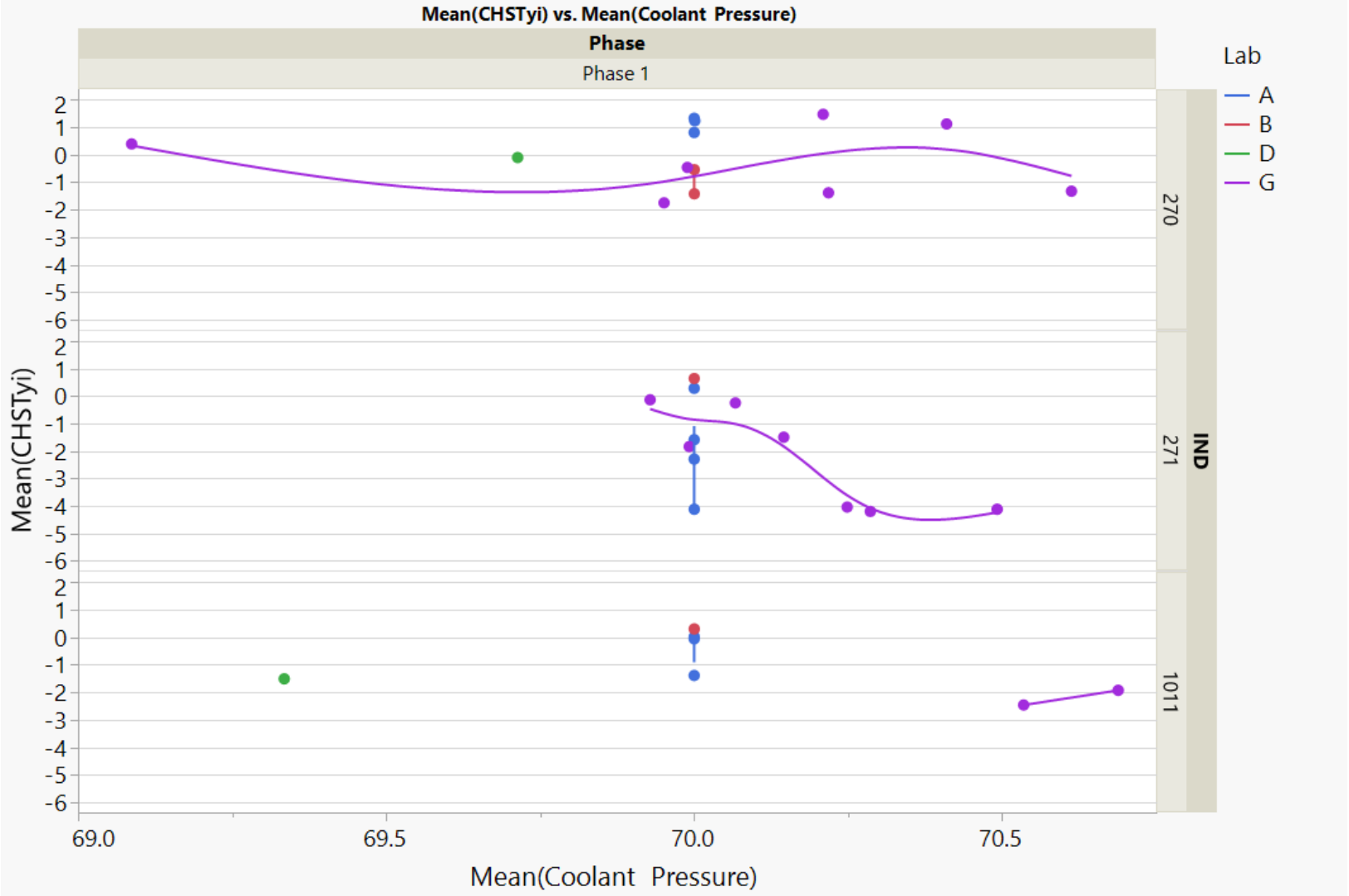
Chst. Vs. Exhaust Backpressure



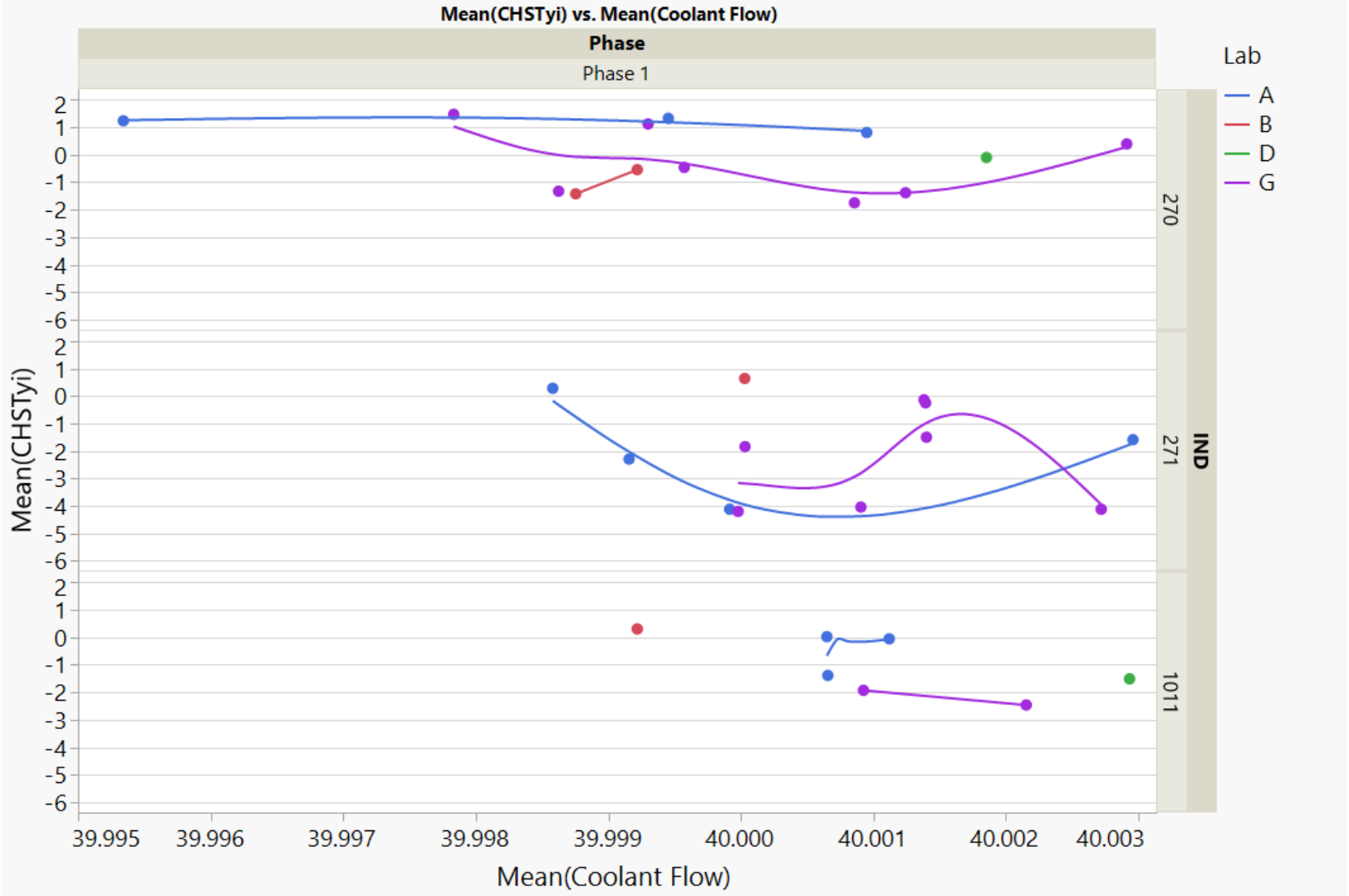
Chst. Vs. Humidity



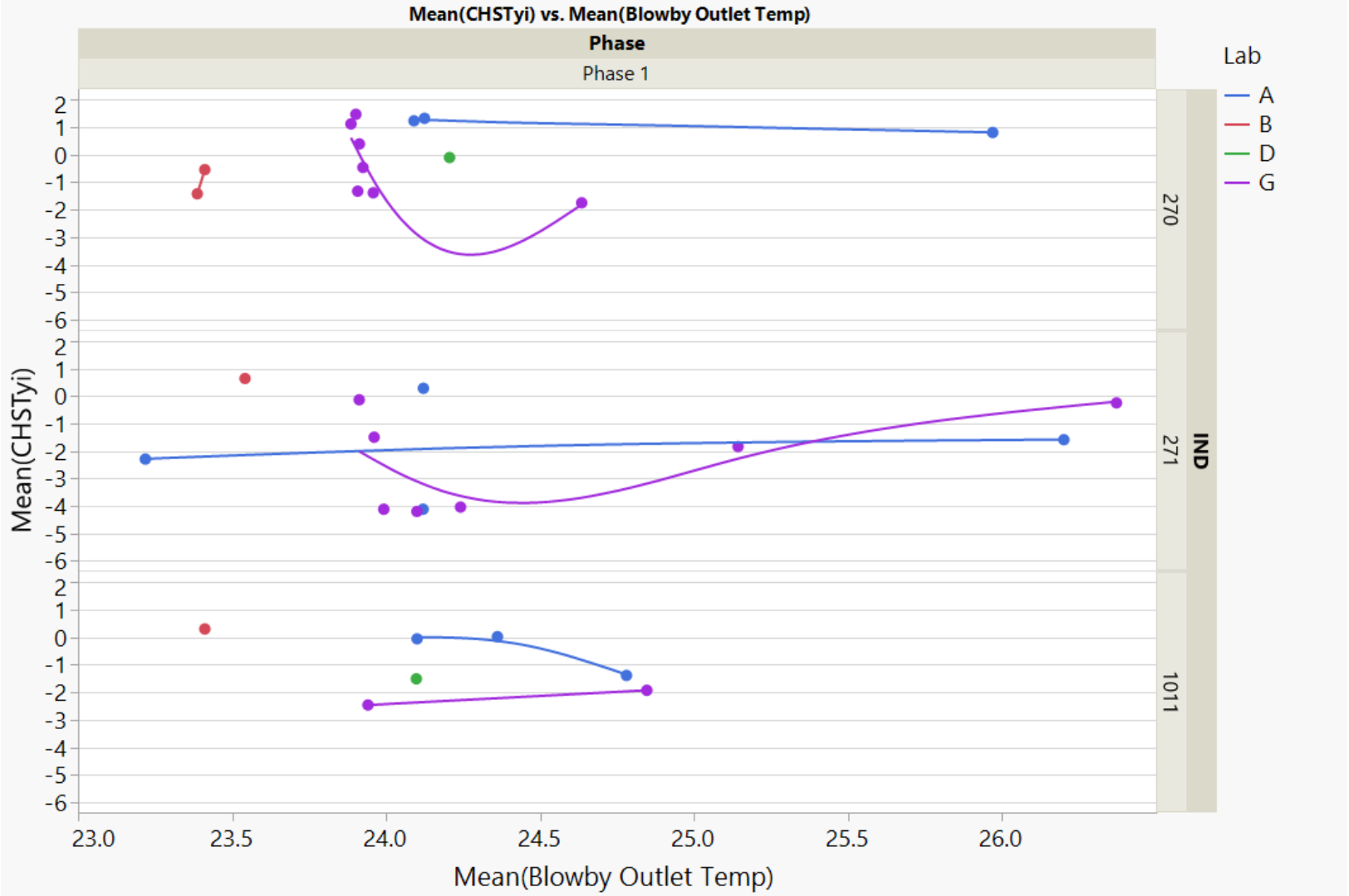
Chst. Vs. Coolant Pressure



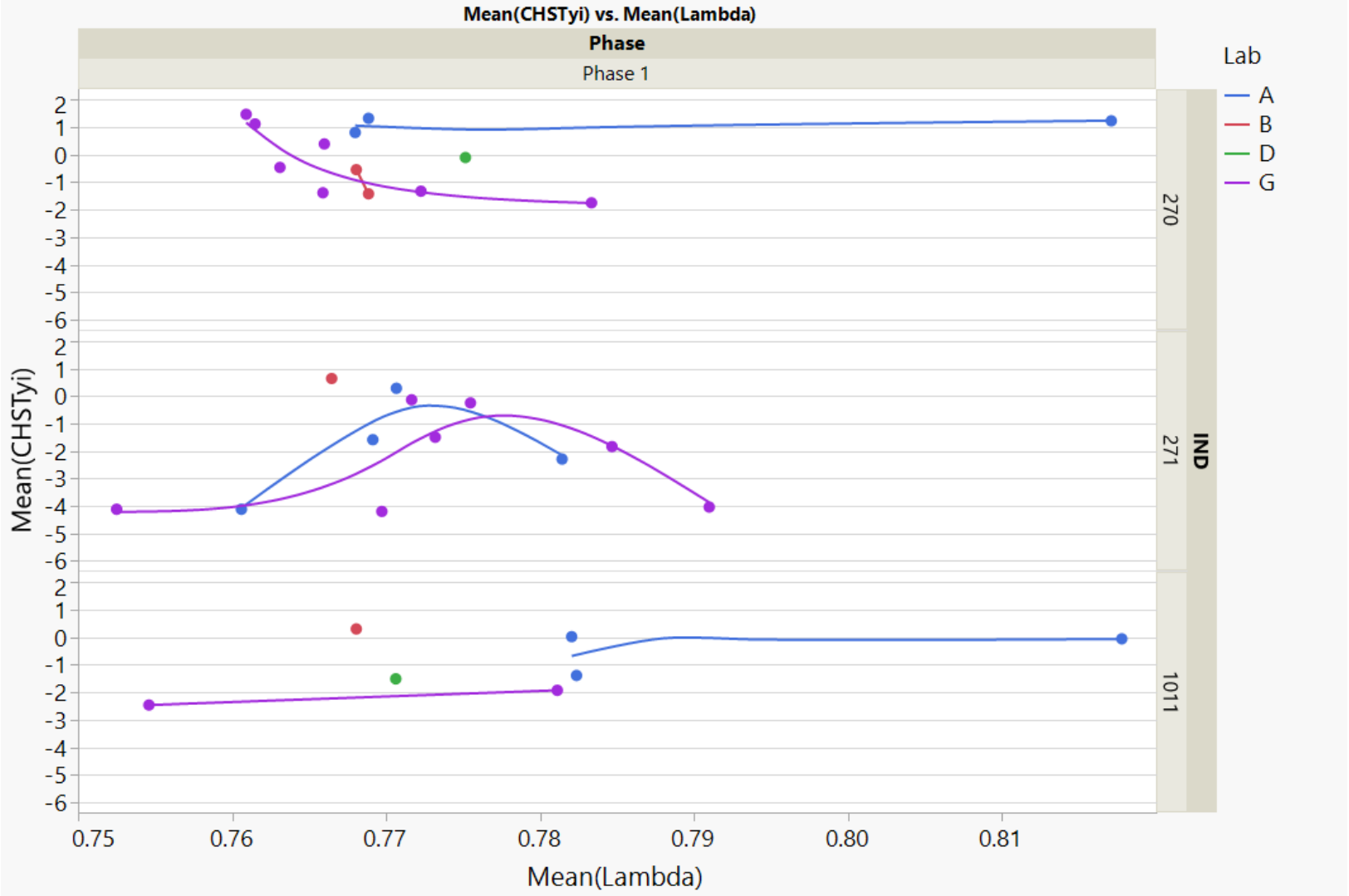
Chst. Vs. Coolant Flow



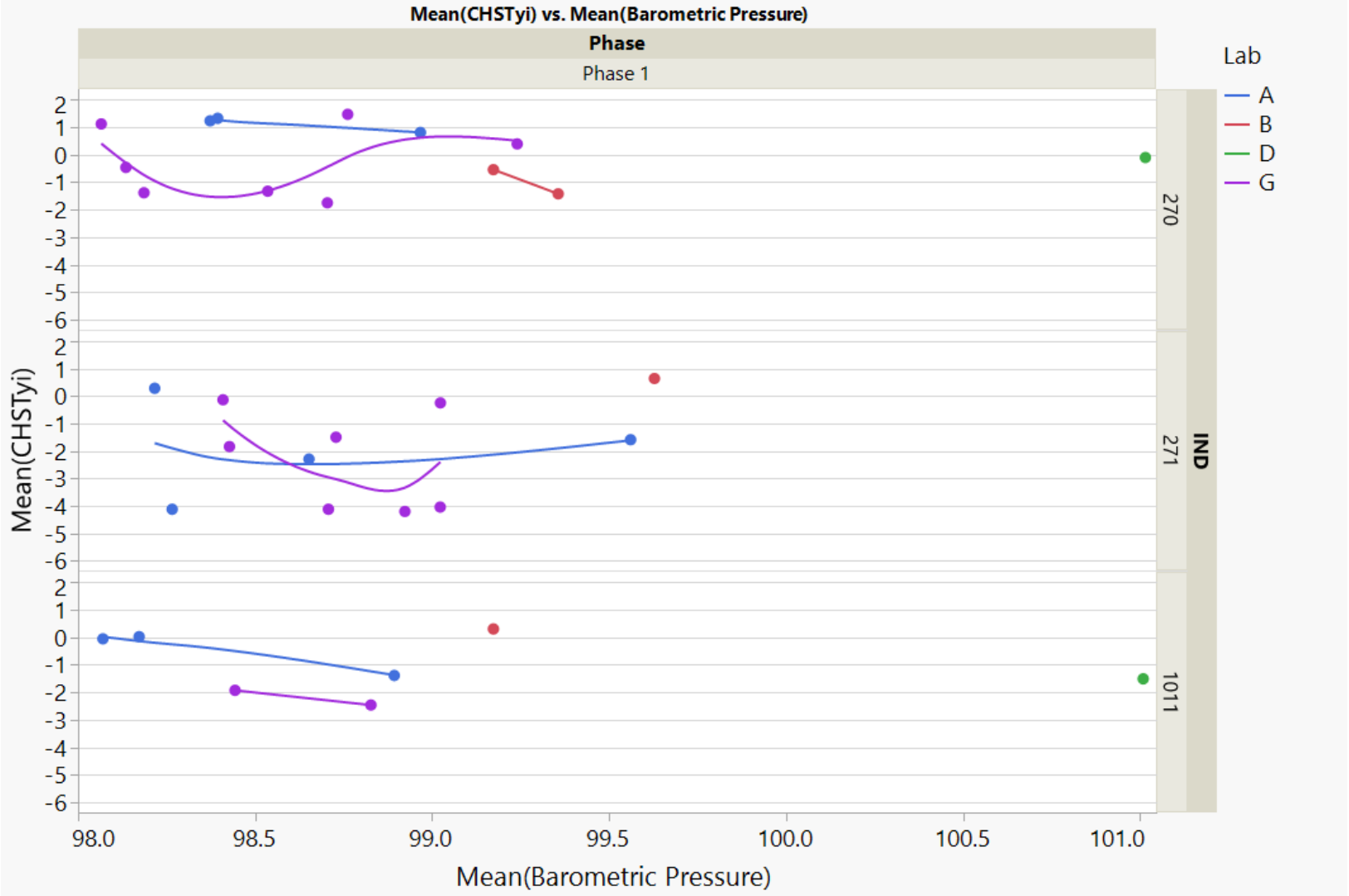
Chst. Vs. Blowby Outlet Temp



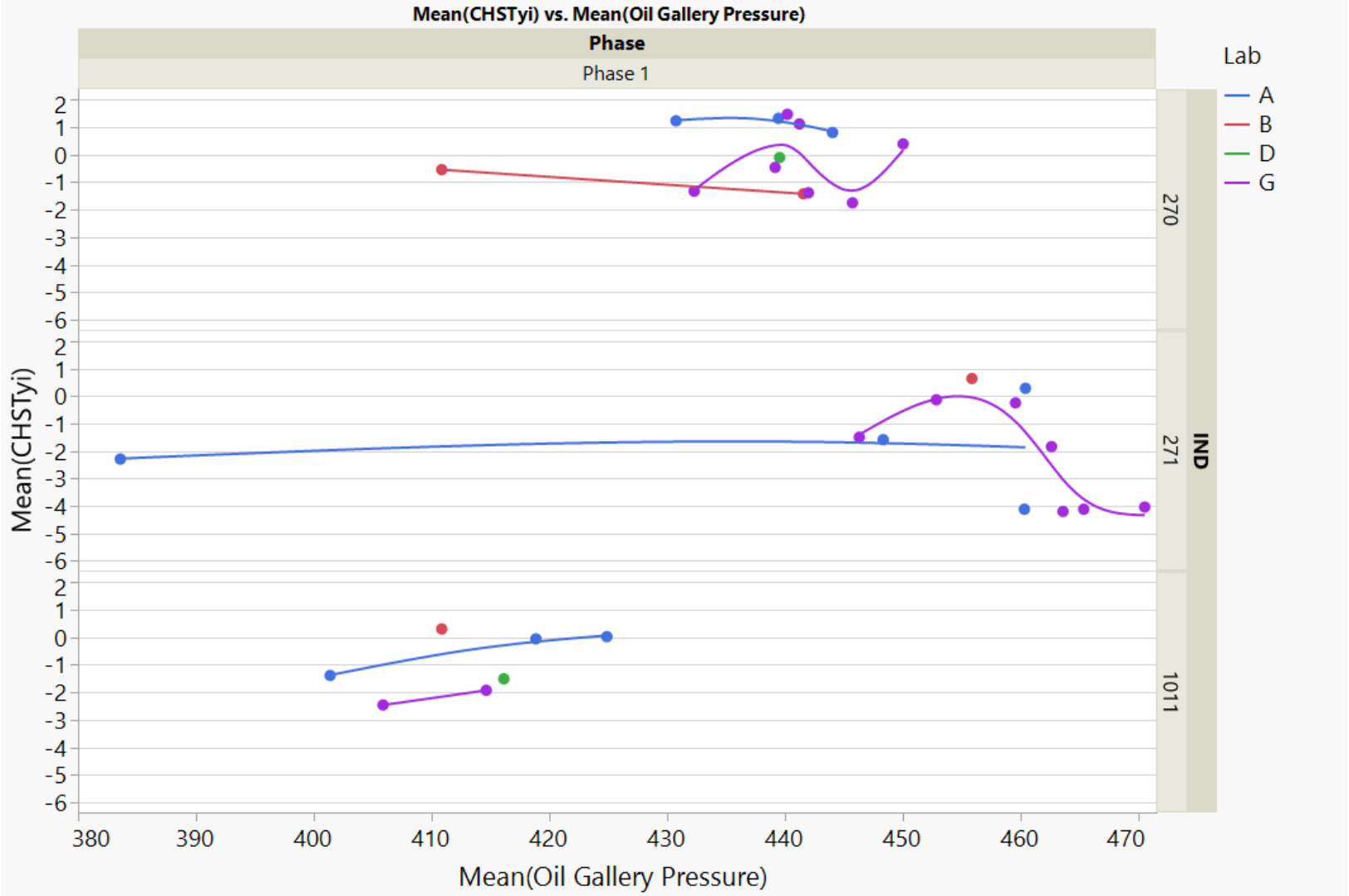
Chst. Vs. Lambda



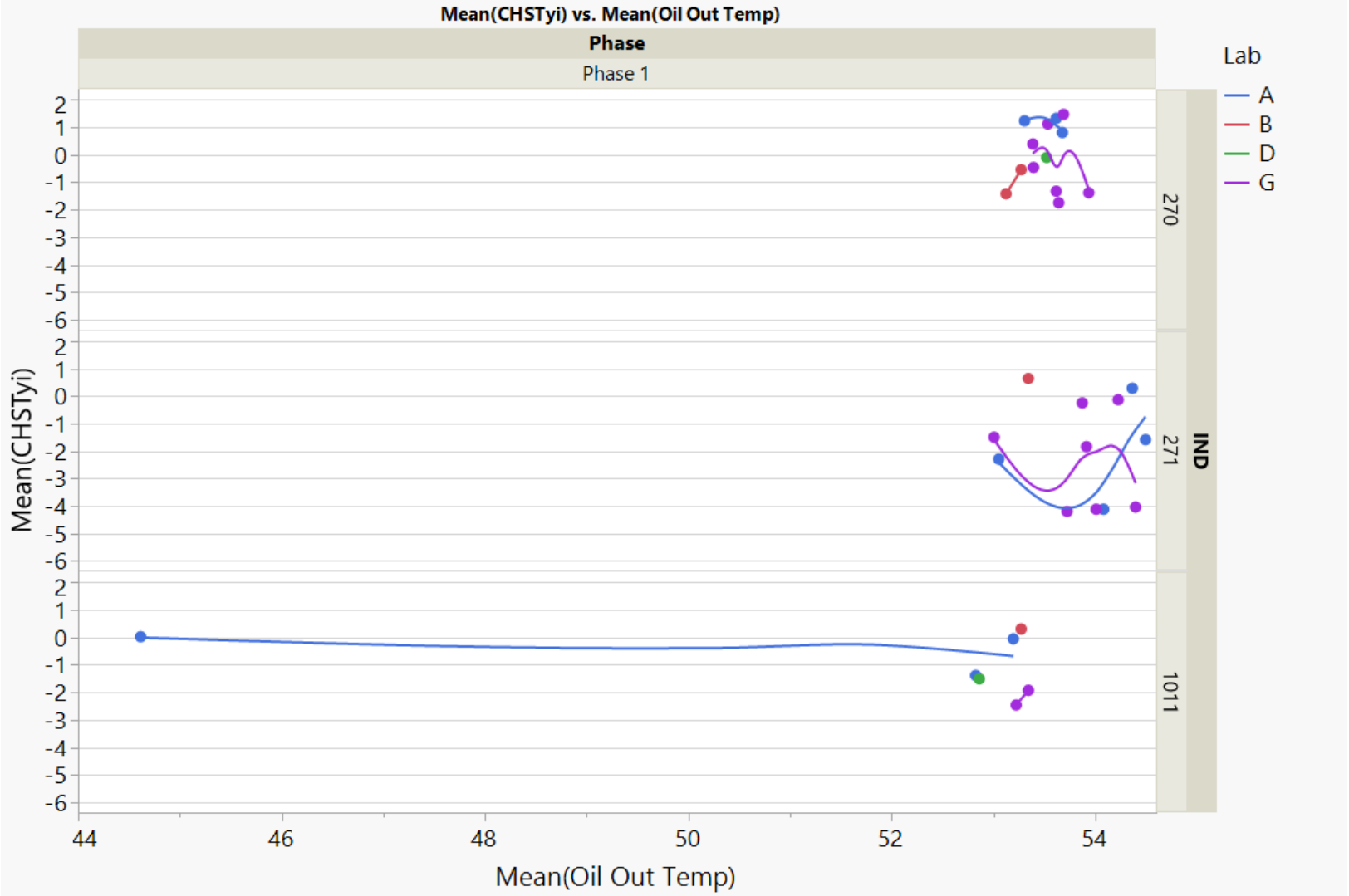
Chst. Vs. Barometric Pressure



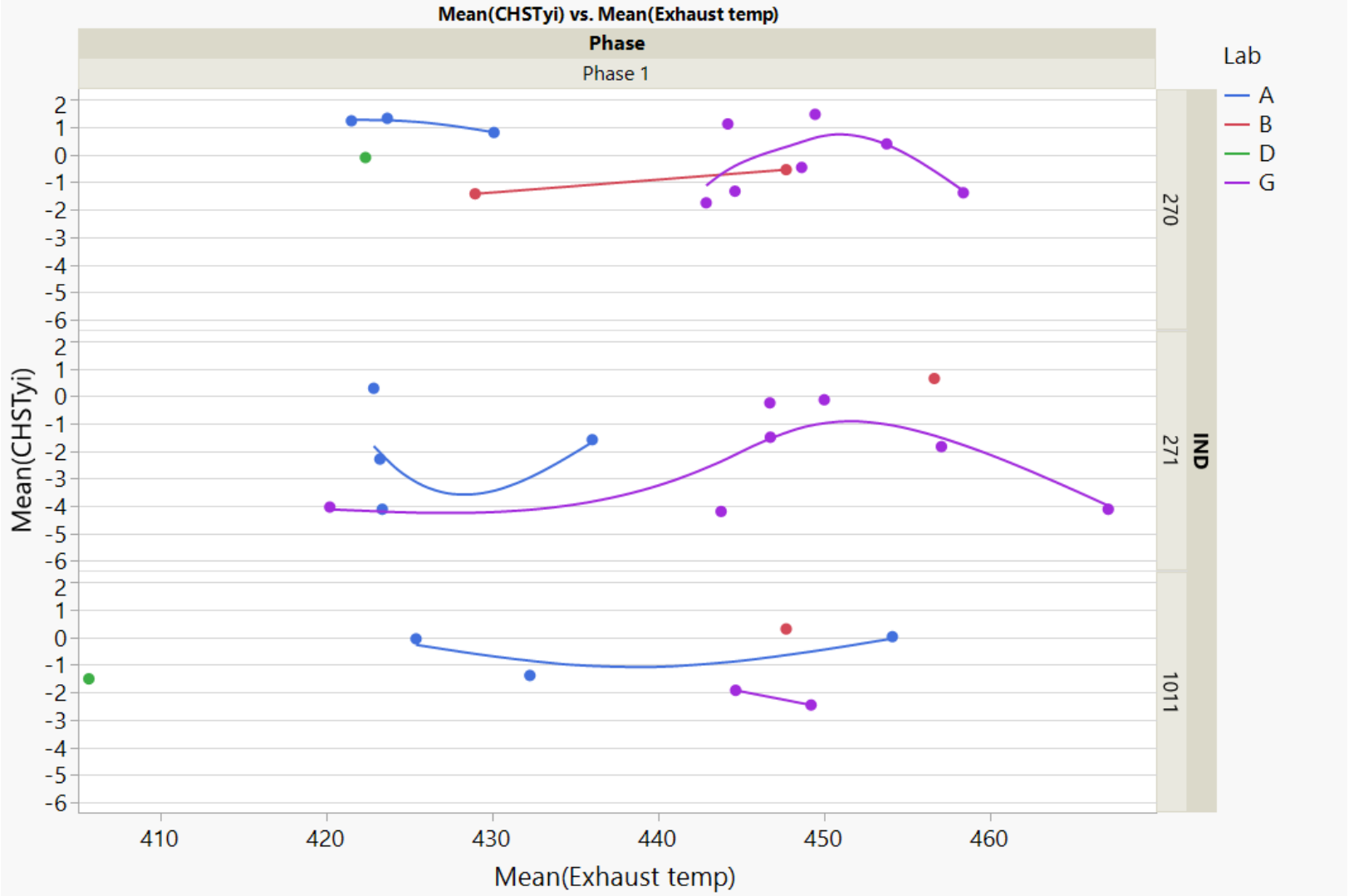
Chst. Vs. Oil Gallery Pressure



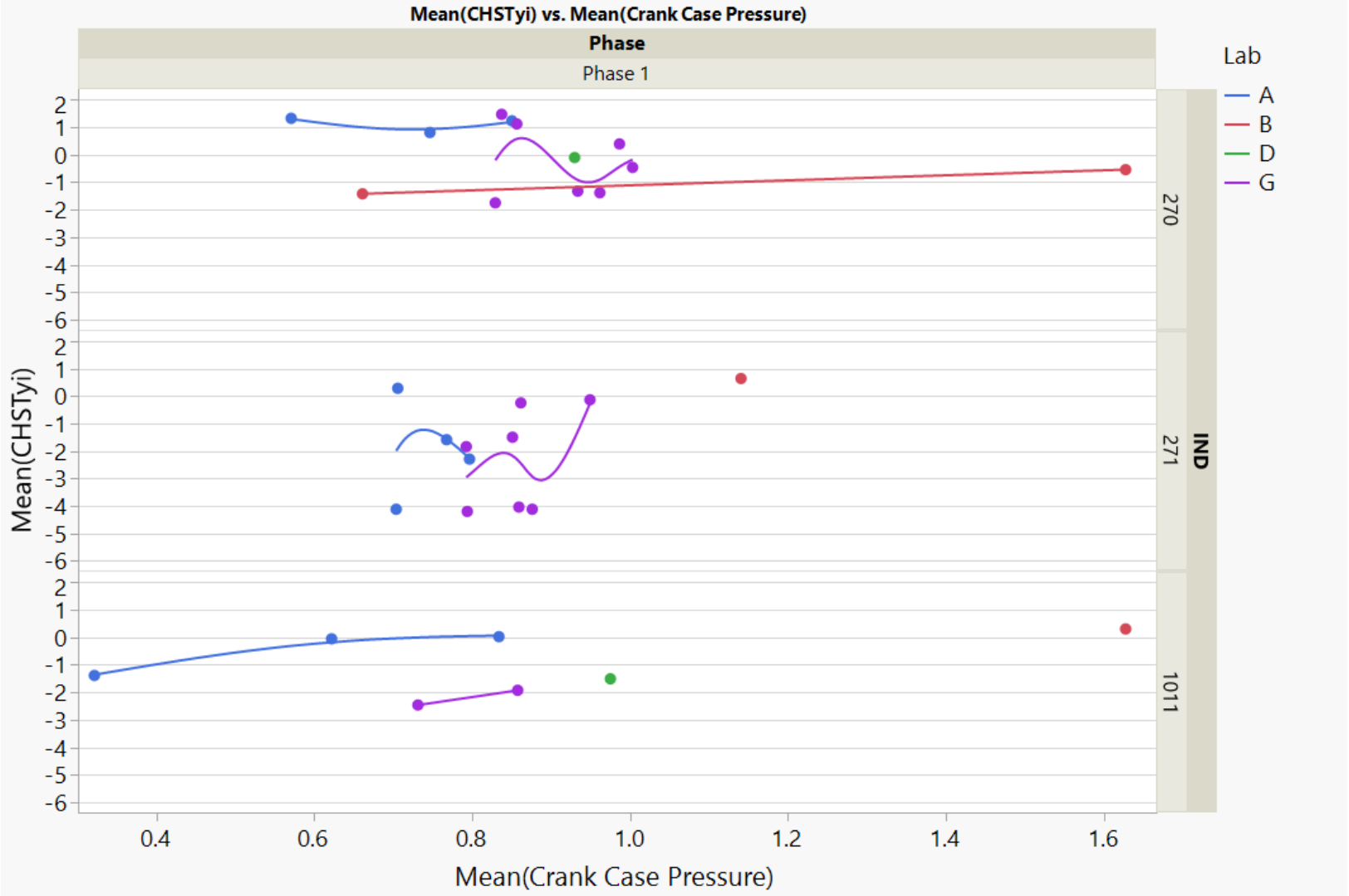
Chst. Vs. Oil Out Temp



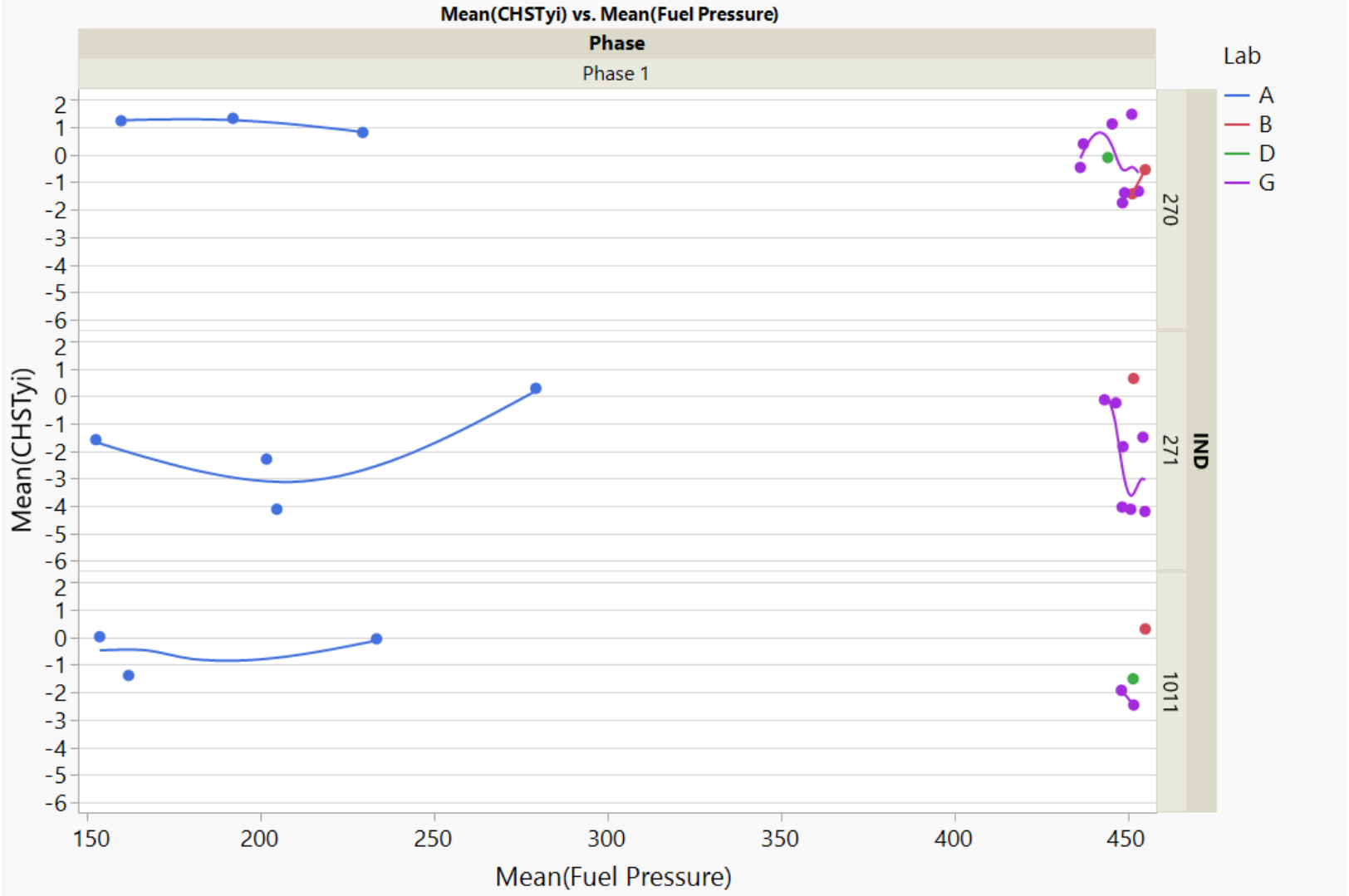
Chst. Vs. Exhaust Temp



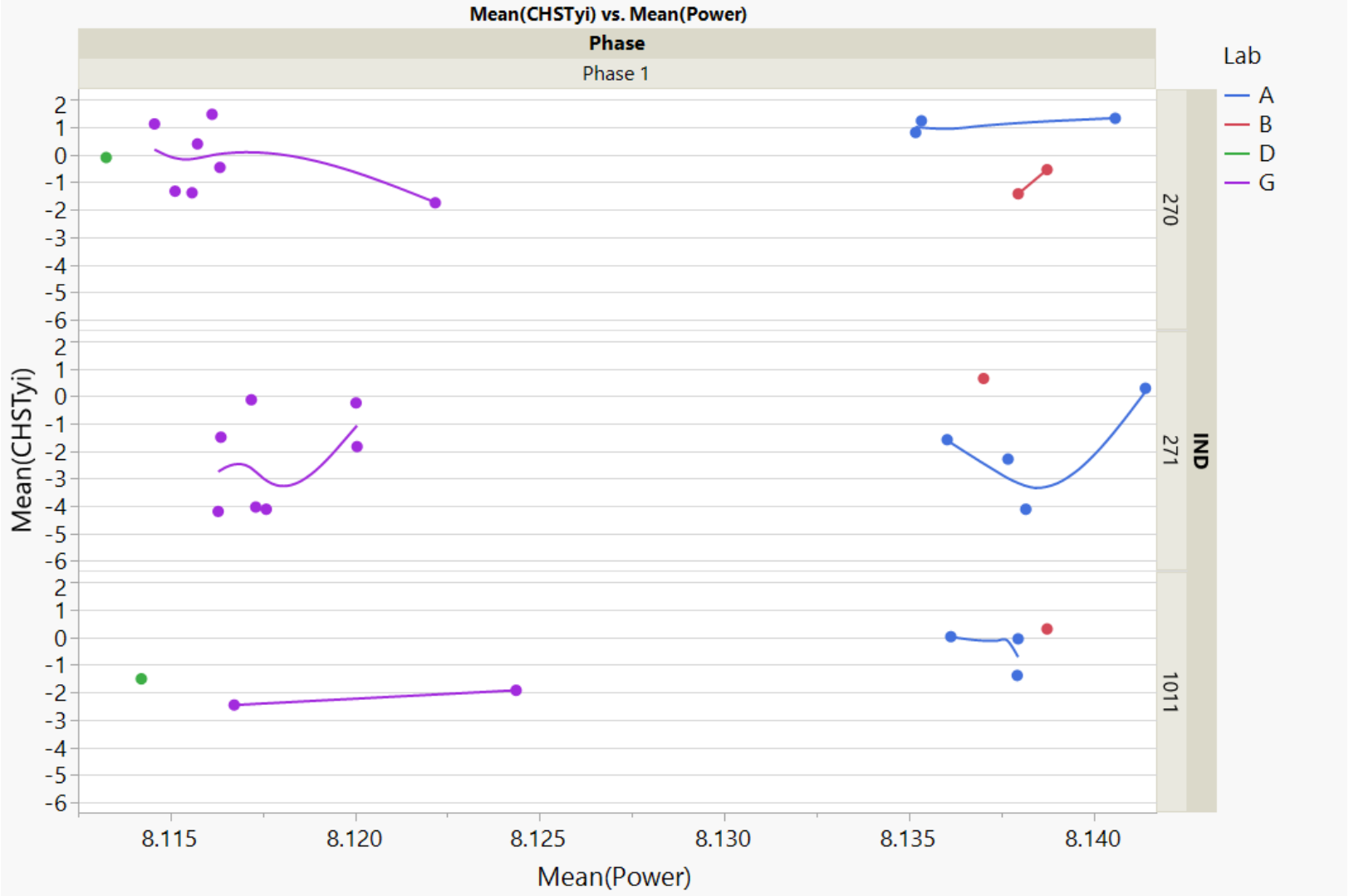
Chst. Vs. Crankcase Pressure



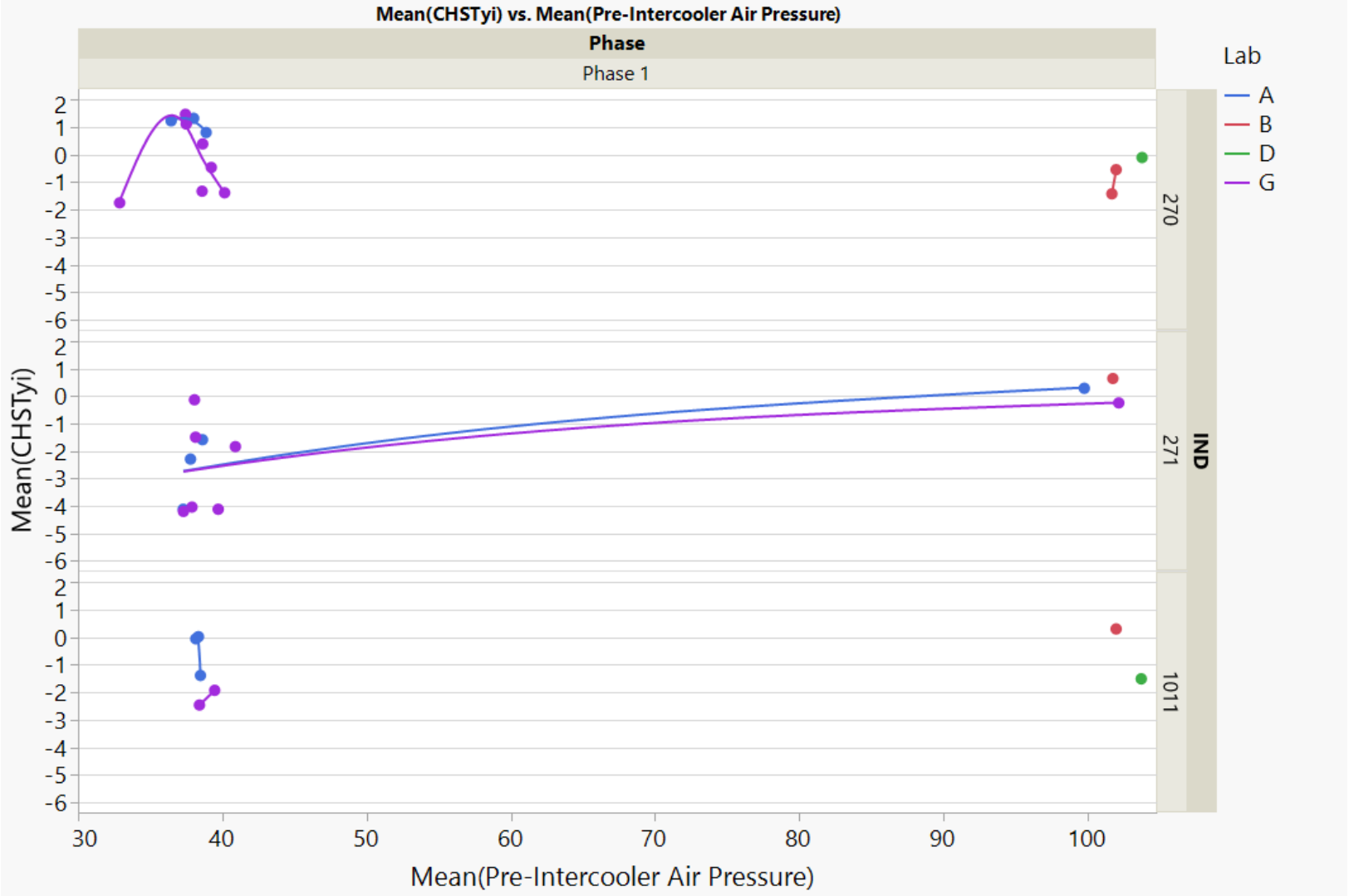
Chst. Vs. Fuel Pressure



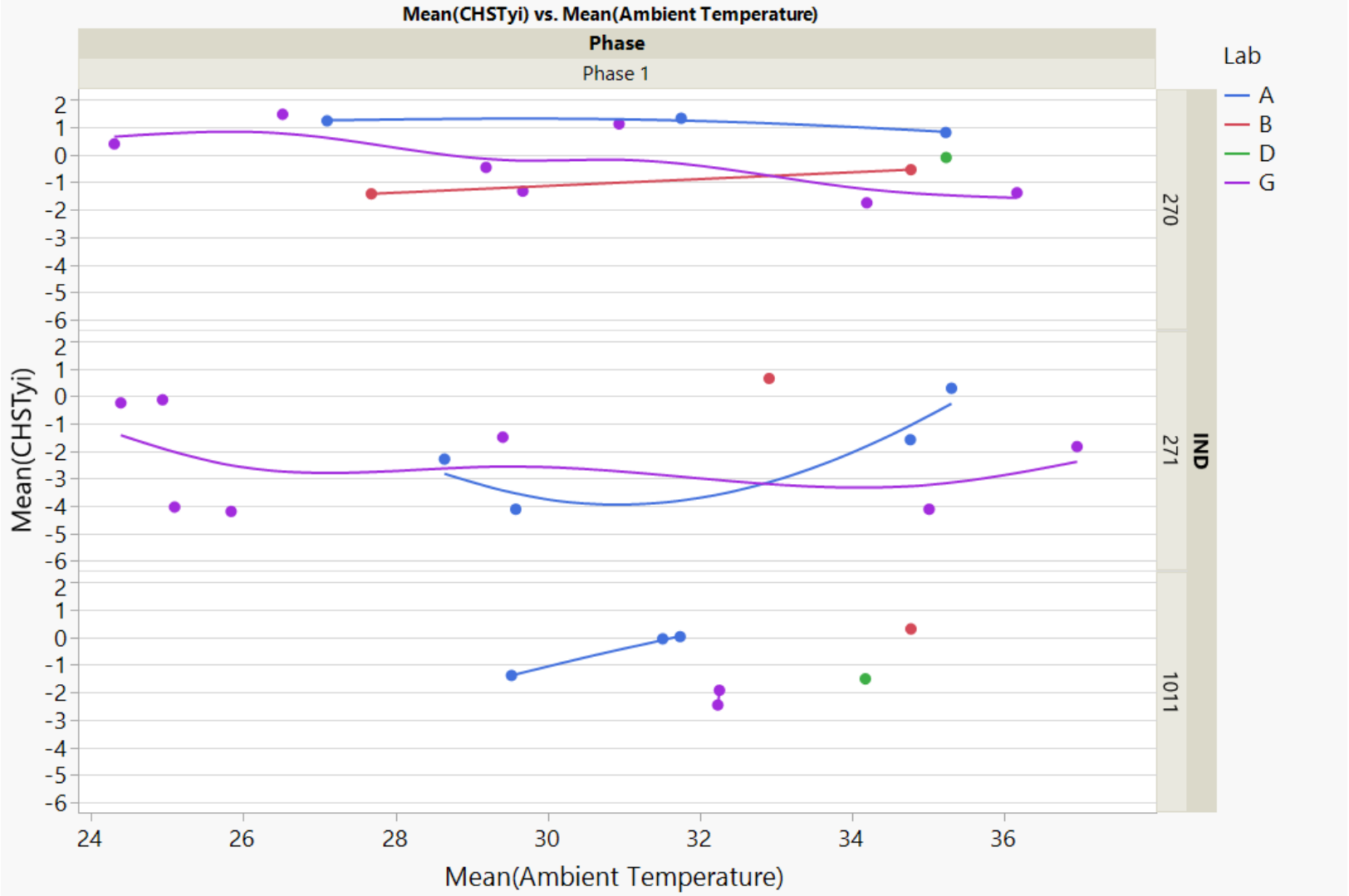
Chst. Vs. Power



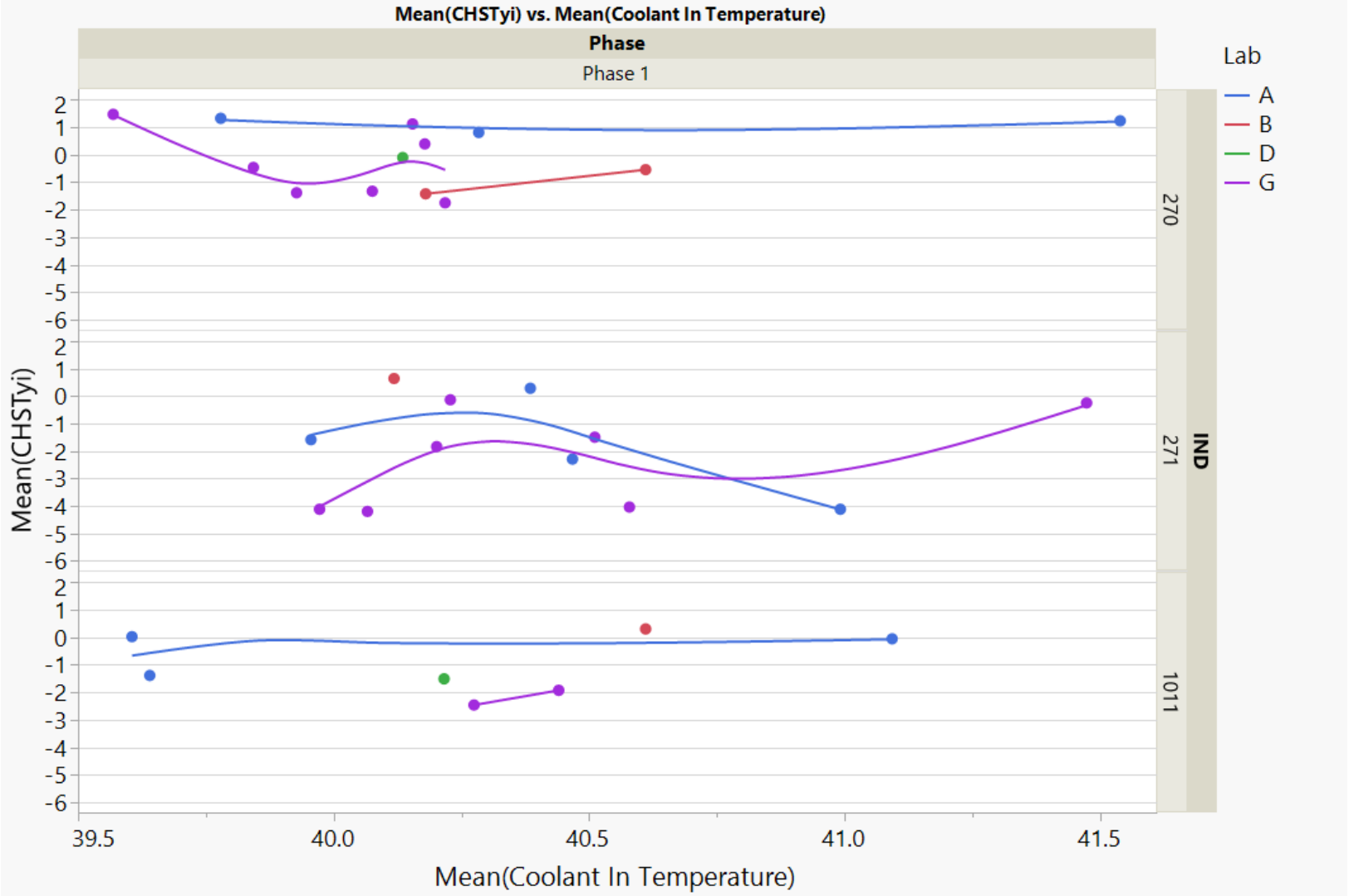
Chst. Vs. Pre-Intercooler Air Pressure



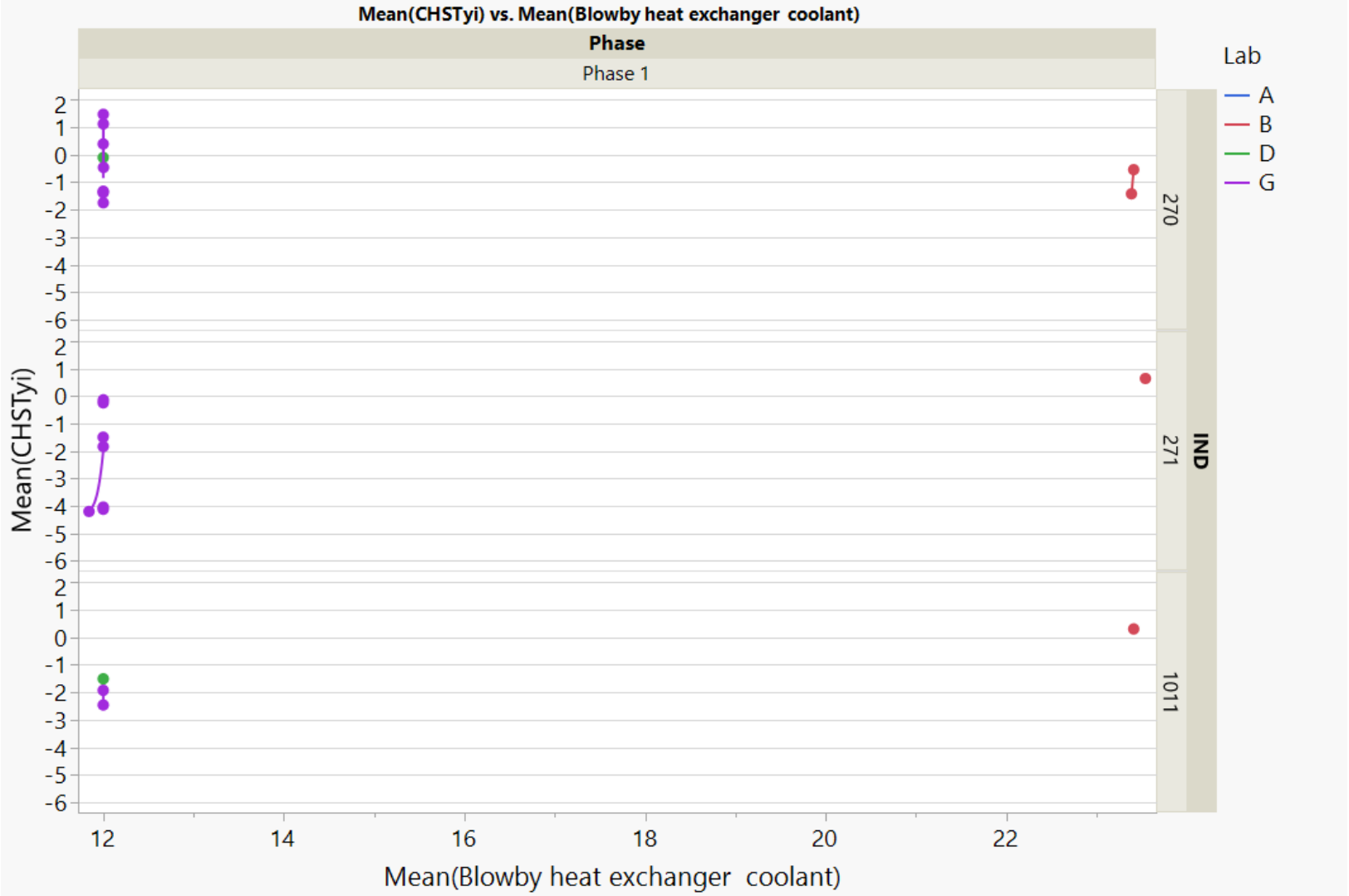
Chst. Vs. Ambient Temp



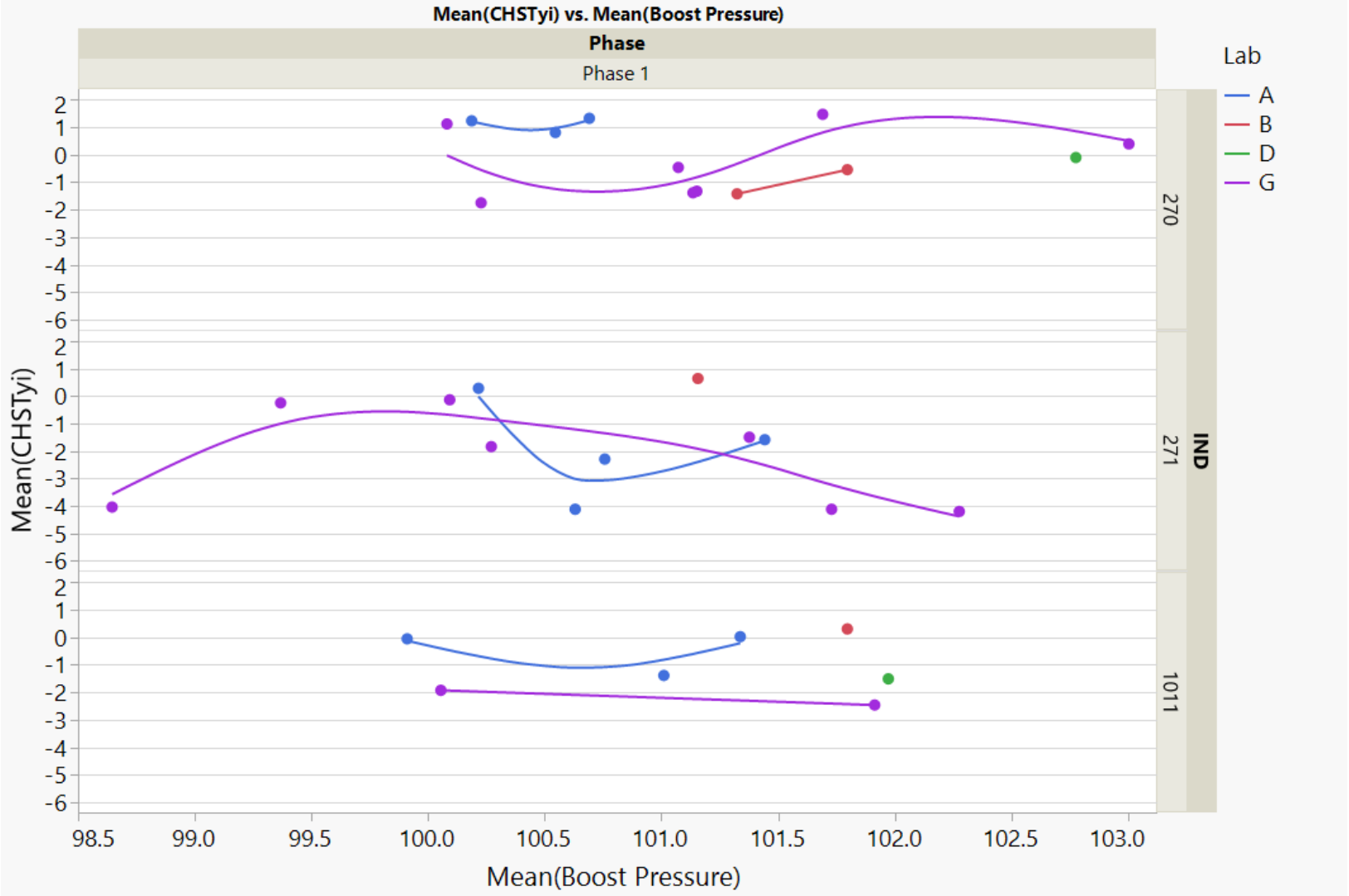
Chst. Vs. Coolant In Temp



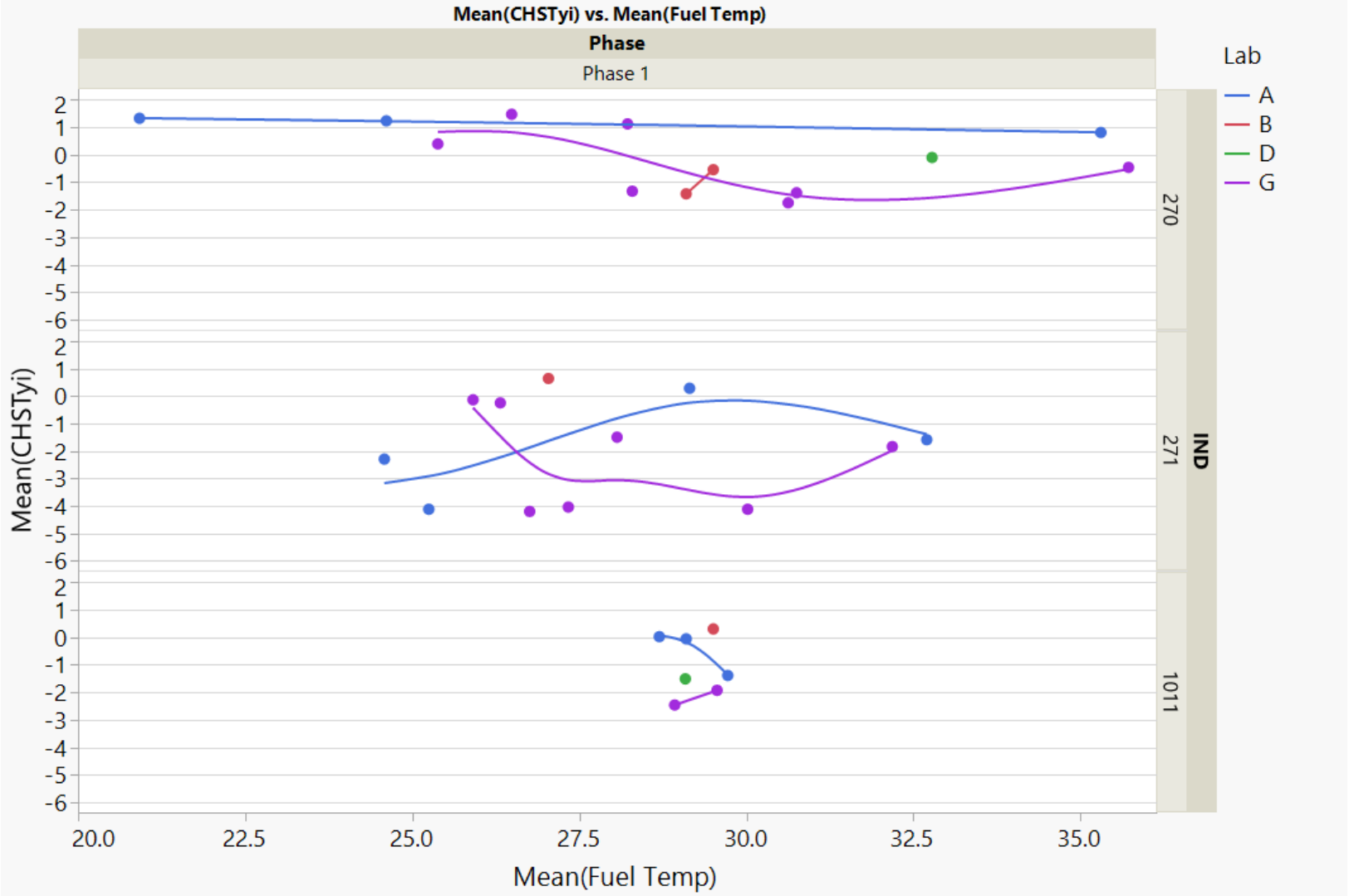
Chst. Vs. Blowby Heat Exchanger Coolant



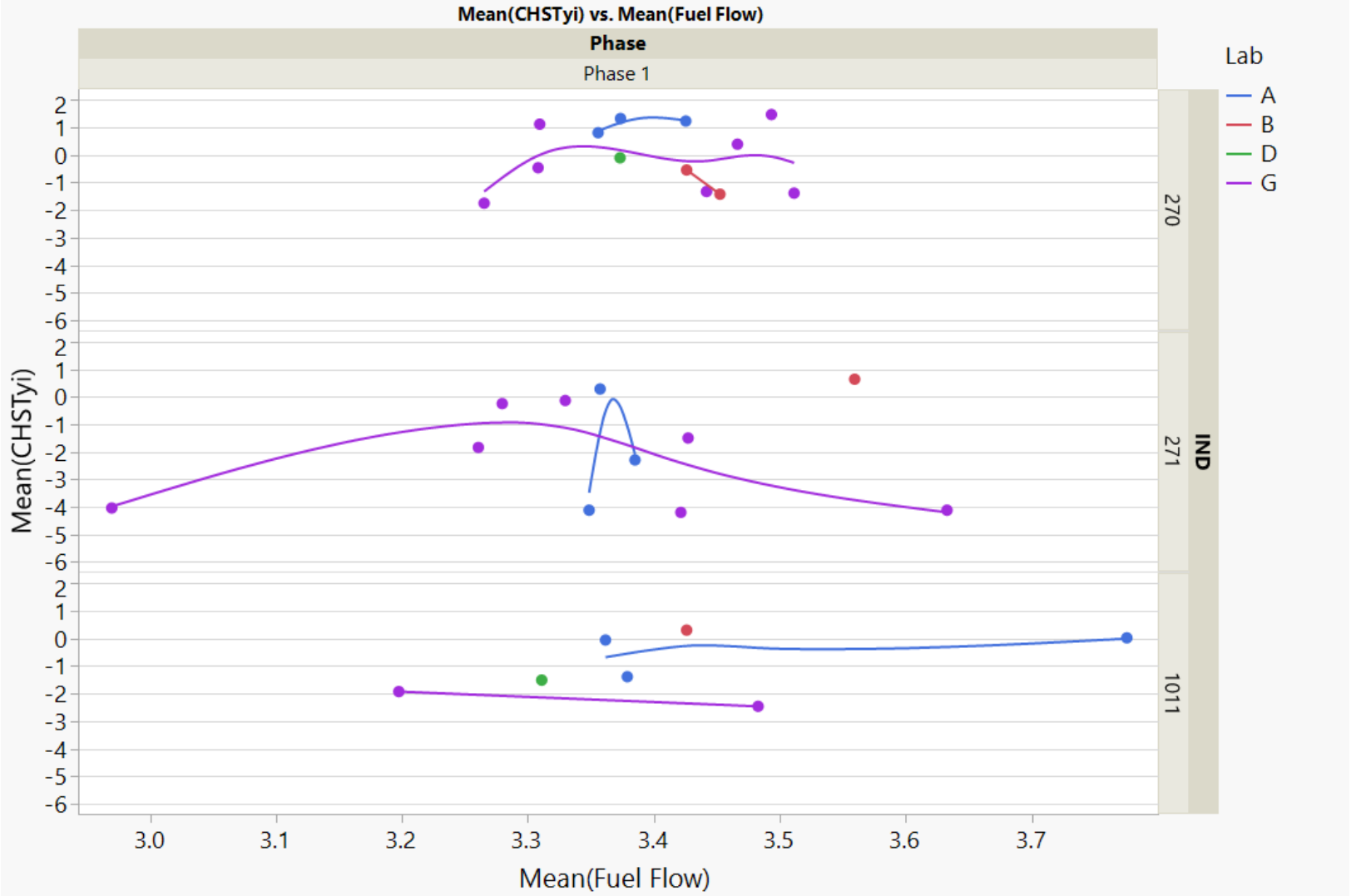
Chst. Vs. Boost Pressure



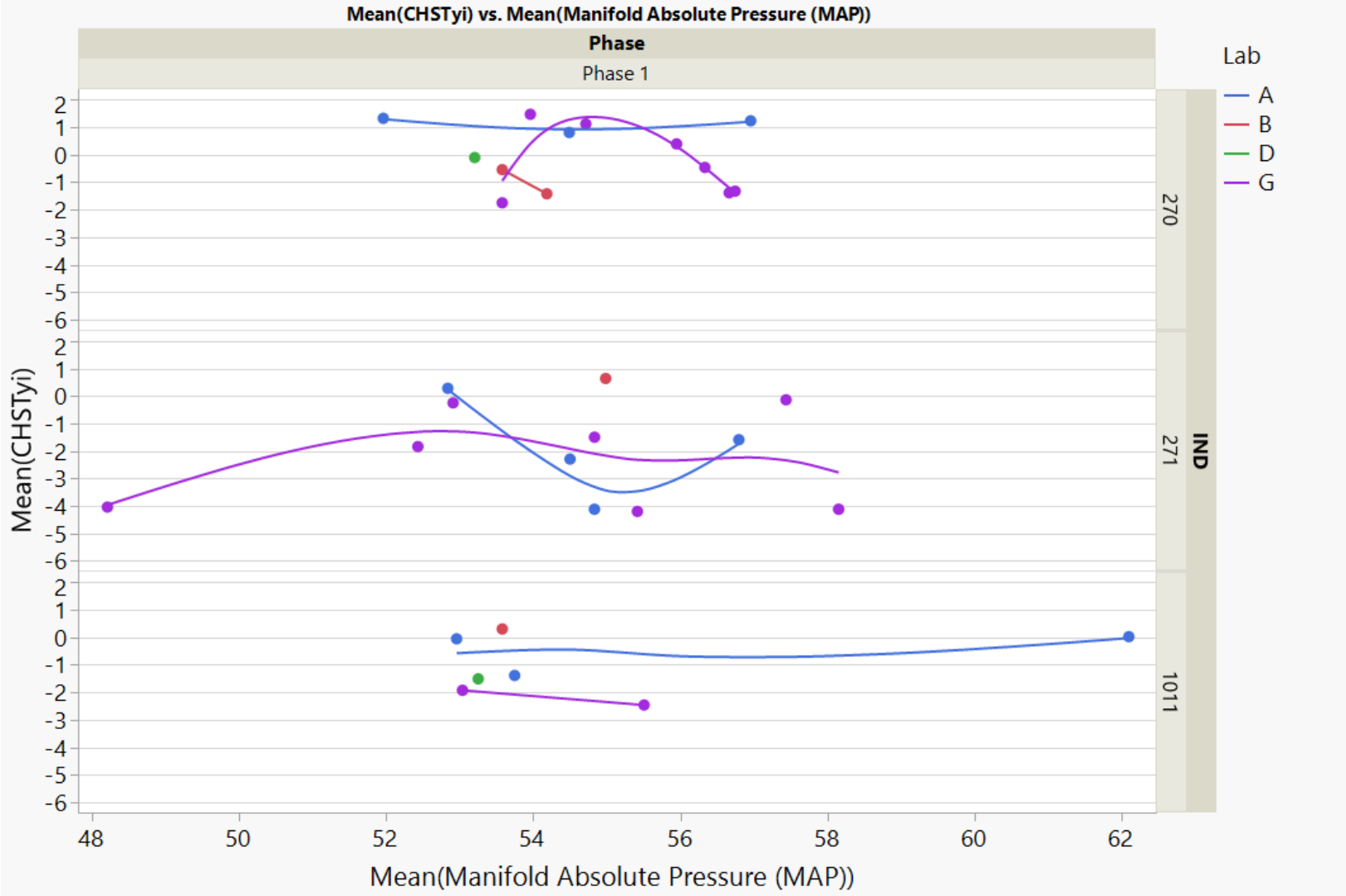
Chst. Vs. Fuel Temp



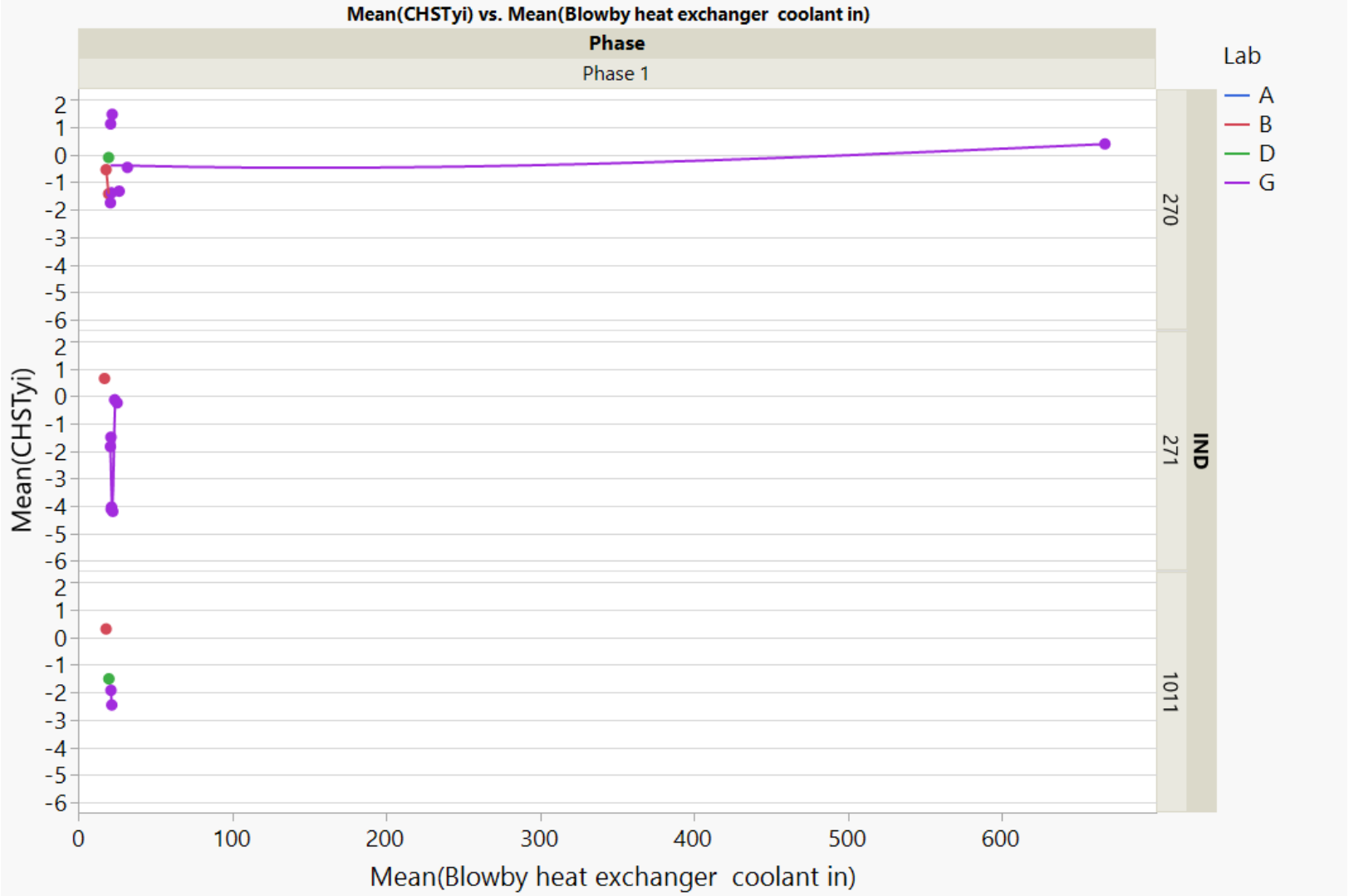
Chst. Vs. Fuel Flow



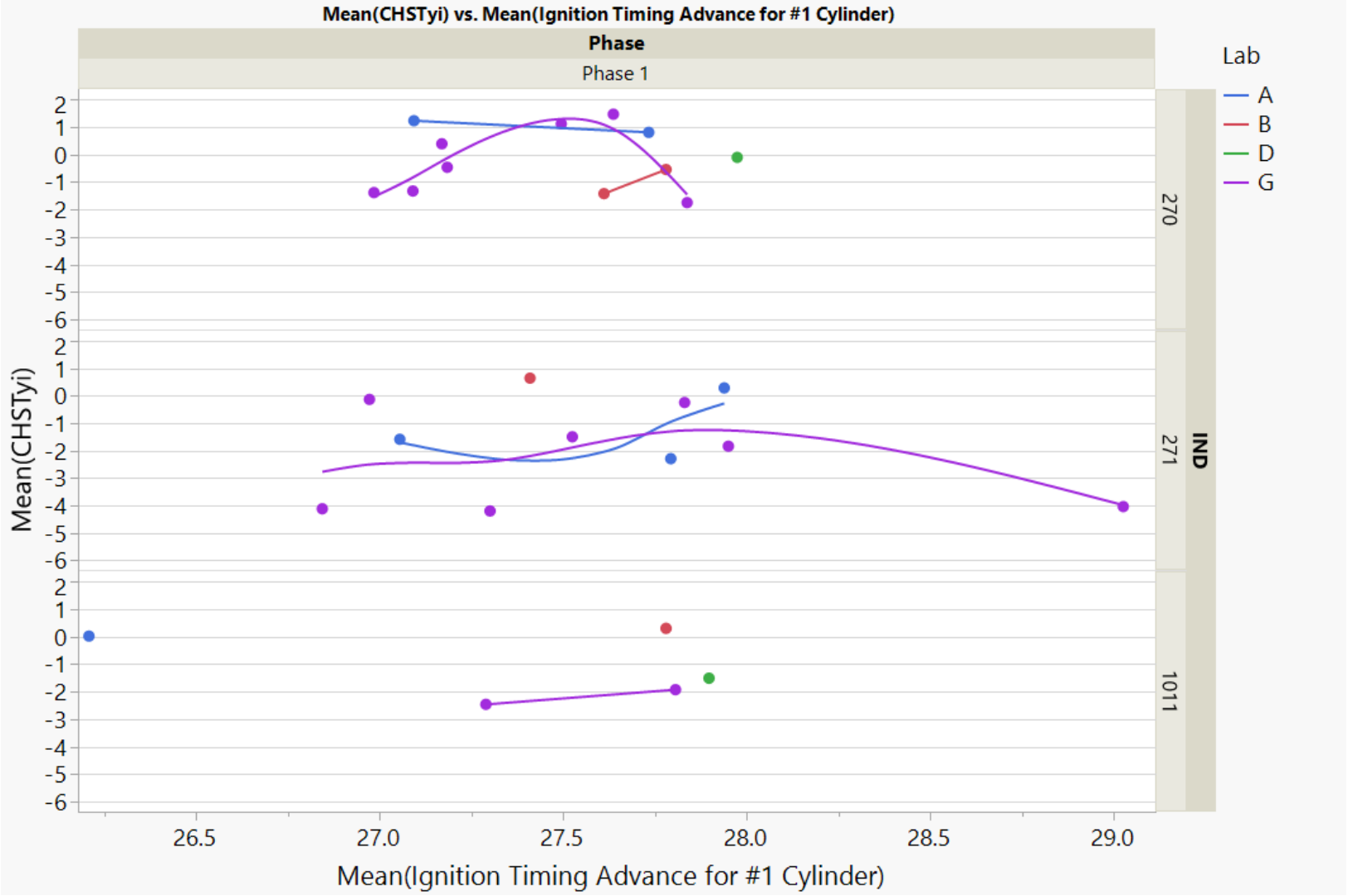
Chst. Vs. Manifold Absolute Pressure



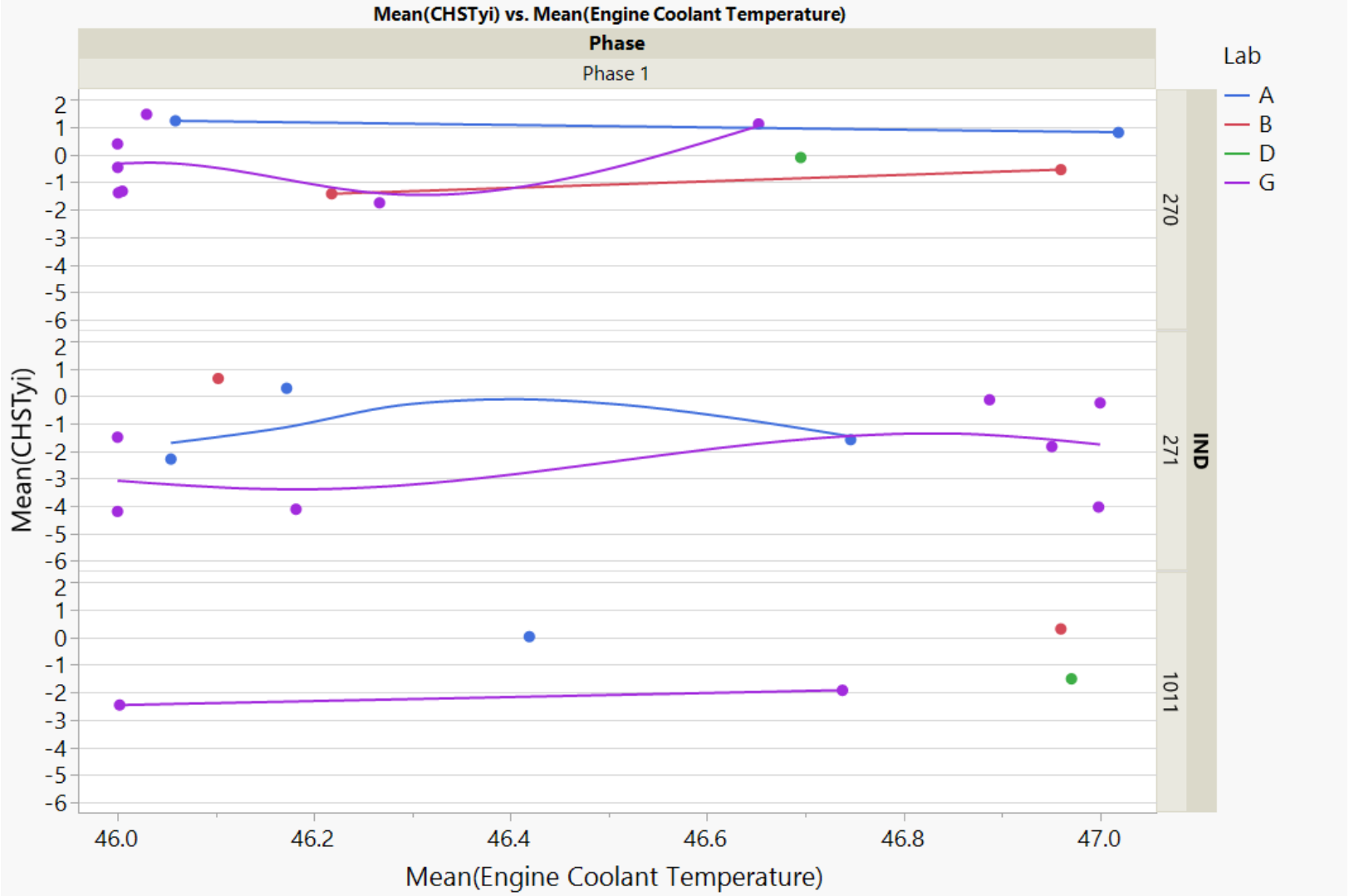
Chst. Vs. Blowby Heat Exchanger Coolant In



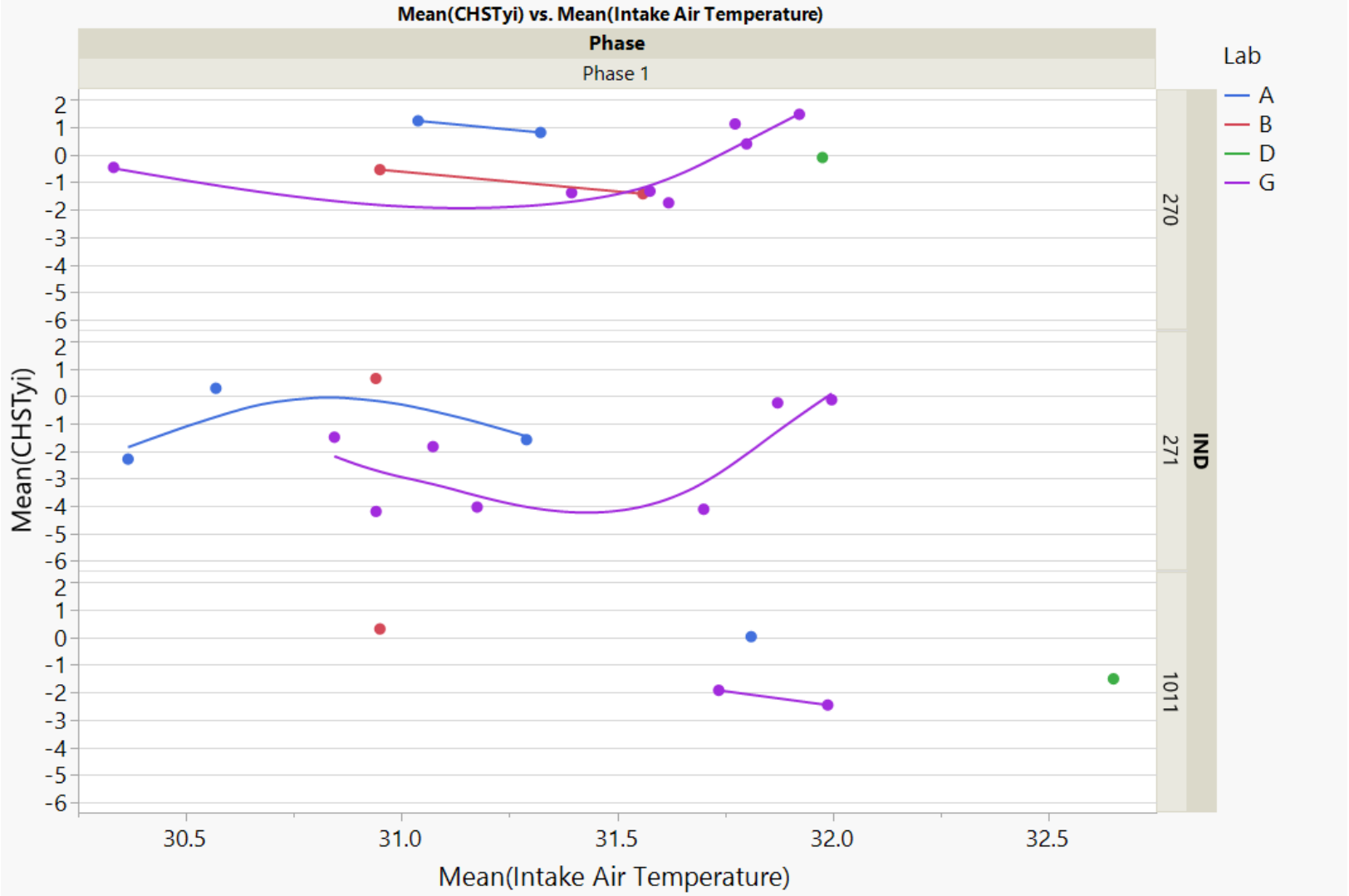
Chst. Vs. Ignition Timing Advance Cyl. #1



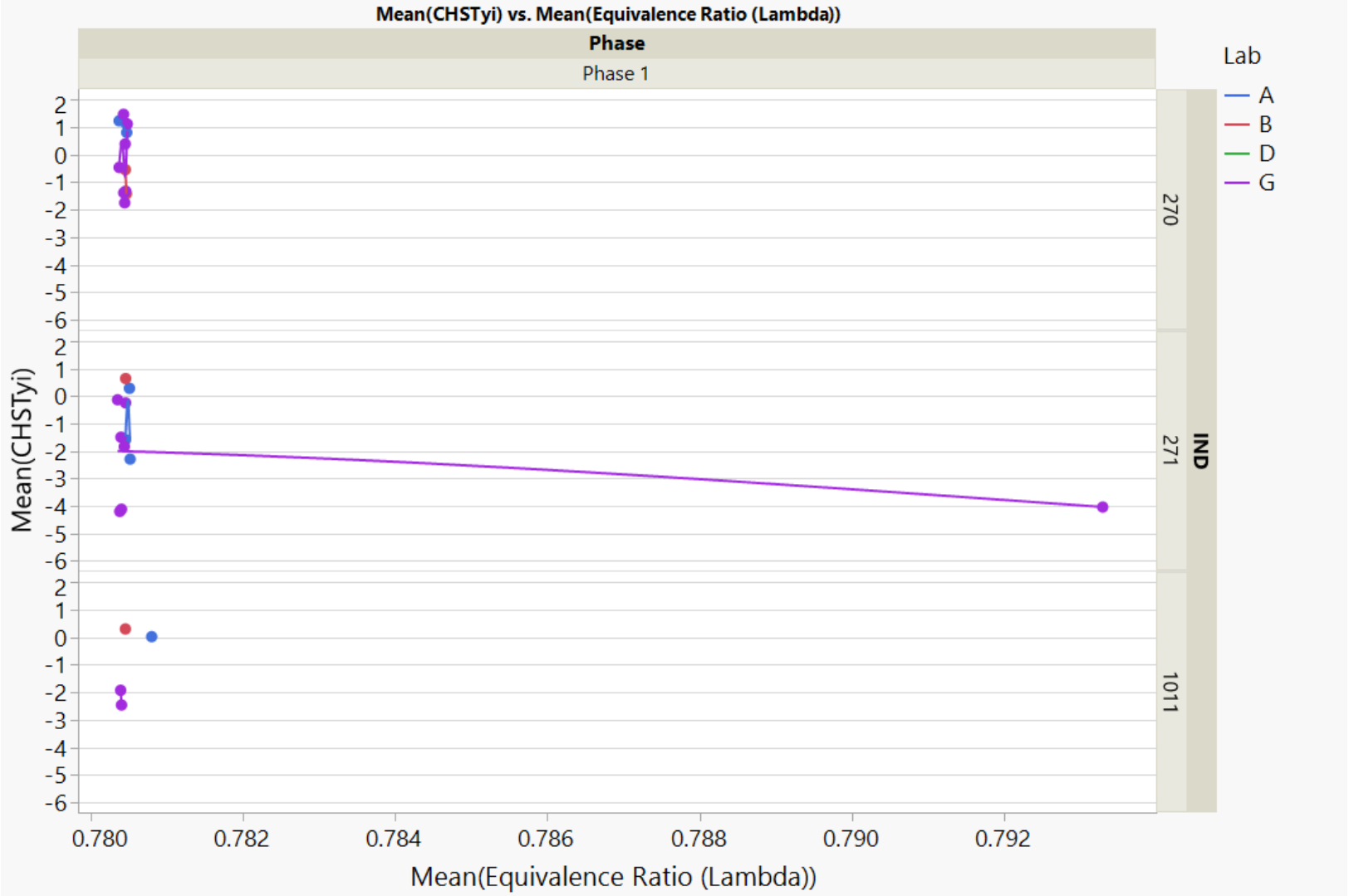
Chst. Vs. Engine Coolant Temp



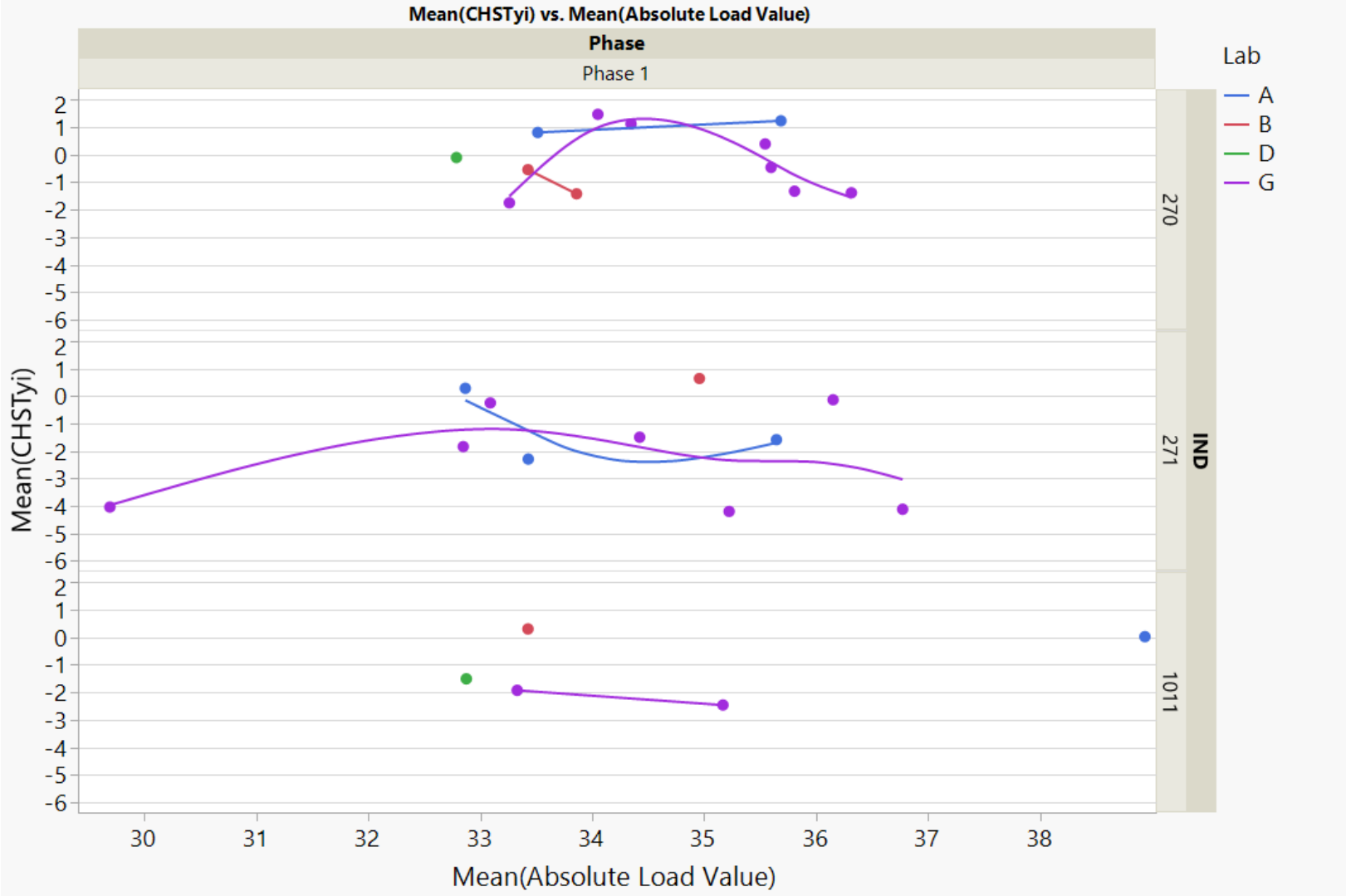
Chst. Vs. Intake Air Temp



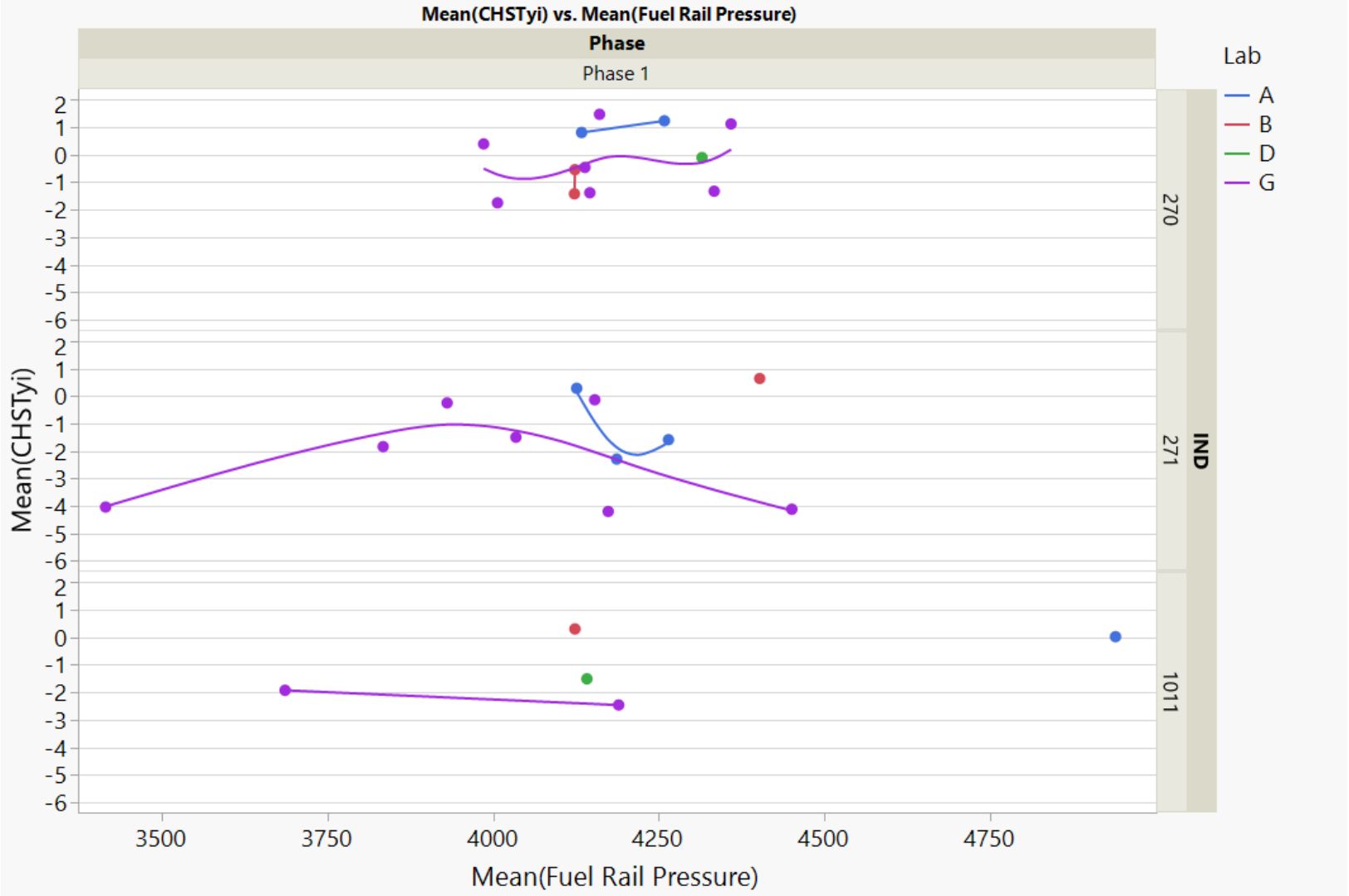
Chst. Vs. Equivalence Ratio (Lambda)



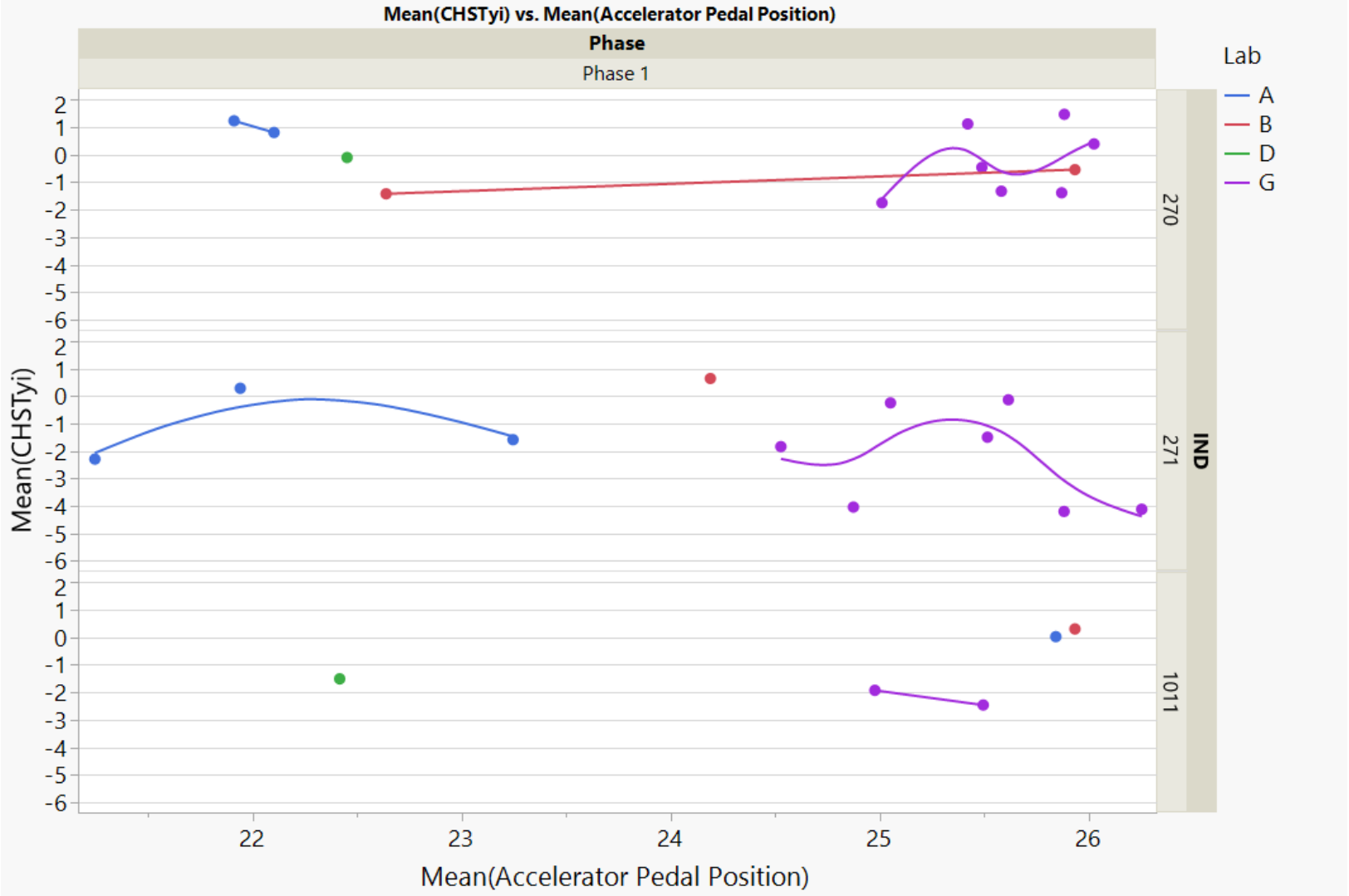
Chst. Vs. Absolute Load Value



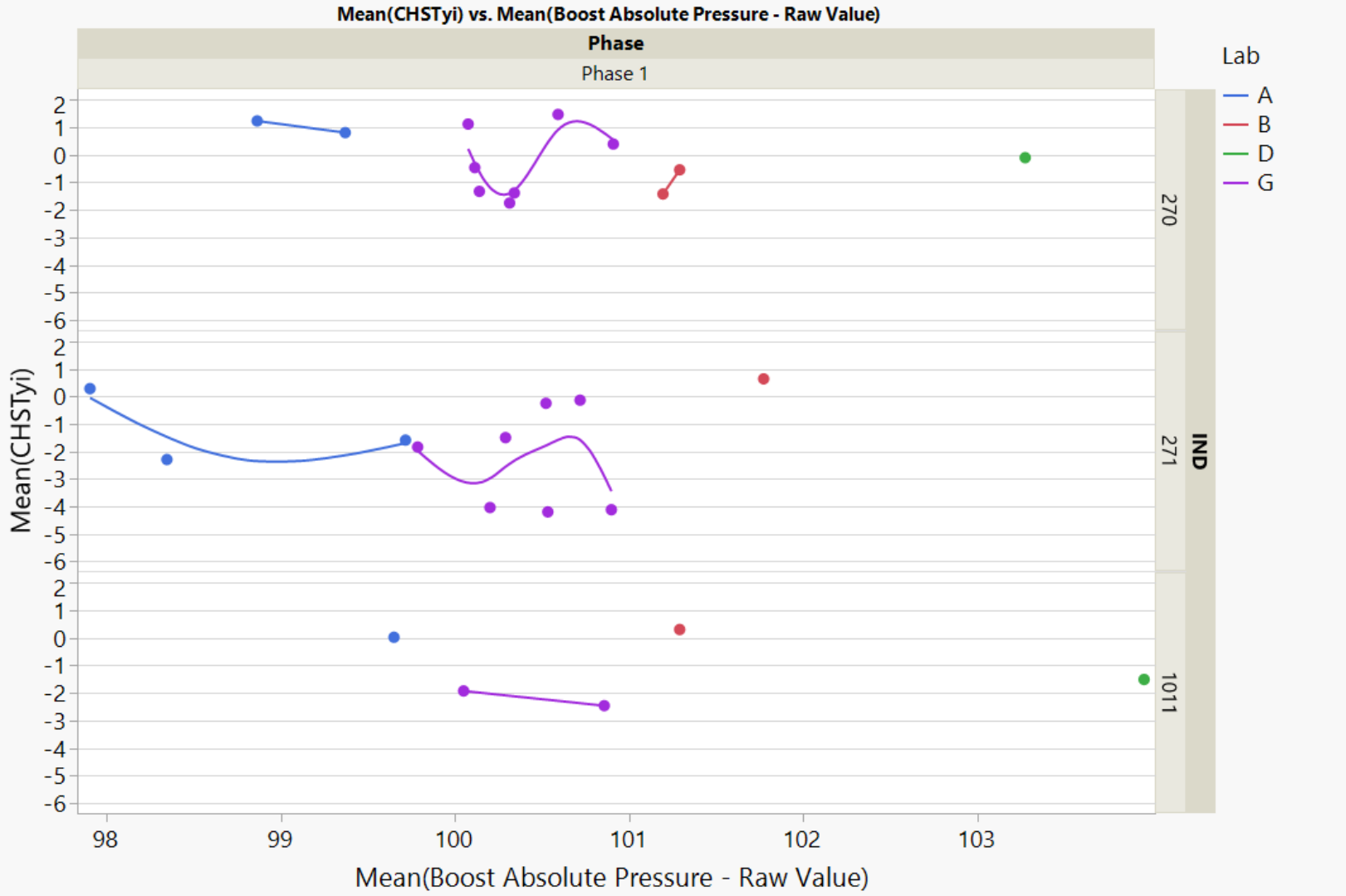
Chst.Vs. Fuel Rail Pressure



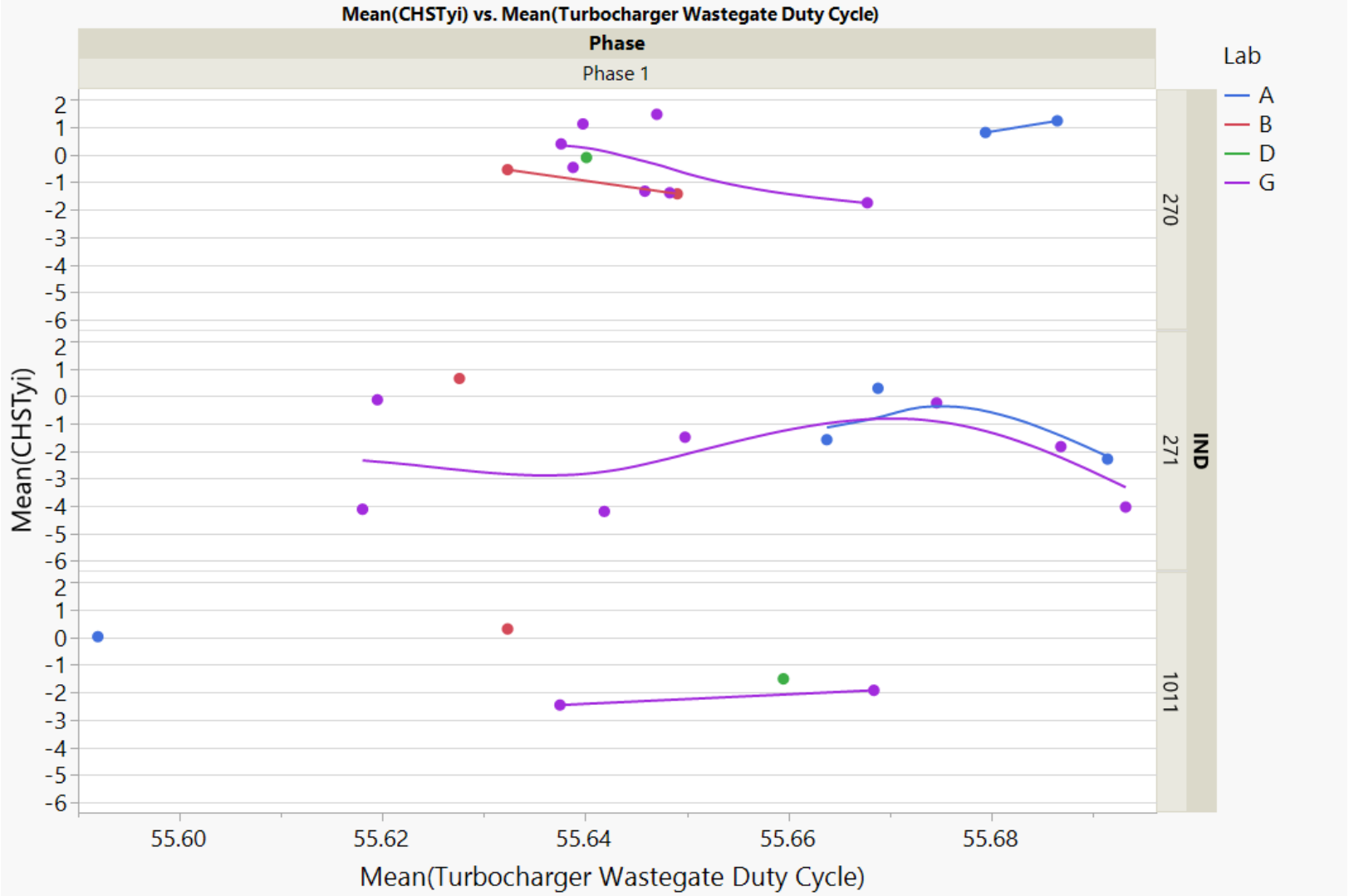
Chst.Vs. APP



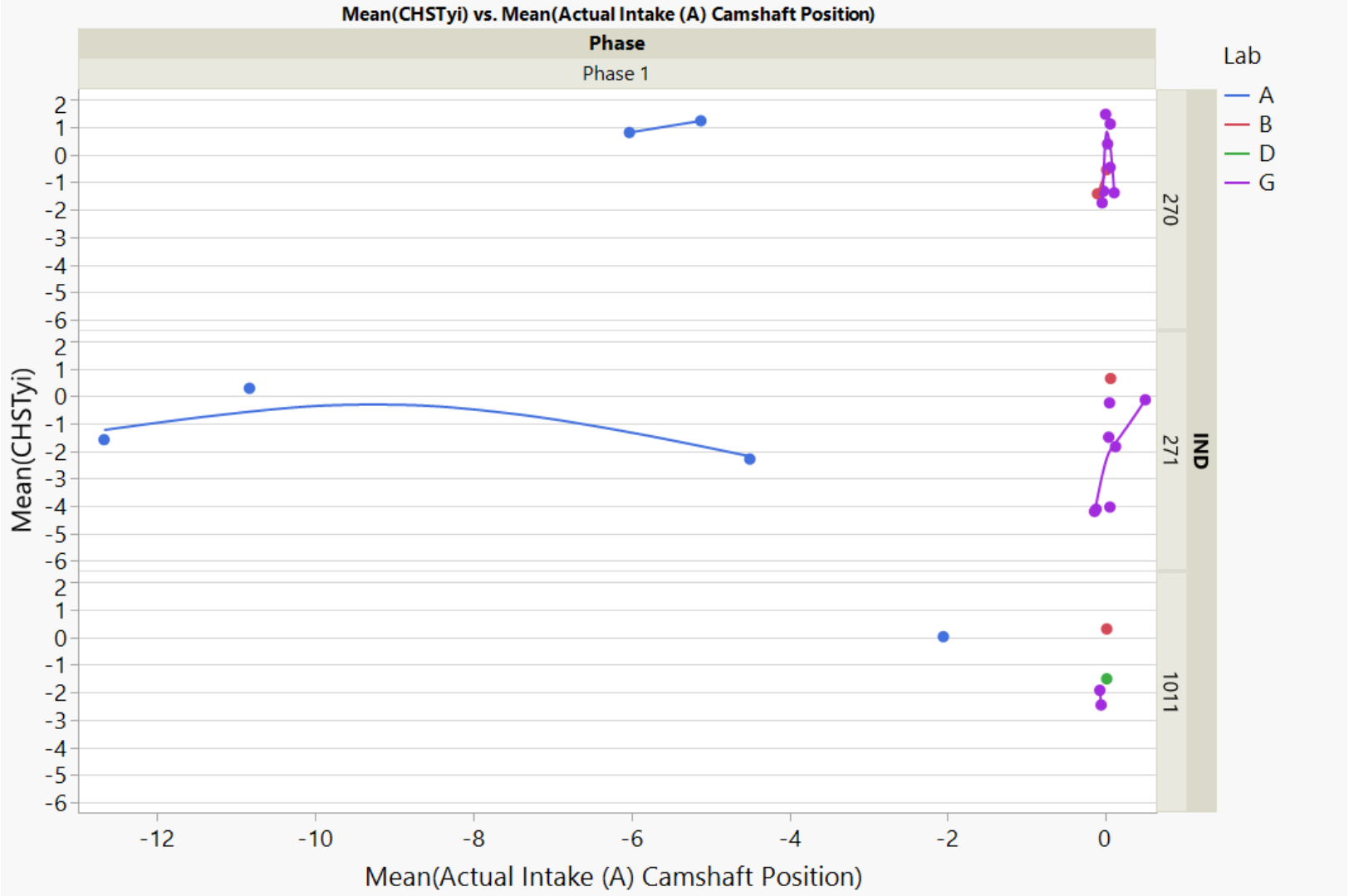
Chst. Vs. Boost Absolute Pressure – Raw Value



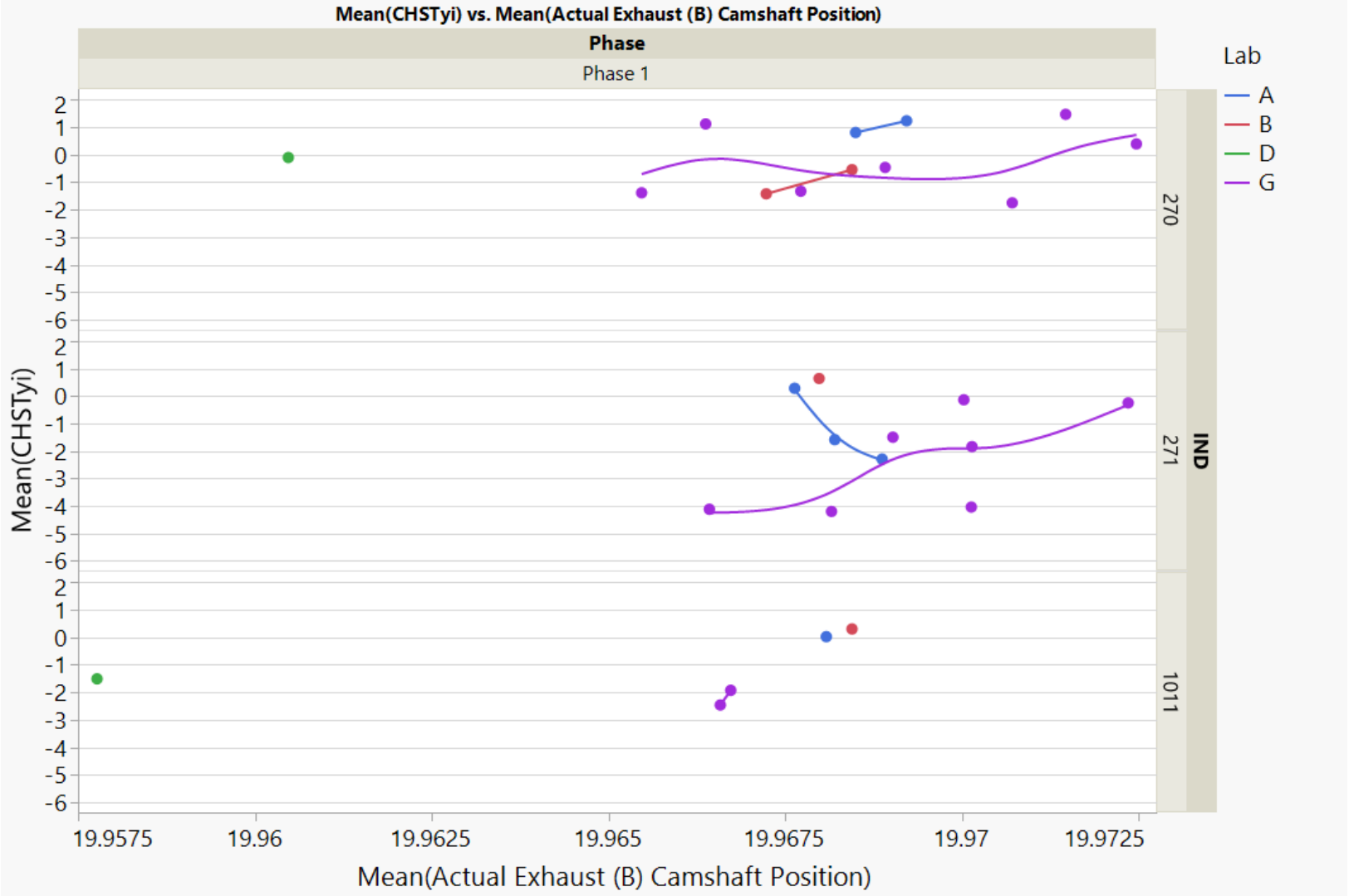
Chst. Vs. Turbocharger Wastegate Duty Cycle



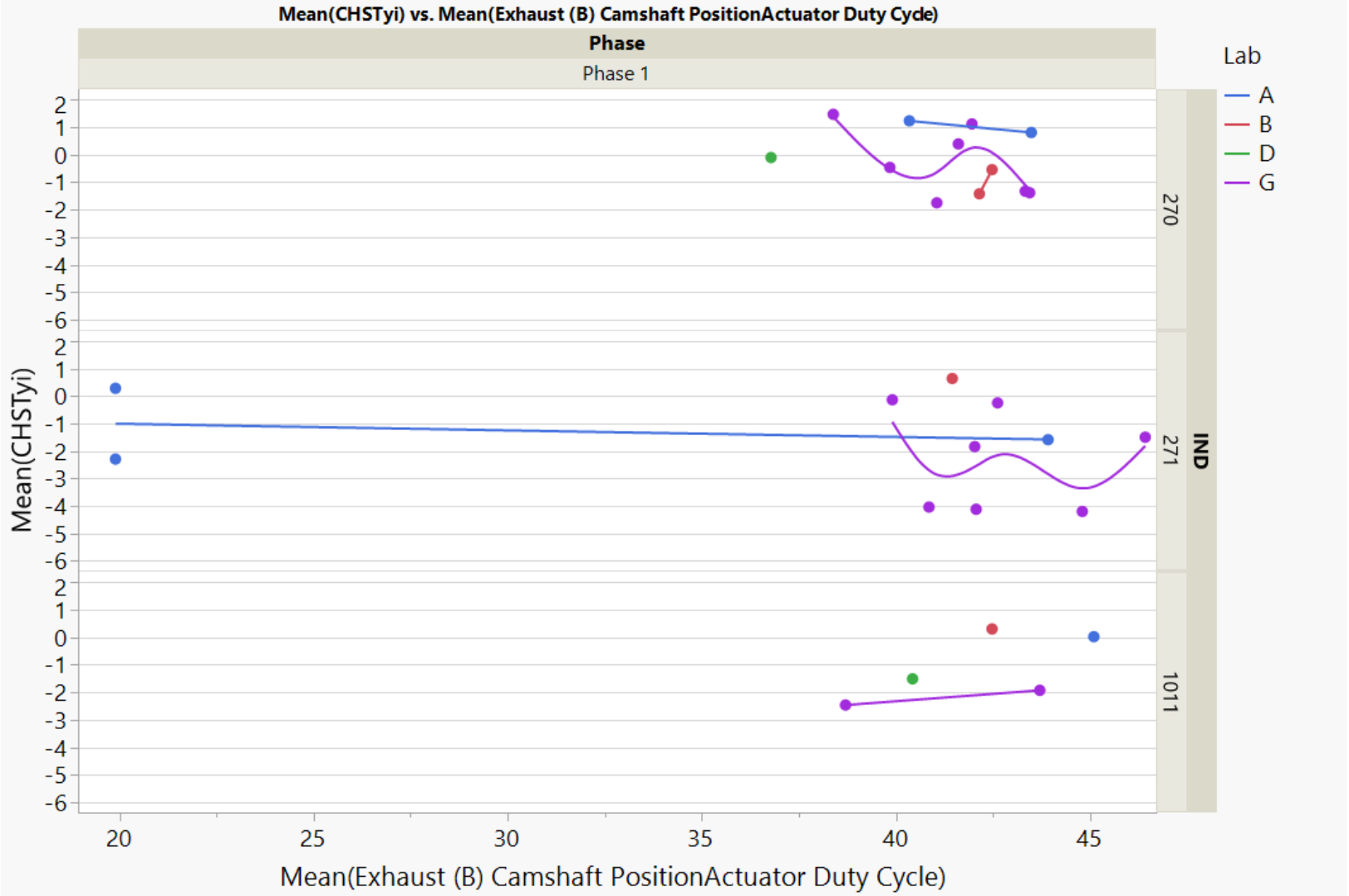
Chst. Vs. Actual Intake (A) Camshaft Position



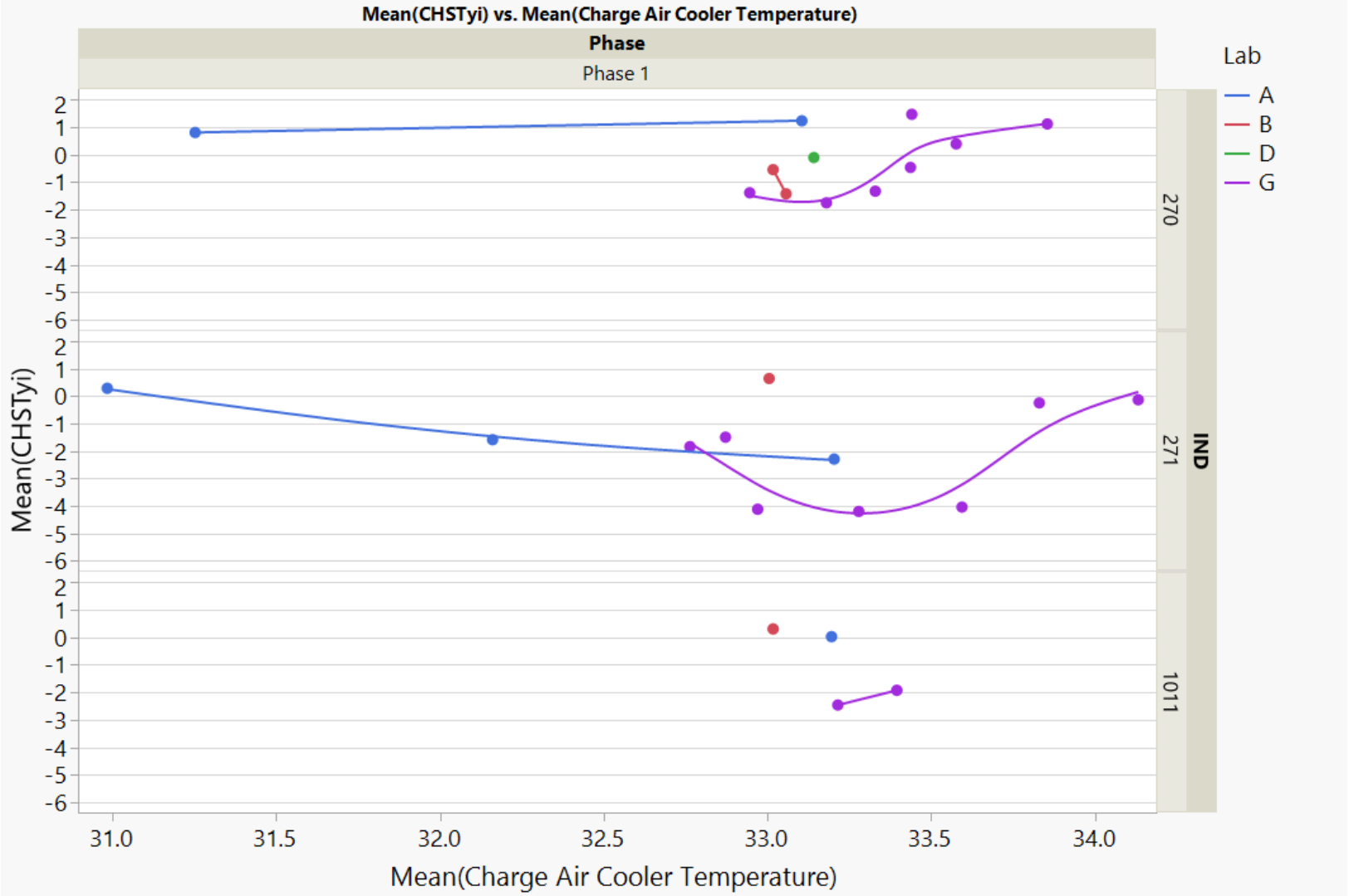
Chst. Vs. Actual Exhaust (B) Camshaft Position



Chst.Vs. Exhaust (B) Camshaft Position Actuator Duty Cycle



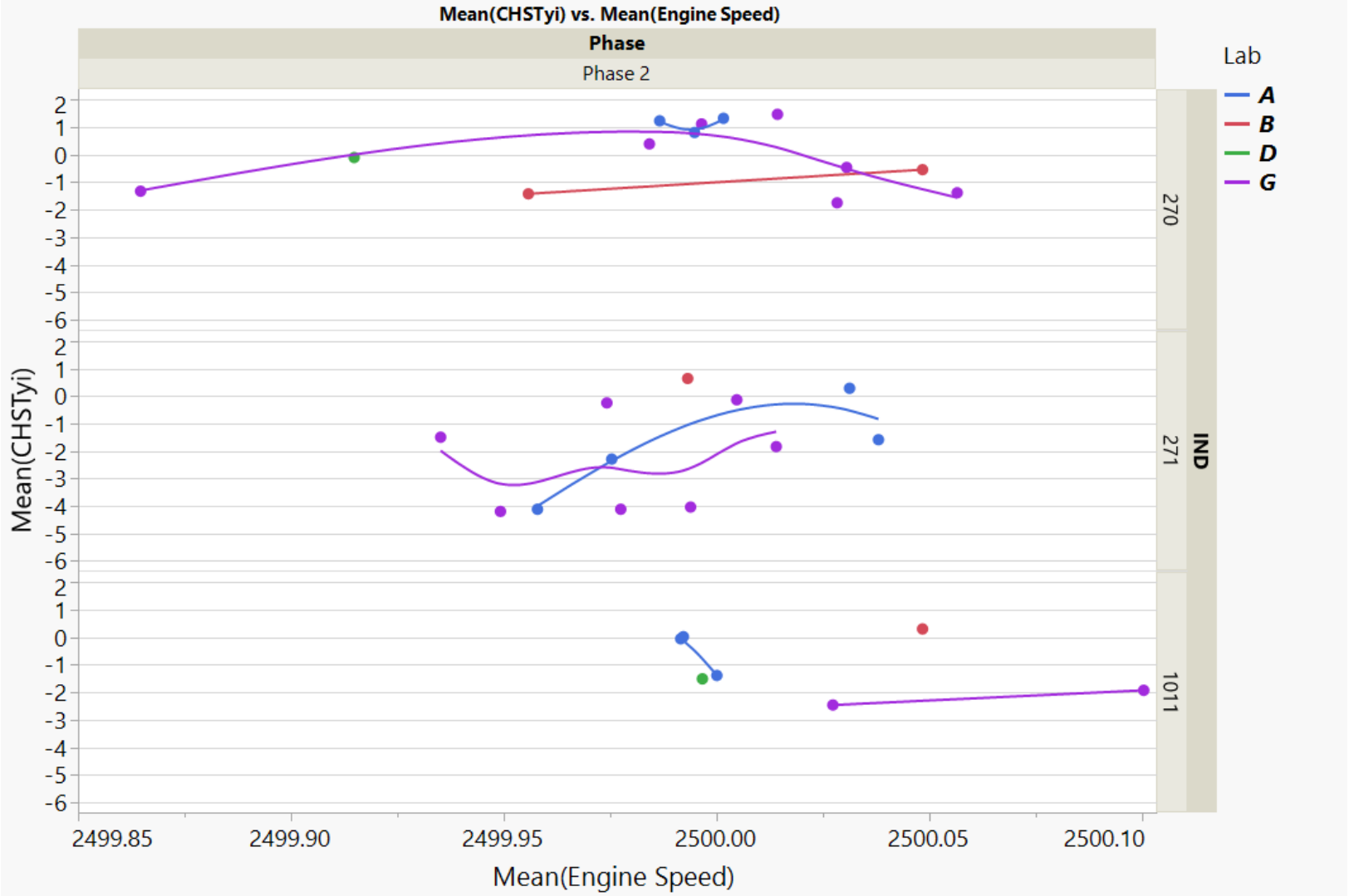
Chst. Vs. Charge Air Cooler Temp



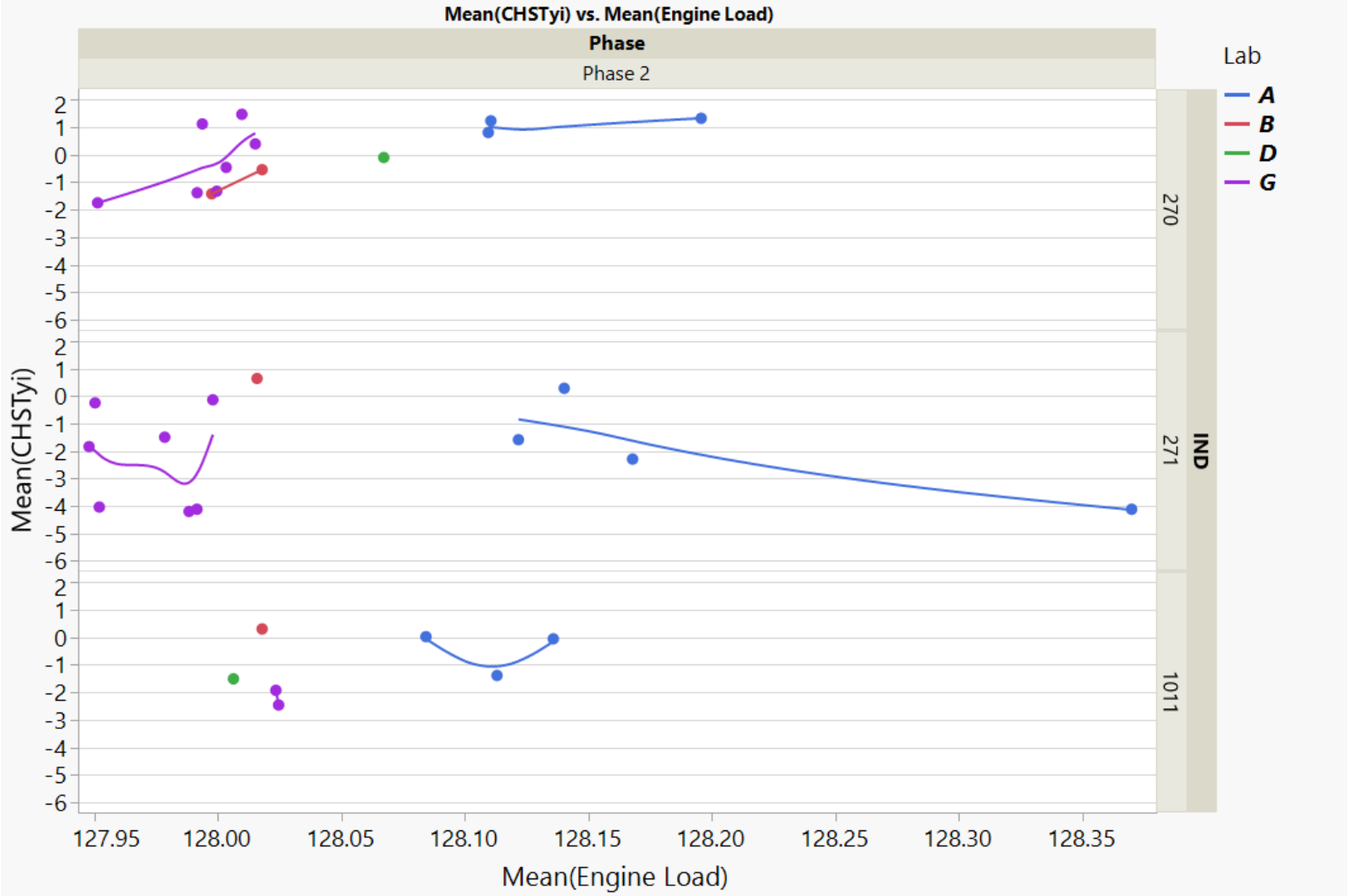
Appendix 2

Phase 2 Average Plots

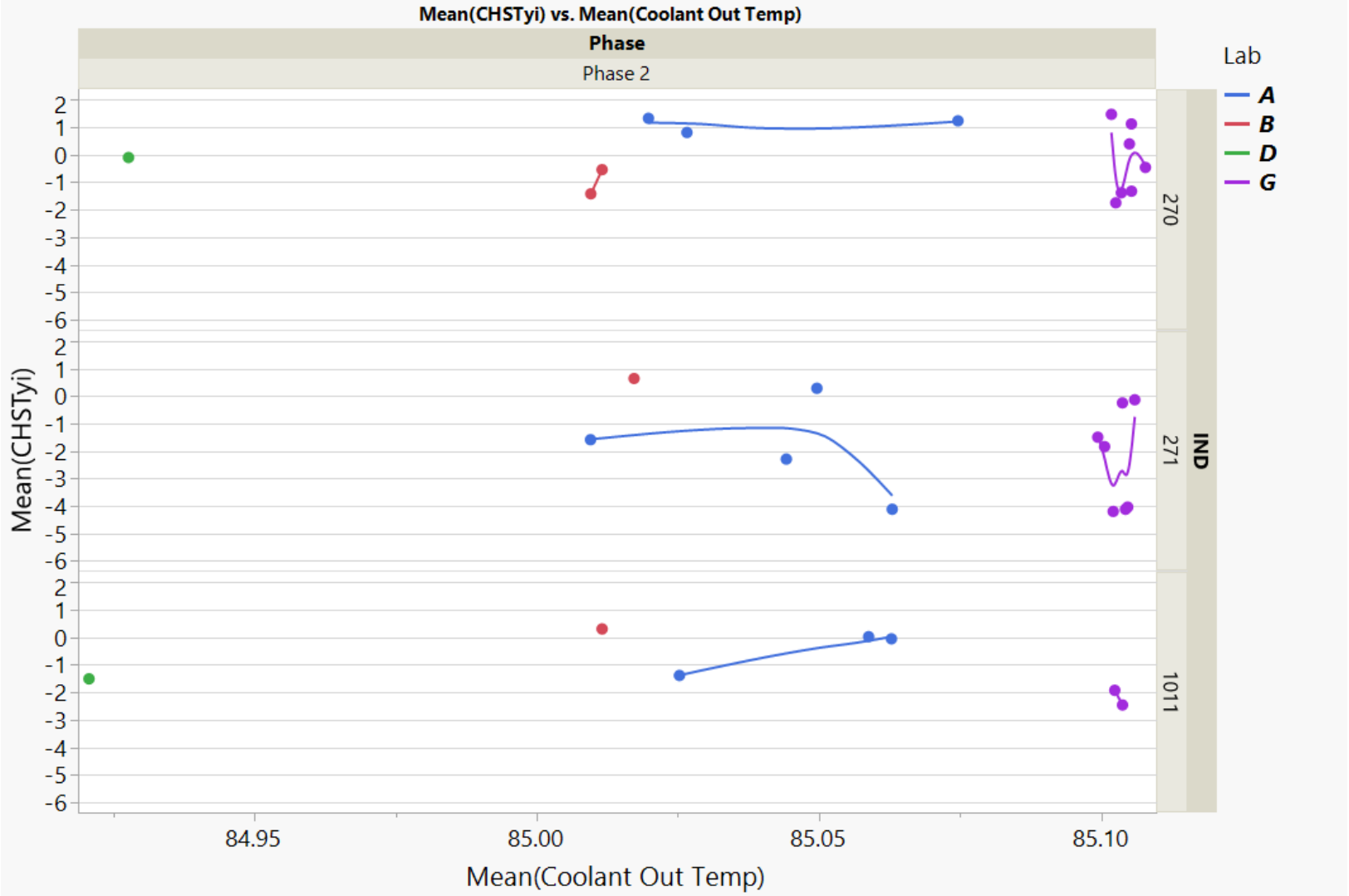
Chst. Vs. Engine Speed



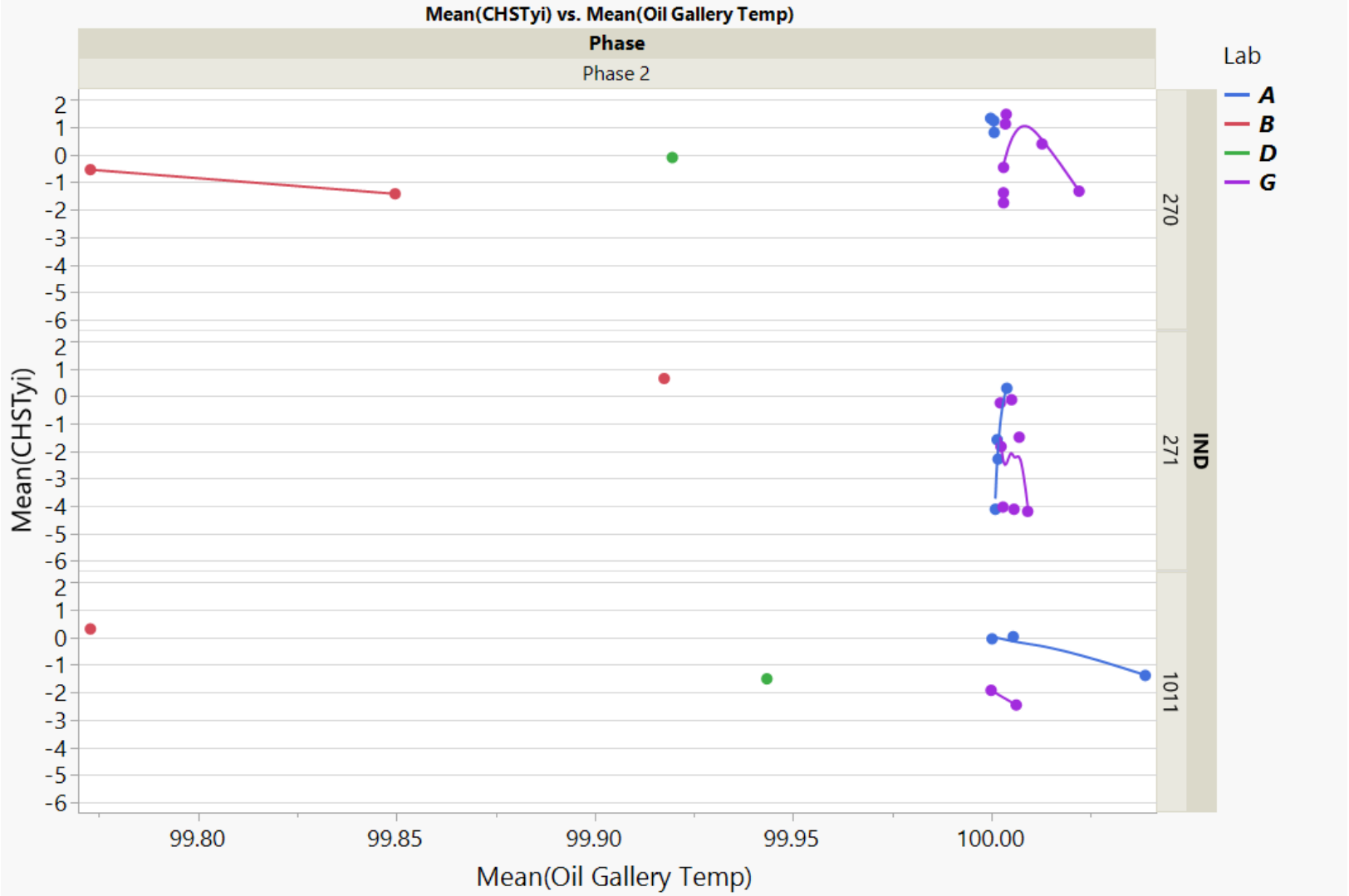
Chst. Vs. Engine Load



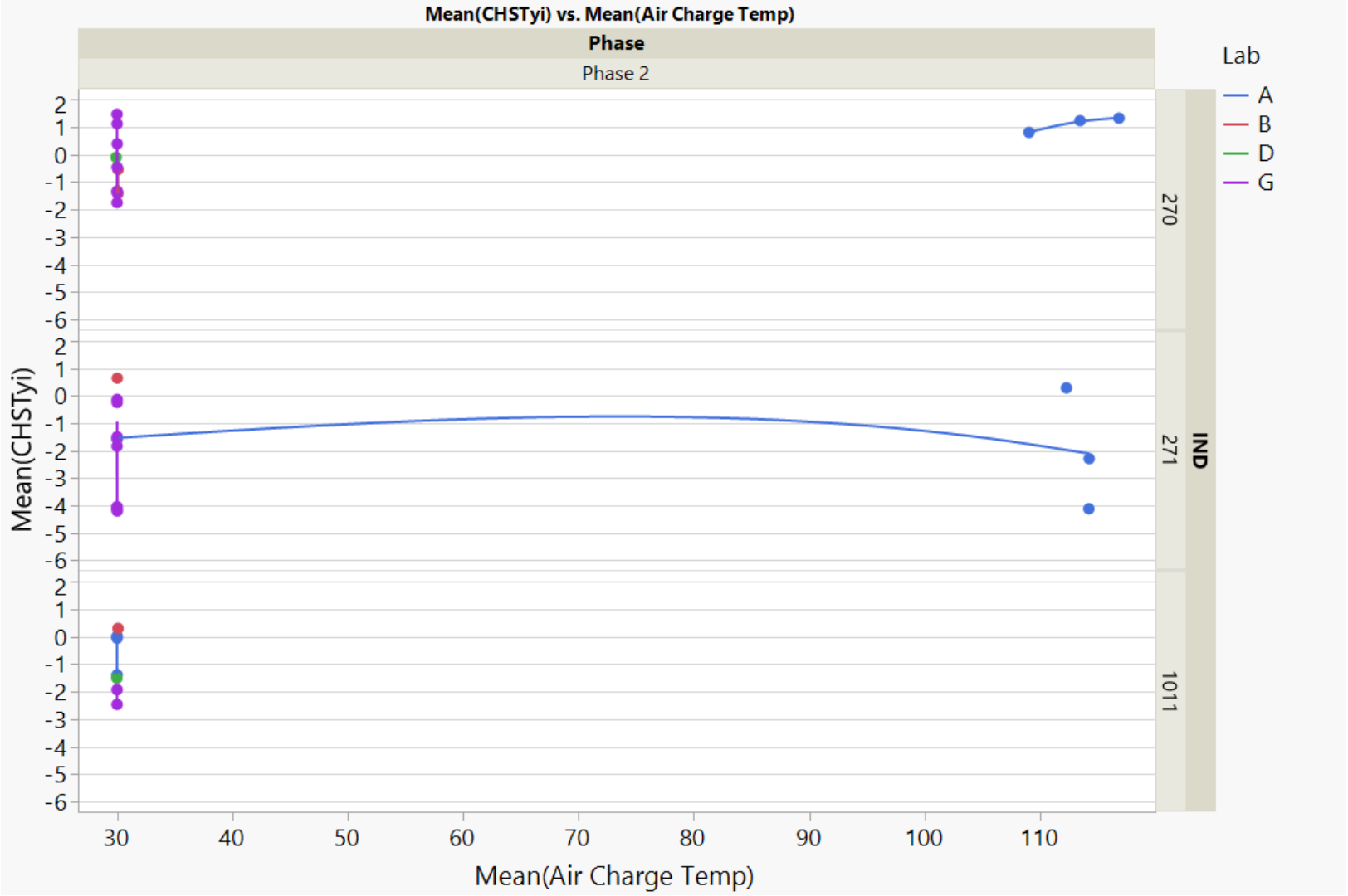
Chst. Vs. Coolant Out Temp



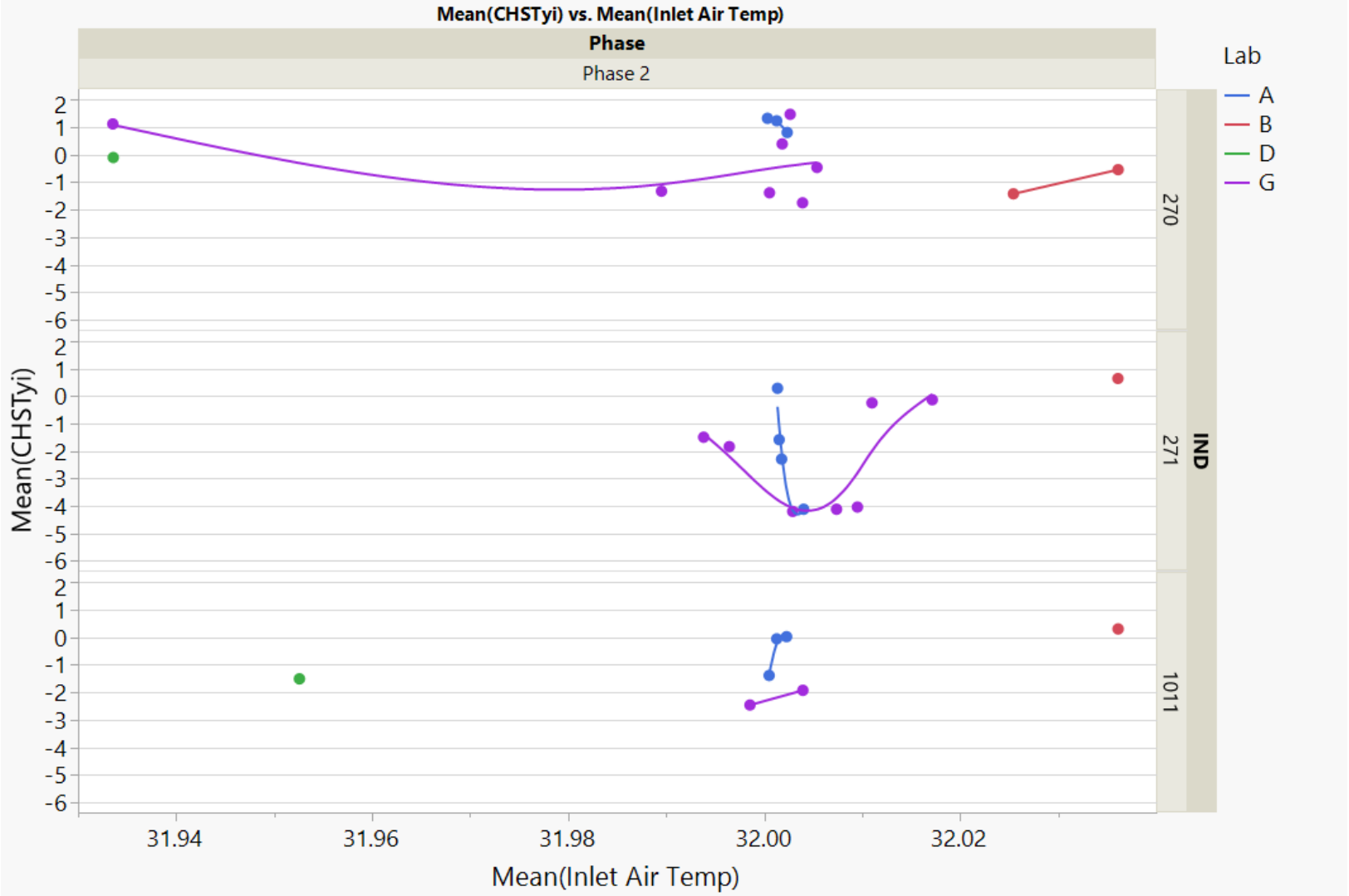
Chst. Vs. Oil Gallery Temp



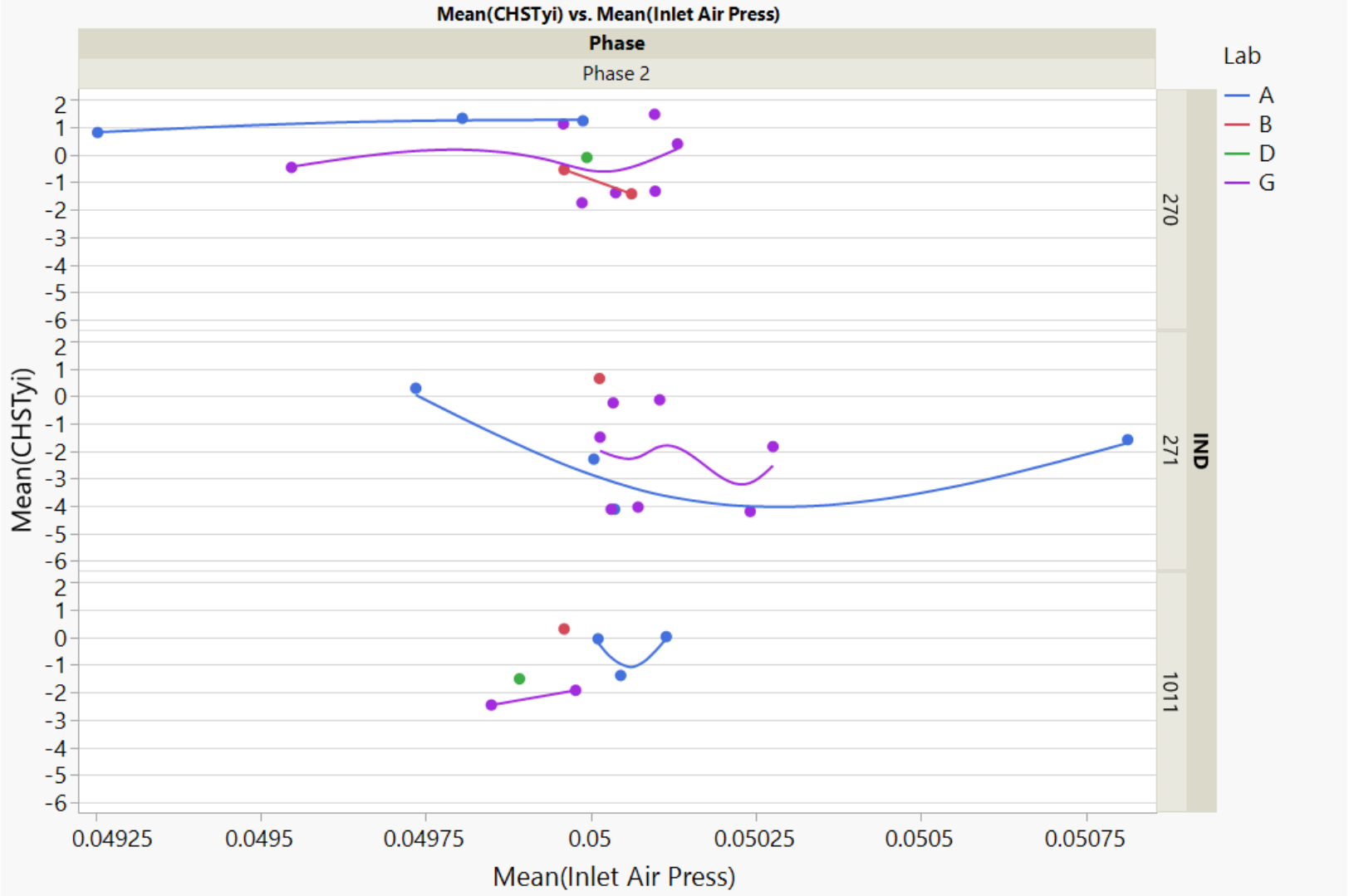
Chst. Vs. Air Charge Temp



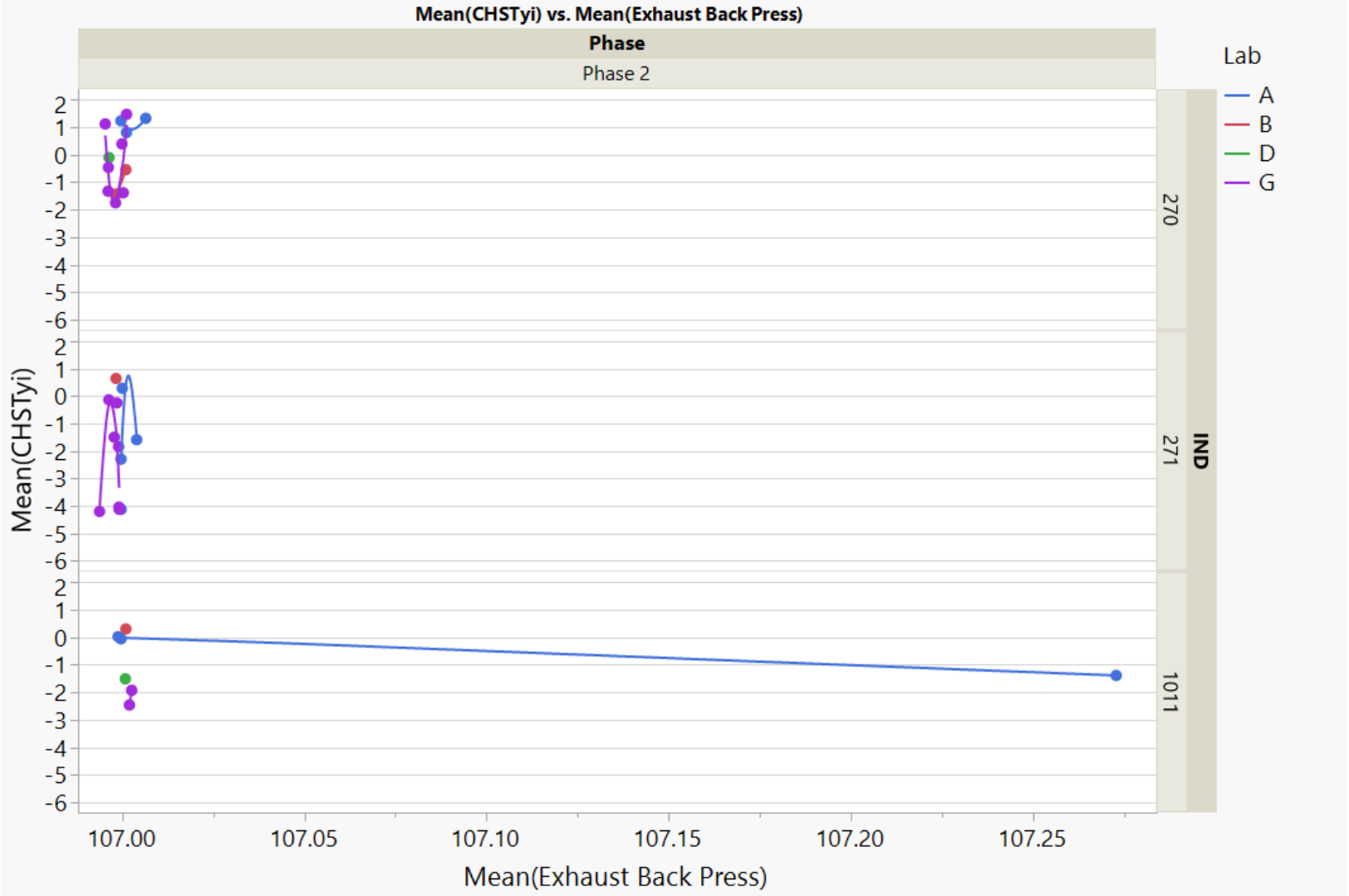
Chst. Vs. Inlet Air Temp



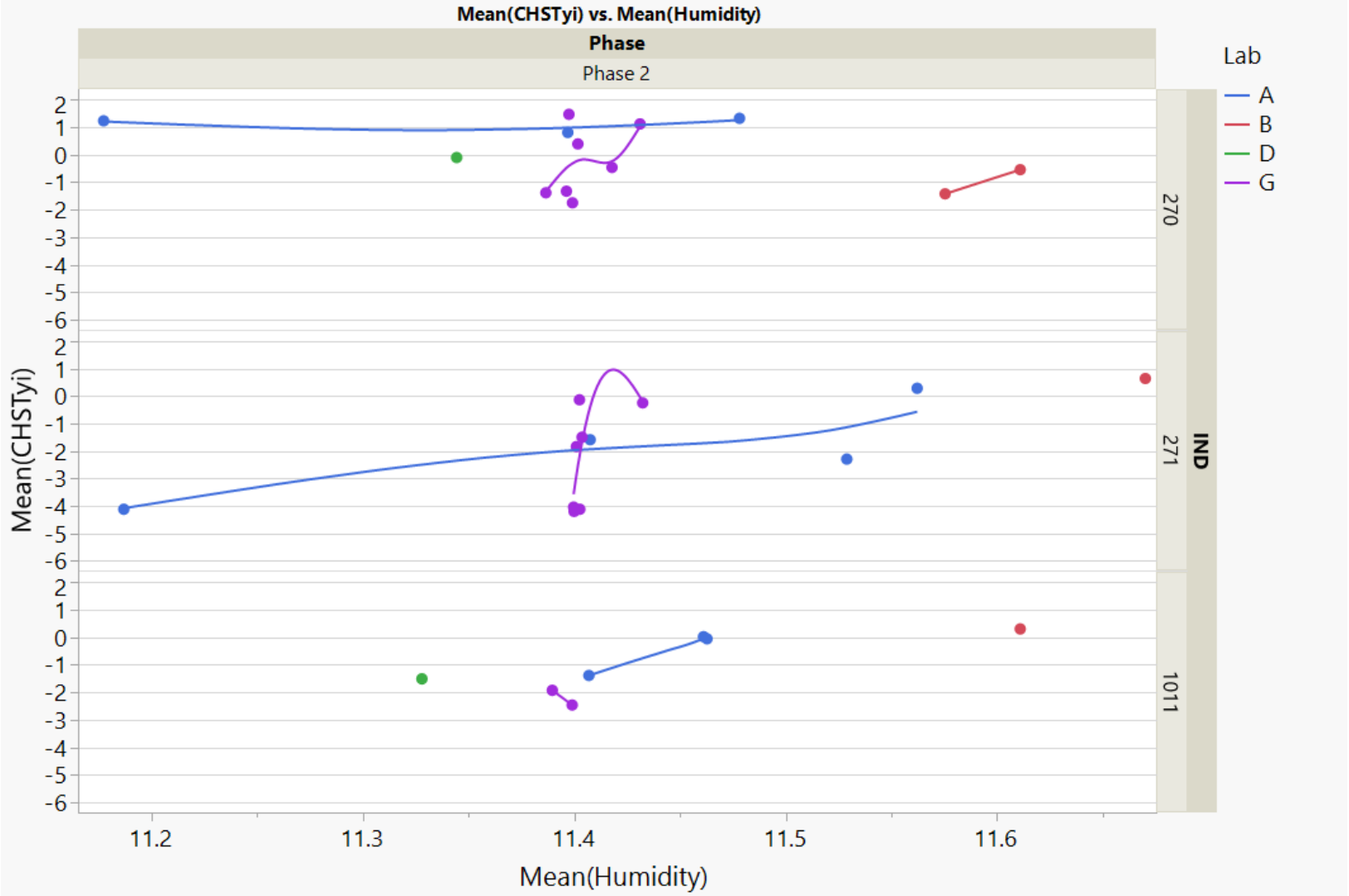
Chst. Vs. Inlet Air Pressure



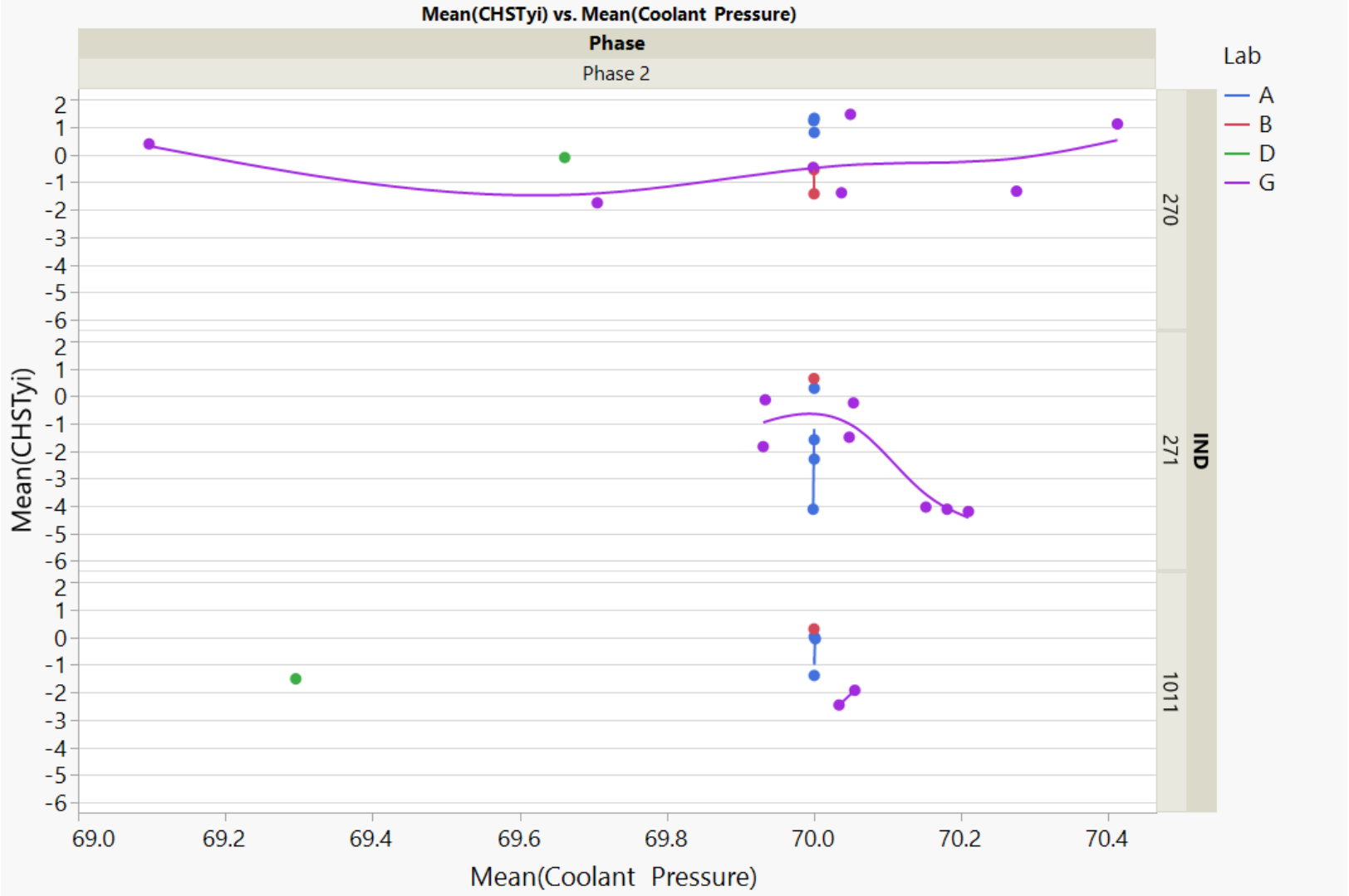
Chst. Vs. Exhaust Backpressure



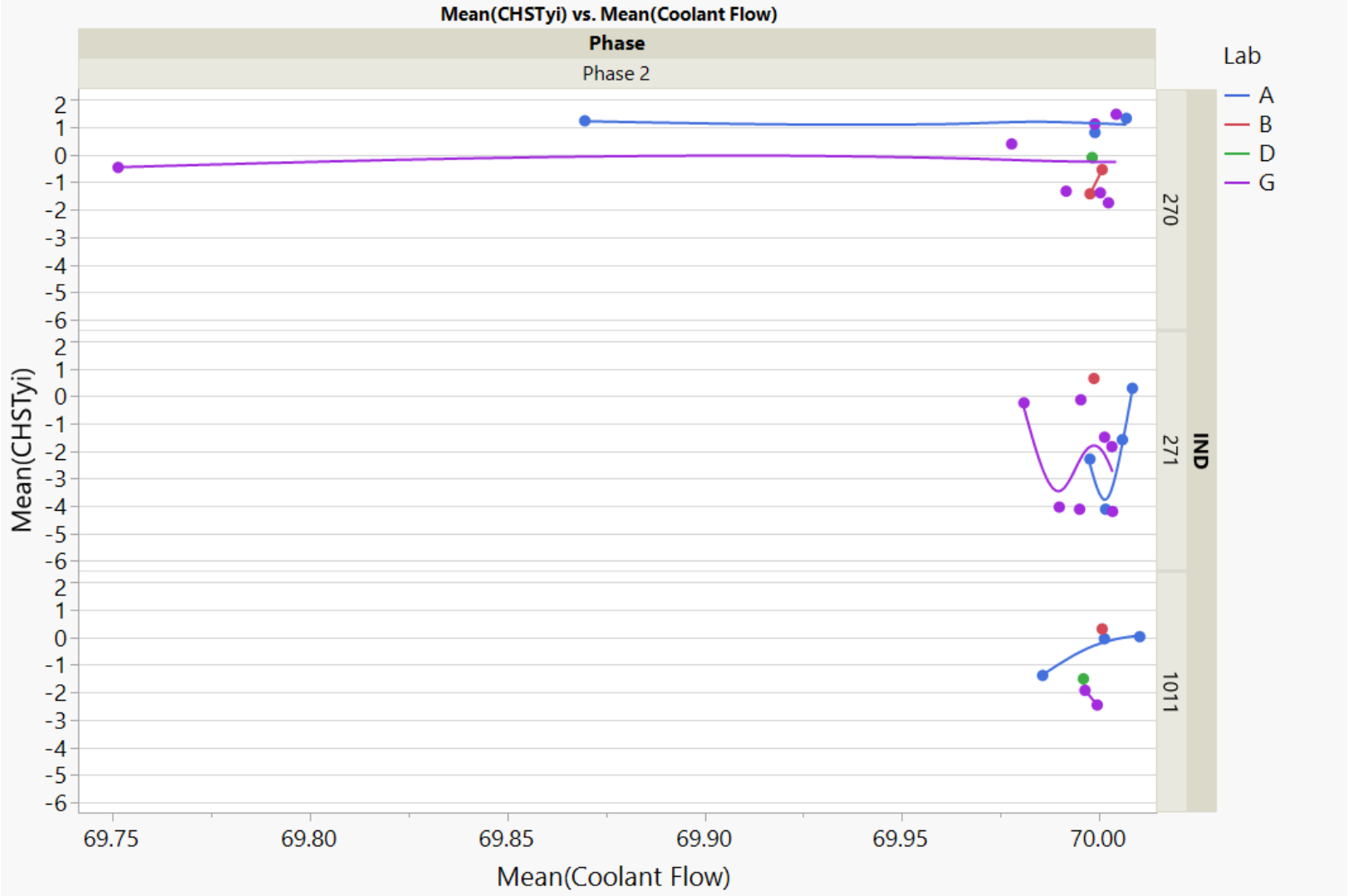
Chst. Vs. Humidity



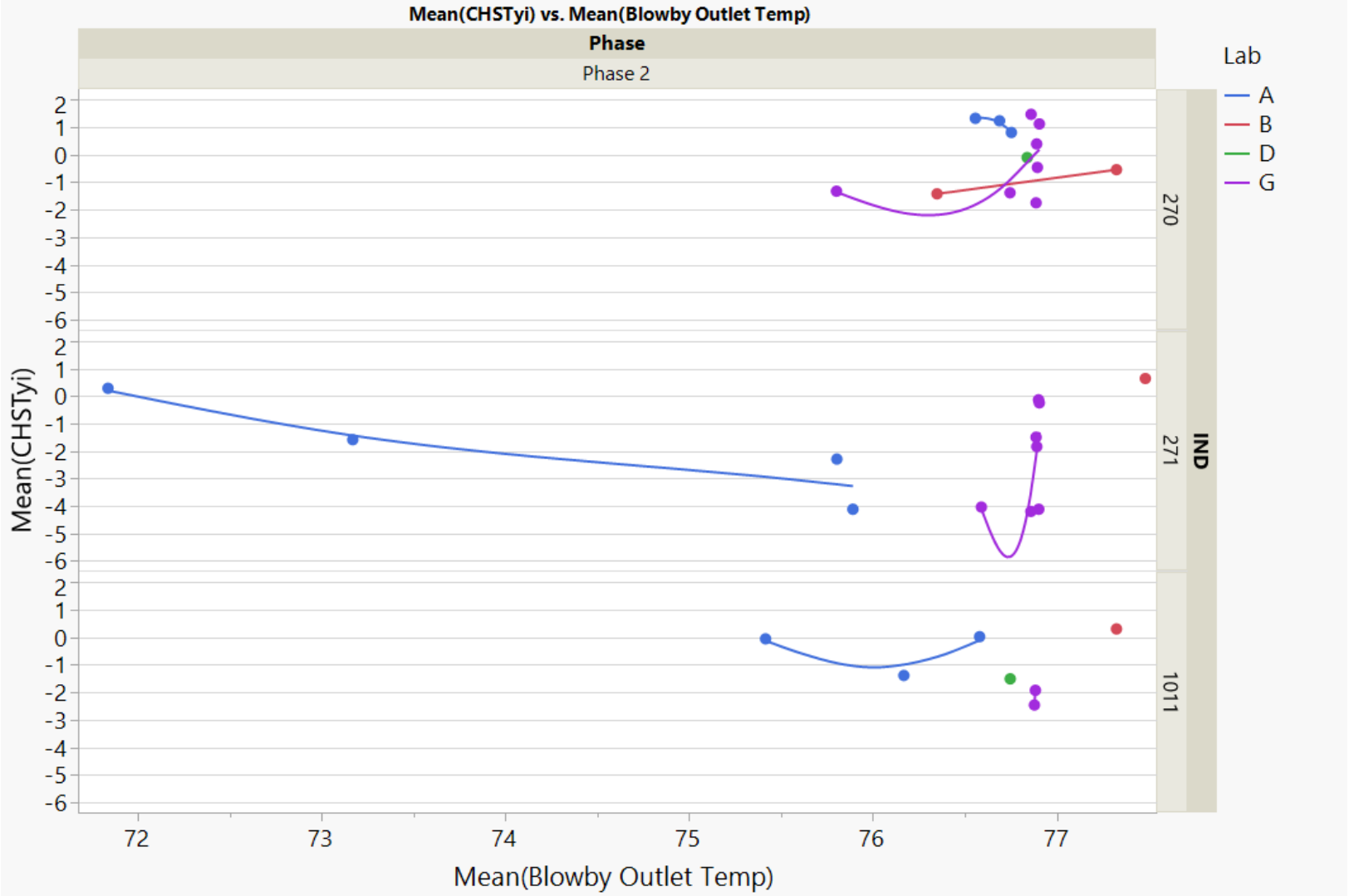
Chst. Vs. Coolant Pressure



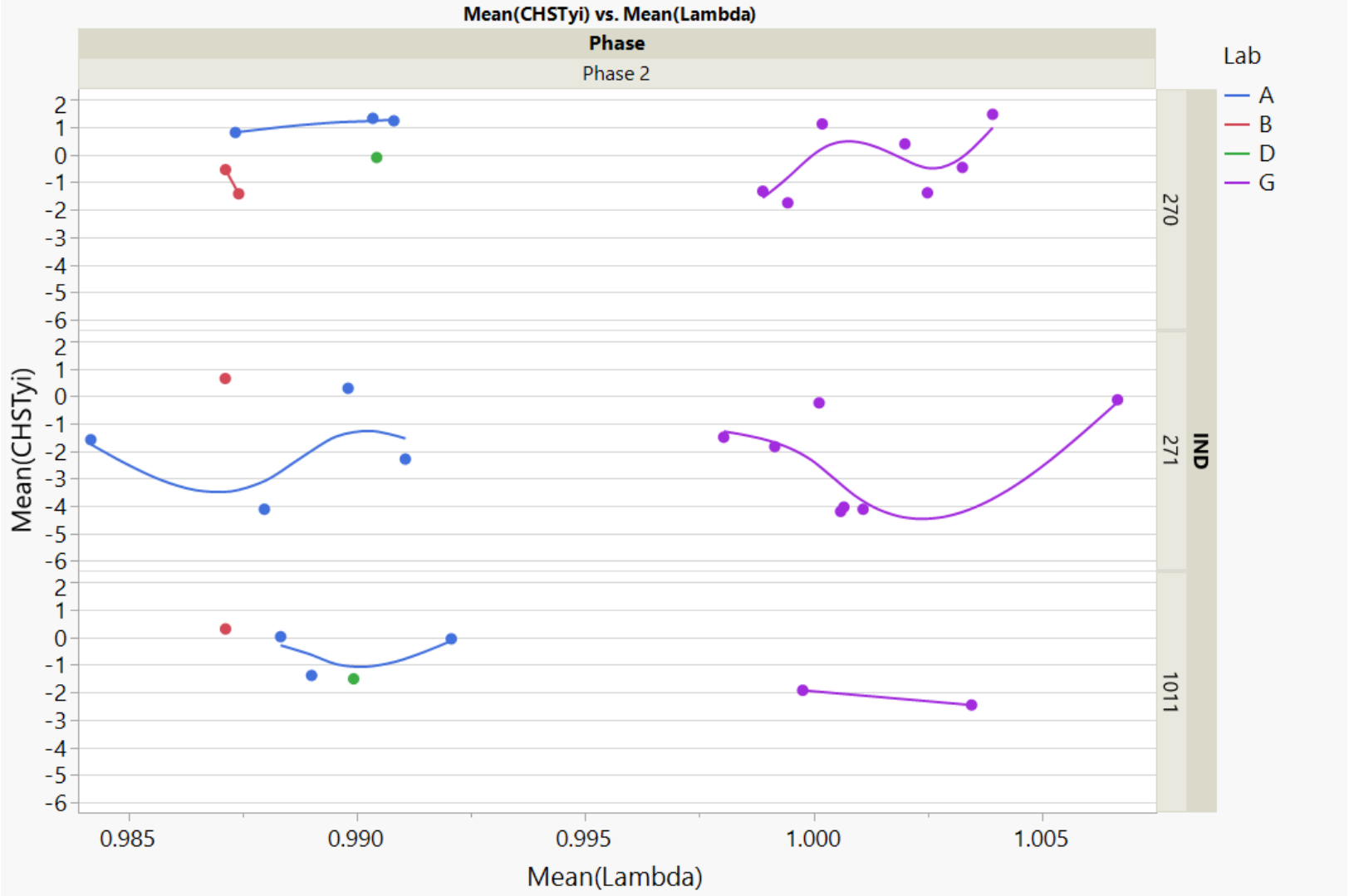
Chst. Vs. Coolant Flow



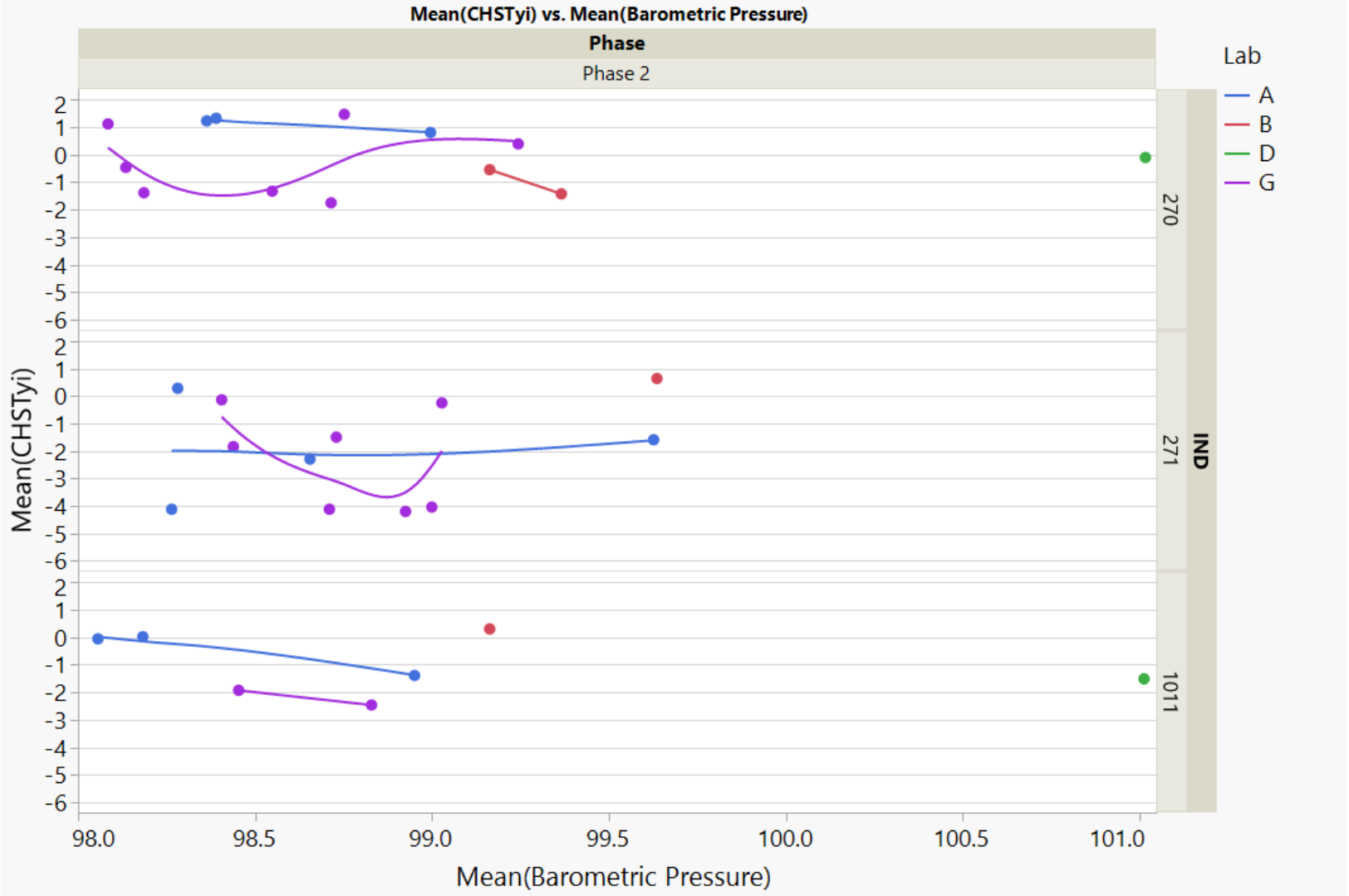
Chst. Vs. Blowby Outlet Temp



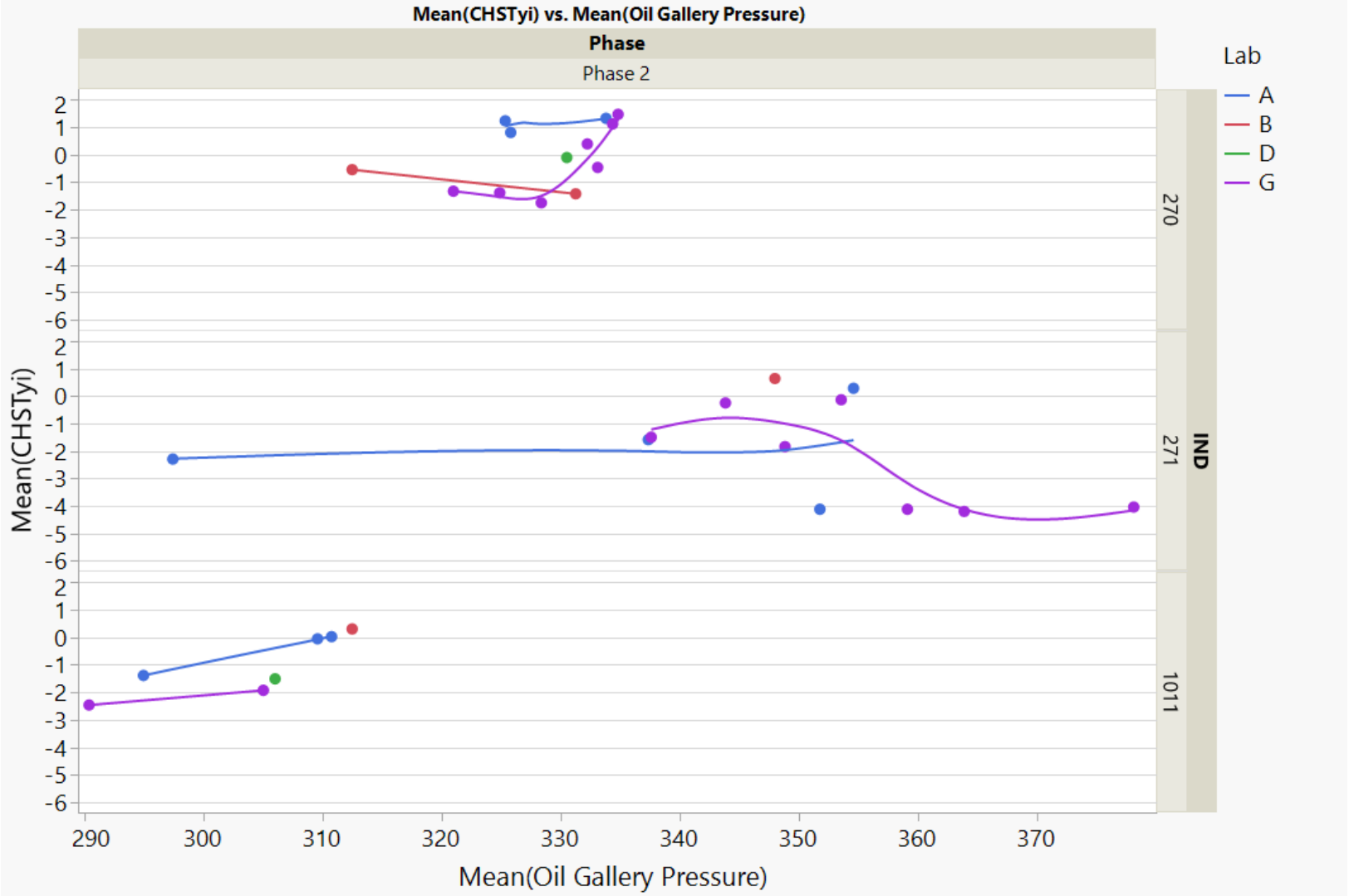
Chst.Vs. Lambda



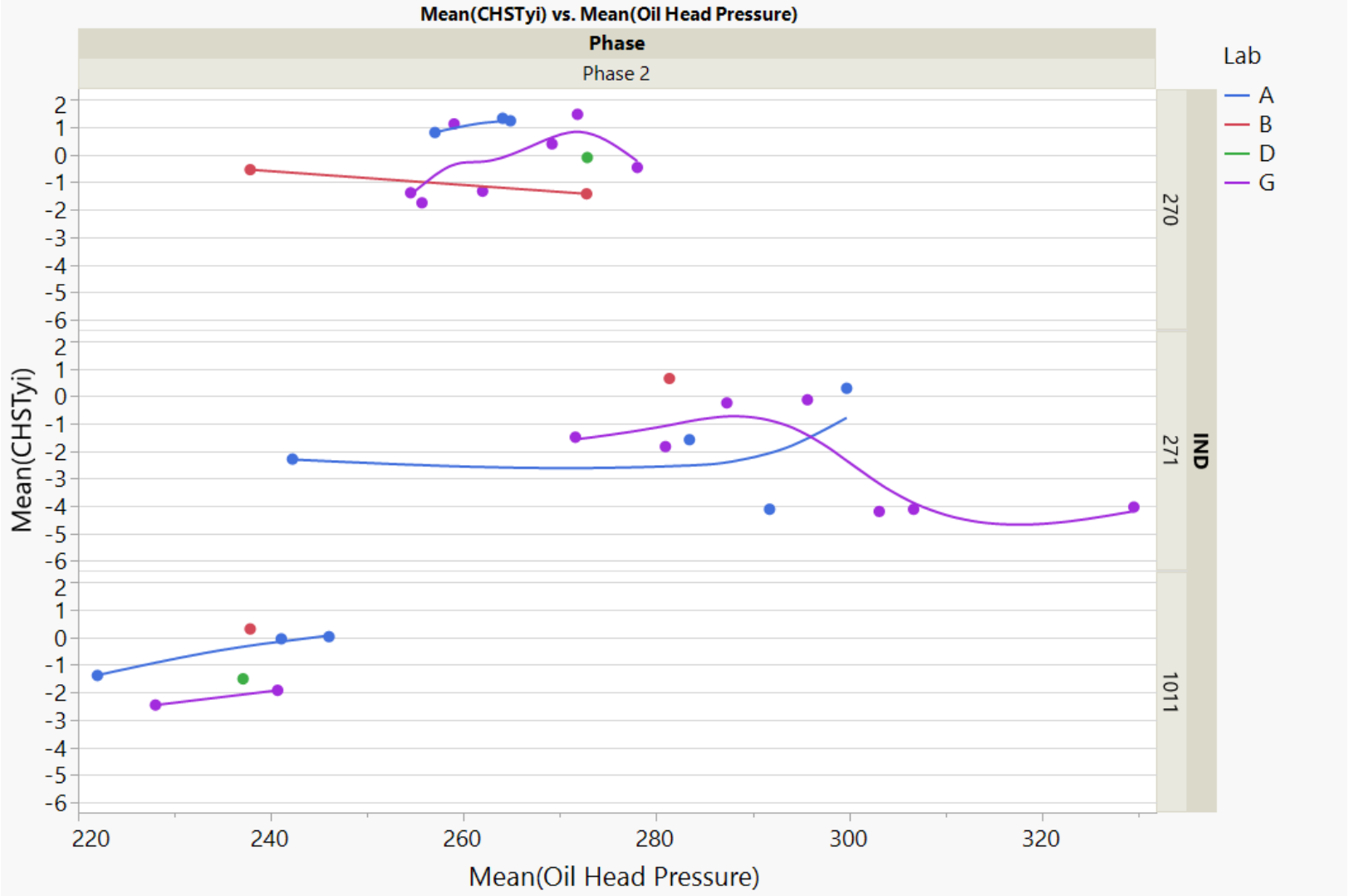
Chst. Vs. Barometric Pressure



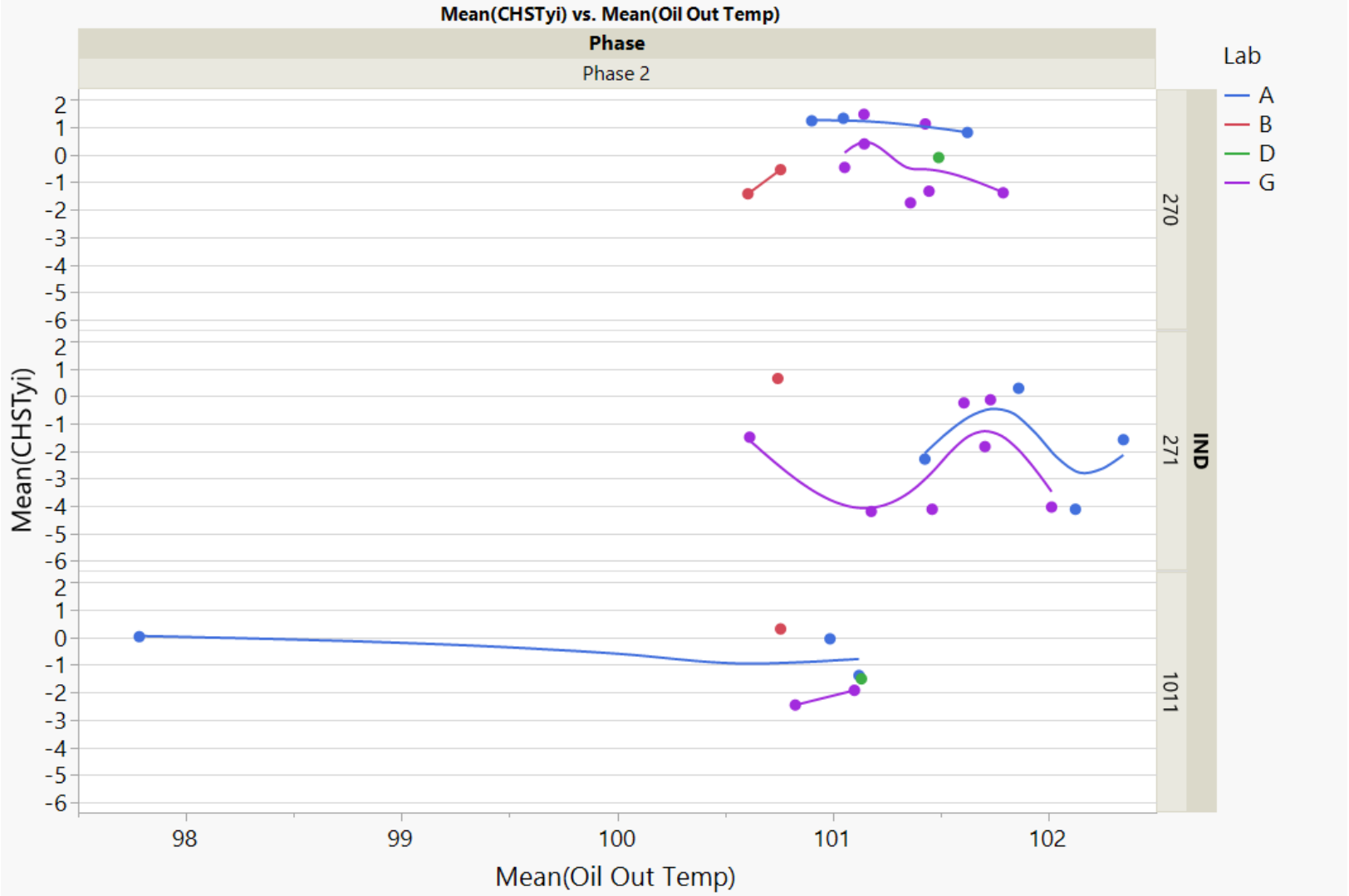
Chst. Vs. Oil Gallery Pressure



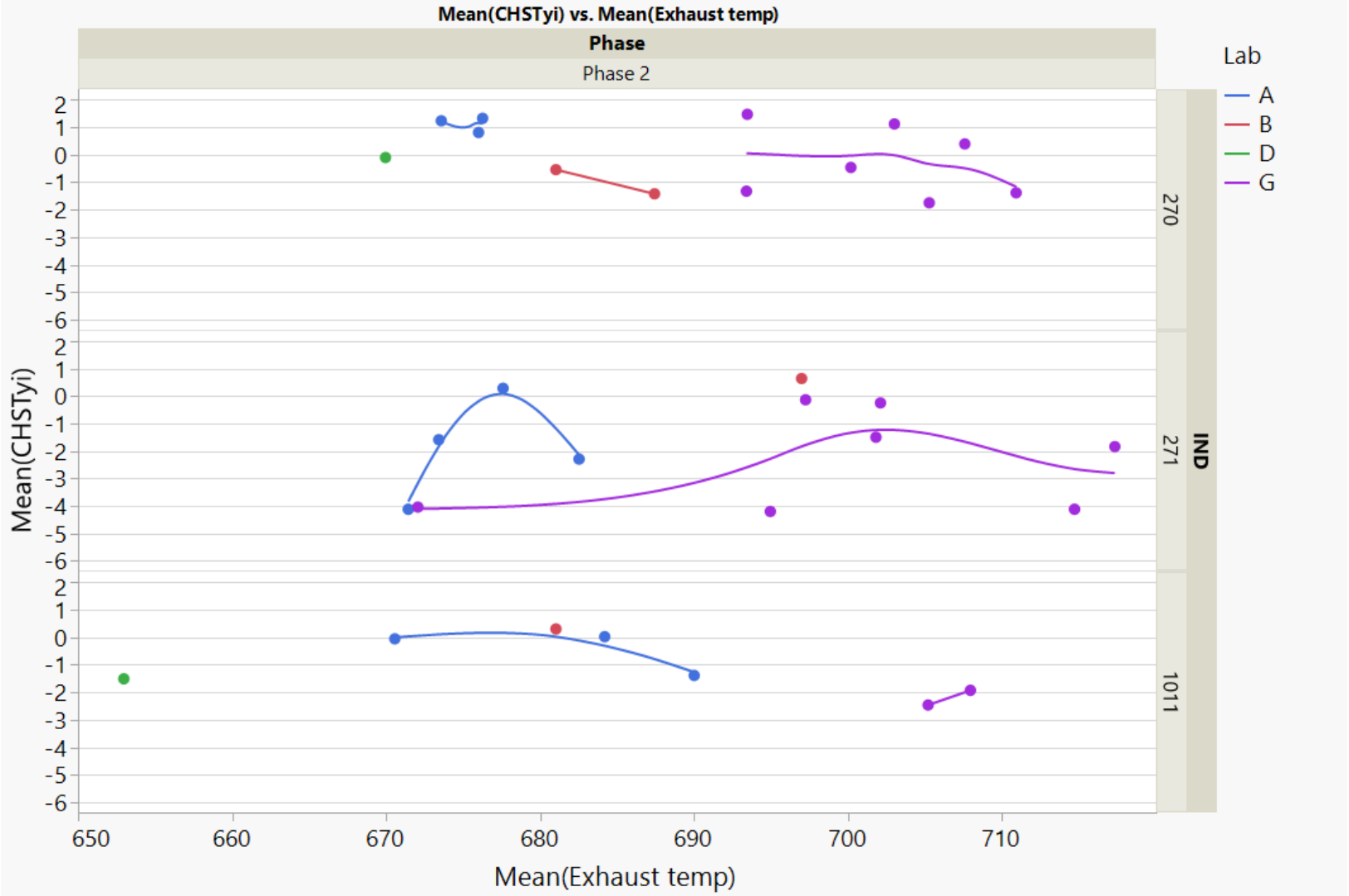
Chst. Vs. Oil Head Pressure



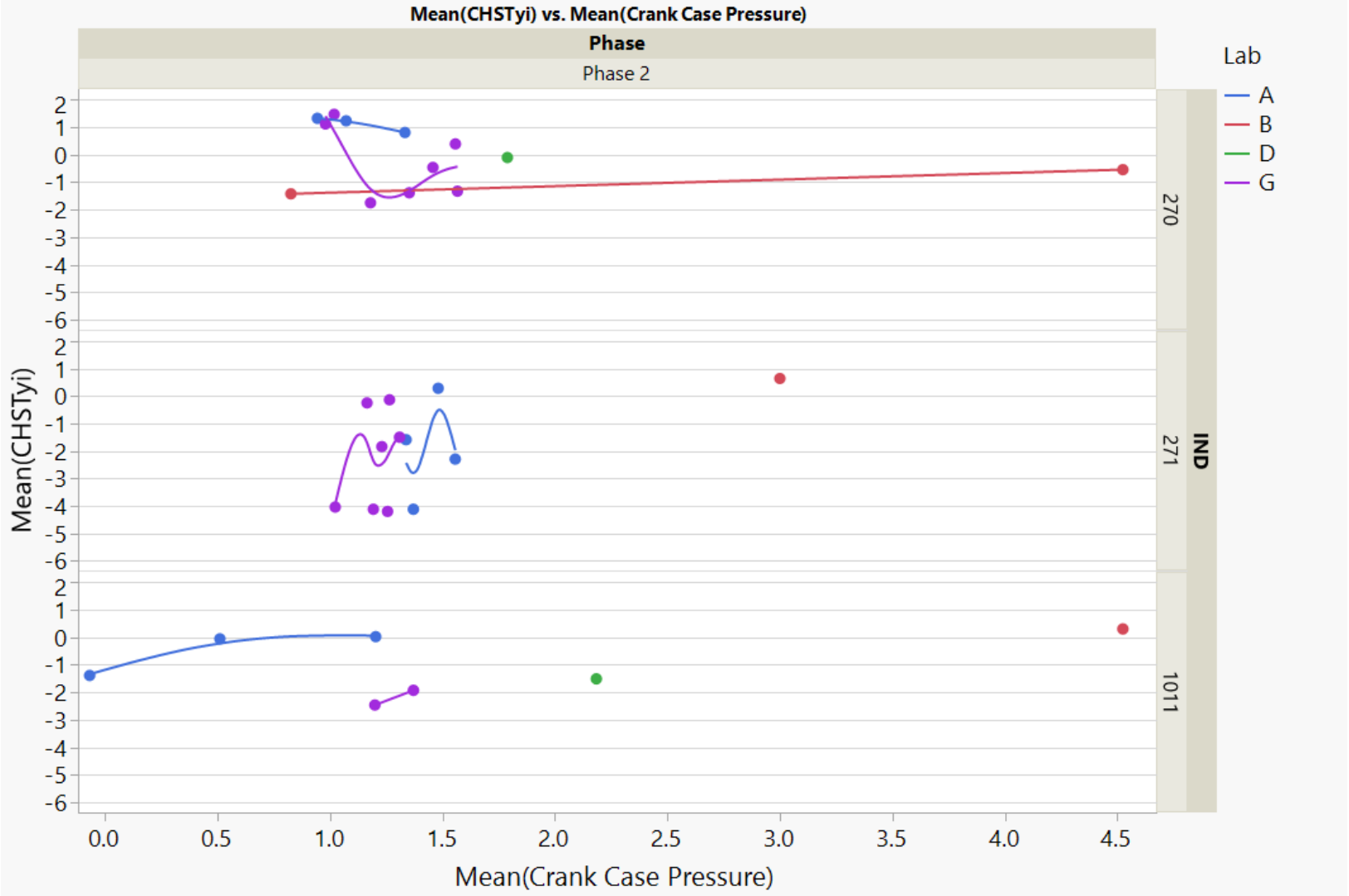
Chst. Vs. Oil Out Temp



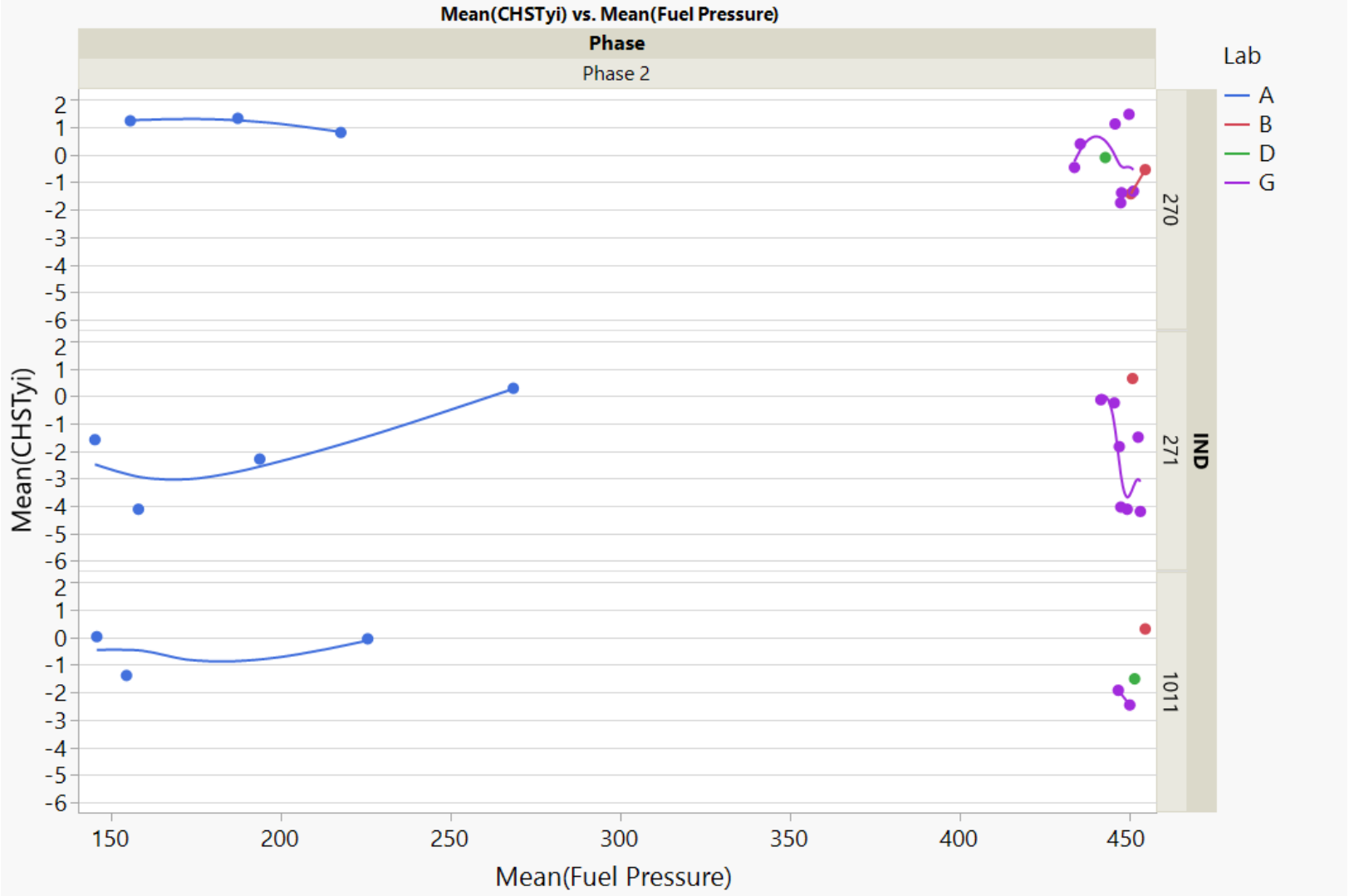
Chst. Vs. Exhaust Temp



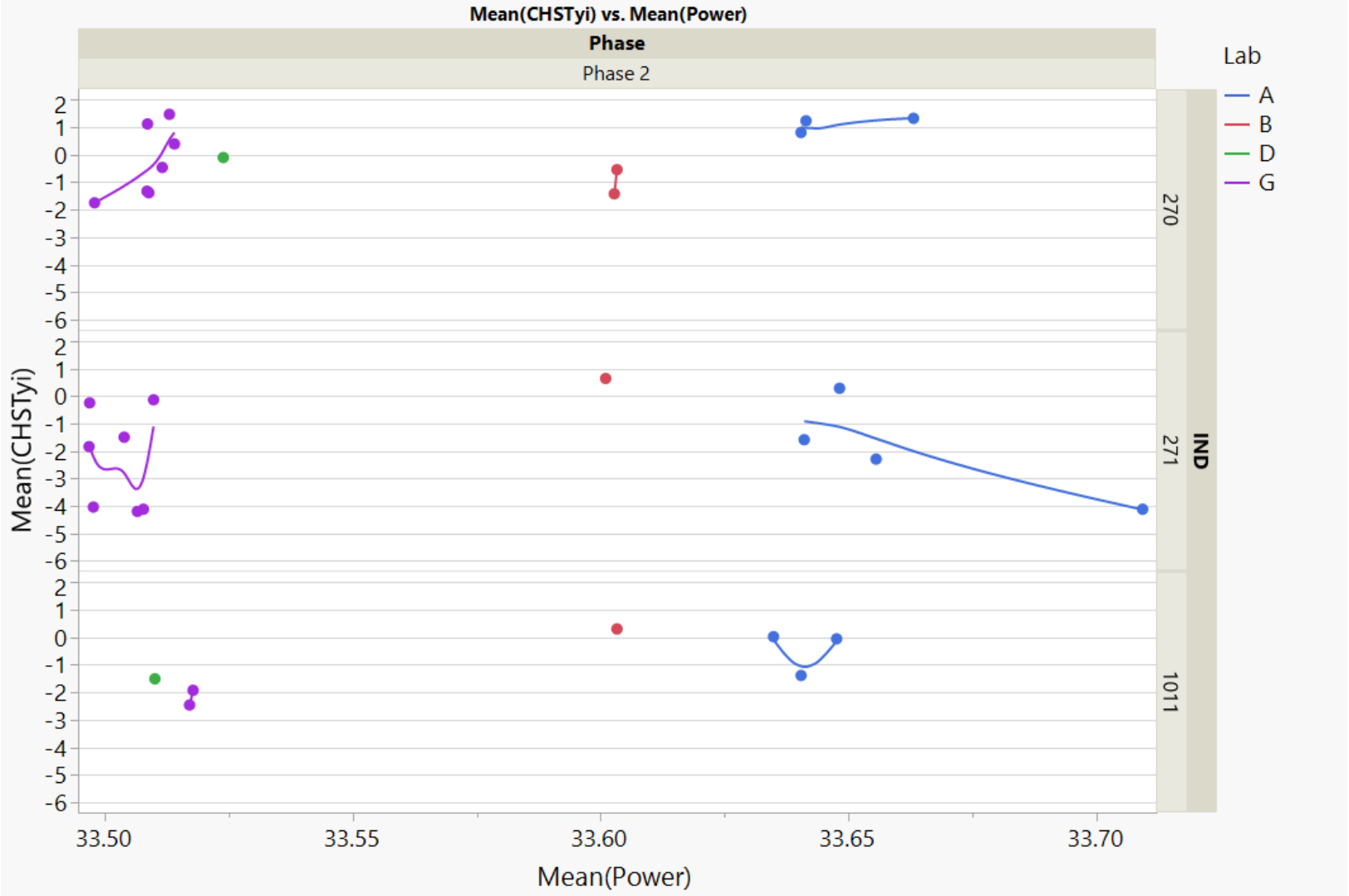
Chst. Vs. Crankcase Pressure



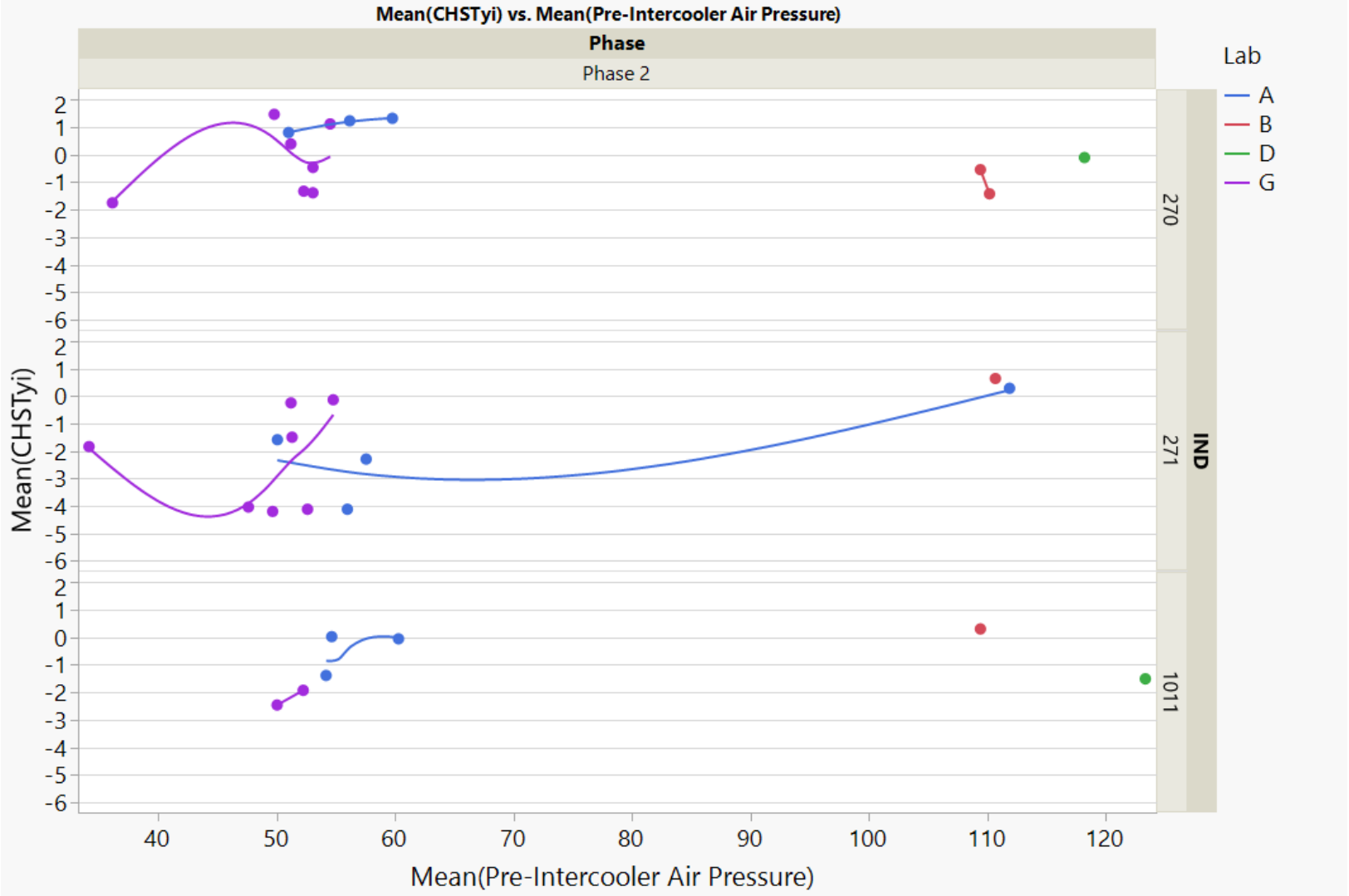
Chst.Vs. Fuel Pressure



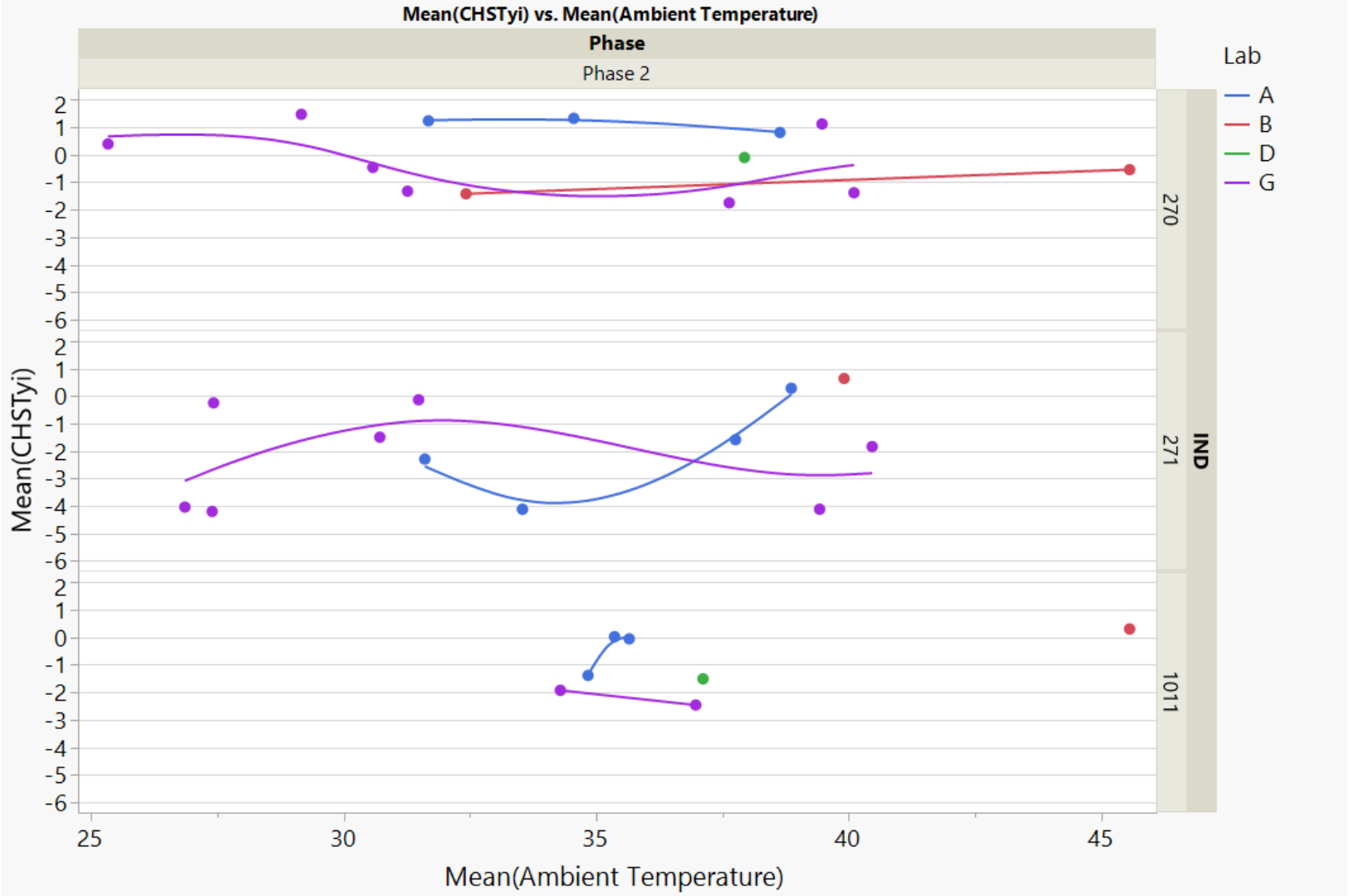
Chst. Vs. Power



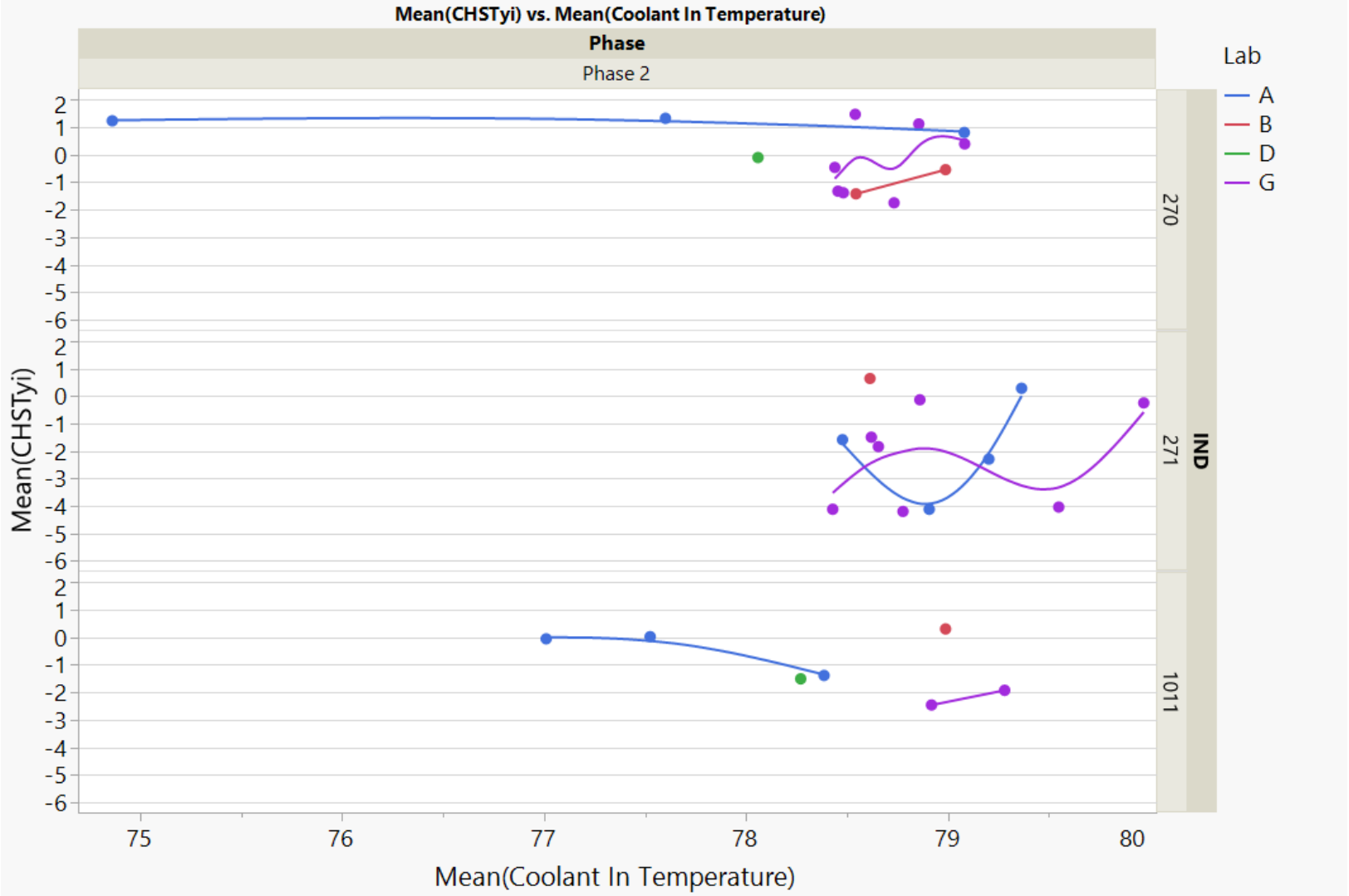
Chst. Vs. Pre-Intercooler Air Pressure



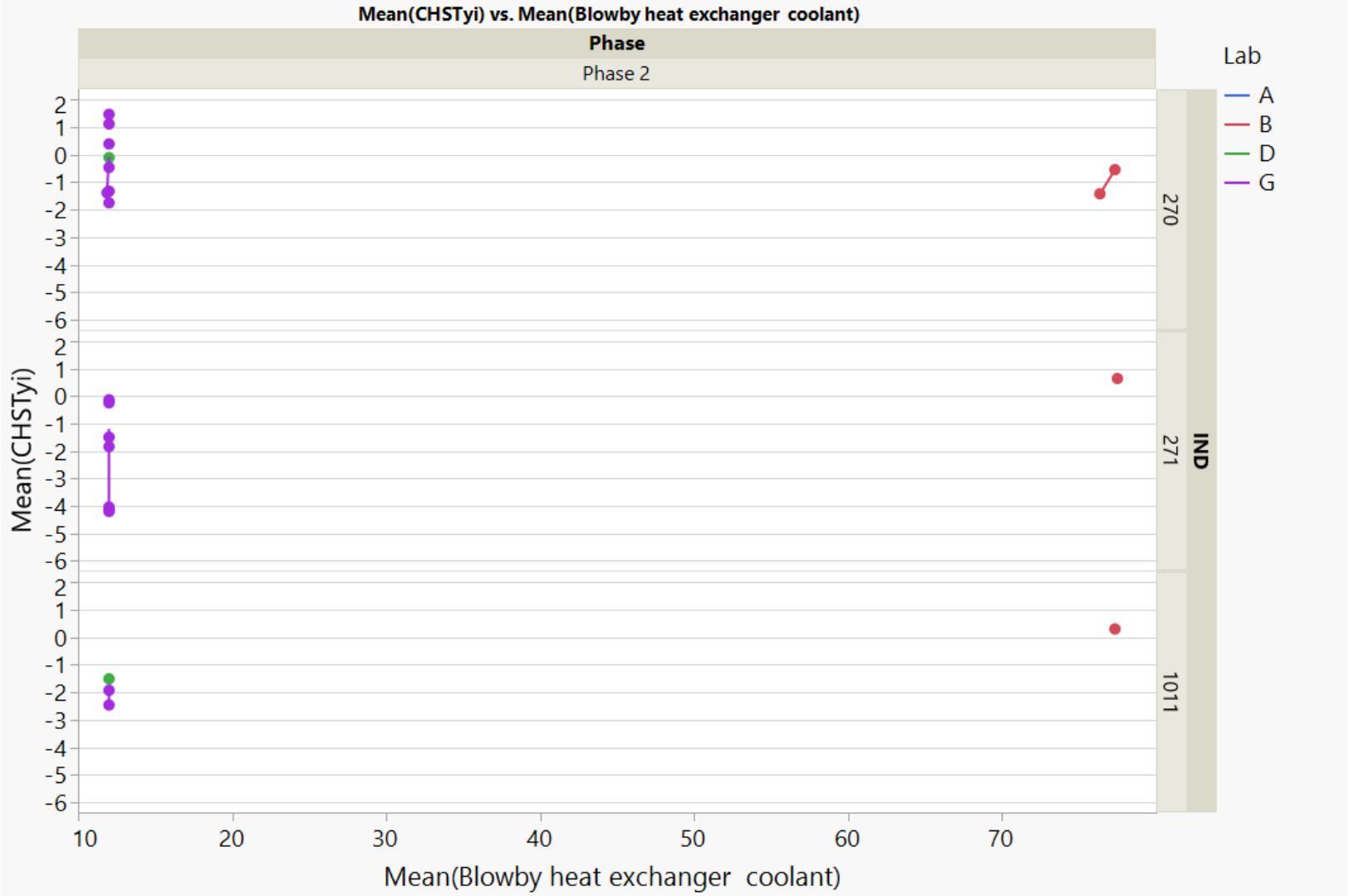
Chst. Vs. Ambient Temperature



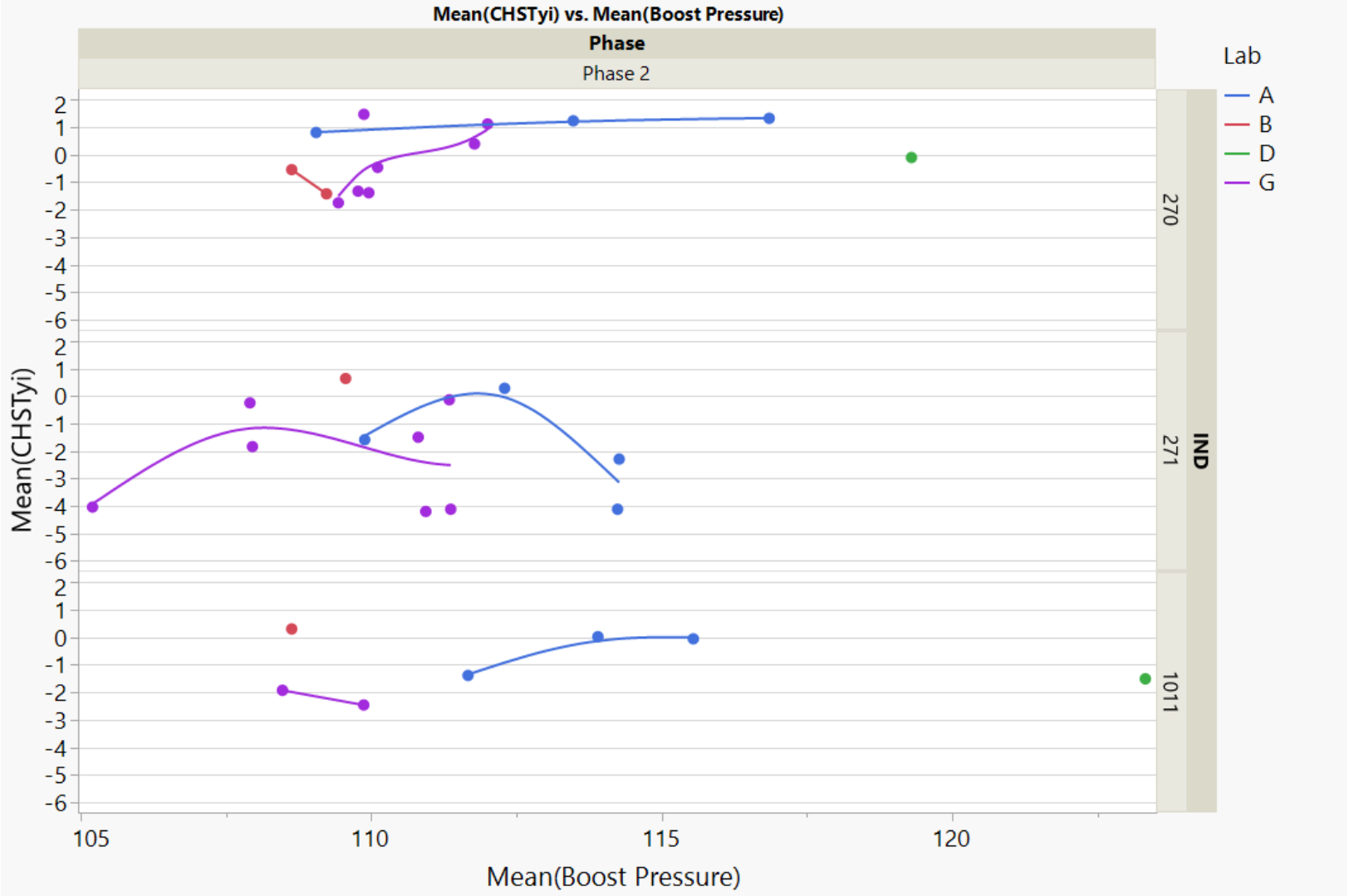
Chst. Vs. Coolant In Temperature



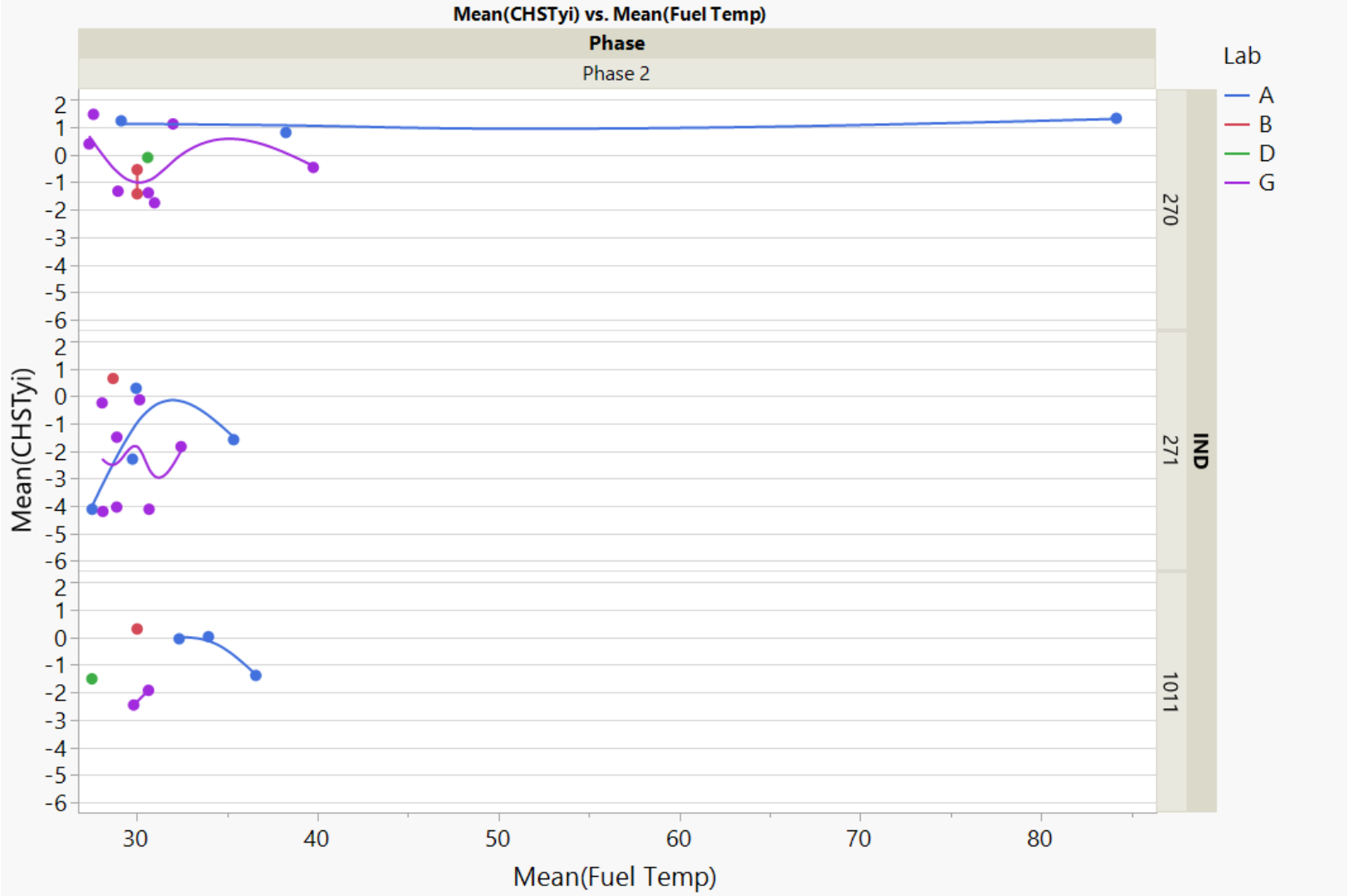
Chst. Vs. Blowby Heat Exchanger Coolant



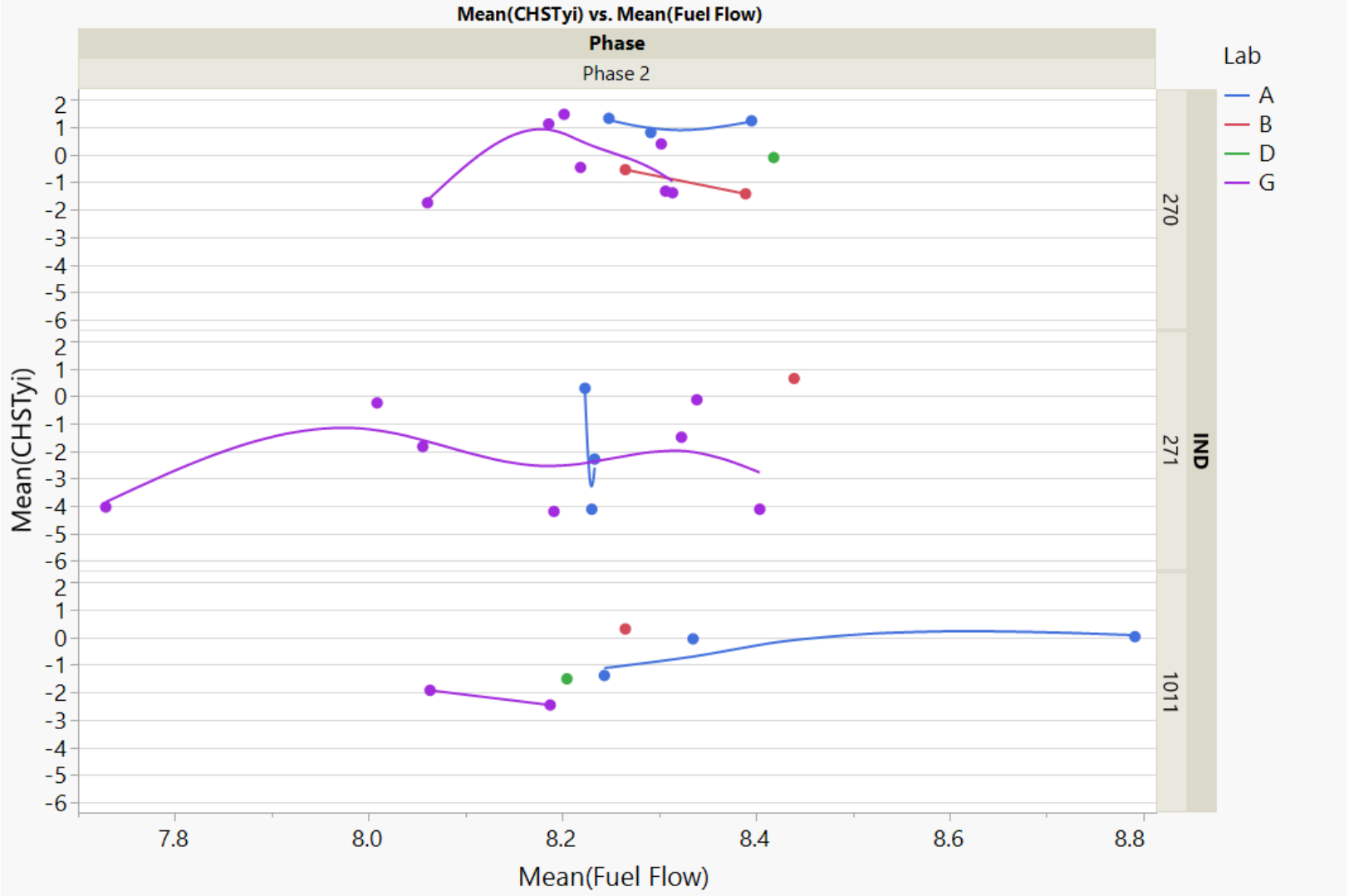
Chst. Vs. Boost Pressure



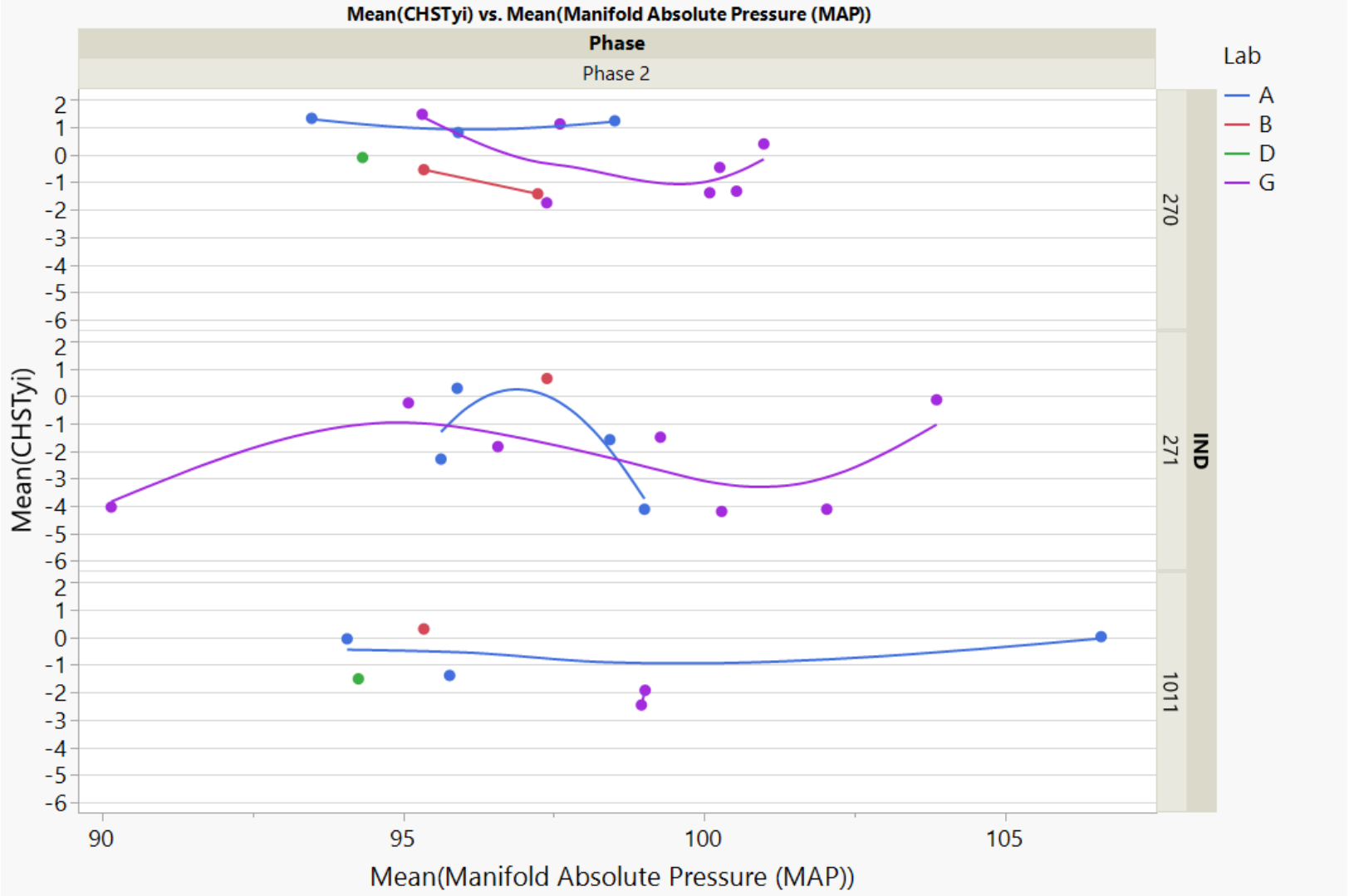
Chst. Vs. Fuel Temperature



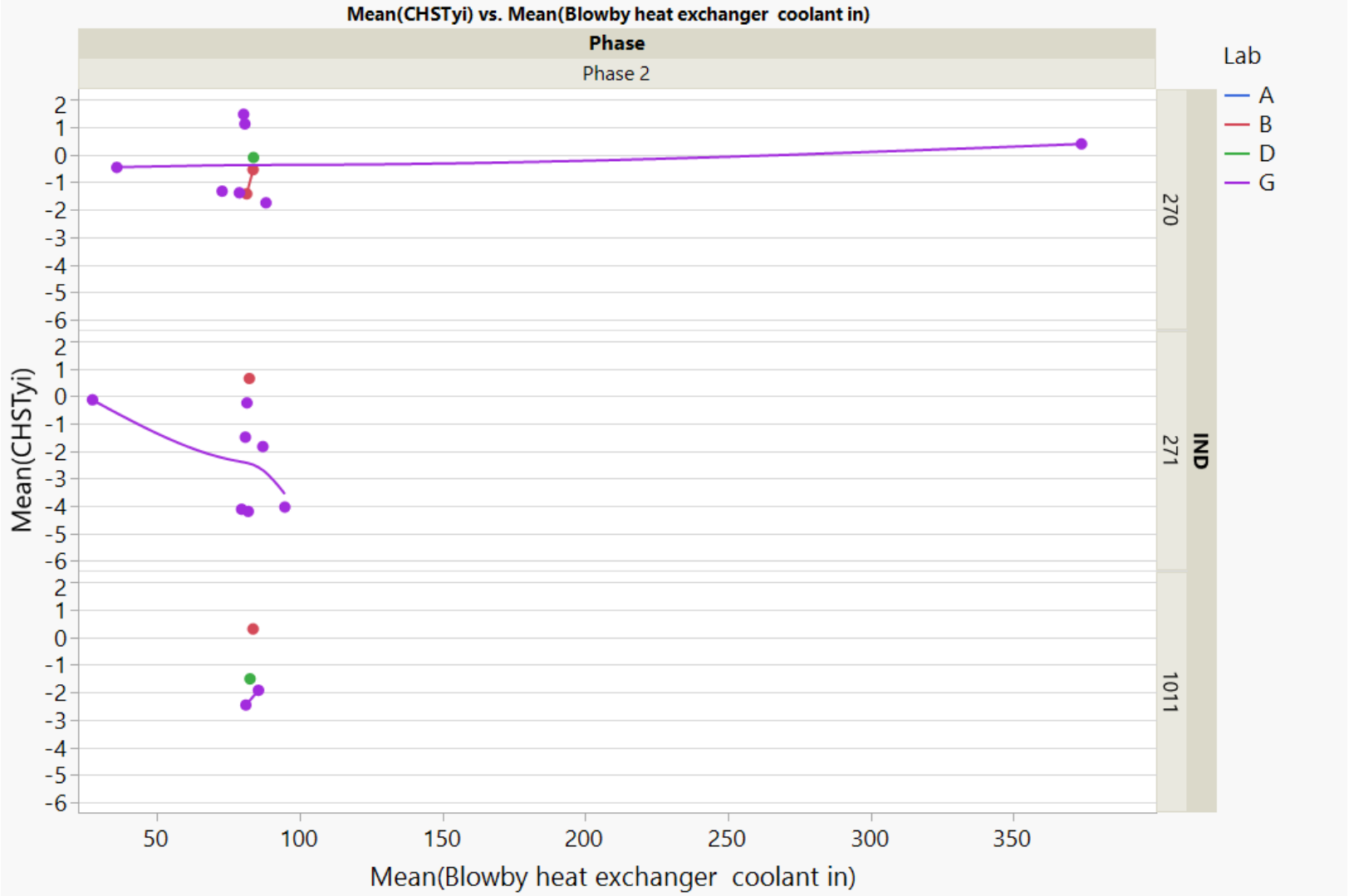
Chst. Vs. Fuel Flow



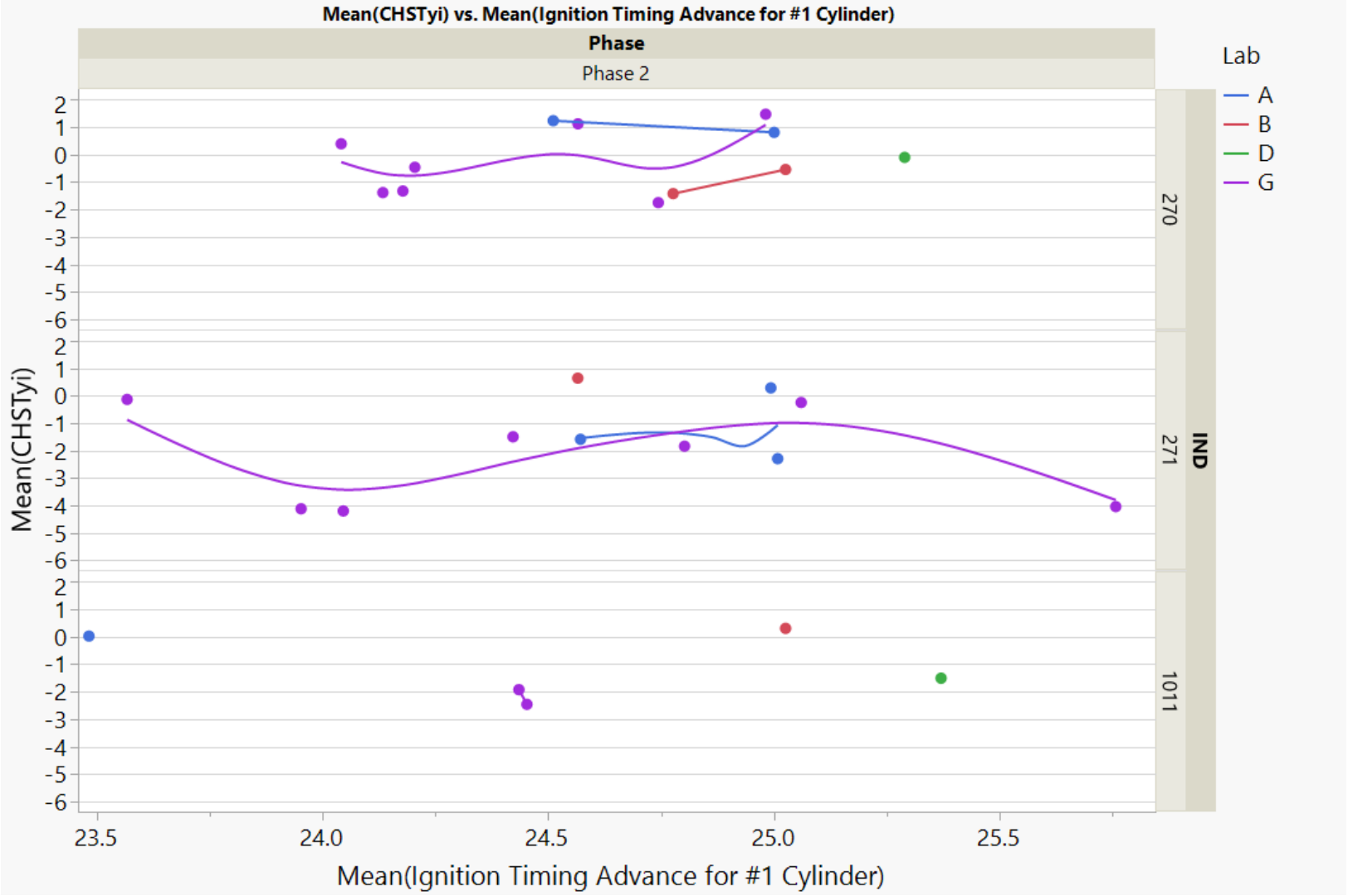
Chst. Vs. Manifold Absolute Pressure



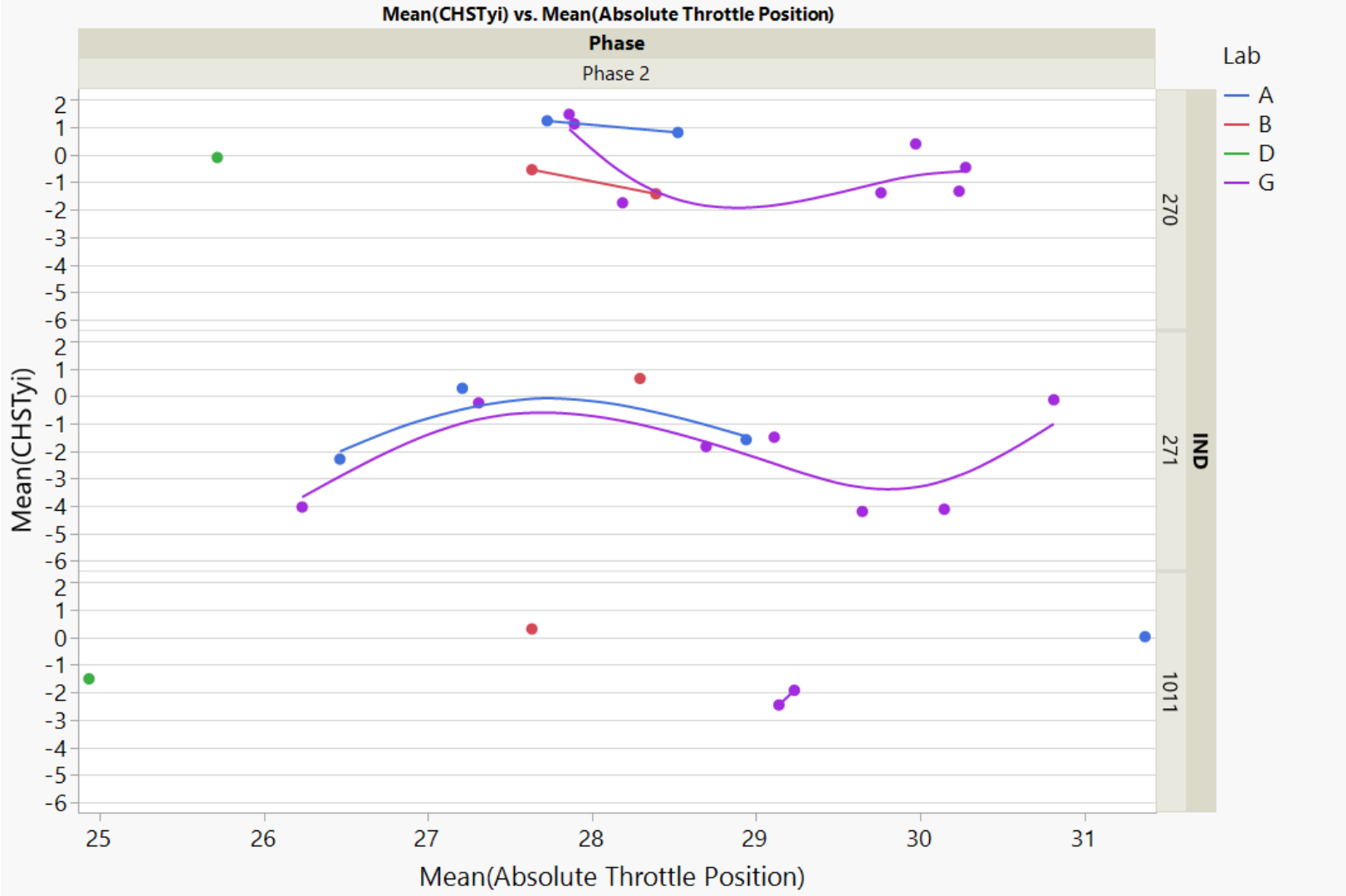
Chst. Vs. Blowby Heat Exchanger Coolant In



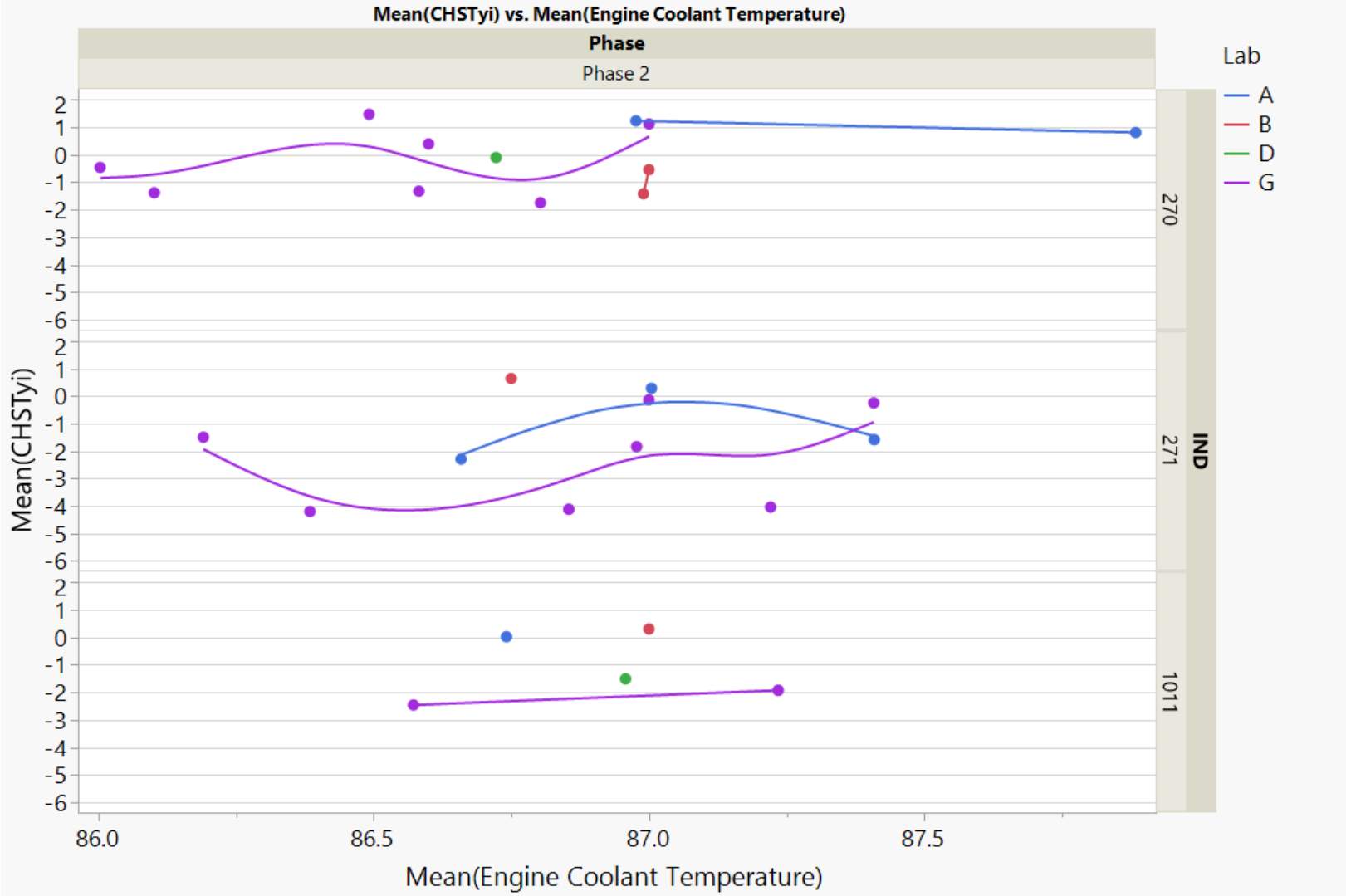
Chst. Vs. Ignition Timing Advance for Cyl. #1



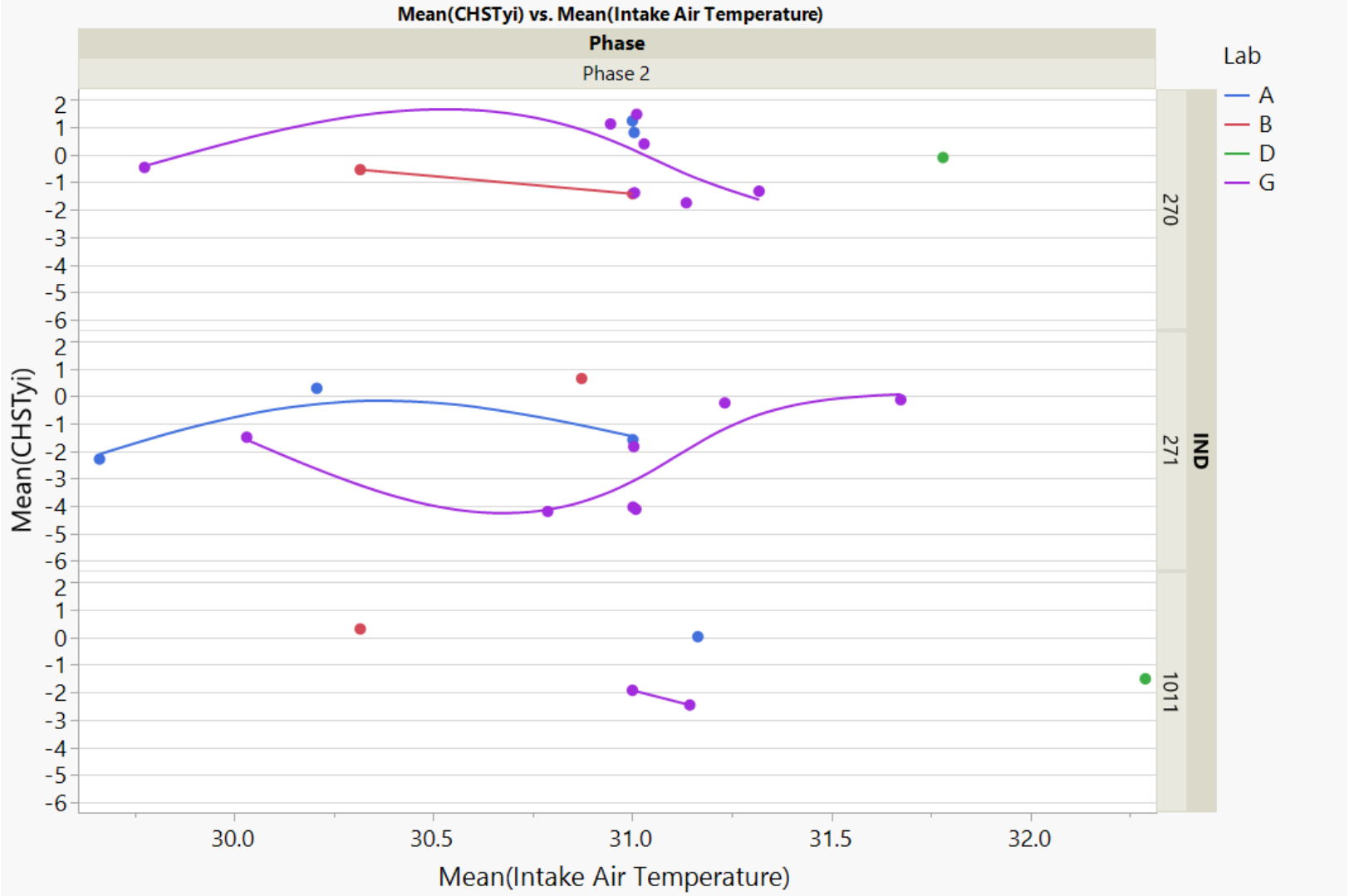
Chst. Vs. Absolute Thottle Position



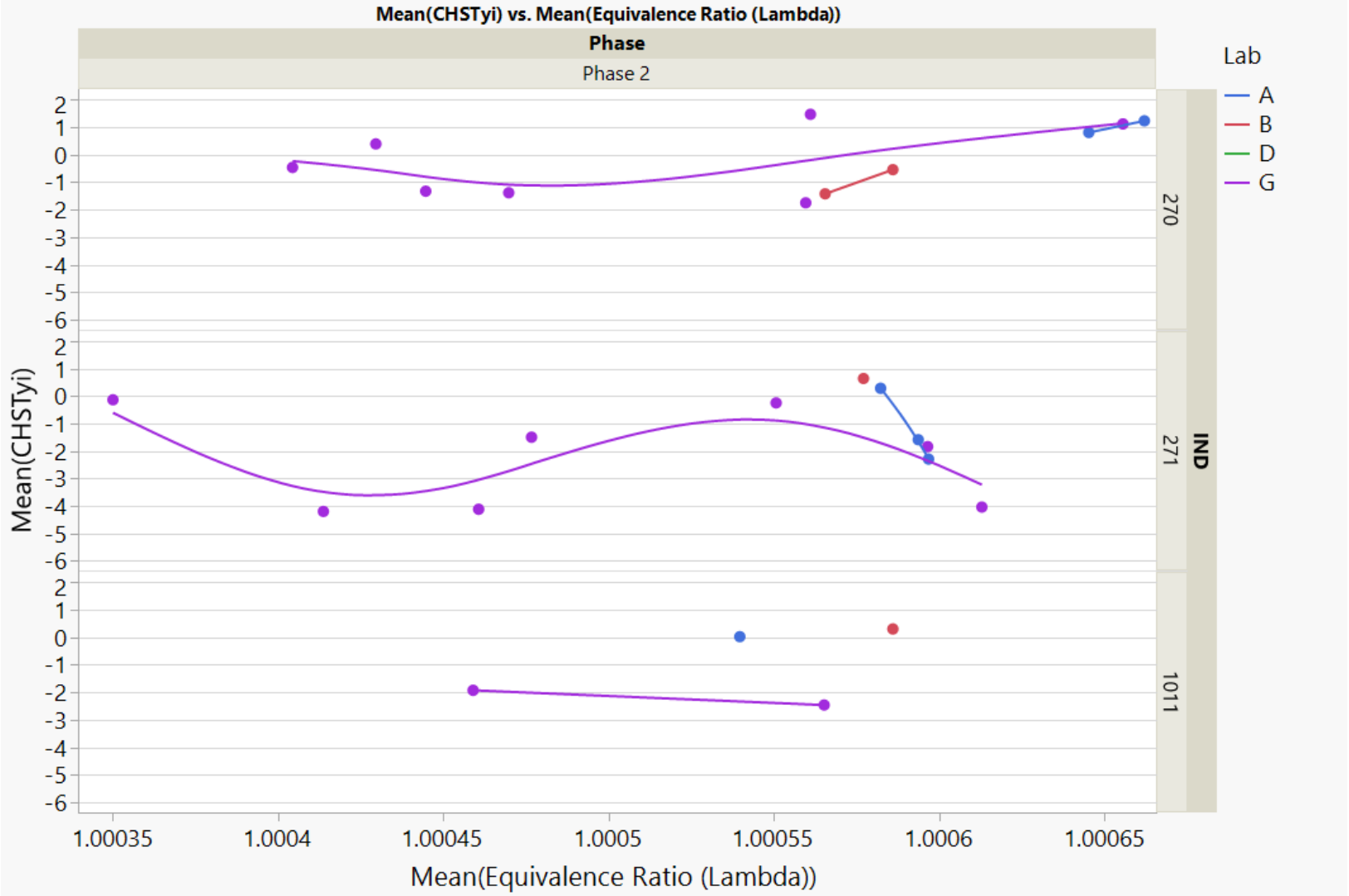
Chst. Vs. Engine Coolant Temp



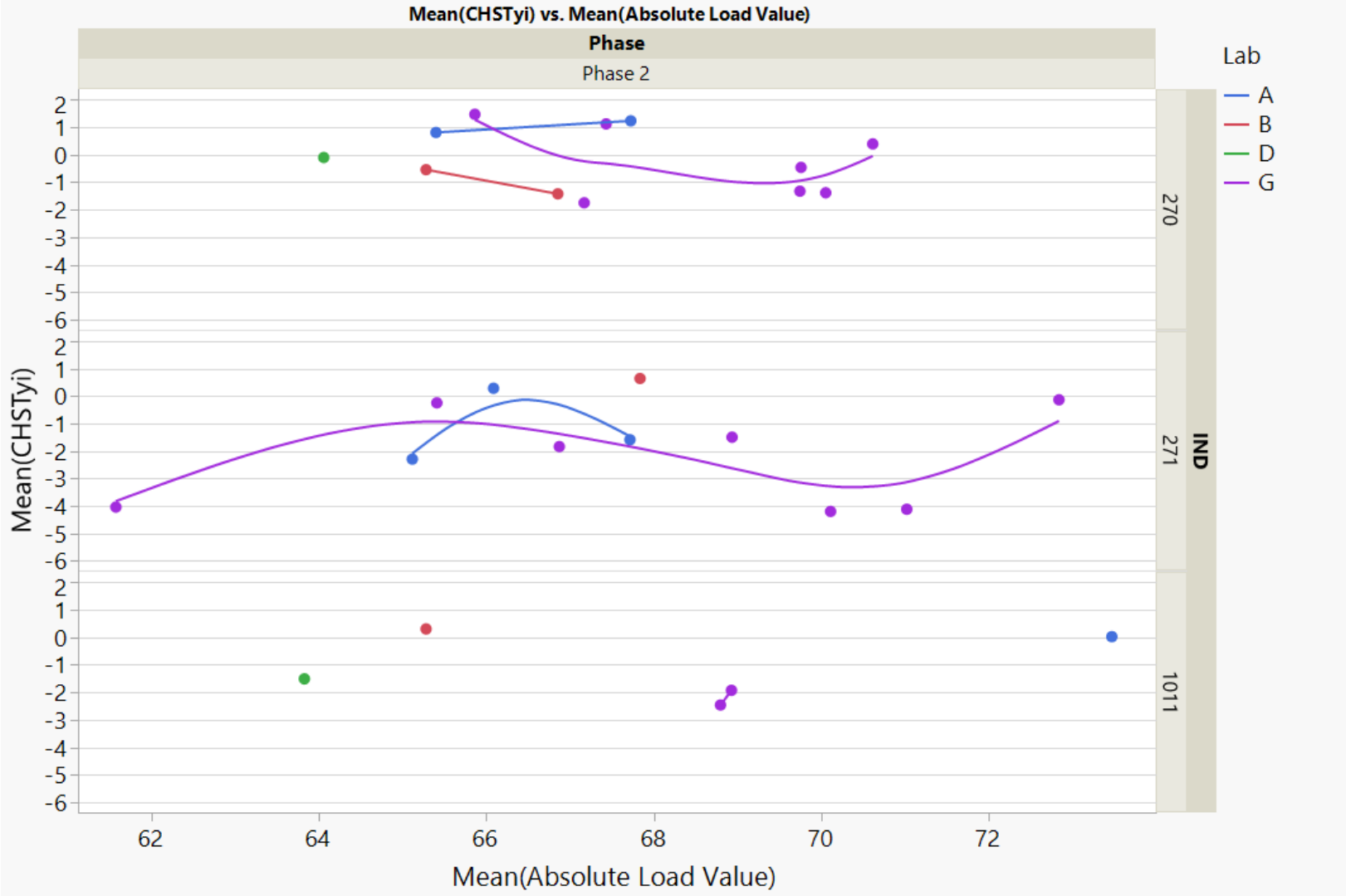
Chst. Vs. Intake Air Temp



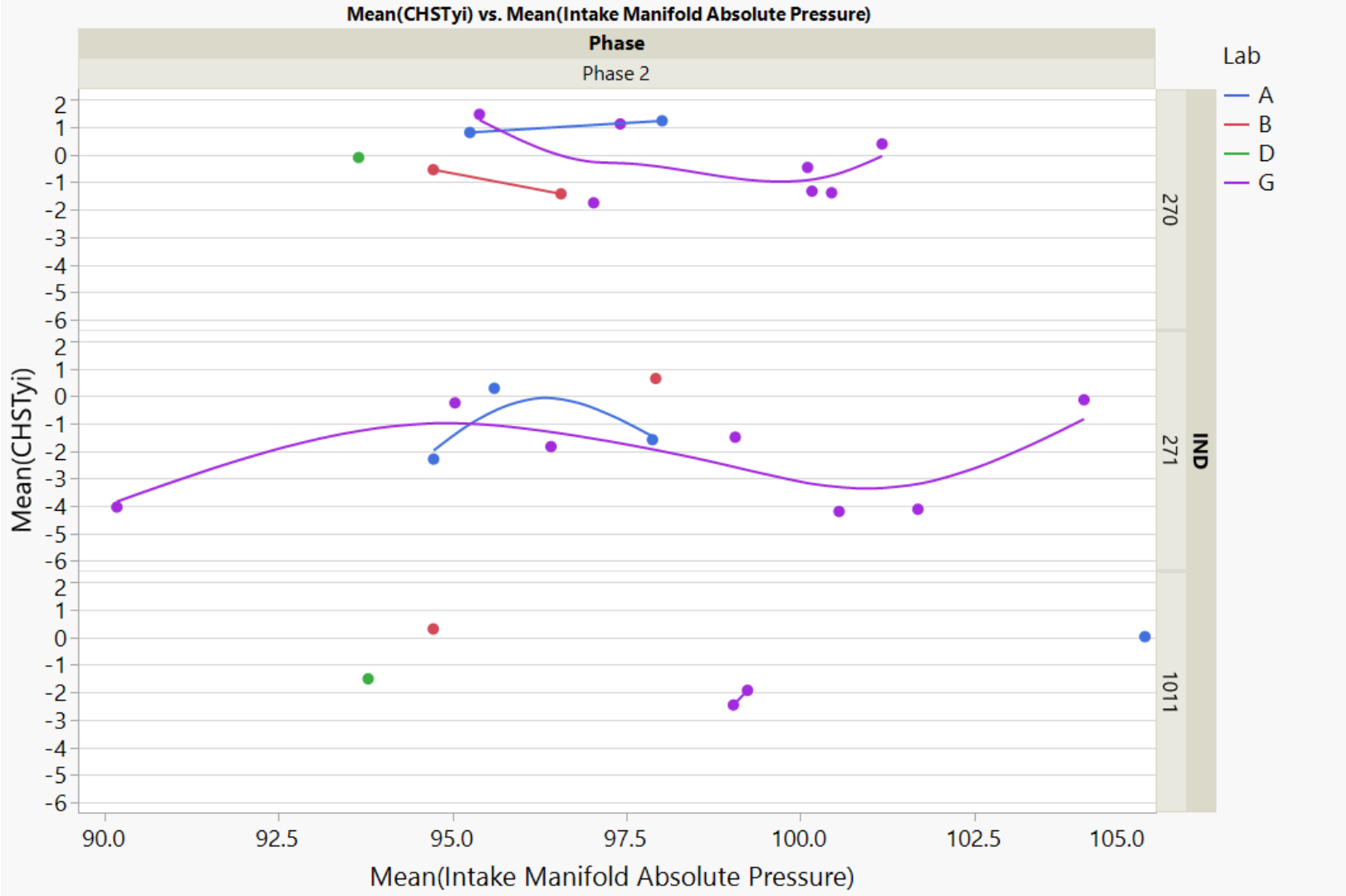
Chst. Vs. Equivalence Ratio (Lambda)



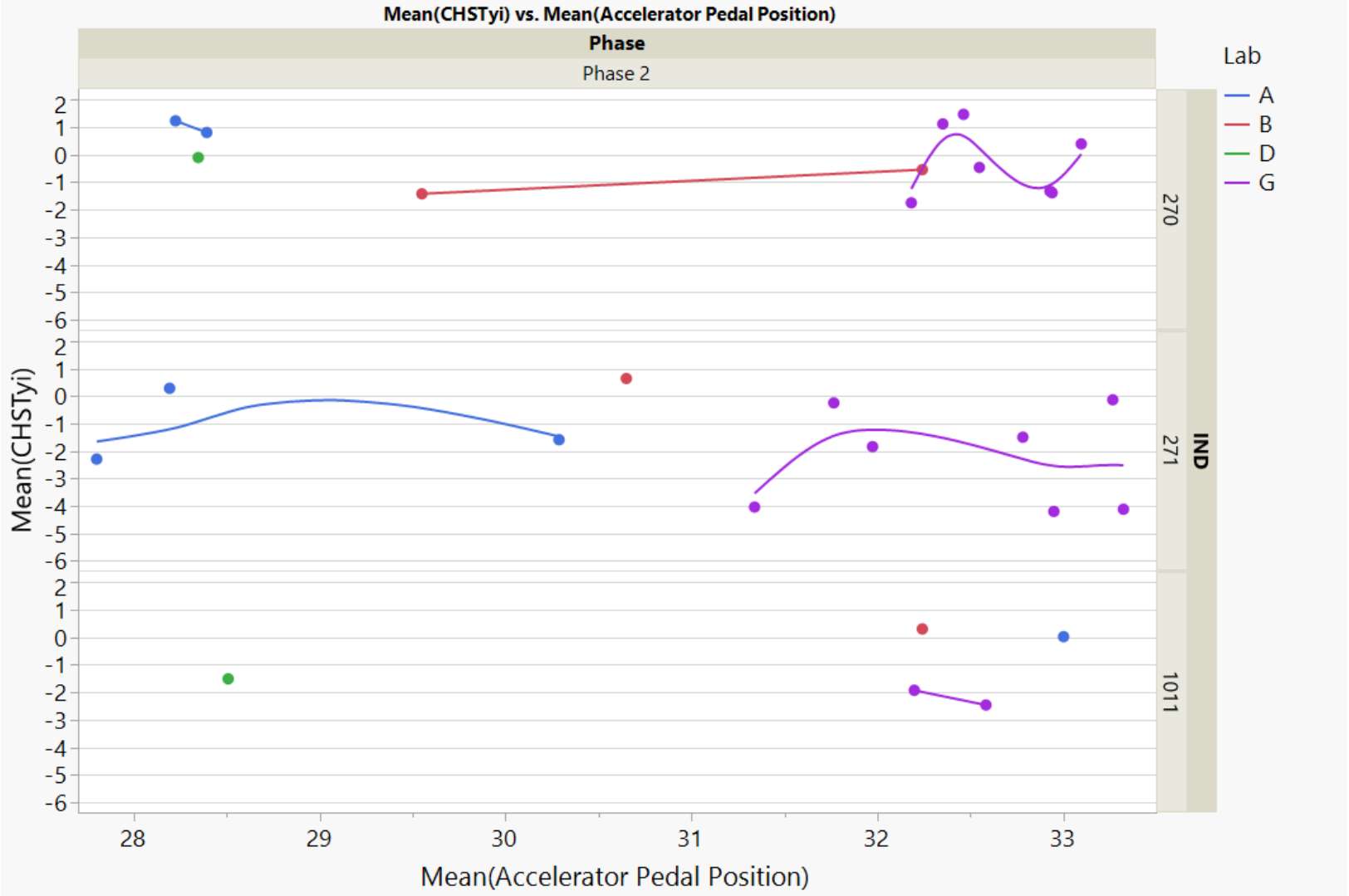
Chst. Vs. Absolute Load Value



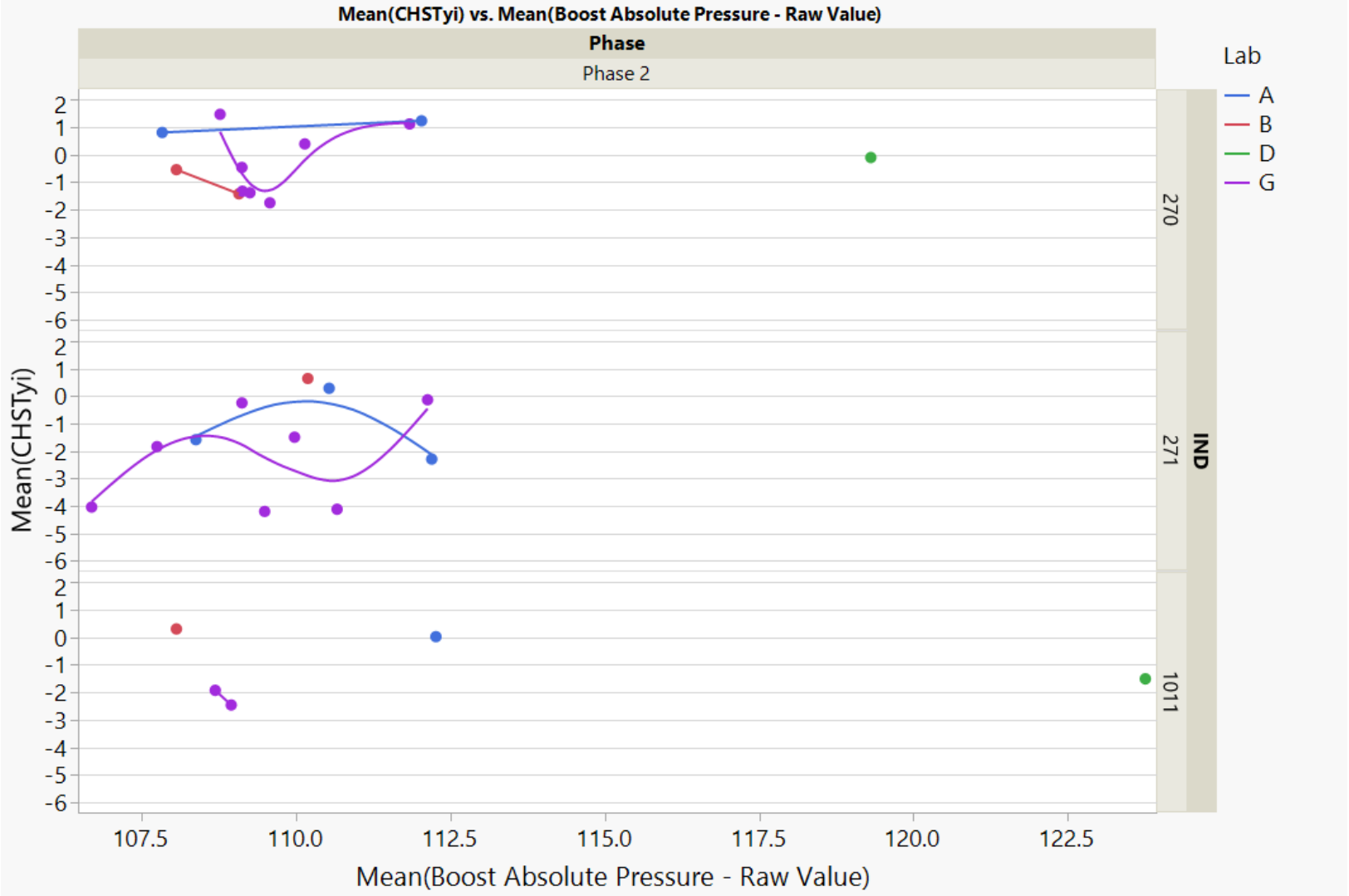
Chst. Vs. Intake Manifold Absolute Pressure



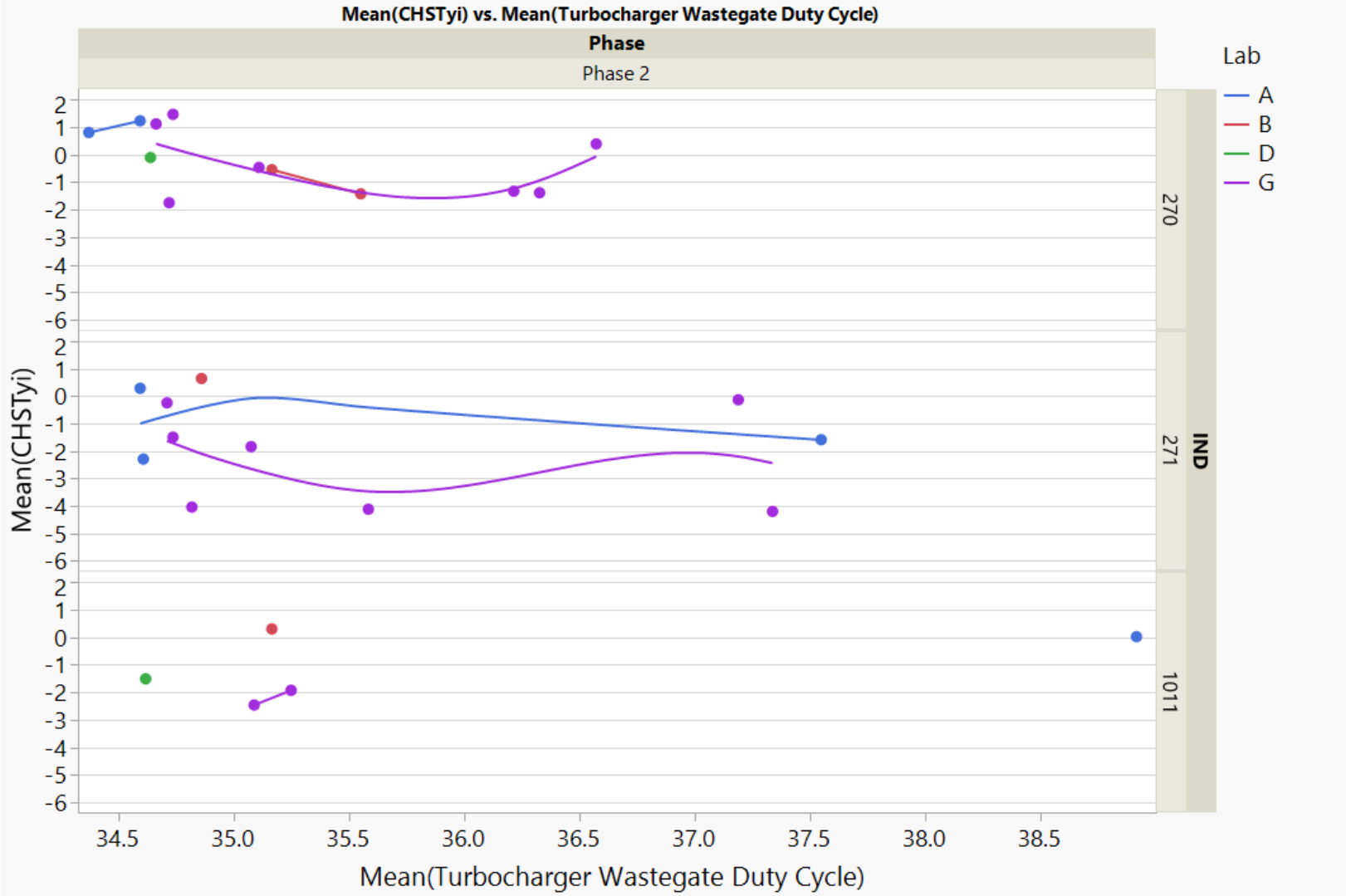
Chst.Vs.APP



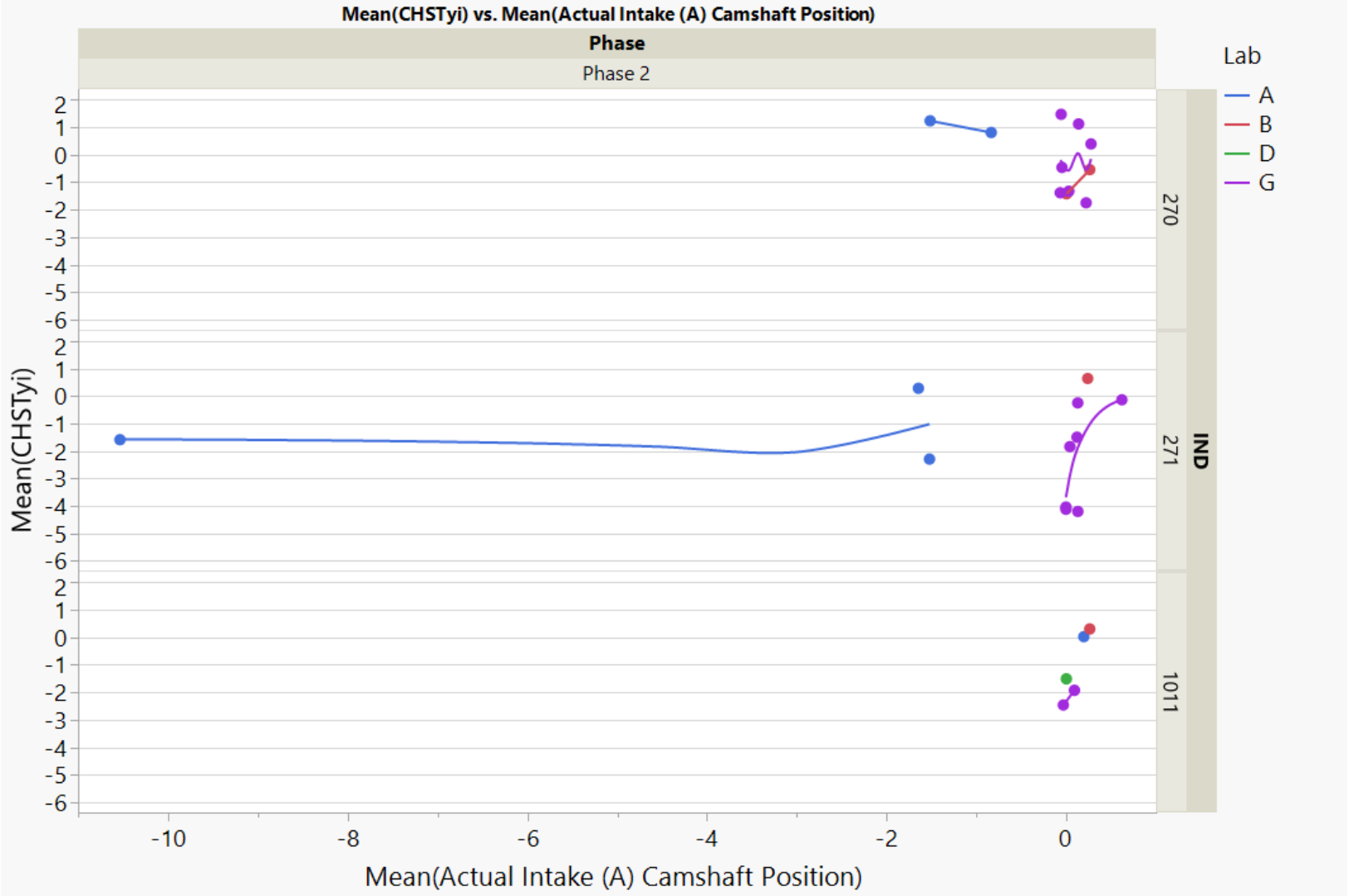
Chst. Vs. Boost Absolute Pressure – Raw Value



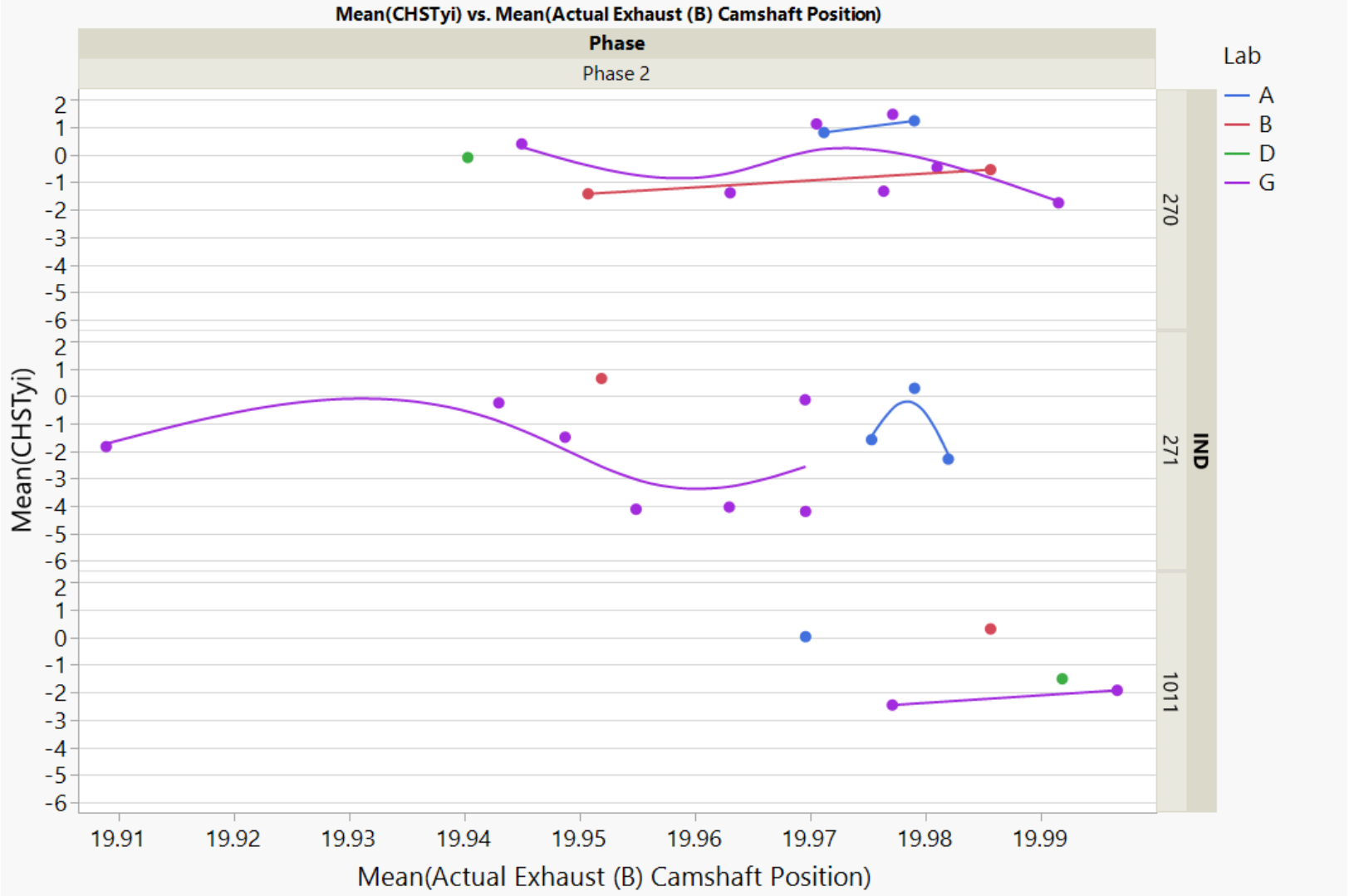
Chst. Vs. Turbocharger Wastegate Duty Cycle



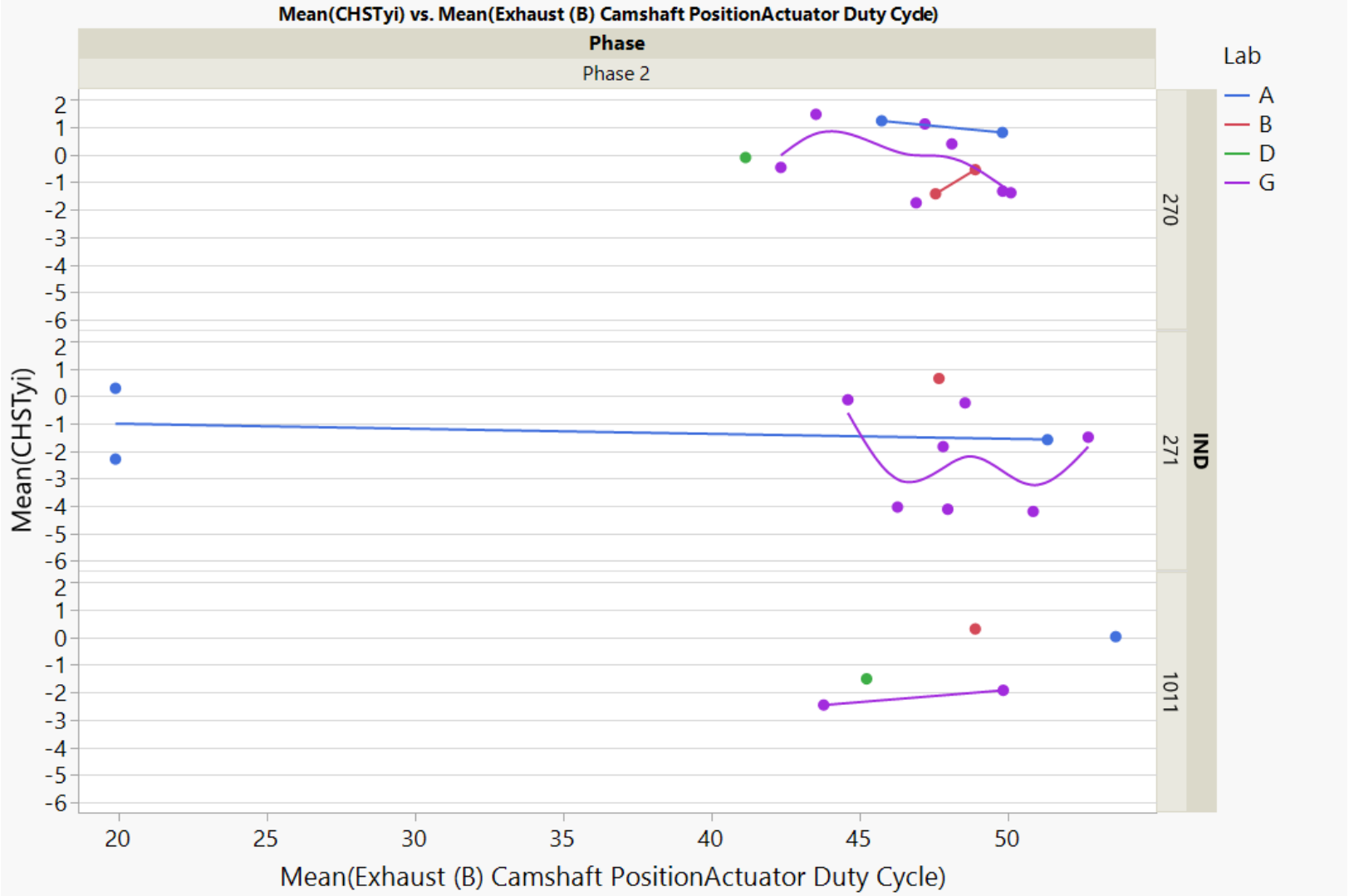
Chst. Vs. Actual Intake (A) Camshaft Position



Chst. Vs. Actual Exhaust (B) Camshaft Position



Chst.Vs. Exhaust (B) Camshaft Position Actuator Duty Cycle



Chst. Vs. Charge Air Cooler Temp