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Originally Issued: November 22, 2016

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Unapproved Minutes of the March 30, 2016
Sequence IV Surveillance Panel Meeting.

The meeting was called to order by Chairman Buscher at 10:06 AM Central Time.

A list of attendees is included as attachment 1. Mark Overaker replaces Tracy King as the voting member for Haltermann.

A copy of the agenda is included as attachment 2.

Minutes from the 1/21/2016 Meeting were approved with no corrections.

Action Items from Previous Meeting
A review of the status of action items from the previous meeting was under taken.

1. Action Item – Sequence IVB test development team and precision matrix labs to re-review time constants and data filtration as per the DACA II requirements.
   Incomplete. Currently being reviewed.

2. Motion – Accept the Sequence IVB Test Development Team's proposal for addressing any precision matrix tests that experience lobe failures. Proposal is as follows:
   1) A precision matrix test that experiences a lobe failure will not be included in the final precision matrix data set and will be replaced with a rerun test.
   2) The laboratory at which the precision matrix test that experienced a lobe failure was conducted at will cover the cost of the rerun test.
   3) The test engine in which the lobe failure occurred, will be removed from service for the remainder of the precision matrix.
   4) The laboratory will replace the test engine in which the lobe failure occurred with a new, zero run, engine and continue the precision matrix after the new engine completes break-in and aging.

   Bill Buscher / Jason Bowden / Passed 12 – 0 – 3
   Completed. This proposal has also been presented to and approved by the PCEOCP and AOAP.

3. Action Item – Sequence IVB Test Development Team to establish a servicing procedure for test engines experiencing lobe failures. A recommendation will then be made for acceptance from the Sequence IVB Task Force and Sequence IV Surveillance Panel. Once approved, laboratories will immediately start following this procedure on any engines that they have removed from service due to a lobe failure or an engine that is currently in service and experiences a lobe failure in the future.
   Incomplete. Temporarily, the Sequence IVB Test Development Team and labs have agreed to <u>remove</u> any engines experiencing a lobe failure <u>from service</u> until the servicing procedure for test engines experiencing lobe failures has been finalized. A 4th section will be drafted for the Sequence IVB Engine Assembly Manual to include this procedure.

4. Action Item – Revisit precision matrix stand selection closer to the start of the precision matrix, once the Sequence IVB Test Development Team completes all items it desires to address prior to the start of the precision matrix.
   Incomplete. To be completed at today's meeting. The Sequence IVB Test Development Team and labs recommend including Intertek stands 100 and 101, SwRI stands 19 and 20 and Lubrizol stand 347.

<u>Incomplete action items carried over from previous meetings:</u>

From the 12/4/15 conference call:

1. Action Item – Sequence IVB test development team to develop a standardized engine cleaning/flushing procedure to implement after a lobe failure occurrence for the Sequence IVB test.
   Completed. Replaced with a new action item from the 1/21/16 meeting.

2. Action Item – Sequence IV surveillance panel to develop an improved flushing method for the Sequence IVB test and incorporate it into the precision matrix, if finalized prior to the start of the precision matrix.
   Incomplete. To be completed at today's meeting. The OHT modified oil pan is now available and will be installed on the precision matrix engines. Details for a 5th flush, which will be a flush of the oil pan without the engine running need to be finalized at today's meeting.

3. Action Item – Sequence IV surveillance panel to reconvene to define and finalize a method to address tests that experience lobe failures for the Sequence IVB test.
   Completed. Precision matrix tests have been addressed. Reference and candidate tests will be addressed separately at a later date, if needed.

4. Action Item – Sequence IVB task force to reconvene to define and finalize operational control ± limits and validity criteria for the Sequence IVB test, prior to the start of the precision matrix.
   Incomplete. To be completed at today's meeting.

From the 10/27/15 meeting:

1. Action Item – Test Monitoring Center to survey the Sequence IVA test labs on the total quantity of both new and used Sequence IVA test engines and cylinder heads on hand. Survey to include a response on the total number of new test engines and cylinder heads on hand and the total number of used test engines and cylinder heads on hand. The survey to also include the total number of runs available from the new engines and cylinder heads and the total number of runs available from the used engines and cylinder heads, based on 48 runs per engine and 24 runs per cylinder head.
   Completed on 2/18/16.

From the 6/4/15 meeting:

1. Action Item – Add Haltermann KA24E Green fuel batch C of A data into Sequence IVB test report and data dictionary.

Incomplete. Will be included with revisions incorporated after completion of the IVB precision matrix.

5. IVB test report and data dictionary.
   Incomplete, but will be included with revisions incorporated after completion of the IVB precision matrix.

Action items from October 27, 2015 Meeting.

6. Action Item – Toyota to schedule a follow-up conference call for 8:00pm Eastern Time this evening, 10/27/15, to discuss SwRI's "Effect of Valve Springs on Lifter Rotation in Sequence IVB" presentation with Hirano-san and the entire Sequence IV Surveillance Panel.
   Completed. Conference call conducted on 10/27/15.

IVA Parts Survey

A review of the results of the hardware survey was conducted and it appears there is sufficient hardware available for the foreseeable future (see attachment 3). There are currently four calibrated IVA stands in industry.

IVA Torsional Vibration Analysis

Results of Torsional Vibration Analysis (TVA) were reviewed during the meeting (attachment 4). One item noted was that there was some "horizontal rocking" on Lubrizol's stand and because of the some of the measurement issues, it was believed that stands 17 and 18 at SwRI may be experiencing "rocking" as well. Also reviewed was the measurement procedure. Also of note was that the weight of the RAC with its associated fluid may affect the vibrational characteristics of the stand. Speed and load control may also have an impact on torsional vibration. Intertek stands were measured with RAC installed while SwRI's stands were measured with the factory RAC. Lubrizol's stand was measured with old and new motor mounts. One conclusion of the analysis was that motor mounts can impact torsional vibration. Aging may be affecting the motor mounts, especially on the exhaust side. One action item was assigned, OHT and Toyota to work to obtain specifications on motor mount material. Axial vibrational analysis revealed SwRI stands exhibit lower axial vibration when compared to Intertek stands, while Lubrizol's stand has higher axial vibration than the other labs and axial vibration increased with the motor mount change. Moving test development away from 4300 rpm may positively improve clutch life. Spring failures may be the result of the Torsional vibration, while the other failures maybe due to the axial.

IVB Procedure Improvements.

Test improvements were discussed. Oil pan modifications were reviewed. This pan will be required for the matrix and requires 5 gallons for an additional flush. Since current matrix oils were shipped as 4 gallons, a 5^{th} flush using EF-411 will be required. Because there is an o-ring used to seal this pan, silicone pacification will be decreased to 25 hours. By controlling coolant flow, wear results on stand 17 were reduced average loss from 3.14 mm^3 to 1.62 mm^3. Lubrizol and Intertek will attempt a test controlling coolant flow to 45 l/min during stage 2 and 75 l/min during stage 1. RAC Flow will also be controlled as well. A new harness will be obtained with OBDII access and labs will gather can bus data for this test for analysis. Motion 5 in attachment addresses approval of these proposed changes. SwRI will also provide the flow rates for engine coolant flow and RAC flow. An action item was taken to request that Afton and

ExxonMobil be added to the test development group. Also an action item was assigned for Lubrizol, SwRI and Intertek to conduct scoping tests controlling coolant flow.

Operational Validity Criteria

A review of methods to determine operational validity was reviewed. Labs agreed to evaluate if a QI type system can be applied to their data based on a proposed method utilizing a QI applied to each data point. A copy of the QI presentation is included in attachment 5. Labs are to determine their system response characteristics and circulate with the test development task force.

Review and approve proposal for proceeding with the IVB precision matrix

Test results from proposed matrix stands were reviewed, see attachment 5. A motion was made to approve the Sequence IVB as ready for precision matrix testing, see motion 12 in attachment . Considerable discussions took place regarding severity of stands and procedure changes to control flow on RAC and engine coolant. Motion was approved 6-5-4. Negative comments from Afton, Lubrizol and ExxonMobil are included as attachment 7.

The meeting was adjourned at 5:53 PM.

A listing of the motions and action items from this meeting is included as attachment 6.

MEMBERSHIP
ASTM IVA SURVEILLANCE PANEL

March 30, 2016

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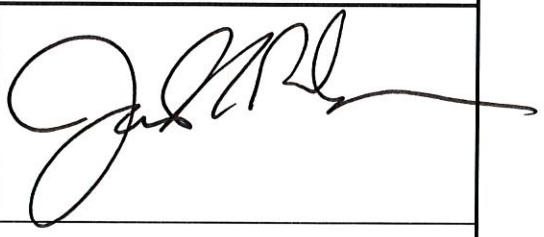
Bowden, Jason	OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 Phone No.: 440-354-7007 Fax No.: 440-354-7080 Email: jhbowden@ohtech.com	
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March 30, 2016

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ASTM IVA SURVEILLANCE PANEL

MARCH 30, 2016

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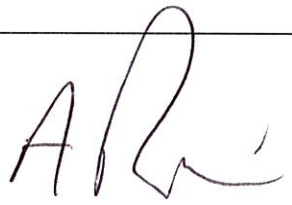
Ritchie, Andrew	Infineum USA L.P. 1900 E. Linden Avenue Linden, NJ 07036-0536 Phone No.: 908-474-2097 Fax No.: 908-474-3637 Email: andrew.ritchie@infineum.com	
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Attachment 2

Sequence IVB Task Force
and
Sequence IV Surveillance Panel

San Antonio, TX
Southwest Research Institute
March 30, 2016
10:00 a.m. - 6:00 p.m.

A G E N D A

1. Chairman comments
2. Attendance sign-in sheet distribution
3. Membership changes
4. Motion and action recorder
5. Approval of minutes for 1/21/2016
6. Action item review
7. Review IVA hardware survey
8. Review IVB TVA report and conclusions
9. Review IVB procedural process improvements
10. Finalize and approve operational control ± limits and validity criteria for the IVB precision matrix
11. Review the status of the IVB precision matrix labs
12. Review and approve proposal for proceeding with the IVB precision matrix
13. Review scope & objectives
14. Old business
15. New business

16. Motion and action item review
17. Next meeting
18. Adjourn

Attachment 6

Sequence IVB Task Force
and
Sequence IV Surveillance Panel
March 30, 2016
10:00AM – 6:00PM
Southwest Research Institute
San Antonio, TX

Motions and Action Items

As Recorded at the Meeting by Bill Buscher

1) Action Item – OHT to work with Toyota to provide the manufacturing specifications (i.e. stiffness and manufacturing tolerances) for the three Toyota OEM motor mounts used on the Sequence IVB Golden Stand.

2) Action Item – Intertek to create a calibration curve for the OHT dipstick and modified oil pan.

3) Action Item – Add rocker cover coolant flow rate control (control valve, PID controller and set point) to the Sequence IVB test. Labs to obtain flow rate data to define a set point. SwRI will take the lead in creating the set up for this Golden Stand addition.

4) Action Item – Lubrizol to add the OBD2 data to the Sequence IVB operational data Excel template previously created for prove-out data review. This will allow for review of this data during and after the precision matrix.

5) Motion – The Sequence IVB Task Force and Sequence IV Surveillance Panel approves the inclusion the following procedural process improvements into the precision matrix tests:

- Each precision matrix stand will start the precision matrix with a new engine assembly, a new clutch assembly and new motor mounts. Prior to the start of the precision matrix the only runtime that this engine and these components will experience is the break-in and aging for Si pacification.
- Will use the OHT modified oil pan, which will improve the oil drain effectiveness for the flushes and end of test drain.
- Will add a 5th flush, which will be an oil pan flush without the engine running. This flush will be conducted prior to the 4 flushes with the engine running. For the precision matrix this flush will use EF-411.
- ifm SM8000 magnetic-inductive flow meters will be added to the Sequence IVB Golden Stand for engine and rocker cover coolant flow rate measurement.
- Will change from engine coolant delta temperature control (2°C for Stage 1 and 5°C for Stage 2) to engine coolant flow rate control (75 lpm for Stage 1 and 45 lpm for Stage 2). This will include a linear 8 second ramp from 45 to 75 lpm between stages 1 and 2.
- Will add rocker cover coolant flow rate control (set-point to be defined).
- Will add data acquisition of a predefined set of OBD2 parameters, at a 1 Hz logging rate.

Bill Buscher / Eric Liu / Passed 14 – 0 – 1

6) Action Item – SwRI to provide the labs the coolant flow operational data so that all three precision matrix labs can mimic SwRI's coolant flow ramps during transitions.

7) Action Item – Sequence IVB Test Development Team to finalize the procedure for the 5th flush, as indicated in the passing motion above.

8) Action Item – Sequence IV Surveillance Panel chair to request to Toyota that Afton and ExxonMobil be added to the Sequence IVB Test Development Team as of 3/30/16, since those companies are contemplating the purchase of Sequence IVB Golden Stands. The chair will also ask Toyota for feedback on when they believe the test development team will be disbanded and the surveillance panel will assume full control of the Sequence IVB test.

9) Action Item – SwRI will complete a scoping test currently running on stand 19 with engine coolant flow control, Intertek will conduct a scoping test on stand 102 with engine coolant flow control, and Lubrizol will conduct a scoping test on stand 347 with engine coolant flow control prior to the start of the precision matrix. SwRI will also conduct a repeat test on stand 17 with engine coolant flow control and Intertek will conduct a test on stand 165 with engine coolant flow control. All tests will be conducted on ASTM REO 1006-2. All tests will be conducted with engine coolant

flow rate set points of 75 lpm for Stage 1 and 45 lpm for Stage 2 and engine coolant flow rate ramping defined from SwRI's operational data from test 17-0-10.

10) Action Item – Eric Liu to provide his Qi Excel spreadsheet to the precision matrix labs to evaluate their operational data for Qi performance.

11) Action Item – Precision matrix labs to review the "variable upper and lower QI limits concept" with their computer data acquisition staff to evaluate whether or not it is possible or realistic to incorporate this concept for Sequence IVB operational data validity determination. If it is possible, determine what the lead time to incorporate this will be. Labs to have this evaluation completed by Wednesday, 4/6/16.

12) Motion – The Sequence IVB Task Force and Sequence IV Surveillance Panel approves the Sequence IVB test as ready for precision matrix testing and recommends proceeding with the precision matrix, including the original three matrix labs, Intertek (stands 100 and 101), SwRI (stands 19 and 20) and Lubrizol (stand 347), the original precision matrix design and the procedural process improvements approved in motion # 5 from today's meeting.
Teri Kowalski / Bill Buscher / Passed 6 – 5 – 4

13) Action Item – Negative voters on motion # 12 from today's meeting to provide comments on their negative votes to the Sequence IV Surveillance Panel chair, for distribution, by the end of business on Friday, 4/1/16.

1. Action Item – Sequence IVB test development team and precision matrix labs to re-review time constants and data filtration as per the DACA II requirements.
   Incomplete. Currently being reviewed.

2. Motion – Accept the Sequence IVB Test Development Team's proposal for addressing any precision matrix tests that experience lobe failures. Proposal is as follows:
   1) A precision matrix test that experiences a lobe failure will not be included in the final precision matrix data set and will be replaced with a rerun test.
   2) The laboratory at which the precision matrix test that experienced a lobe failure was conducted at will cover the cost of the rerun test.
   3) The test engine in which the lobe failure occurred, will be removed from service for the remainder of the precision matrix.
   4) The laboratory will replace the test engine in which the lobe failure occurred with a new, zero run, engine and continue the precision matrix after the new engine completes break-in and aging.

   Bill Buscher / Jason Bowden / Passed 12 – 0 – 3
   Completed. This proposal has also been presented to and approved by the PCEOCP and AOAP.

3. Action Item – Sequence IVB Test Development Team to establish a servicing procedure for test engines experiencing lobe failures. A recommendation will then be made for acceptance from the Sequence IVB Task Force and Sequence IV Surveillance Panel. Once approved, laboratories will immediately start following this procedure on any engines that they have removed from service due to a lobe failure or an engine that is currently in service and experiences a lobe failure in the future.
   Incomplete. Temporarily, the Sequence IVB Test Development Team and labs have agreed to <u>remove</u> any engines experiencing a lobe failure <u>from service</u> until the servicing procedure for test engines experiencing lobe failures has been finalized. A 4th section will be drafted for the Sequence IVB Engine Assembly Manual to include this procedure.

4. Action Item – Revisit precision matrix stand selection closer to the start of the precision matrix, once the Sequence IVB Test Development Team completes all items it desires to address prior to the start of the precision matrix.
   Incomplete. To be completed at today's meeting. The Sequence IVB Test Development Team and labs recommend including Intertek stands 100 and 101, SwRI stands 19 and 20 and Lubrizol stand 347.

<u>Incomplete action items carried over from previous meetings:</u>

From the 12/4/15 conference call:

1. Action Item – Sequence IVB test development team to develop a standardized engine cleaning/flushing procedure to implement after a lobe failure occurrence for the Sequence IVB test.
   Completed. Replaced with a new action item from the 1/21/16 meeting.

2. Action Item – Sequence IV surveillance panel to develop an improved flushing method for the Sequence IVB test and incorporate it into the precision matrix, if finalized prior to the start of the precision matrix.
   Incomplete. To be completed at today's meeting. The OHT modified oil pan is now available and will be installed on the precision matrix engines. Details for a 5th flush, which will be a flush of the oil pan without the engine running need to be finalized at today's meeting.

3. Action Item – Sequence IV surveillance panel to reconvene to define and finalize a method to address tests that experience lobe failures for the Sequence IVB test.
   Completed. Precision matrix tests have been addressed. Reference and candidate tests will be addressed separately at a later date, if needed.

4. Action Item – Sequence IVB task force to reconvene to define and finalize operational control ± limits and validity criteria for the Sequence IVB test, prior to the start of the precision matrix.
   Incomplete. To be completed at today's meeting.

From the 10/27/15 meeting:

1. Action Item – Test Monitoring Center to survey the Sequence IVA test labs on the total quantity of both new and used Sequence IVA test engines and cylinder heads on hand. Survey to include a response on the total number of new test engines and cylinder heads on hand and the total number of used test engines and cylinder heads on hand. The survey to also include the total number of runs available from the new engines and cylinder heads and the total number of runs available from the used engines and cylinder heads, based on 48 runs per engine and 24 runs per cylinder head.
   Completed on 2/18/16.

From the 6/4/15 meeting:

1. Action Item – Add Haltermann KA24E Green fuel batch C of A data into Sequence IVB test report and data dictionary.

Incomplete. Will be included with revisions incorporated after completion of the IVB precision matrix.

5. IVB test report and data dictionary.
   Incomplete, but will be included with revisions incorporated after completion of the IVB precision matrix.

Action items from October 27, 2015 Meeting.

6. Action Item – Toyota to schedule a follow-up conference call for 8:00pm Eastern Time this evening, 10/27/15, to discuss SwRI's "Effect of Valve Springs on Lifter Rotation in Sequence IVB" presentation with Hirano-san and the entire Sequence IV Surveillance Panel.
   Completed. Conference call conducted on 10/27/15.

IVA Parts Survey

A review of the results of the hardware survey was conducted and it appears there is sufficient hardware available for the foreseeable future (see attachment 3). There are currently four calibrated IVA stands in industry.

IVA Torsional Vibration Analysis

Results of Torsional Vibration Analysis (TVA) were reviewed during the meeting (attachment 4). One item noted was that there was some "horizontal rocking" on Lubrizol's stand and because of the some of the measurement issues, it was believed that stands 17 and 18 at SwRI may be experiencing "rocking" as well. Also reviewed was the measurement procedure. Also of note was that the weight of the RAC with its associated fluid may affect the vibrational characteristics of the stand. Speed and load control may also have an impact on torsional vibration. Intertek stands were measured with RAC installed while SwRI's stands were measured with the factory RAC. Lubrizol's stand was measured with old and new motor mounts. One conclusion of the analysis was that motor mounts can impact torsional vibration. Aging may be affecting the motor mounts, especially on the exhaust side. One action item was assigned, OHT and Toyota to work to obtain specifications on motor mount material. Axial vibrational analysis revealed SwRI stands exhibit lower axial vibration when compared to Intertek stands, while Lubrizol's stand has higher axial vibration than the other labs and axial vibration increased with the motor mount change. Moving test development away from 4300 rpm may positively improve clutch life. Spring failures may be the result of the Torsional vibration, while the other failures maybe due to the axial.

IVB Procedure Improvements.

Test improvements were discussed. Oil pan modifications were reviewed. This pan will be required for the matrix and requires 5 gallons for an additional flush. Since current matrix oils were shipped as 4 gallons, a 5^{th} flush using EF-411 will be required. Because there is an o-ring used to seal this pan, silicone pacification will be decreased to 25 hours. By controlling coolant flow, wear results on stand 17 were reduced average loss from 3.14 mm^3 to 1.62 mm^3. Lubrizol and Intertek will attempt a test controlling coolant flow to 45 l/min during stage 2 and 75 l/min during stage 1. RAC Flow will also be controlled as well. A new harness will be obtained with OBDII access and labs will gather can bus data for this test for analysis. Motion 5 in attachment addresses approval of these proposed changes. SwRI will also provide the flow rates for engine coolant flow and RAC flow. An action item was taken to request that Afton and

ExxonMobil be added to the test development group. Also an action item was assigned for Lubrizol, SwRI and Intertek to conduct scoping tests controlling coolant flow.

Operational Validity Criteria

A review of methods to determine operational validity was reviewed. Labs agreed to evaluate if a QI type system can be applied to their data based on a proposed method utilizing a QI applied to each data point. A copy of the QI presentation is included in attachment 5. Labs are to determine their system response characteristics and circulate with the test development task force.

Review and approve proposal for proceeding with the IVB precision matrix

Test results from proposed matrix stands were reviewed, see attachment . A motion was made to approve the Sequence IVB as ready for precision matrix testing, see motion 12 in attachment . Considerable discussions took place regarding severity of stands and procedure changes to control flow on RAC and engine coolant. Motion was approved 6-5-4.

The meeting was adjourned at 5:53 PM.

A listing of the motions and action items from this meeting is included as attachment 6.

Attachment 2

Sequence IVB Task Force
and
Sequence IV Surveillance Panel

San Antonio, TX
Southwest Research Institute
March 30, 2016
10:00 a.m. - 6:00 p.m.

A G E N D A

1. Chairman comments
2. Attendance sign-in sheet distribution
3. Membership changes
4. Motion and action recorder
5. Approval of minutes for 1/21/2016
6. Action item review
7. Review IVA hardware survey
8. Review IVB TVA report and conclusions
9. Review IVB procedural process improvements
10. Finalize and approve operational control ± limits and validity criteria for the IVB precision matrix
11. Review the status of the IVB precision matrix labs
12. Review and approve proposal for proceeding with the IVB precision matrix
13. Review scope & objectives
14. Old business
15. New business

16. Motion and action item review
17. Next meeting
18. Adjourn

Bill Buscher Intertek

From: Rich Grundza <reg@astmtmc.cmu.edu>
Sent: Thursday, February 18, 2016 1:41 PM
To: Bill Buscher Intertek
Subject: FW: IVA Engine Survey

Totals:
All:
Can you review and complete the following survey and return to me by February 18, 2016:
Please provide the following quantities related to Sequence IVA Hardware

1) Number of New Sequence IVA Engines available __8__ One lab has no new engines remaining
2) Number of New Sequence IVA Heads available __17__ One lab has no new heads remaining
3) Number of Used Sequence IVA Engines Available __67__
4) Number of Used Sequence IVA Heads available __101__

Also, based on 48 runs per engine and 24 runs per head

5) Number of runs available on new engines _388___
6) Number of runs available on used Engines _1709___
7) Number of runs available on new heads __408__
8) Number of runs available on used heads _1358___

If you have any questions feel free to contact me.
Best regards;

Richard E. Grundza
Senior Project Engineer
ASTM Test Monitoring Center

Phone: 412-365-1031
Cell: 412-848-8840

Attachment 4

Sequence IVB

Torsional Vibration Analysis (TVA)

Summary

Summary of Findings

Nine Engine Systems Evaluated

- ***Intertek: Stands 100, 101, 102, & 165***
- ***SwRI: Stands 17, 18, 19, & 20***
- ***Lubrizol: Stand 347***

Flywheel Clutch Failures

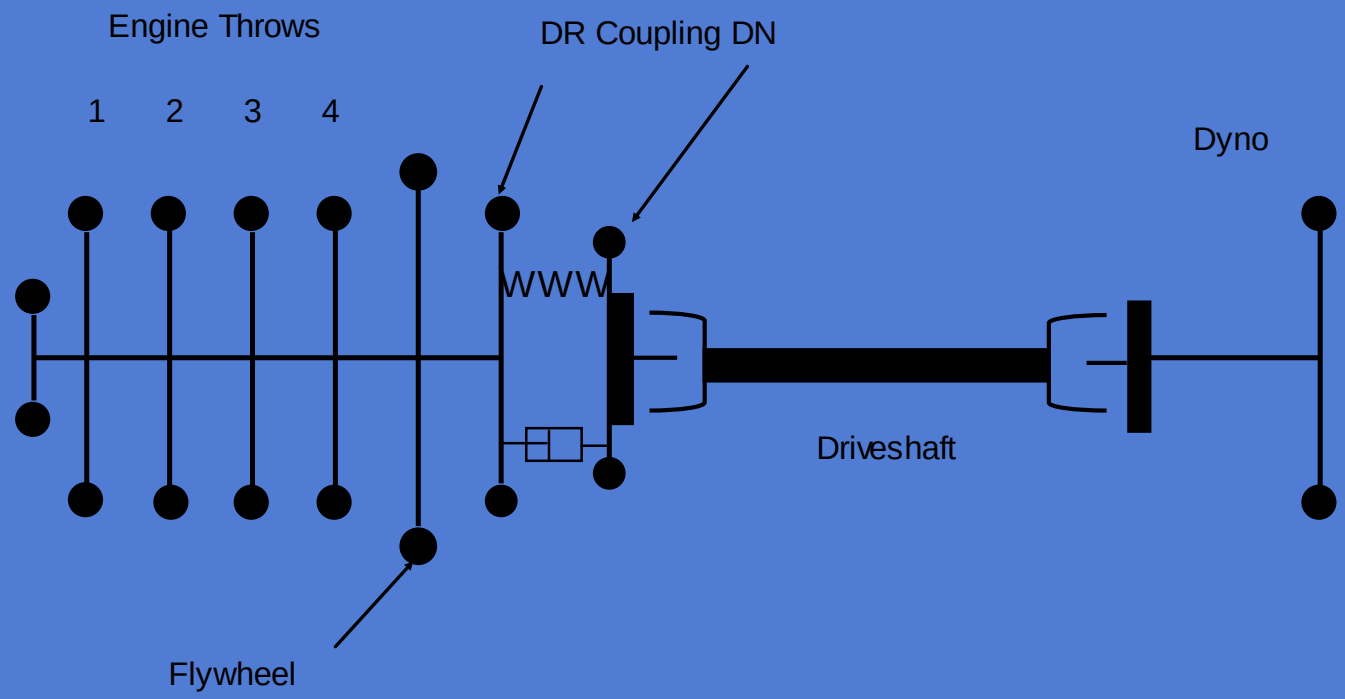
- ***Excessive Vibratory Torque***
  - ***Torsional Resonance***
  - ***Fatigues Steel Helical Springs***
- ***Axial Vibratory Deflection***
  - ***Impacts Clutch Structure***

Torsional Vibration Analysis, TVA

Mathematical Representation of System

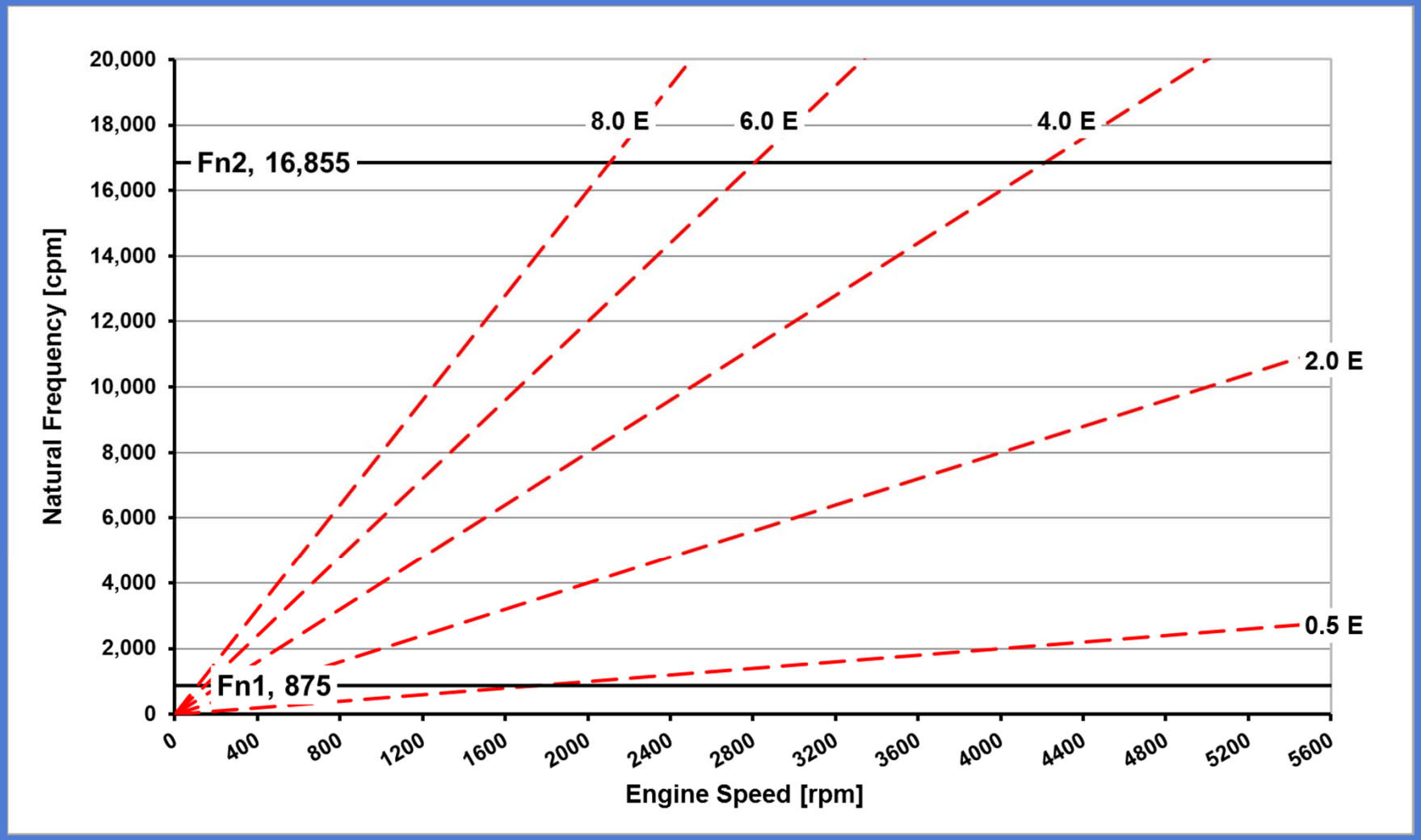
- ***Determines Torsional Natural Frequencies, TNF***
- ***Predicts Torsional Response in Components***
  - ***Vibratory Amplitude, Torque, or Stress***
- ***Requires***
  - ***Mass-Elastic Data of Driving, Driven, and Connecting Devices***
  - ***Damping Available***
  - ***Values of Forcing Functions/Harmonics***

Torsional Schematic

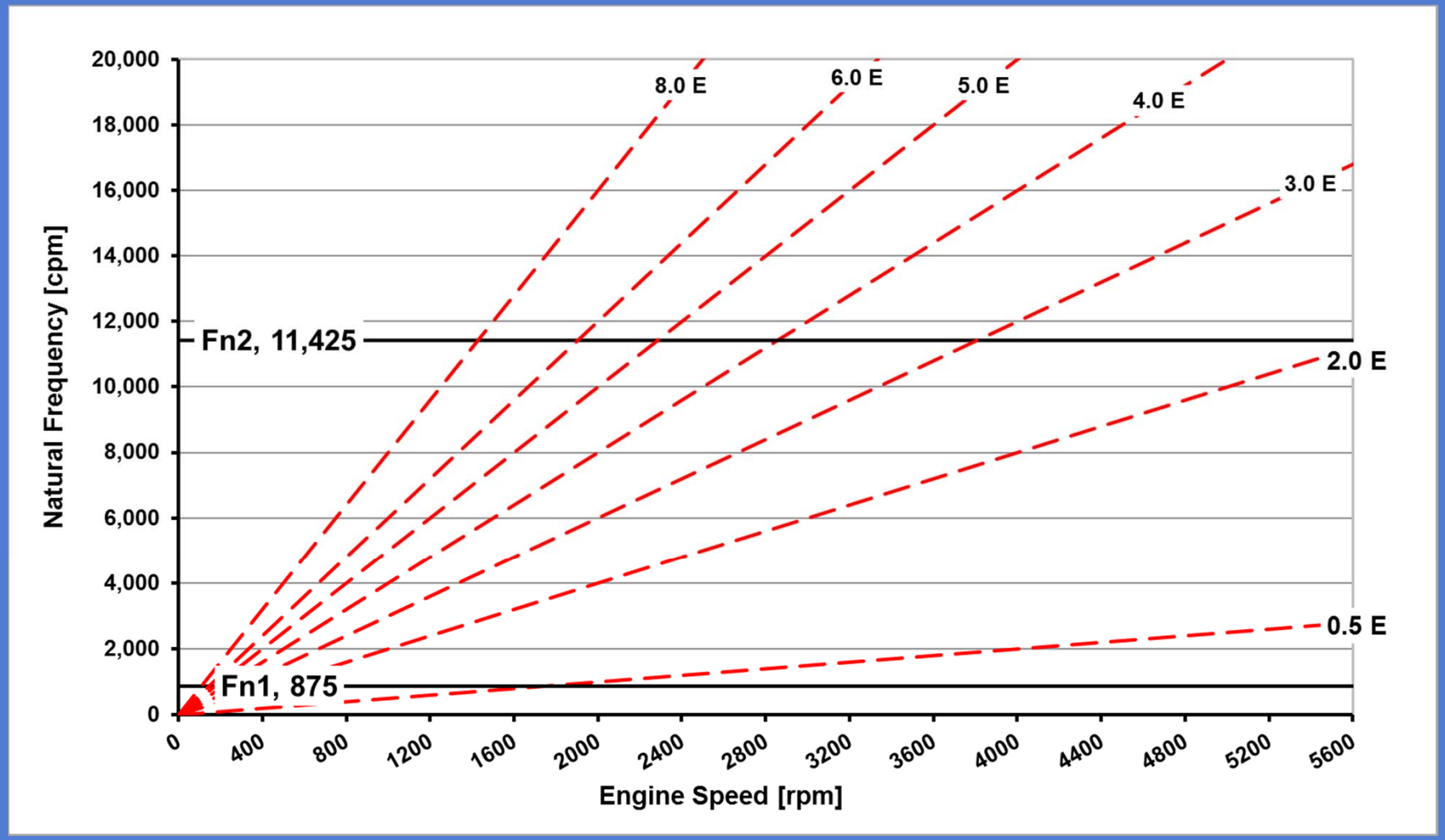


Advanced Vibration Solutions

Critical Speeds, Original Model

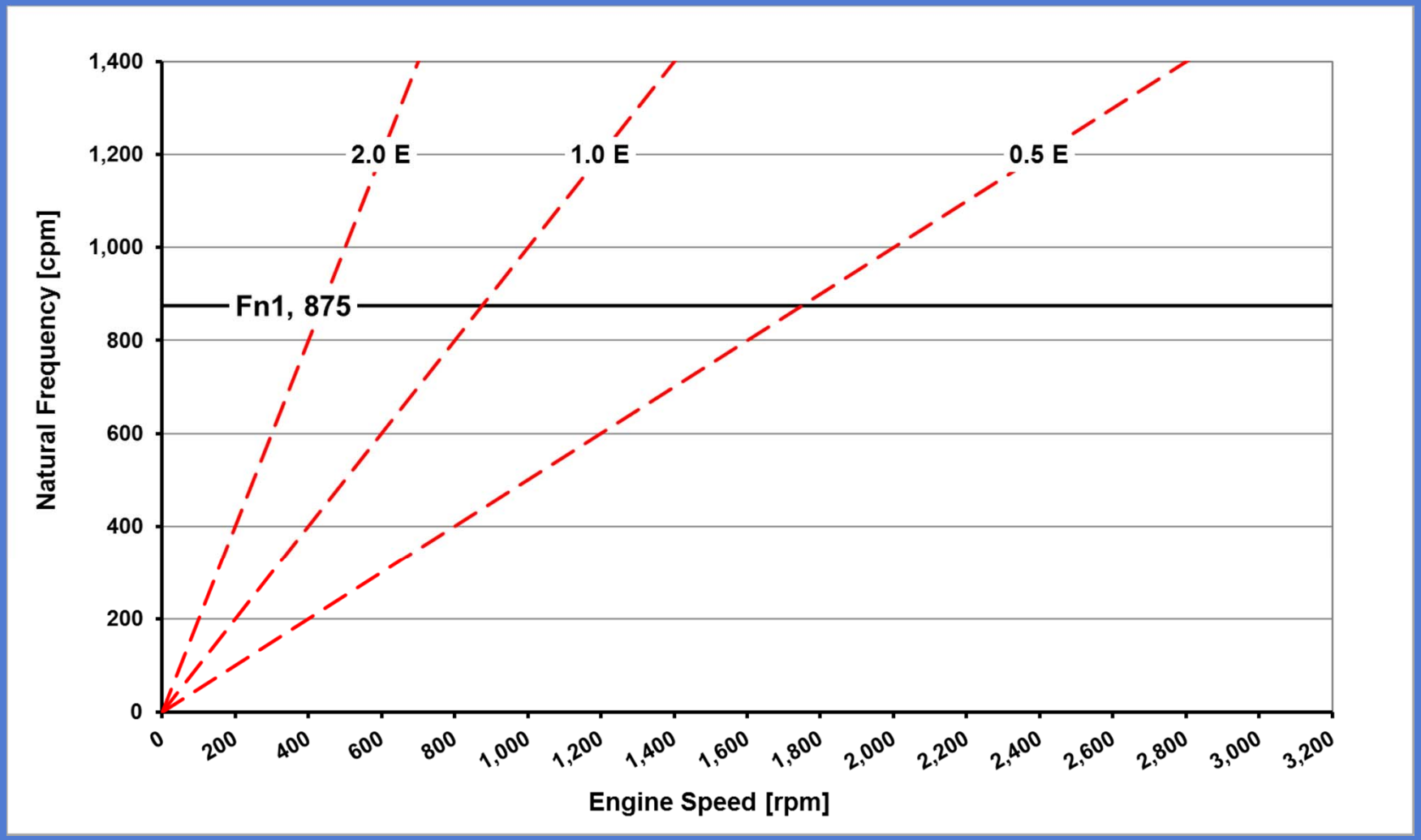


Critical Speeds, Revised Model



Advanced Vibration Solutions

Mode 1 TNF

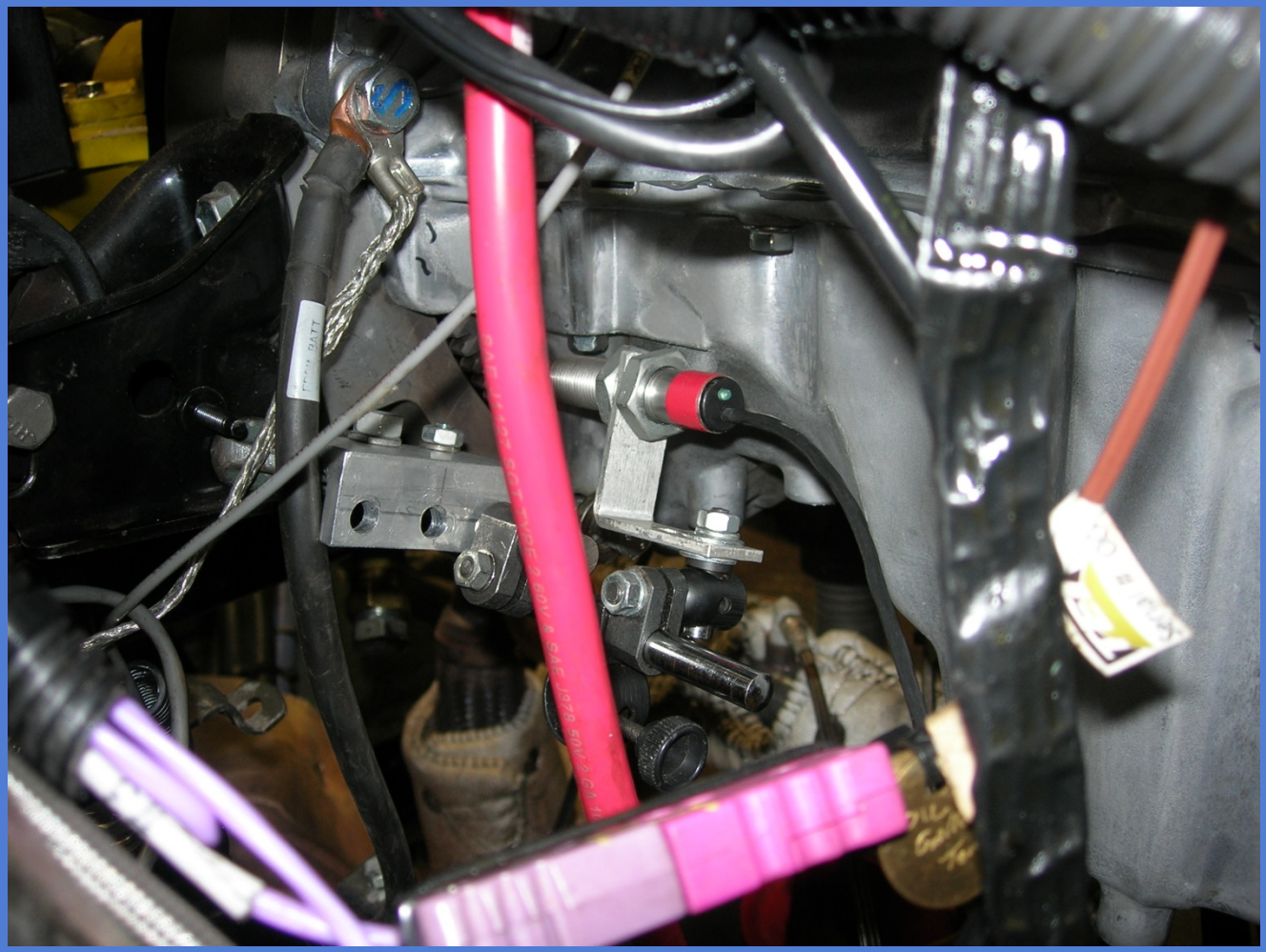

1,400
1,200
1,000
800
600
400
200
0
Natural Frequency [cpm]
2.0 E
1.0 E
0.5 E
Fn1, 875
0
200
400
600
800
1,000
1,200
1,400
1,600
1,800
2,000
2,200
2,400
2,600
2,800
3,000
3,200
Engine Speed [rpm]

Measurement

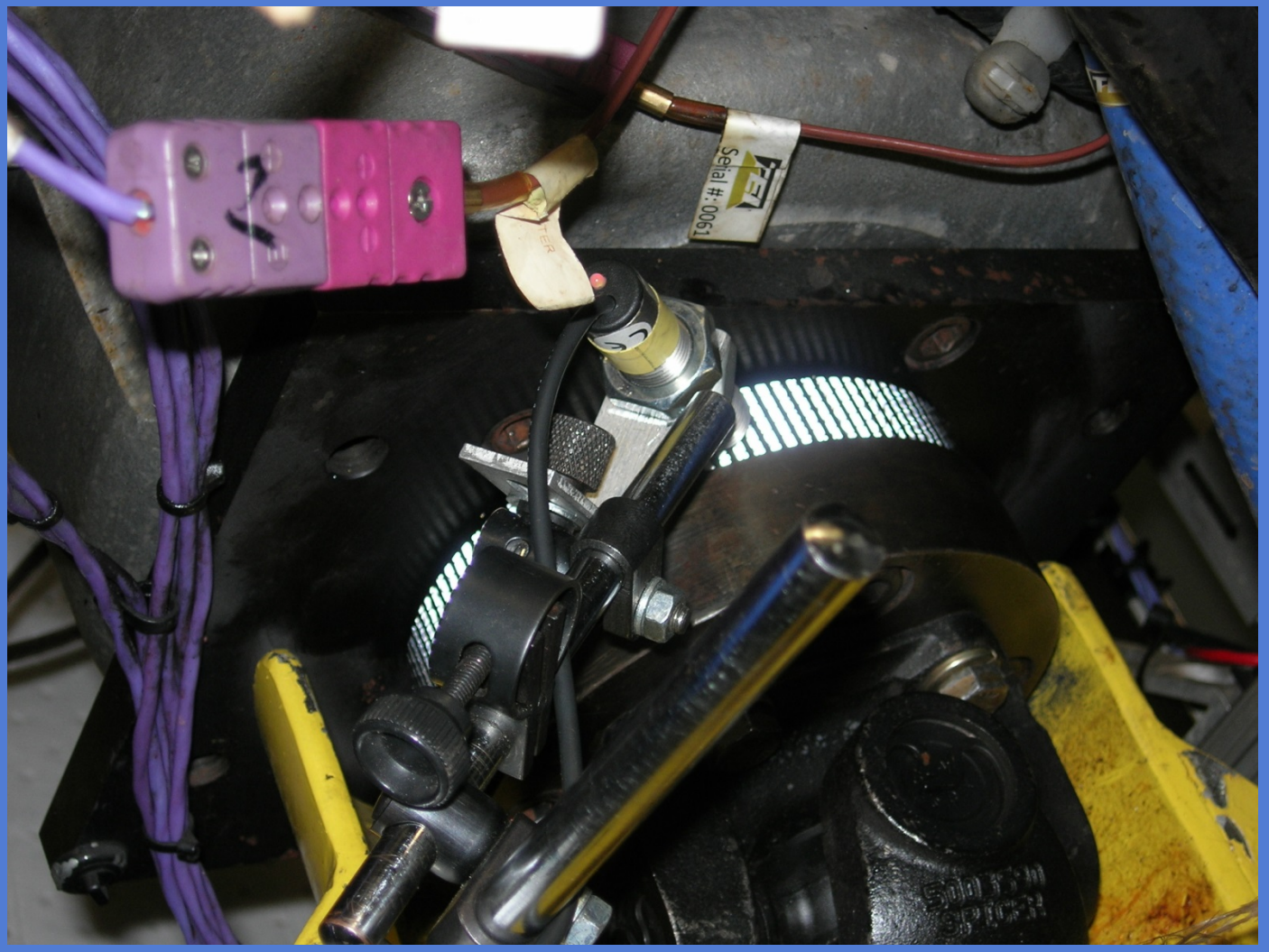
Equipment

- vibDaq 4-Channel FFT Analyzer
- Monarch Infra-Red Sensors
  - Flywheel Ring Gear Teeth
  - Clutch Output Flange, Striped Tape
- Monarch Optical Sensor
  - Dyno Input Hub
- CoppTek Modulators
  - IR Sensors
- CTC Accelerometer
  - Engine Axial Vibration

Flywheel Ring Gear

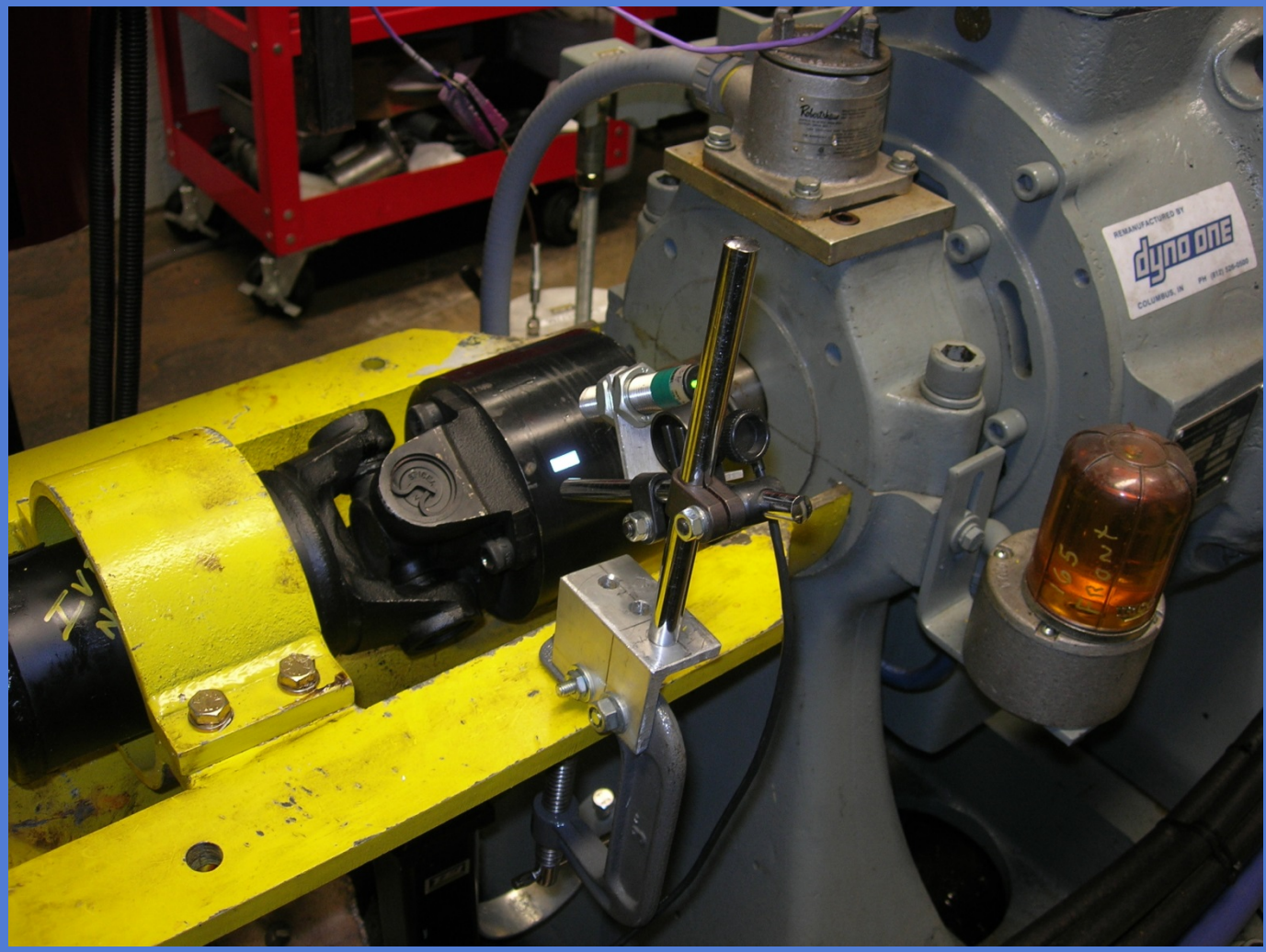


Clutch Output Flange

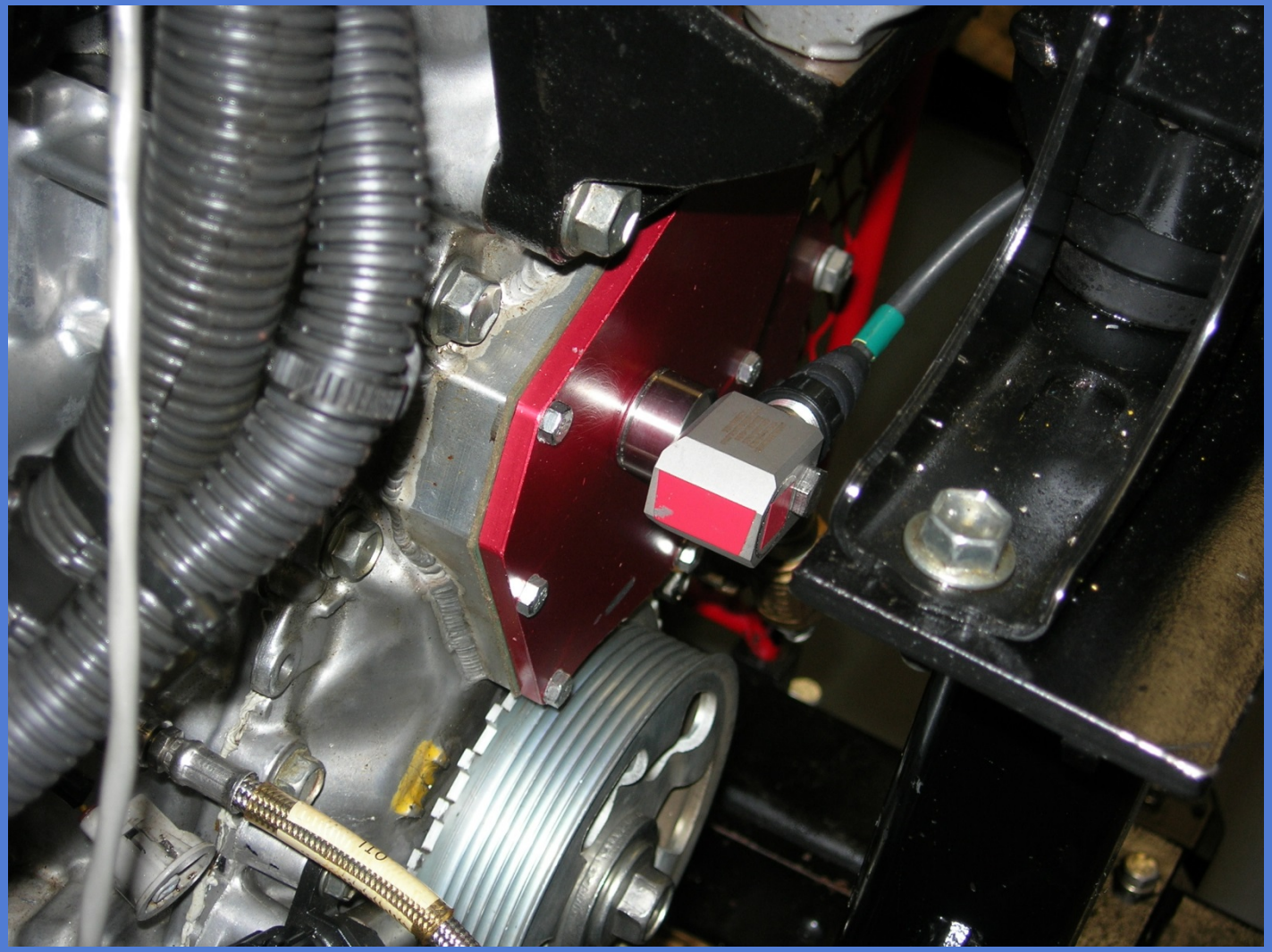


Advanced Vibration Solutions

Tach Signal

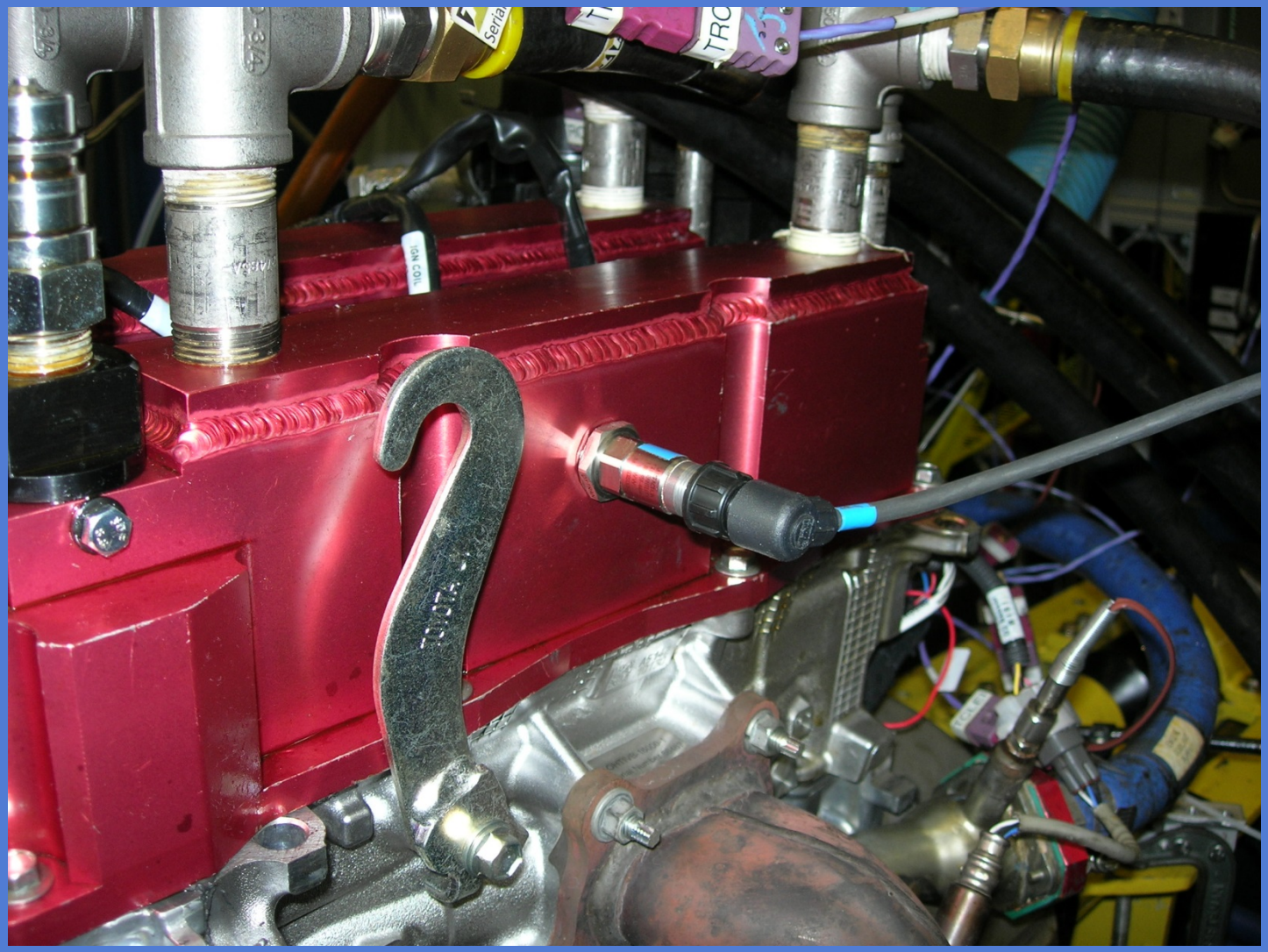


Engine Axial



Advanced Vibration Solutions

Engine Horizontal



Torsional Oscillations

Waterfall Plots During Cycle Test

- *FW Ring Gear & Clutch Output Flange*
- *Three Cycles Selected*

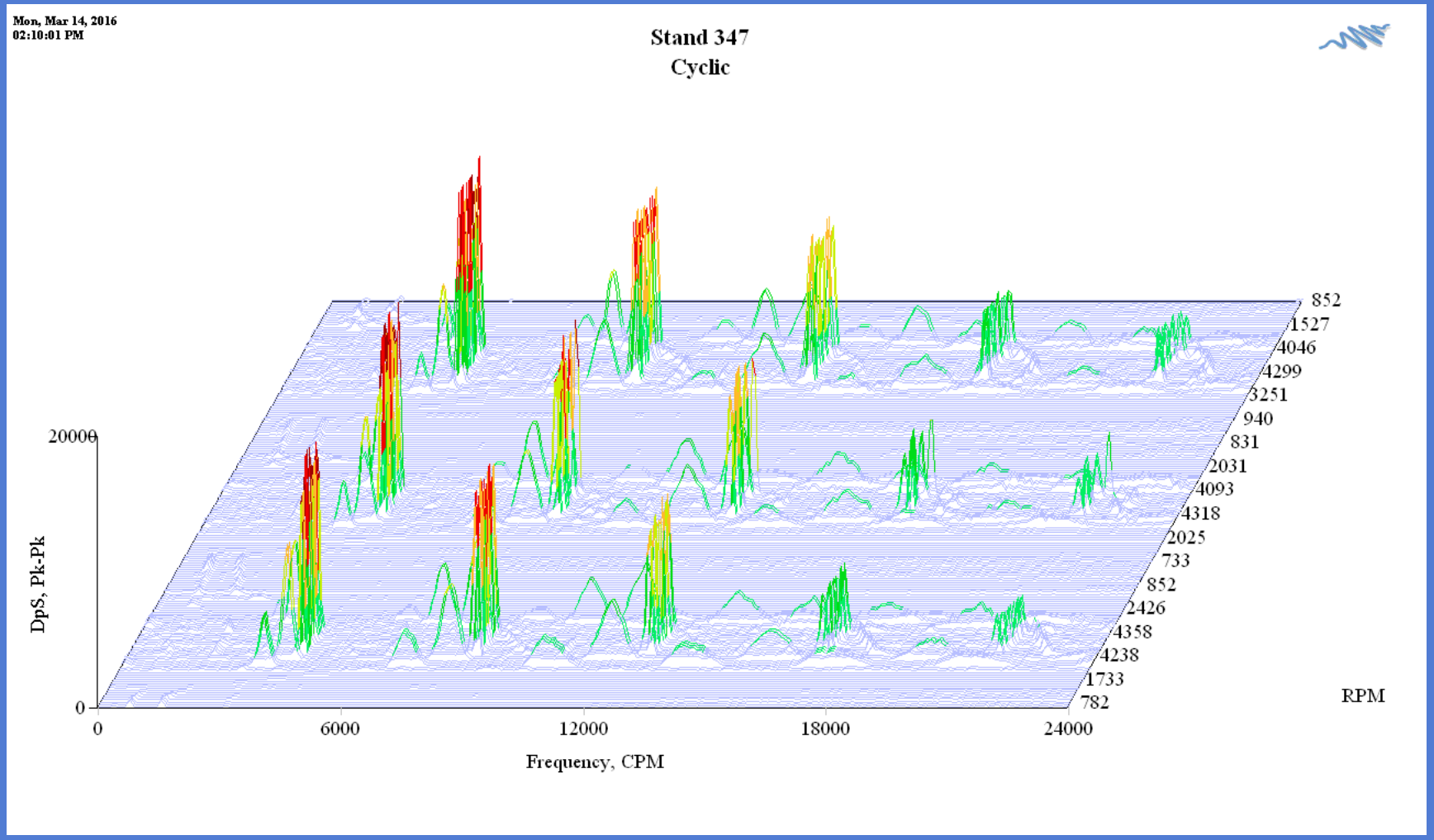
FFT Plots at 4300 rpm

- *FW Ring Gear & Clutch Output Flange*
- *Oscillations Measured in Degrees per Second, DpS*
  - *Significant Harmonics Selected*
  - *Converted to Deflection in Radians*

Vibratory Torque in Clutch

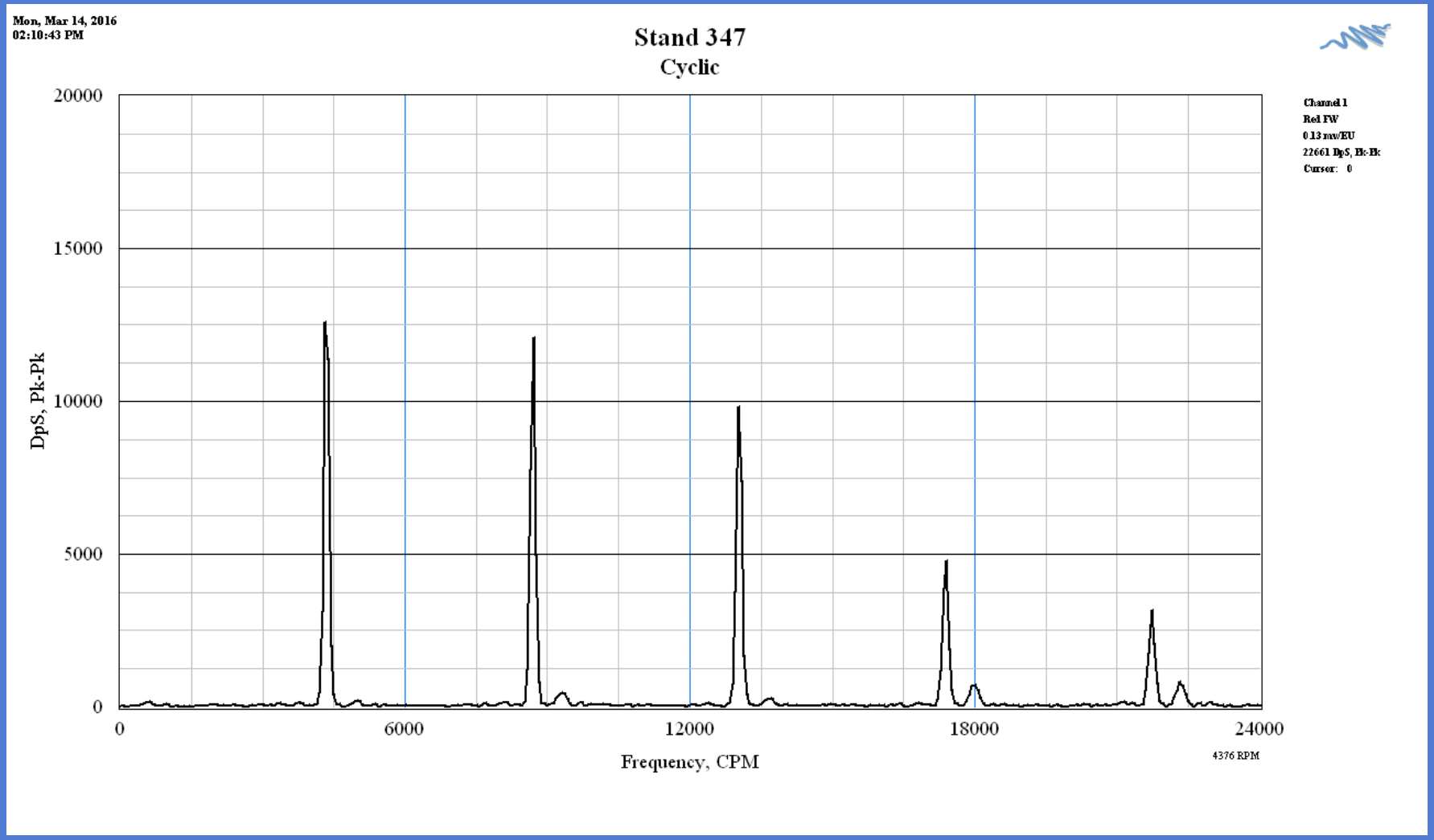
- *= Change in Deflection x Clutch Stiffness*
- *Summarized in Charts*
- *Vibratory Torque is Superimposed on Mean Transmitted Torque*

FW Ring Gear, Cycle Test WFL



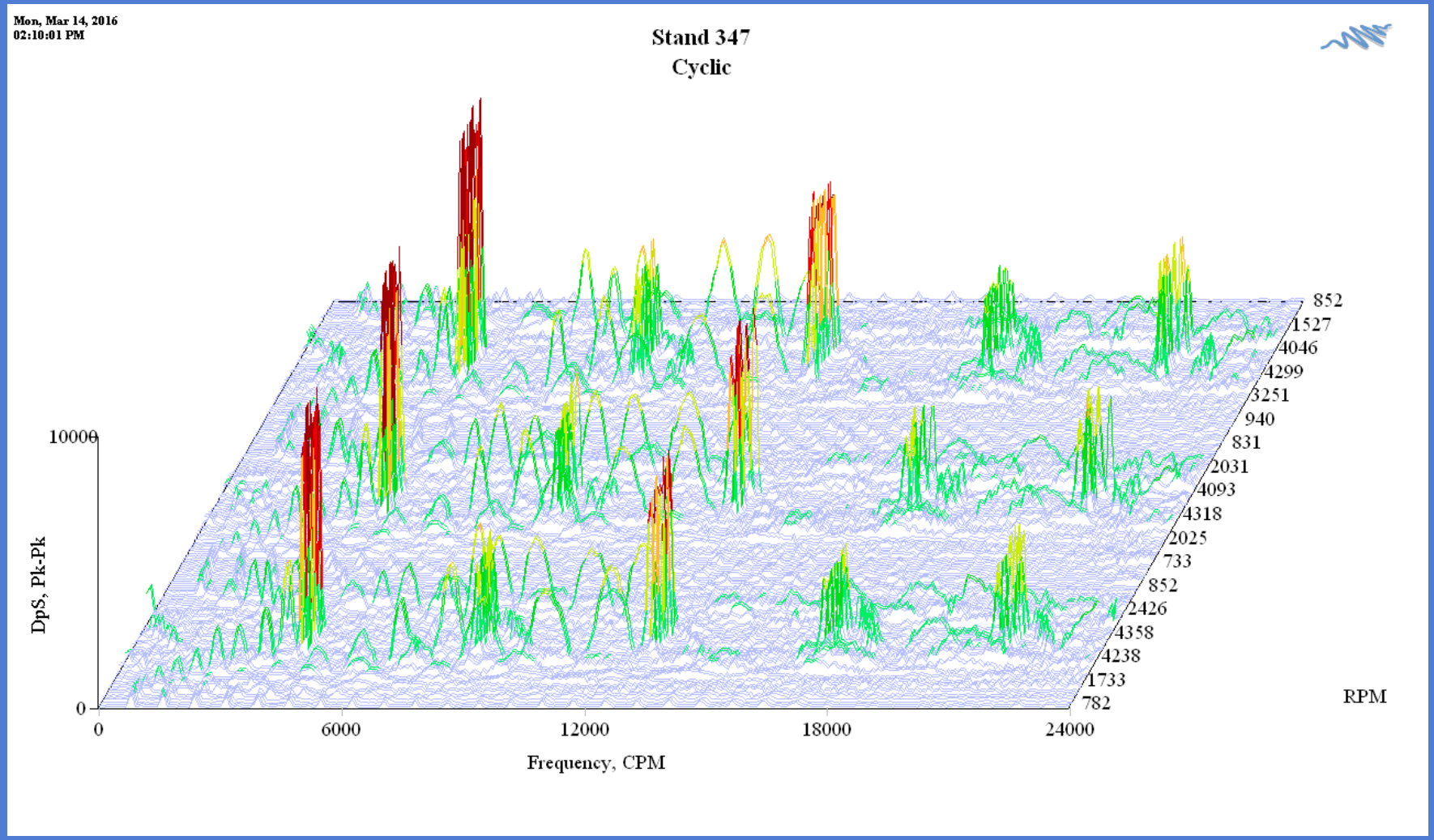
Advanced Vibration Solutions

FW Ring Gear, Cycle Test FFT



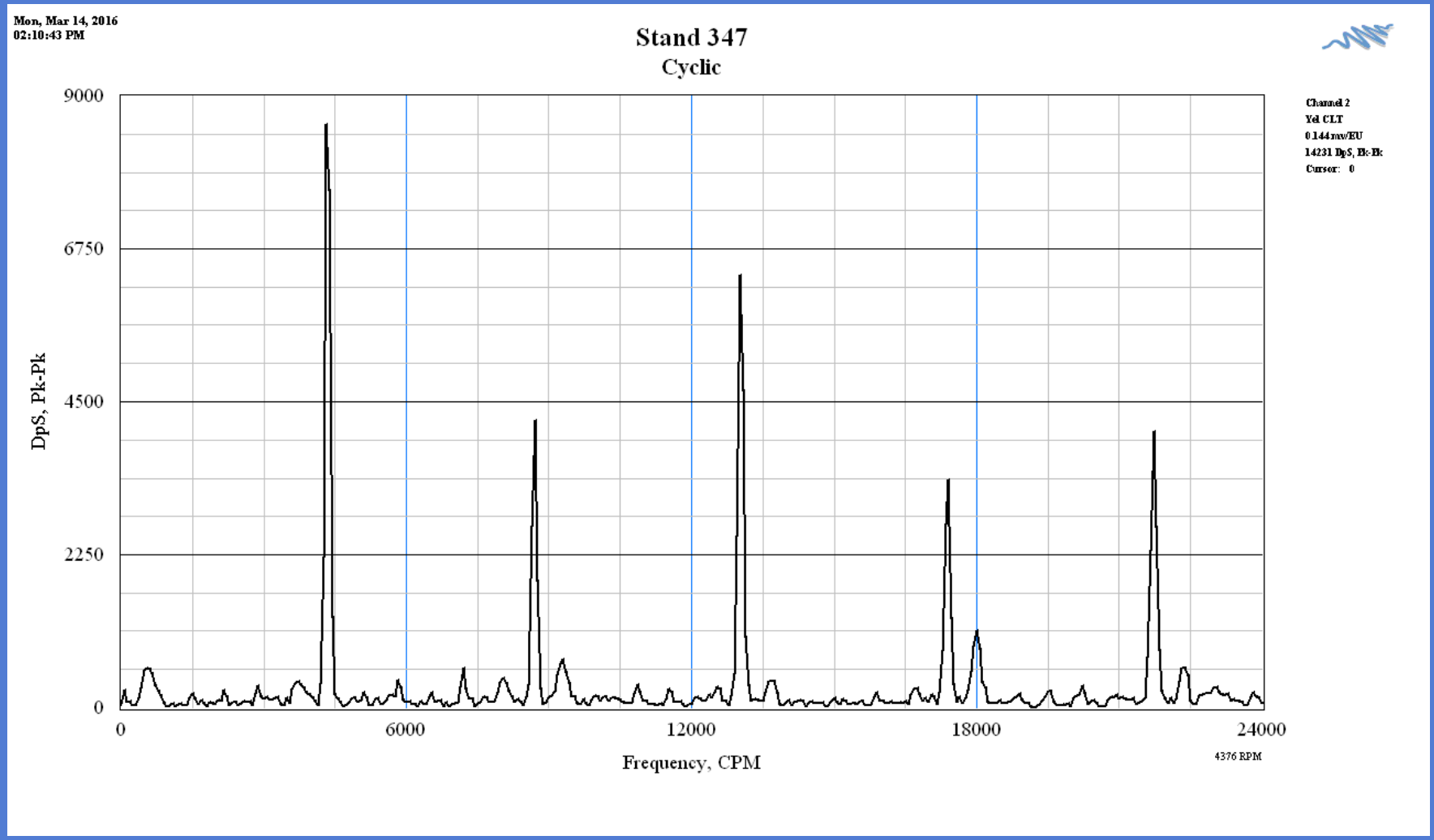
Advanced Vibration Solutions

Clutch Flange, Cycle Test WFL



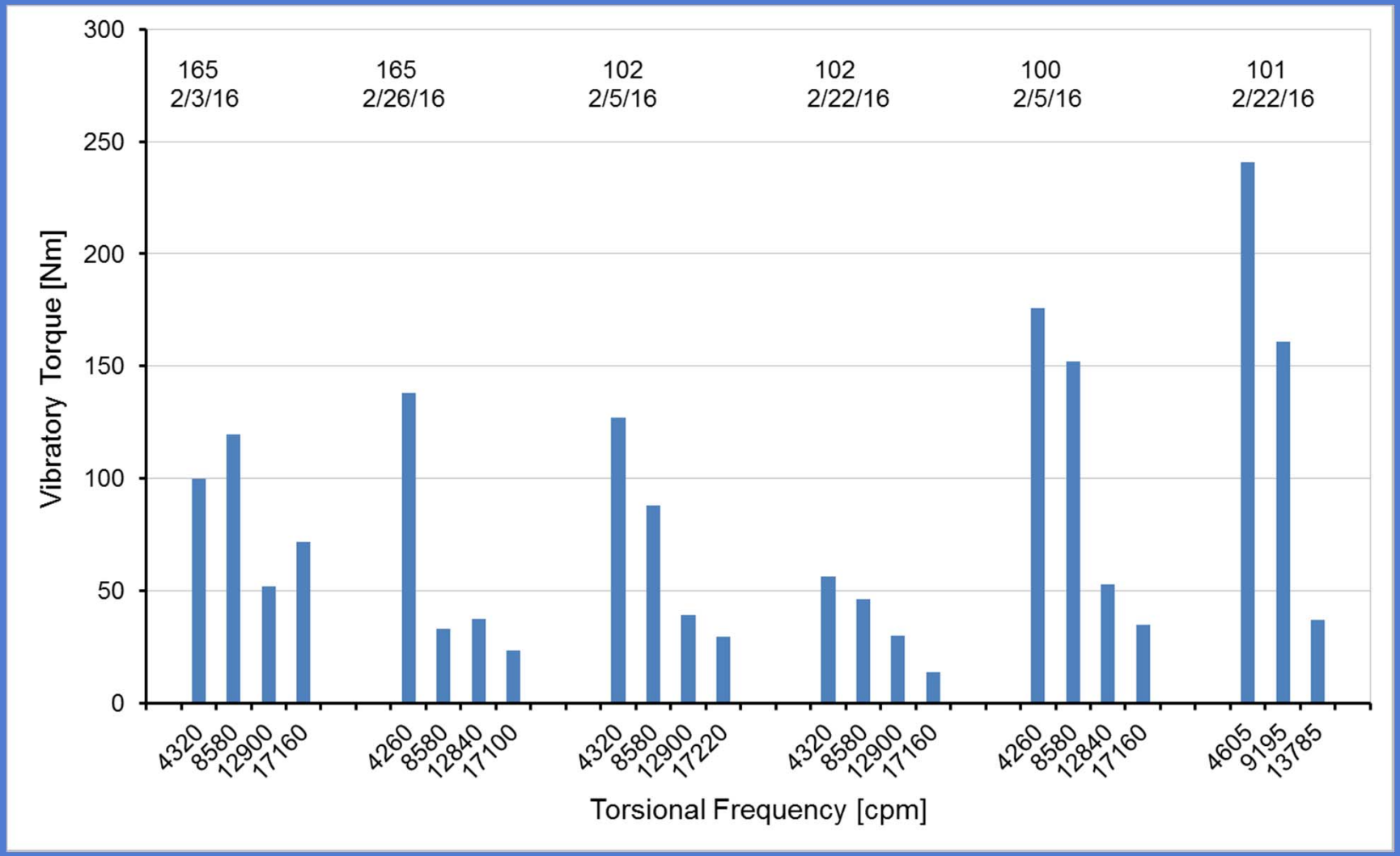
Advanced Vibration Solutions

Clutch Flange, Cycle Test FFT



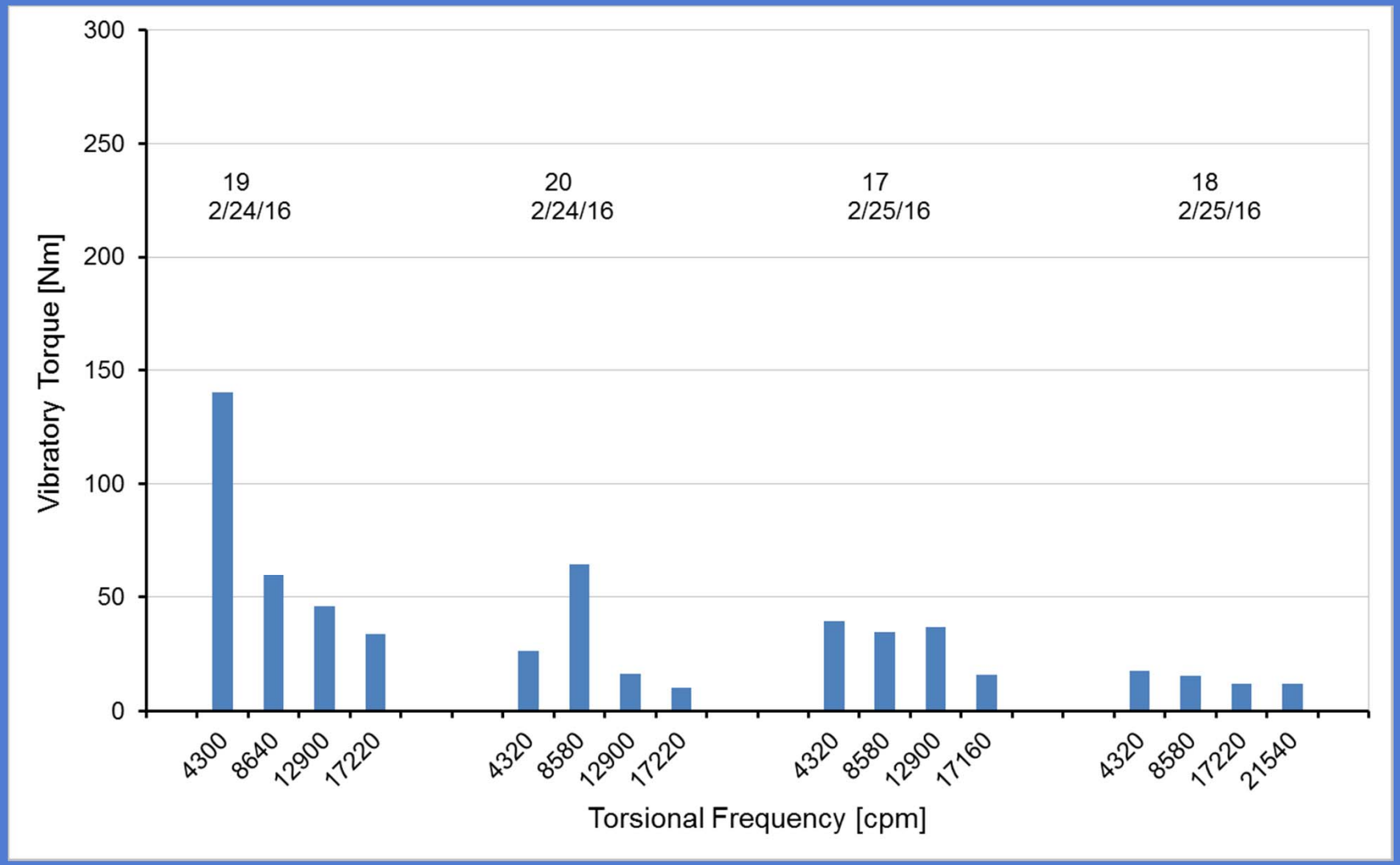
Advanced Vibration Solutions

Intertek Stands, Torsional



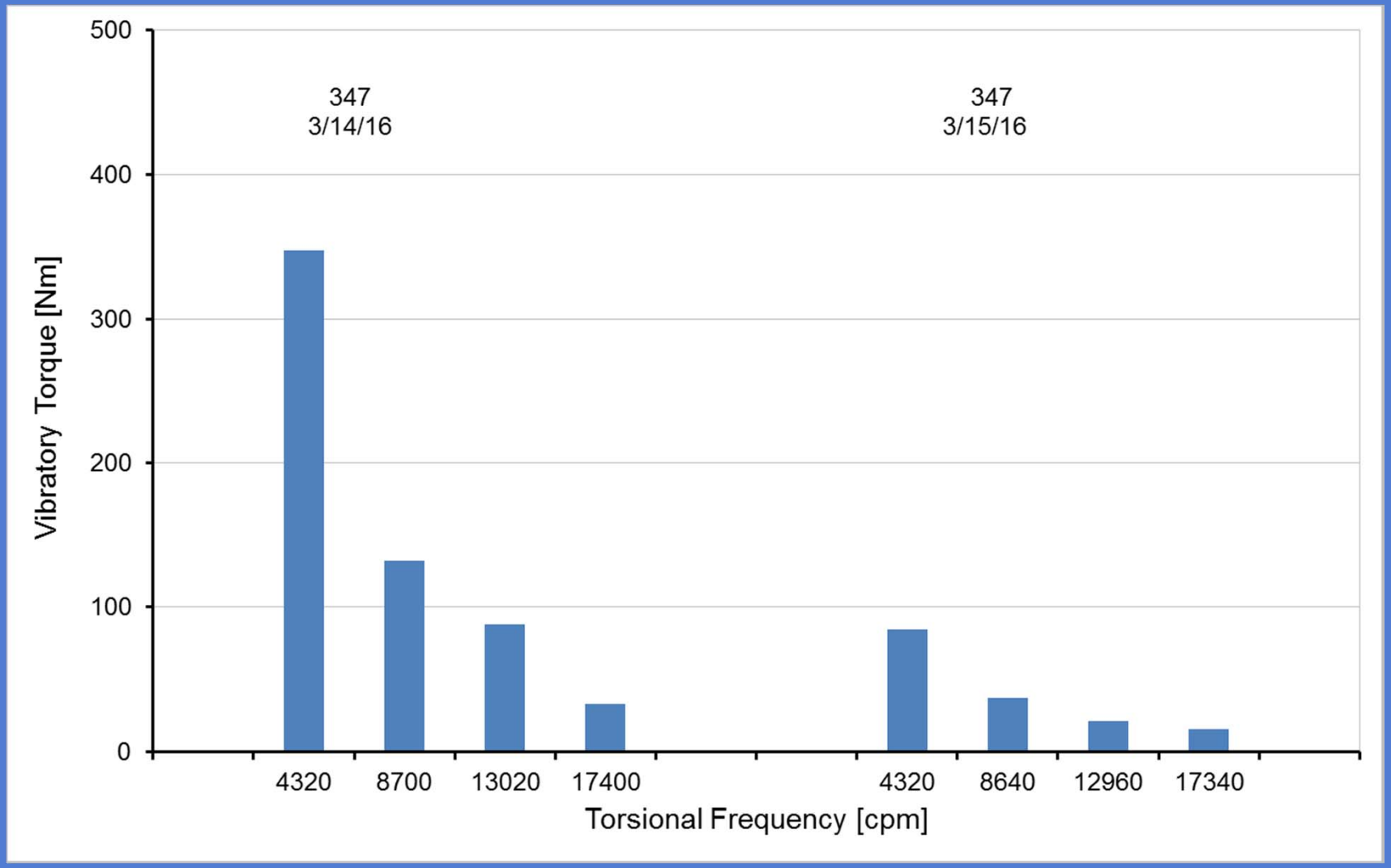
Advanced Vibration Solutions

SwRI Stands, Torsional



Advanced Vibration Solutions

Lubrizol Stand, Torsional



Advanced Vibration Solutions

Engine Axial Vibration

Waterfall Plots During Cycle Test

- ***Two or Three Cycles Selected***

FFT Plots at 4300 rpm

- ***Prominent Harmonics Selected***
- ***Significant Axial Displacements of Engines on Their Mounts***
- ***Induced by Flexing of Crankshaft Webs***

Engine Axial Vibration

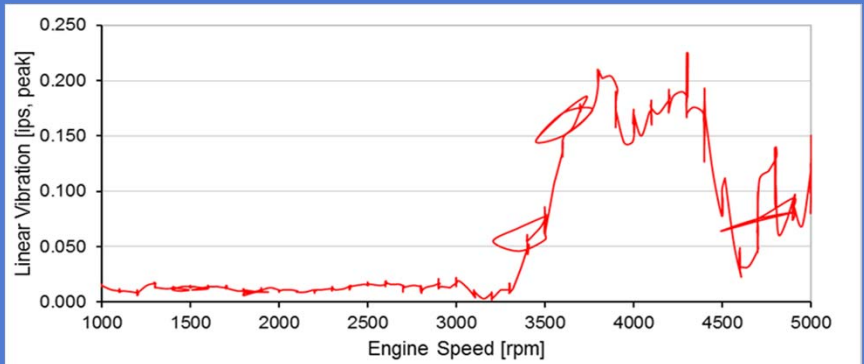


Figure B2-3: Stand 102 Axial

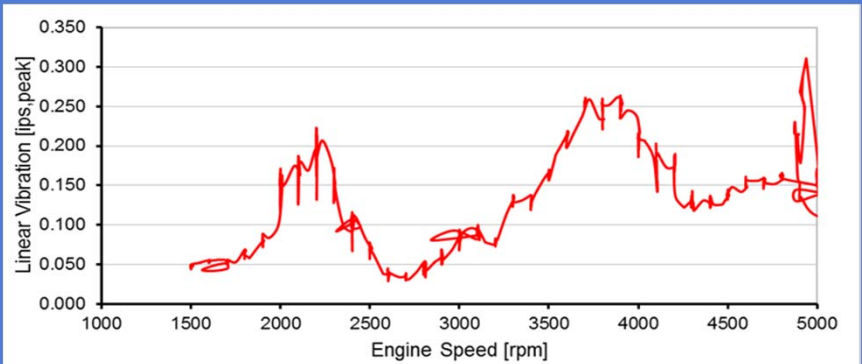


Figure A2-3: Stand 165 Axial

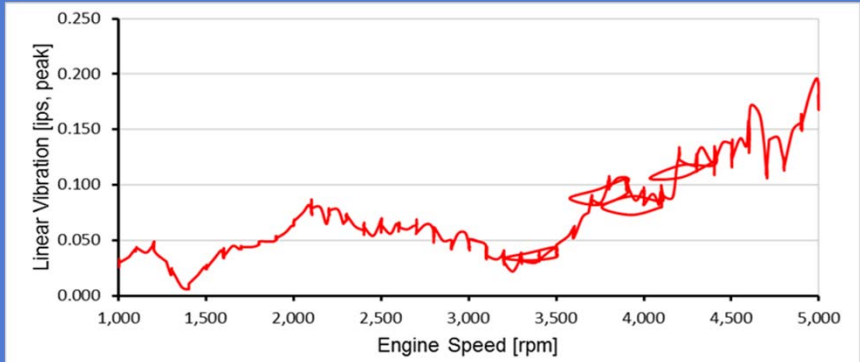


Figure A-3: Stand 19 Axial

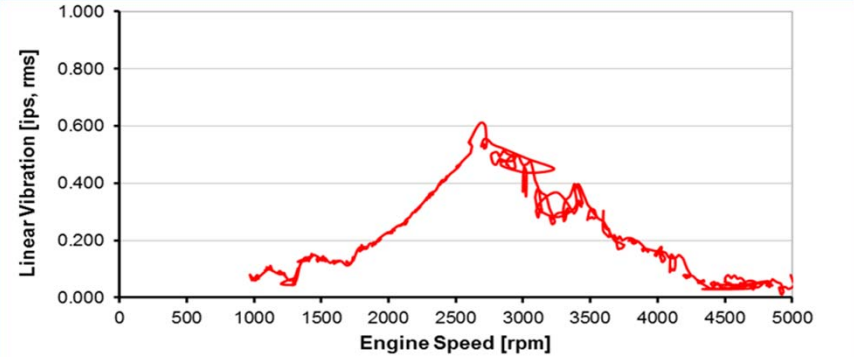
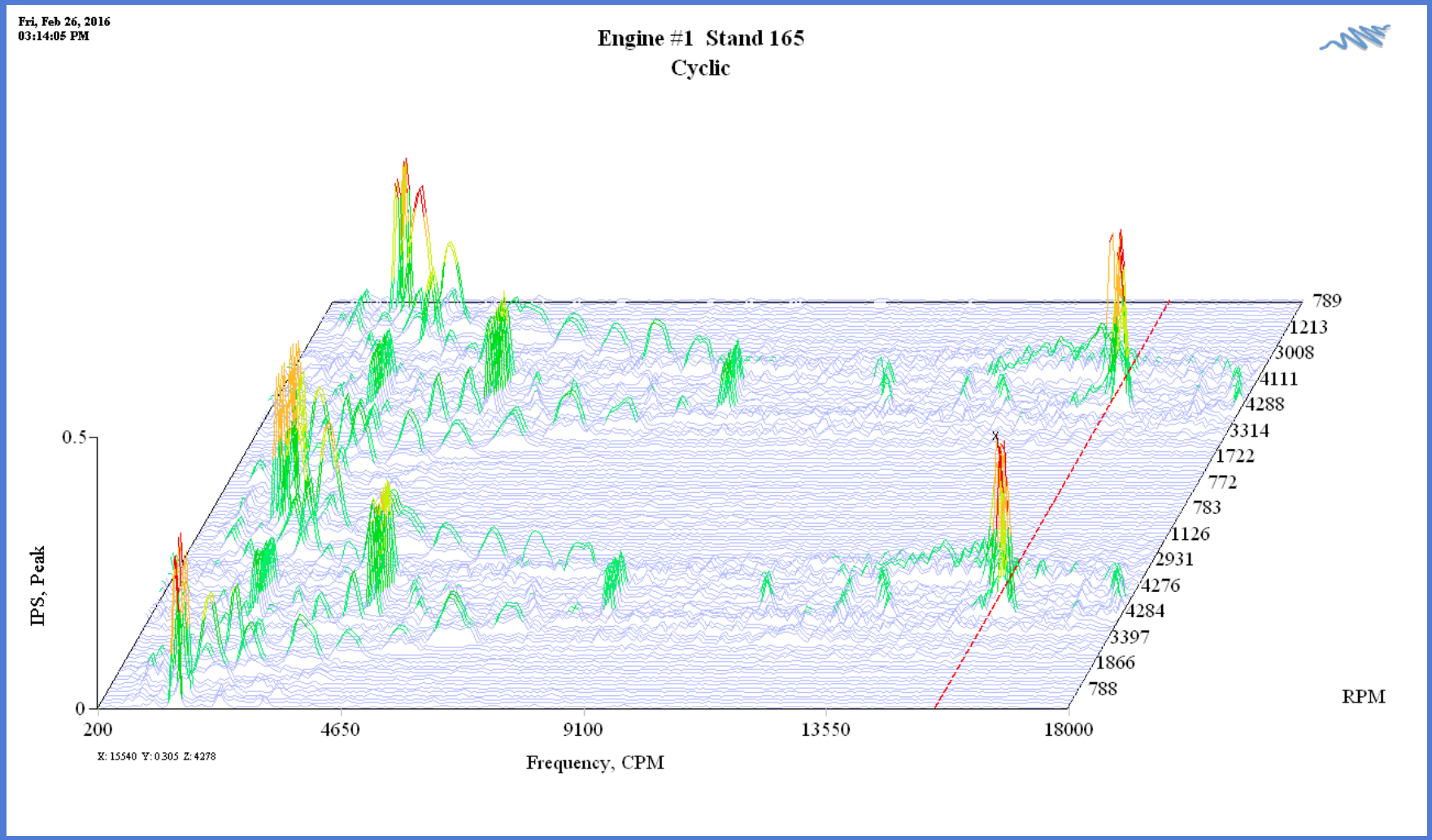


Figure A-3: Stand 347 Axial

Advanced Vibration Solutions

Axial Cycle Test WFL



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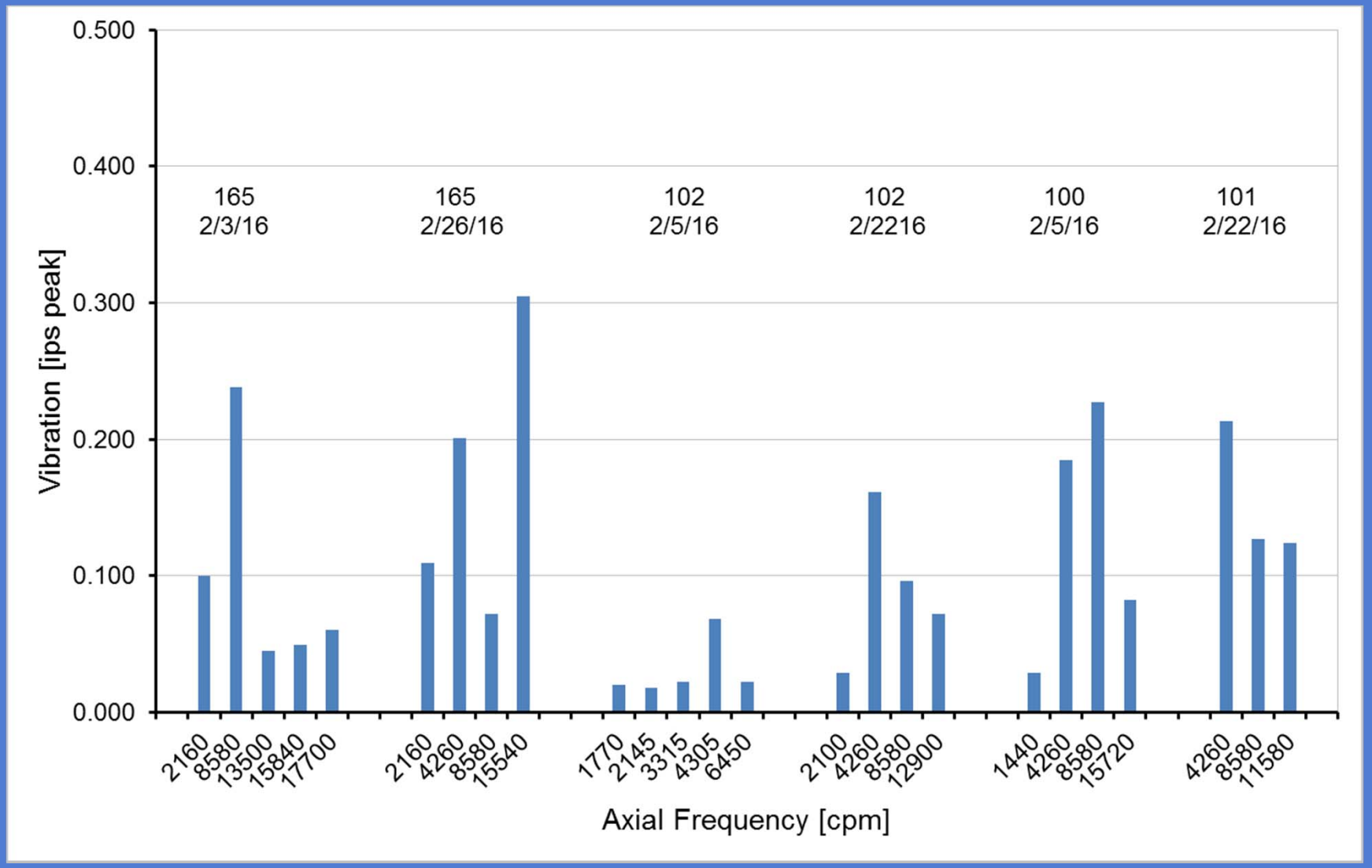
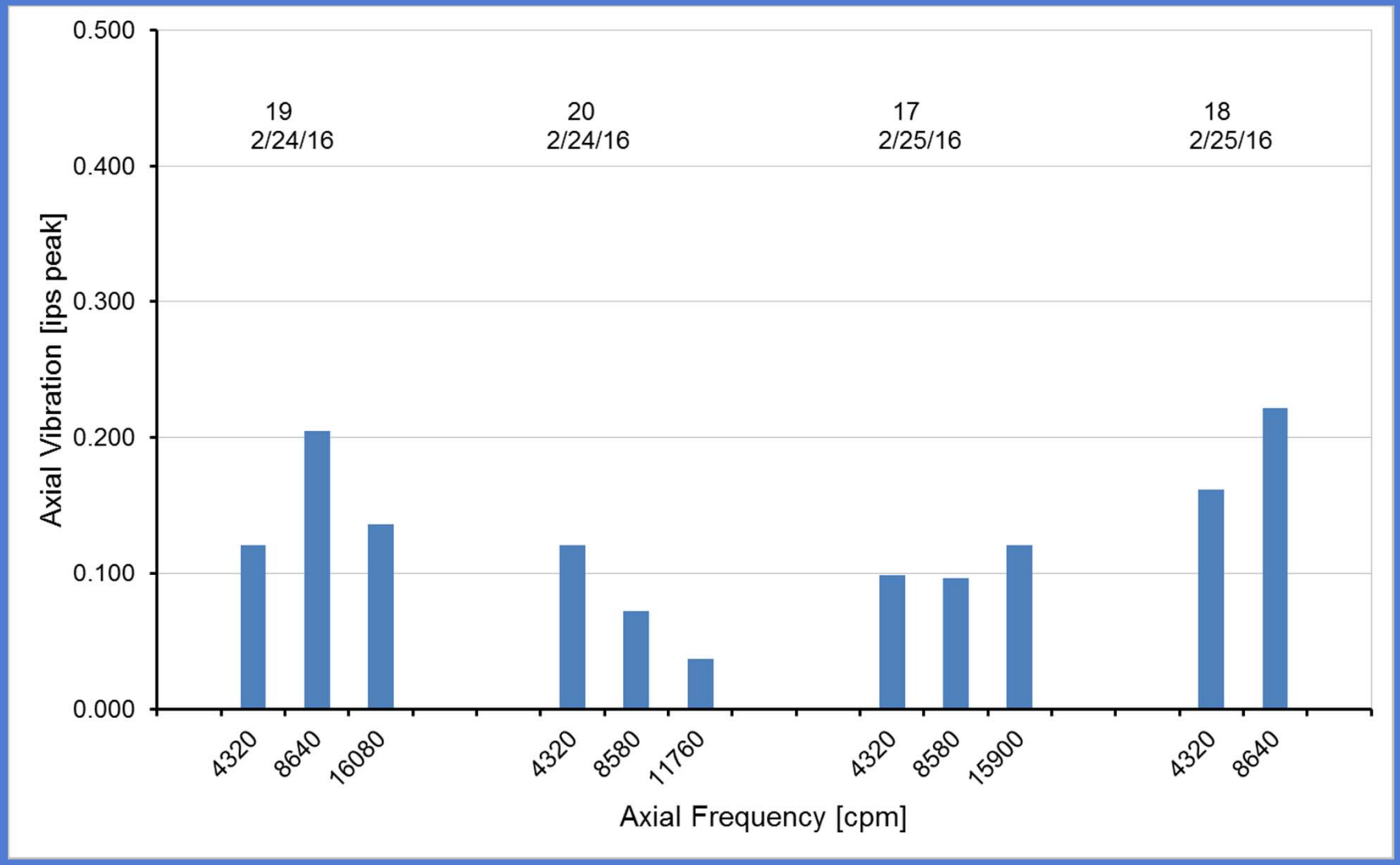
Intertek Stands, Axial



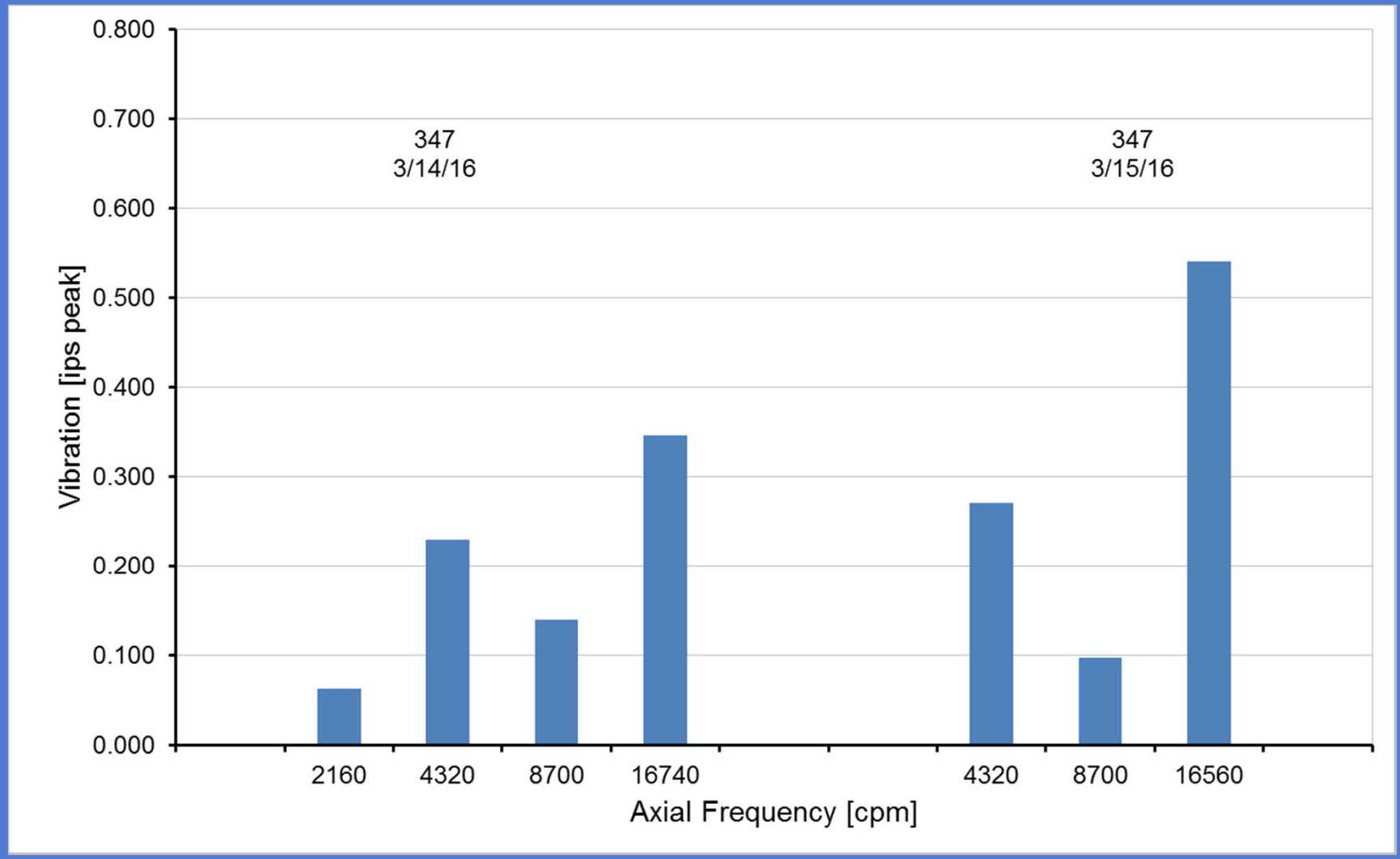
Advanced Vibration Solutions

SwRI Stands, Axial



Advanced Vibration Solutions

Lubrizol Stand, Axial



Advanced Vibration Solutions

Sequence IVB Operational Validity Criteria Options

SOUTHWEST RESEARCH INSTITUTE®

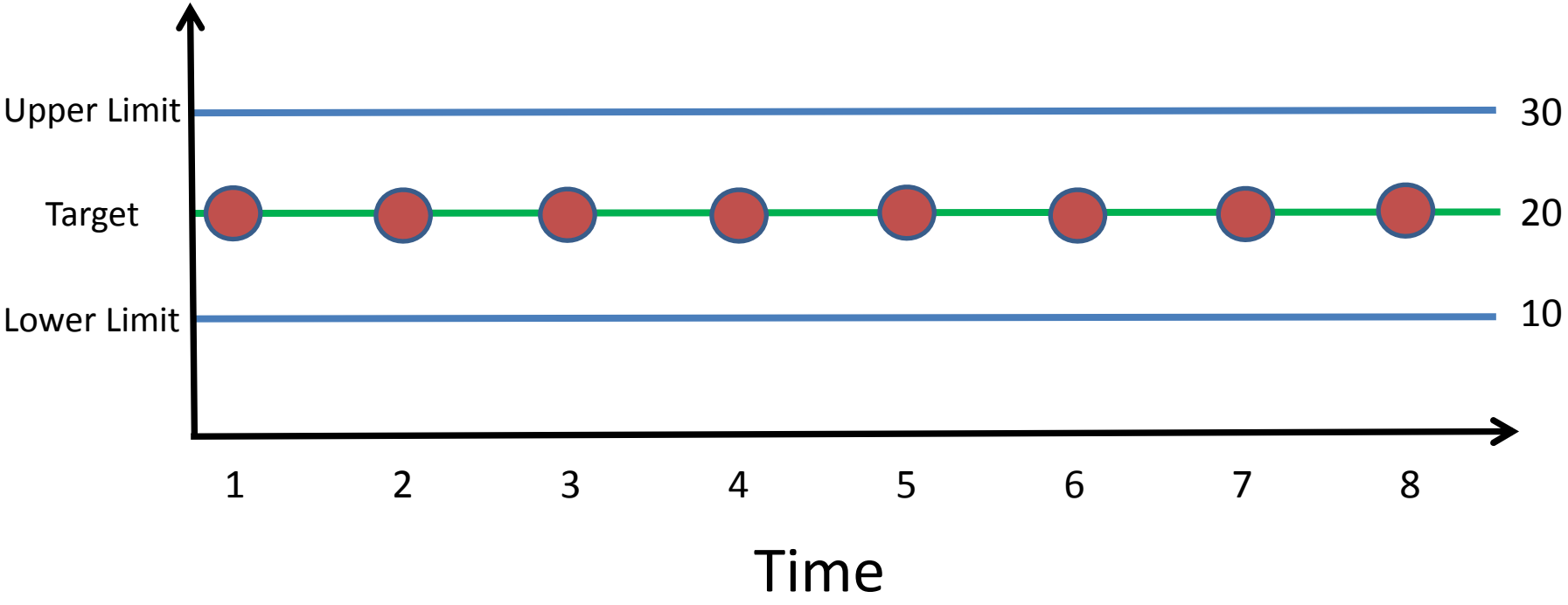
Quality Index Calculation

$$QI_i = 1 - \frac{1}{n}\sum_{1}^{n}\left(\frac{U + L - 2X_i}{U - L}\right)^2$$

$$QI_i = 1 - \frac{1}{n}\sum_{1}^{n}\left(\frac{Target - X_i}{\frac{U - L}{2}}\right)^2$$

$$QI_i = 1 - \frac{1}{n}\sum_{1}^{n}\left(\begin{array}{c}Deviation\ from\ target\\ as\ \%\ of\ distance\ from\\ target\ to\ U\ or\ L\end{array}\right)^2$$

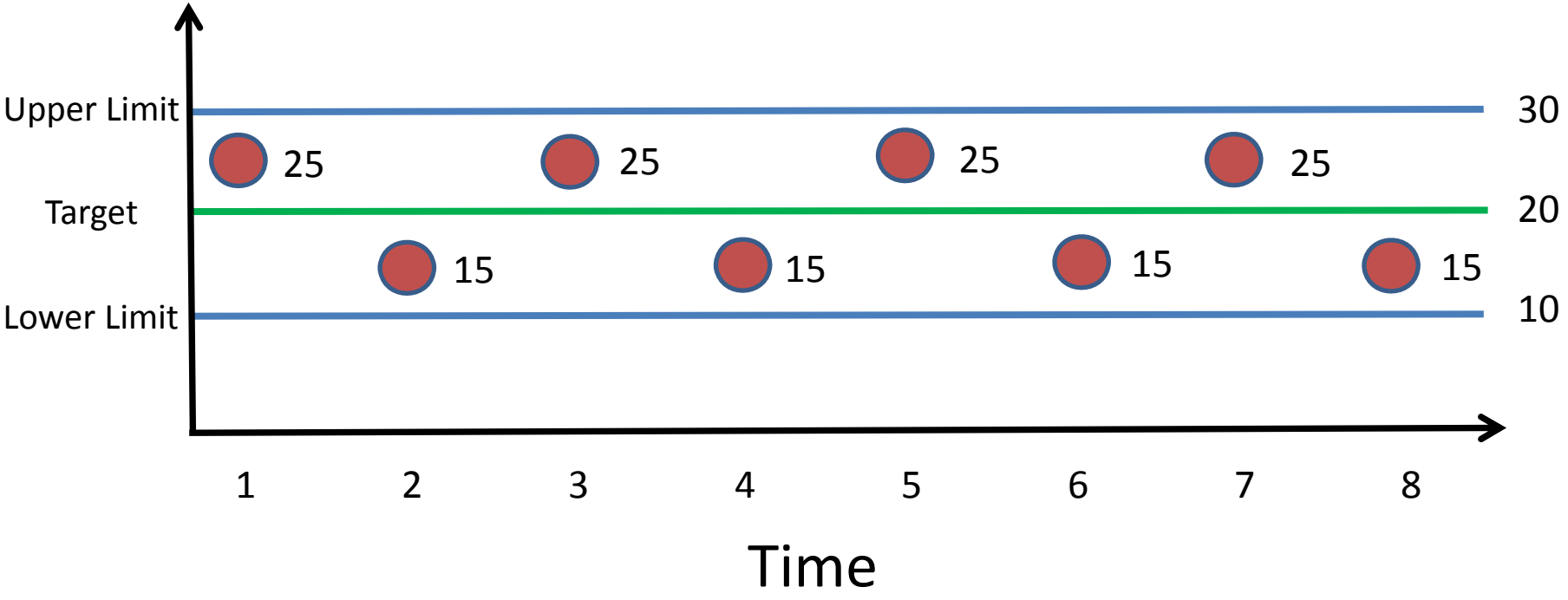
Quality Index Calculation



$$QI_i = 1 - \frac{1}{n}\sum_{1}^{n}\left(\frac{U + L - 2X_i}{U - L}\right)^2$$

QI = 1

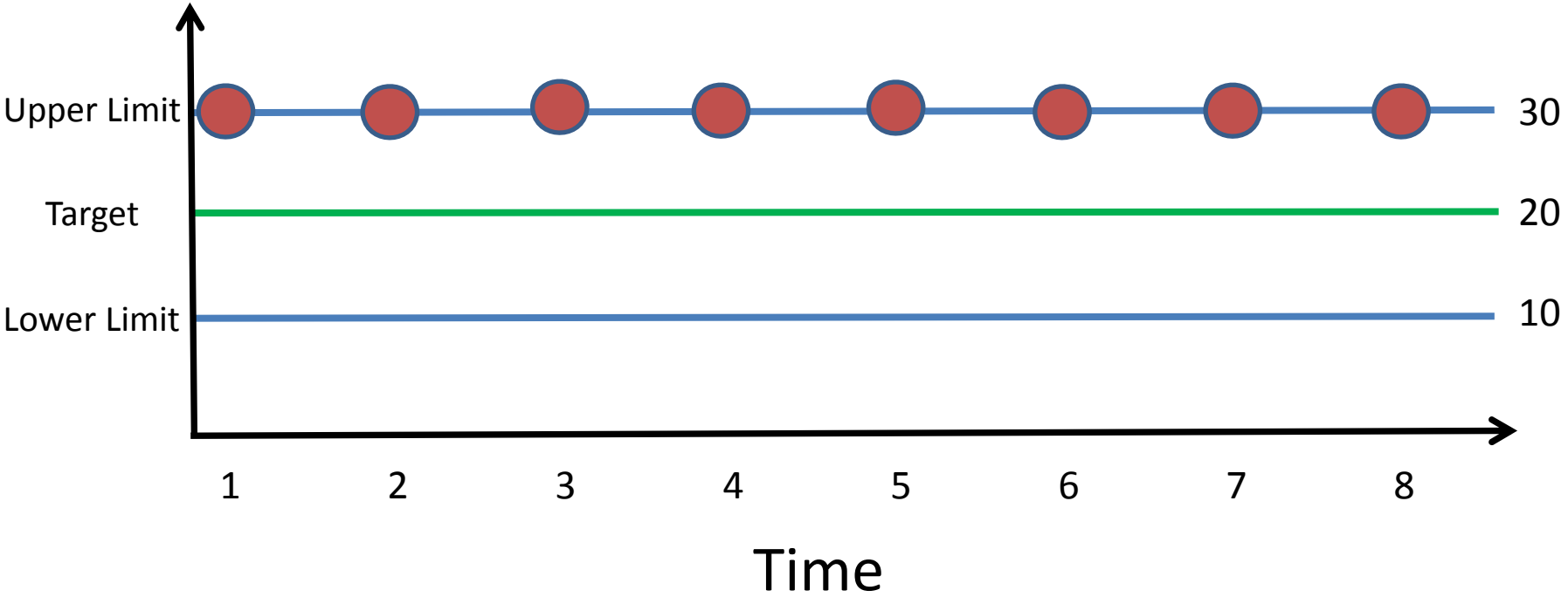
Quality Index Calculation



$$QI_i = 1 - \frac{1}{n}\sum_{1}^{n}\left(\frac{U + L - 2X_i}{U - L}\right)^2$$

QI = .75

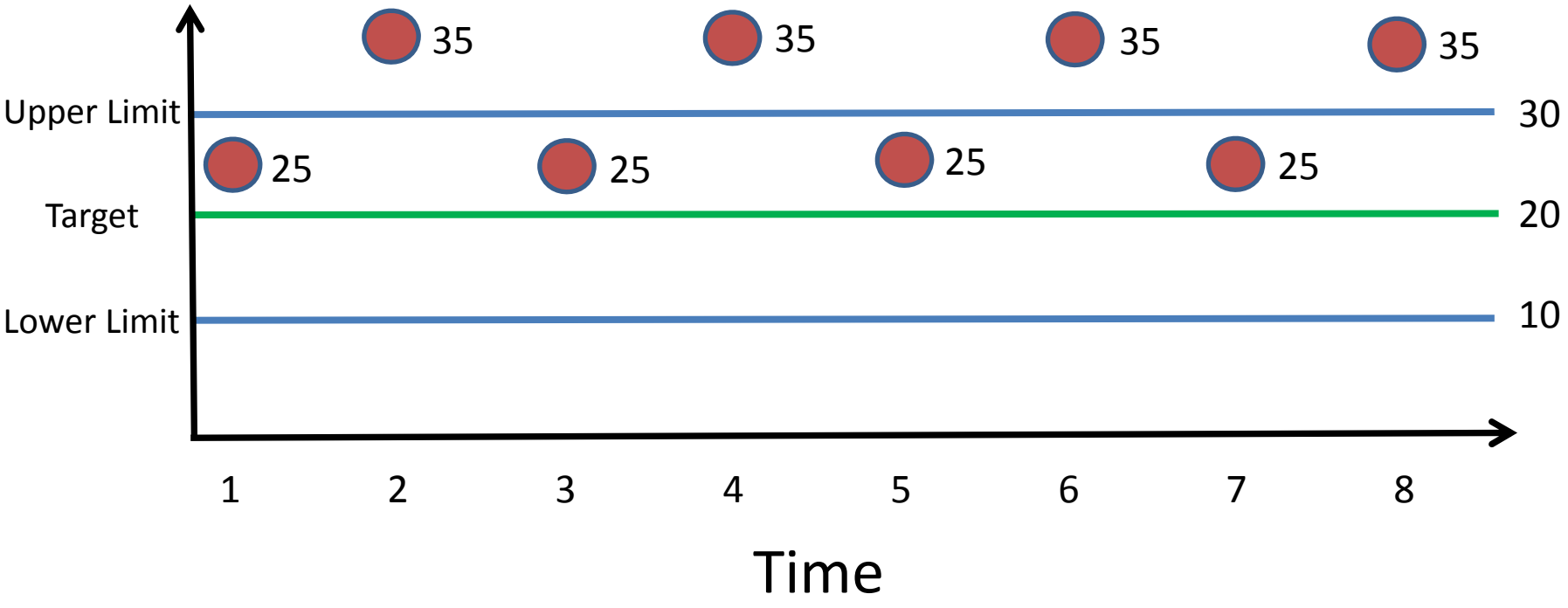
Quality Index Calculation



$$QI_i = 1 - \frac{1}{n}\sum_{1}^{n}\left(\frac{U + L - 2X_i}{U - L}\right)^2$$

QI = 0

Quality Index Calculation



$$QI_i = 1 - \frac{1}{n}\sum_{1}^{n}\left(\frac{U + L - 2X_i}{U - L}\right)^2$$

QI = -.25

How Can We Determine Operational Validity of Transient Parameters?

The Data Set

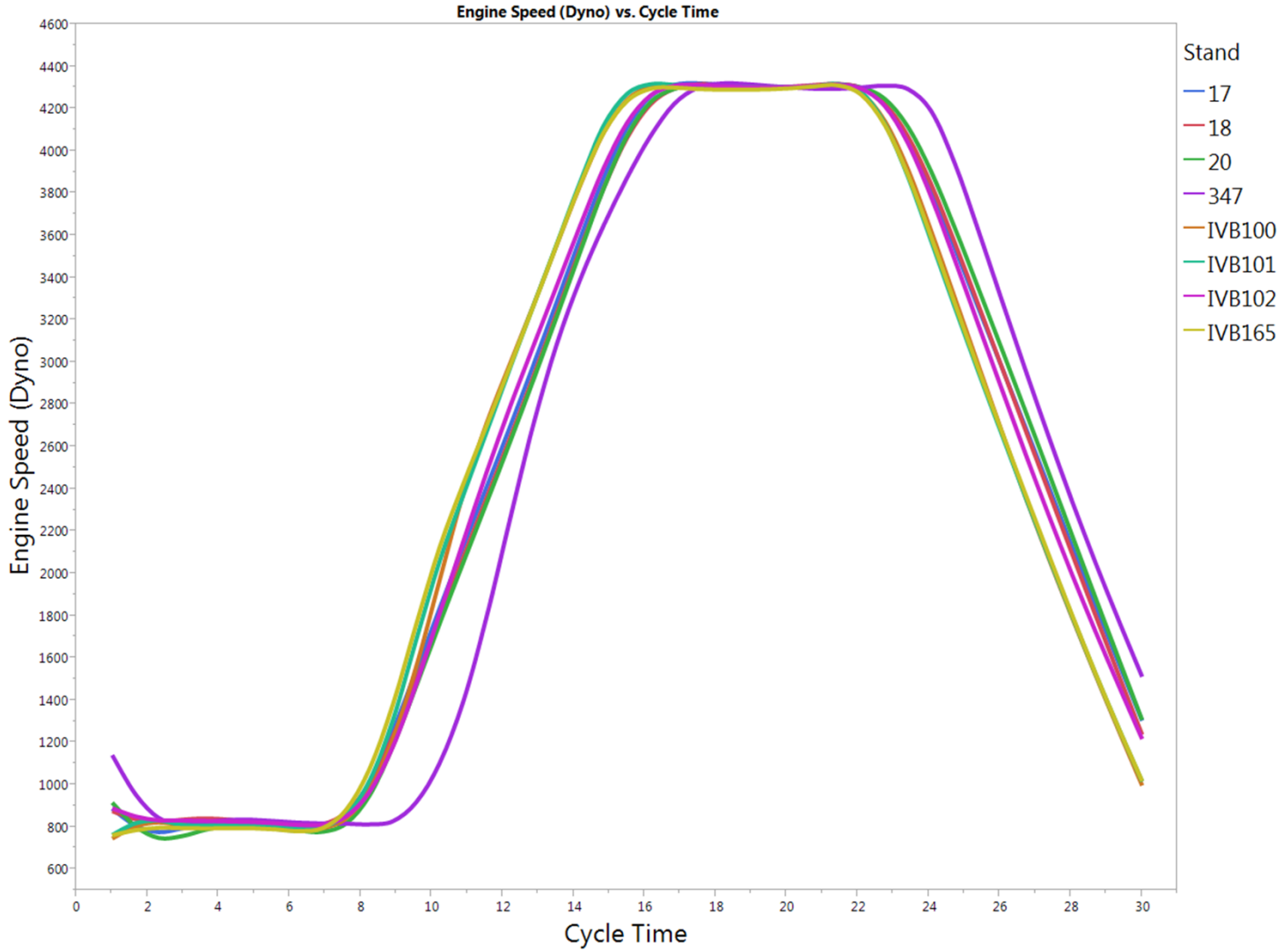
The list on the right shows the tests that were included in the plots shown on the following slides.

For the mock Engine Speed QI targets and limits, LZ data was not included in the calculation due to the apparent shift seen in these tests. Starting targets for each second on the ramps were determined by the LS means of SwRI and IAR data.

Important
All upper and lower limits were determined loosely by looking at the standard deviation at each second in the cycle, and are in no way intended to be proposed actual limits, but merely to be a starting point for discussion.

Validity of Transient Parameters

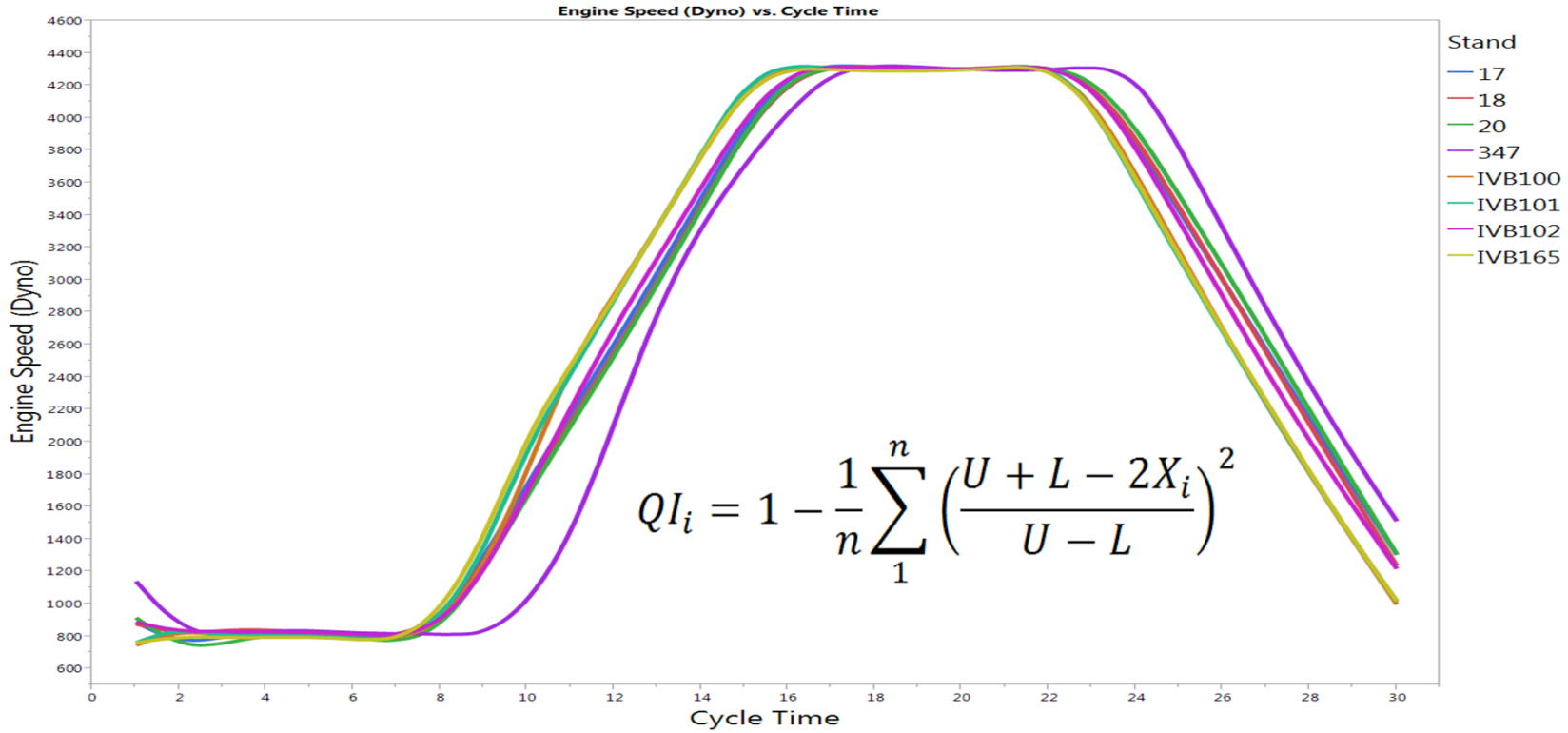
-Plot of Engine Speed by Cycle Time for each Stand



Validity of Transient Parameters

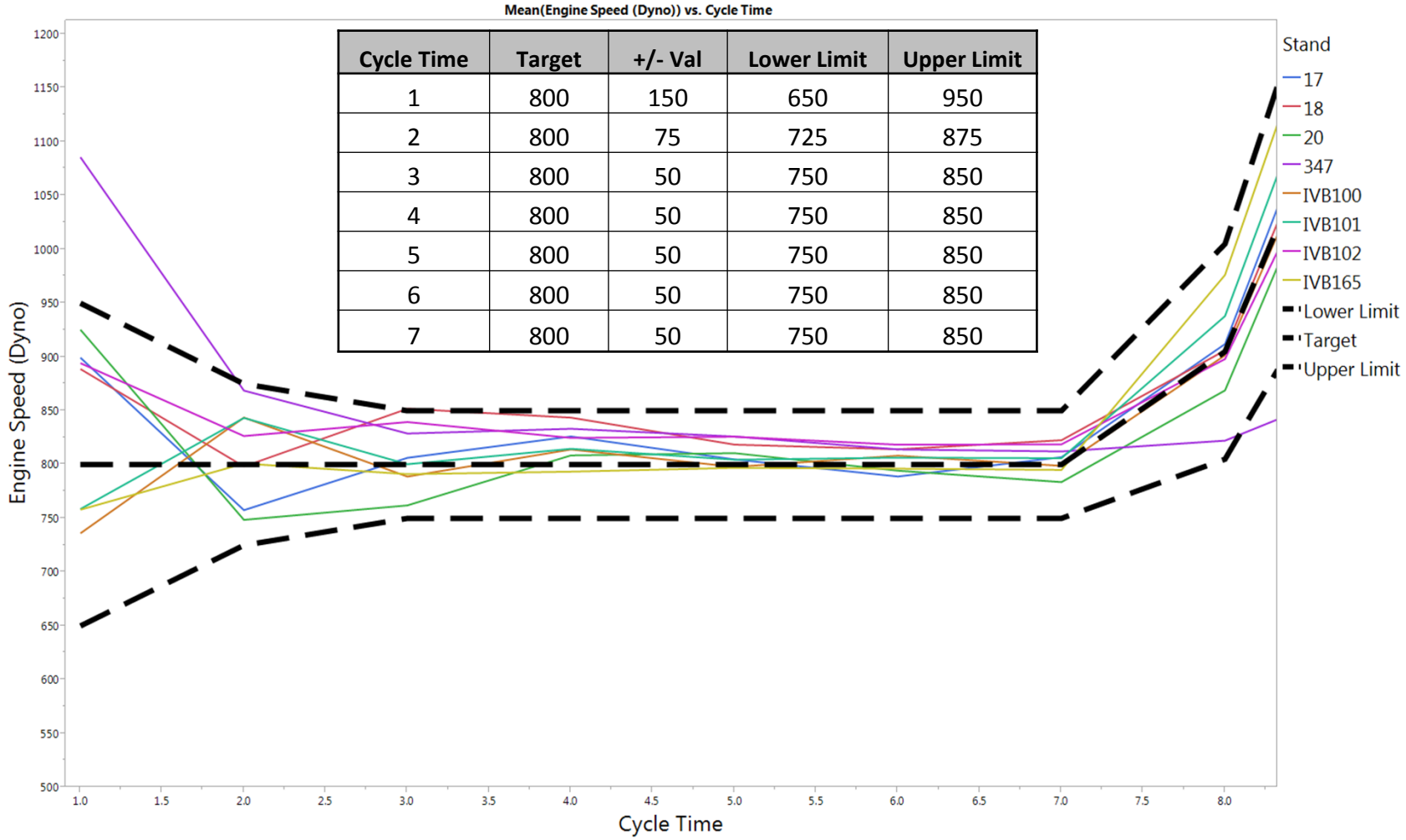
Variable upper and lower QI Limits can be established, with the frequency to be determined by the Task Force, with options including:

-second by second (could be up to 30 combinations of limits and targets)
-once per stage, perhaps the midpoint (4 times per cycle)
-only at select seconds per cycle (e.g. for stage 1, only seconds 2-7)
-some other combination of frequency



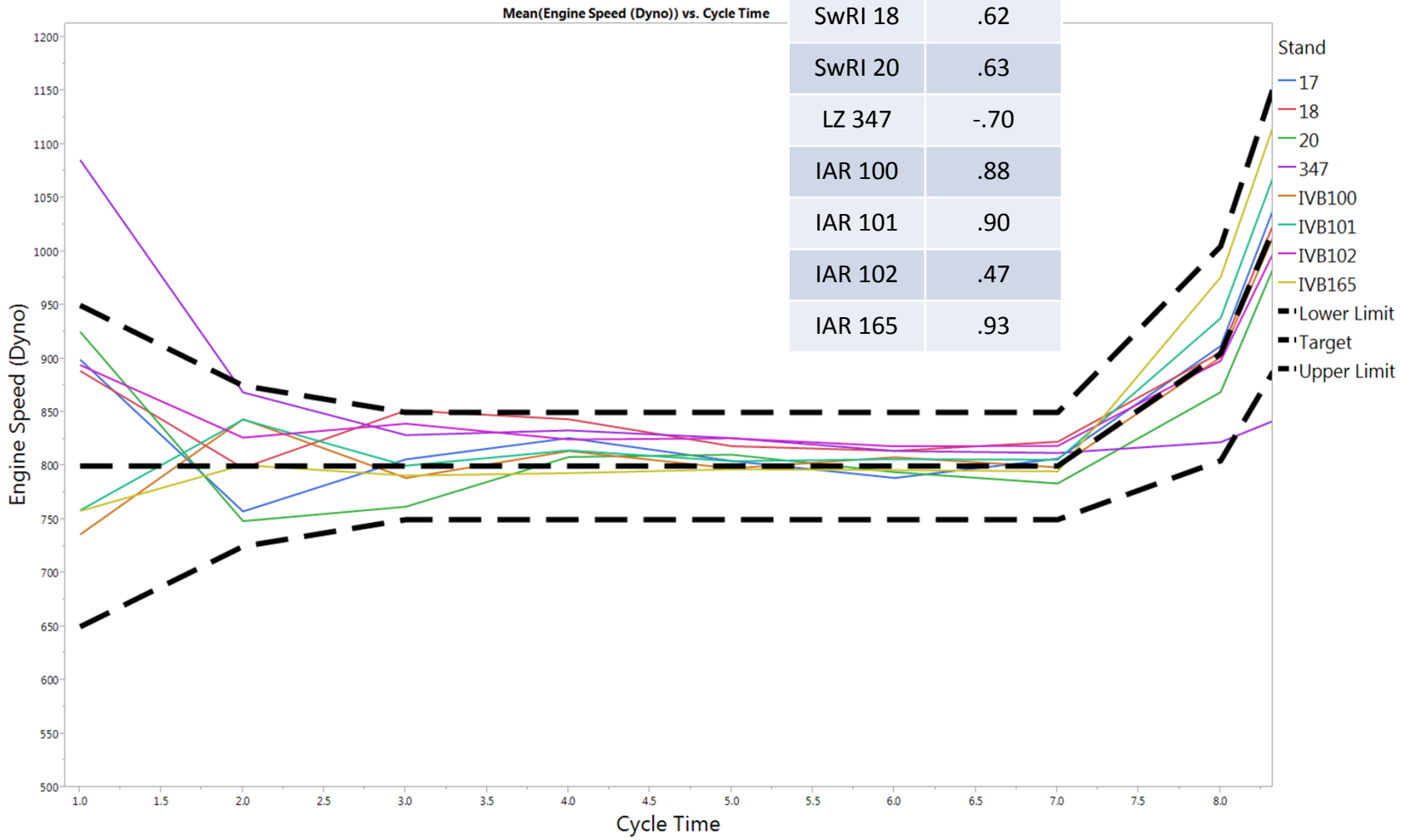
Engine Speed, Stage I

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
1	800	150	650	950
2	800	75	725	875
3	800	50	750	850
4	800	50	750	850
5	800	50	750	850
6	800	50	750	850
7	800	50	750	850



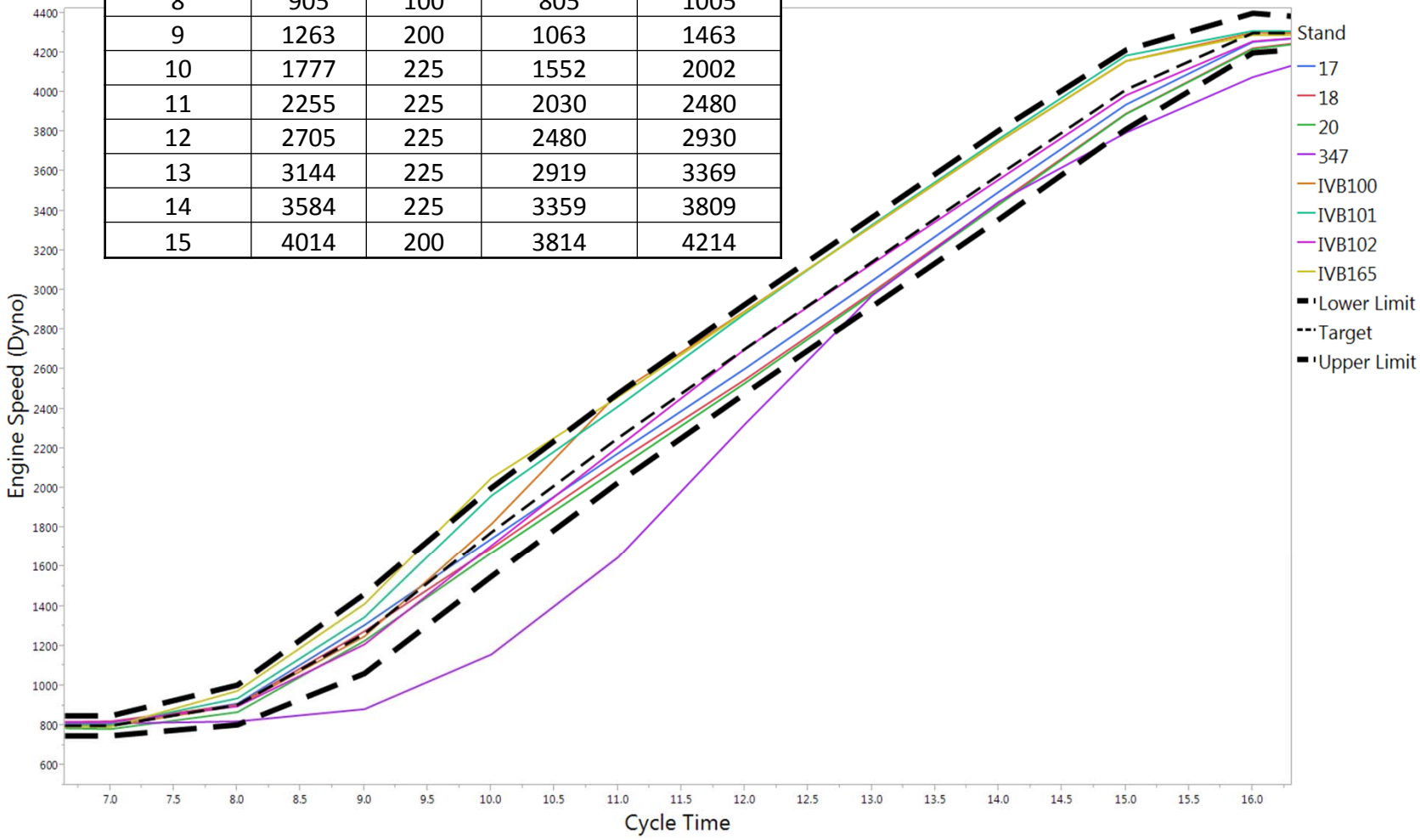
Engine Speed, Stage 1

Stand	Average Stage 1 QI
SwRI 17	.80
SwRI 18	.62
SwRI 20	.63
LZ 347	-.70
IAR 100	.88
IAR 101	.90
IAR 102	.47
IAR 165	.93



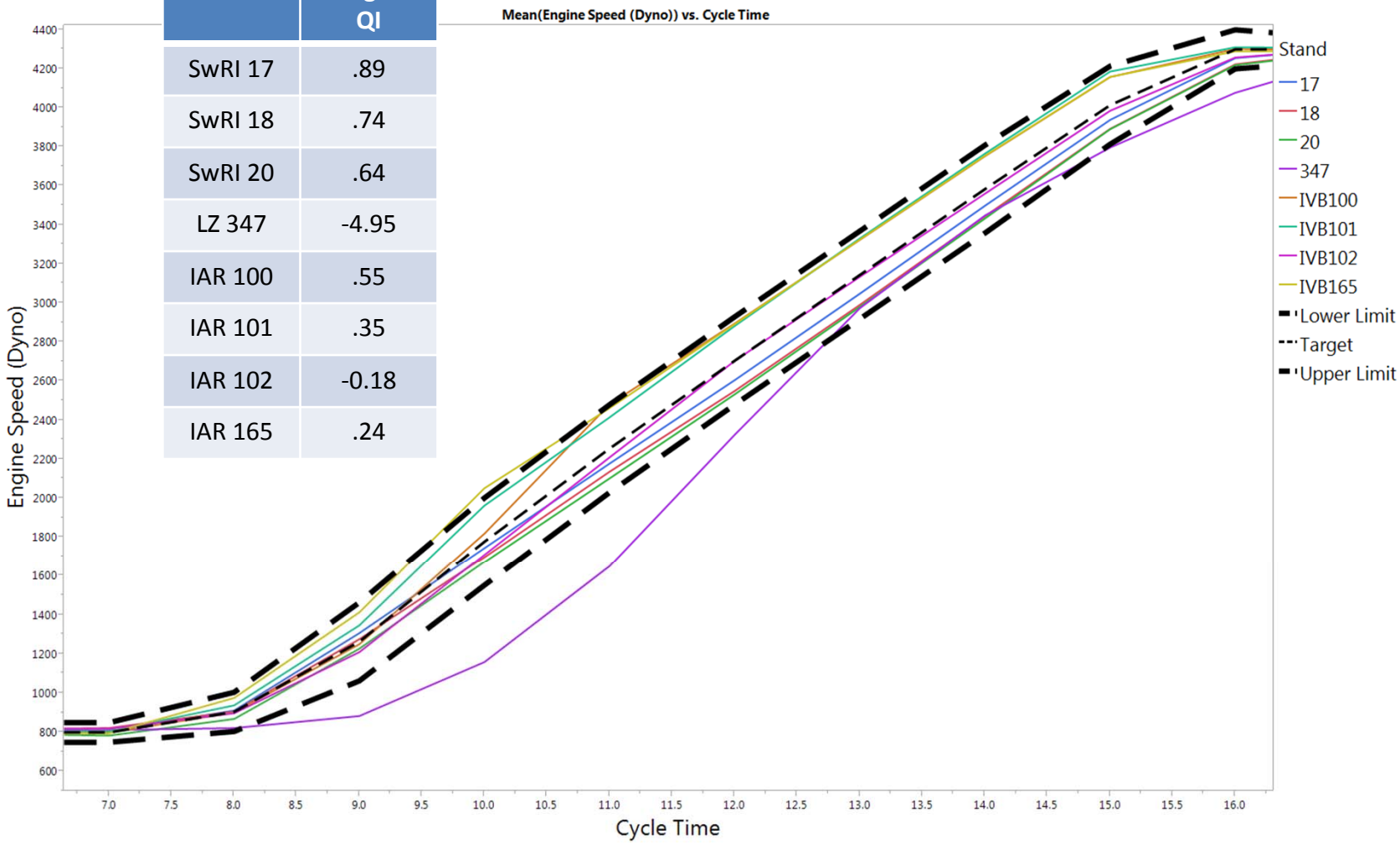
Engine Speed, Stage 1-2

Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
8	905	100	805	1005
9	1263	200	1063	1463
10	1777	225	1552	2002
11	2255	225	2030	2480
12	2705	225	2480	2930
13	3144	225	2919	3369
14	3584	225	3359	3809
15	4014	200	3814	4214

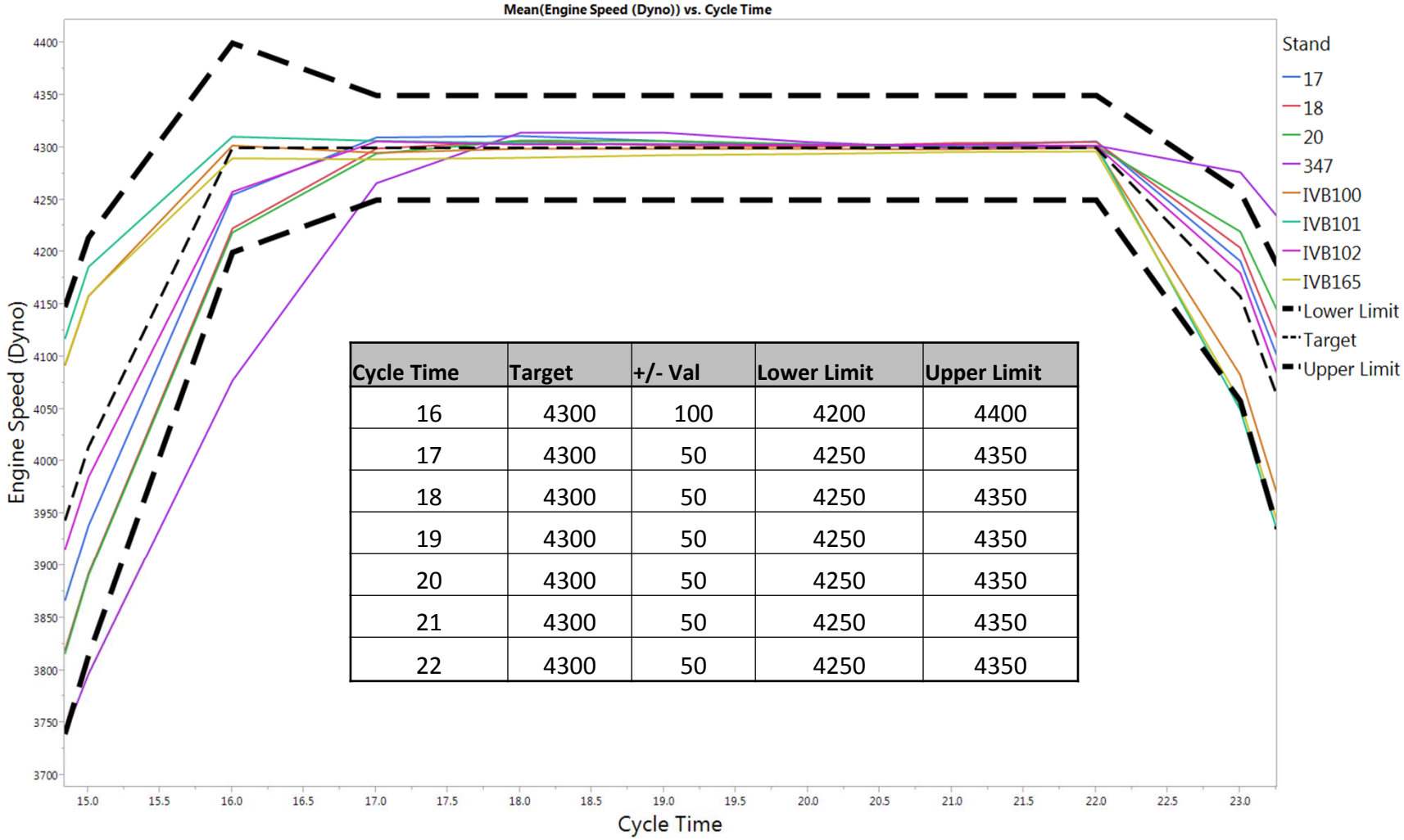


Engine Speed, Stage 1-2

Stand	Average Stage 1 QI
SwRI 17	.89
SwRI 18	.74
SwRI 20	.64
LZ 347	-4.95
IAR 100	.55
IAR 101	.35
IAR 102	-0.18
IAR 165	.24

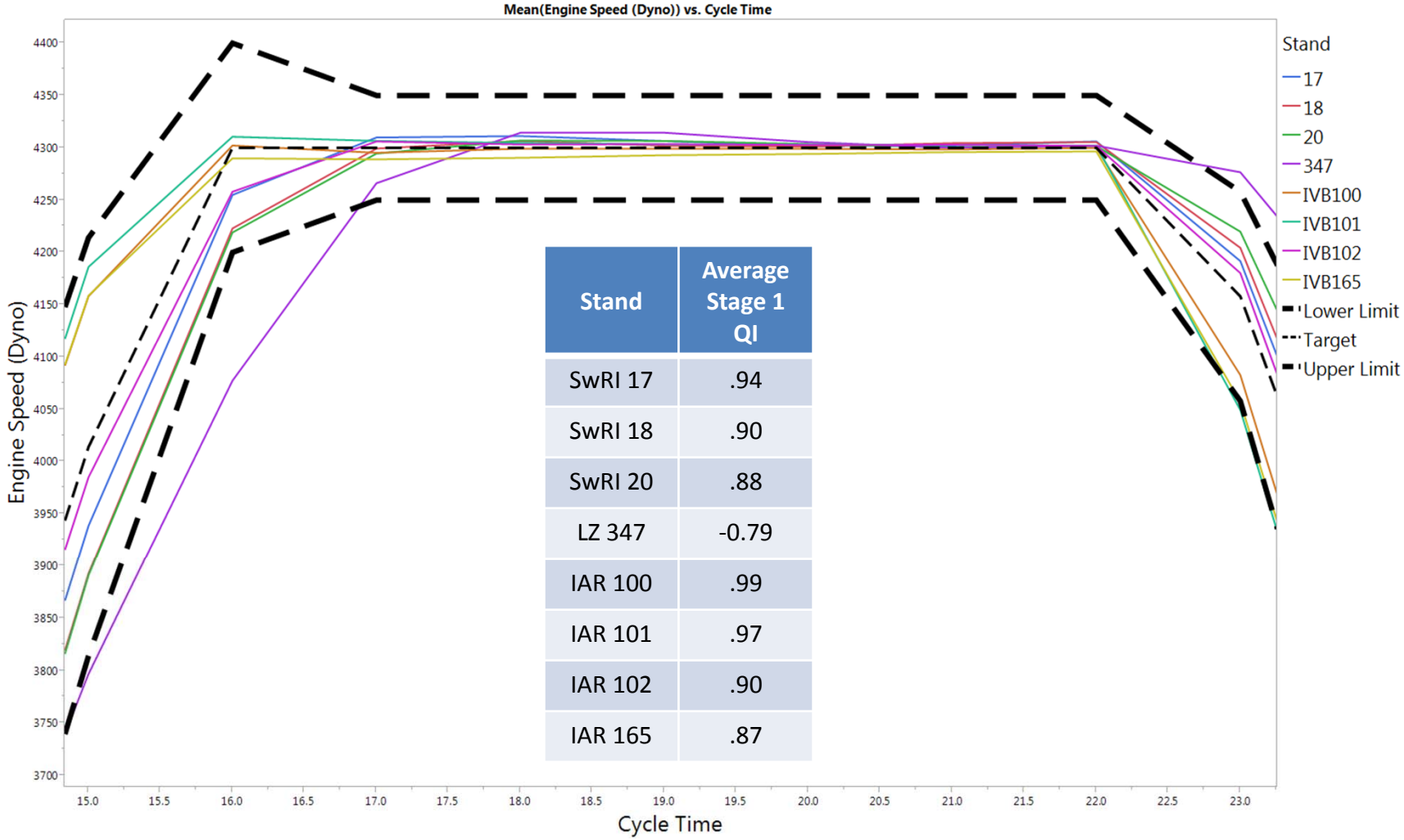


Engine Speed, Stage 2



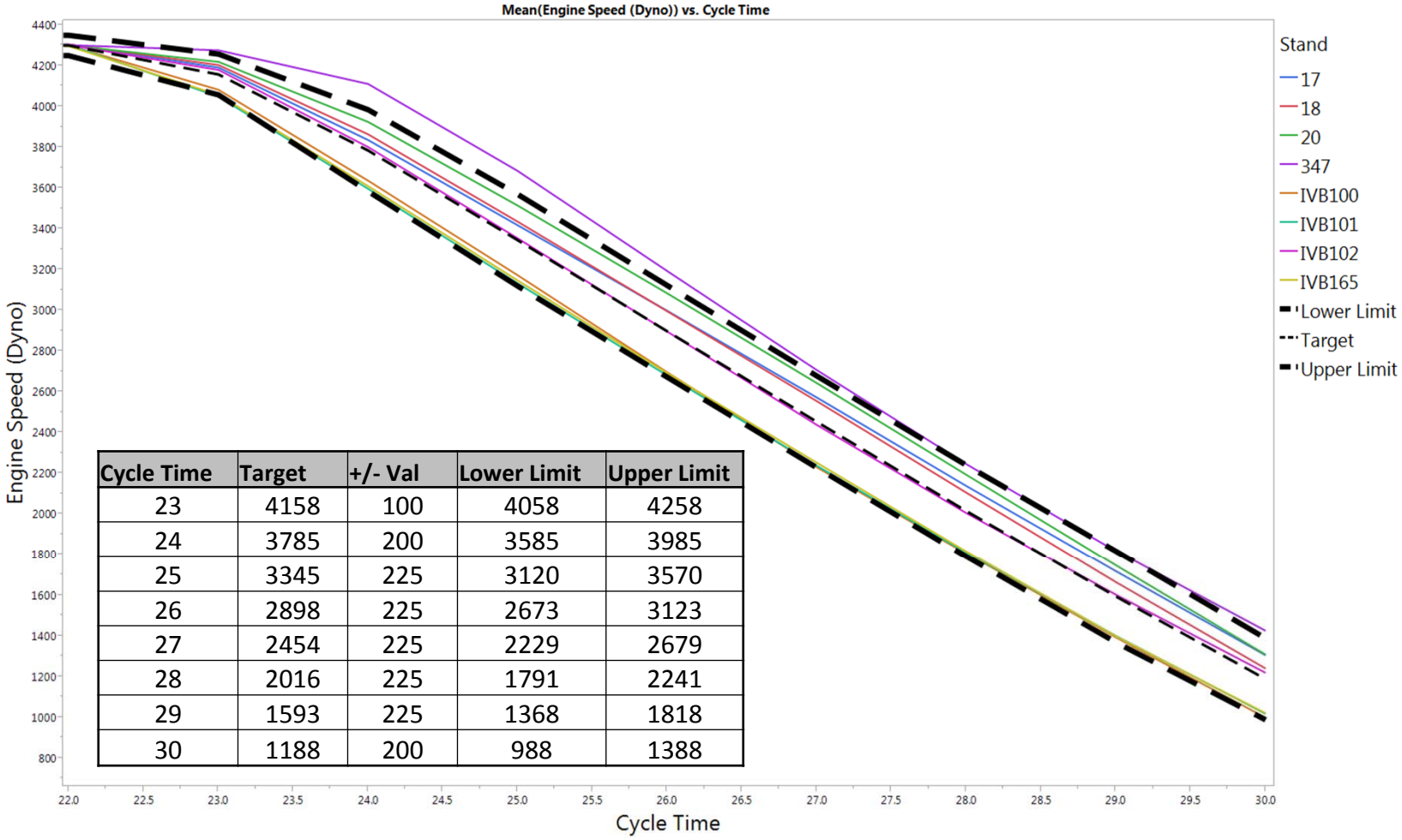
Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
16	4300	100	4200	4400
17	4300	50	4250	4350
18	4300	50	4250	4350
19	4300	50	4250	4350
20	4300	50	4250	4350
21	4300	50	4250	4350
22	4300	50	4250	4350

Engine Speed, Stage 2



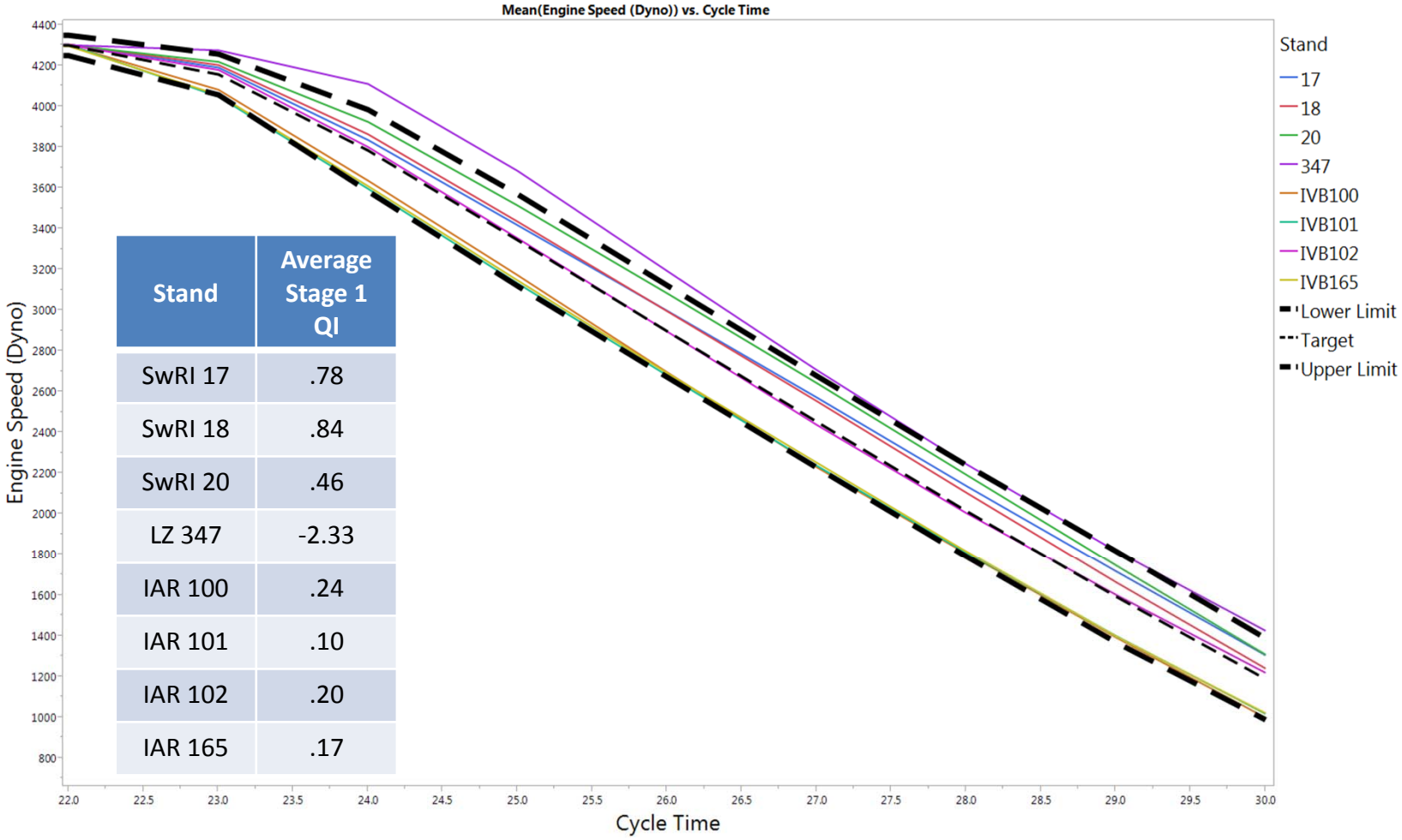
Stand	Average Stage 1 QI
SwRI 17	.94
SwRI 18	.90
SwRI 20	.88
LZ 347	-0.79
IAR 100	.99
IAR 101	.97
IAR 102	.90
IAR 165	.87

Engine Speed, Stage 2-1



Cycle Time	Target	+/- Val	Lower Limit	Upper Limit
23	4158	100	4058	4258
24	3785	200	3585	3985
25	3345	225	3120	3570
26	2898	225	2673	3123
27	2454	225	2229	2679
28	2016	225	1791	2241
29	1593	225	1368	1818
30	1188	200	988	1388

Engine Speed, Stage 2-1



Stand	Average Stage 1 QI
SwRI 17	.78
SwRI 18	.84
SwRI 20	.46
LZ 347	-2.33
IAR 100	.24
IAR 101	.10
IAR 102	.20
IAR 165	.17

Engine Speed Avg. QI by Test, Stage

Test	QI Stage 1	QI Stage 1-2	QI Stage 2	QI Stage 2-1	QI Final
17-0-4	.87	.89	.94	.82	.88
17-0-6	.74	.89	.94	.75	.83
18-0-6	.62	.74	.90	.84	.78
20-0-26	.45	.66	.89	.40	.59
20-0-27	.62	.62	.88	.40	.62
20-0-28	.82	.65	.88	.58	.73
100-0-3	.91	.56	.99	.24	.66
100-0-6	.86	.54	.99	.24	.64
101-0-17	.92	.14	.98	.09	.51
101-0-18	.95	.17	.99	-.02	.49
101-0-5	.88	.39	.95	.19	.58
101-0-8	.85	.41	.95	.09	.55
101-0-9	.89	.66	.98	.15	.65
102-0-2	.21	-.47	.87	.09	.13
102-0-3	.73	.15	.97	.31	.52
165-0-1	.96	.19	.95	.35	.59
165-0-7	.91	.29	.79	.00	.47
Average	**.77**	**.41**	**.93**	**.29**	**.58**

What if?

The data suggests the ramp windows need to be widened, and stage 2 windows should be tighter.

Cycle Time	Target	SD	+/- Val1	+/- Val2
1	800	110	150	150
2	800	42	75	75
3	800	33	50	50
4	800	16	50	50
5	800	14	50	50
6	800	12	50	50
7	800	14	50	50
8	905	59	100	100
9	1263	145	200	200
10	1777	225	225	250
11	2255	194	225	250
12	2705	175	225	250
13	3144	172	225	250
14	3584	166	225	250
15	4014	157	200	200
16	4300	65	100	100
17	4300	29	50	40
18	4300	20	50	40
19	4300	14	50	40
20	4300	11	50	40
21	4300	10	50	40
22	4300	9	50	40
23	4158	92	100	100
24	3785	162	200	200
25	3345	179	225	250
26	2898	187	225	250
27	2454	190	225	250
28	2016	182	225	250
29	1593	173	225	250
30	1188	160	200	200

Engine Speed Avg. QI by Test, Stage

Test	QI Stage 1	QI Stage 1-2	QI Stage 2	QI Stage 2-1	QI Final
17-0-4	0.87	0.91	0.93	0.84	.89
17-0-6	0.74	0.91	0.92	0.78	.84
18-0-6	0.62	0.78	0.89	0.86	.79
20-0-26	0.45	0.71	0.86	0.48	.62
20-0-27	0.62	0.68	0.87	0.48	.66
20-0-28	0.82	0.71	0.87	0.63	.75
100-0-3	0.91	0.63	0.98	0.33	.70
100-0-6	0.86	0.61	0.98	0.34	.68
101-0-17	0.92	0.26	0.97	0.19	.56
101-0-18	0.95	0.29	0.98	0.08	.55
101-0-5	0.88	0.48	0.92	0.29	.63
101-0-8	0.85	0.5	0.92	0.19	.60
101-0-9	0.89	0.71	0.97	0.25	.69
102-0-2	0.21	-0.33	0.8	0.17	.19
102-0-3	0.73	0.26	0.95	0.39	.57
165-0-1	0.96	0.3	0.92	0.43	.63
165-0-7	0.91	0.39	0.68	0.11	.51
Average	**0.78**	**0.52**	**0.91**	**0.40**	**.64**

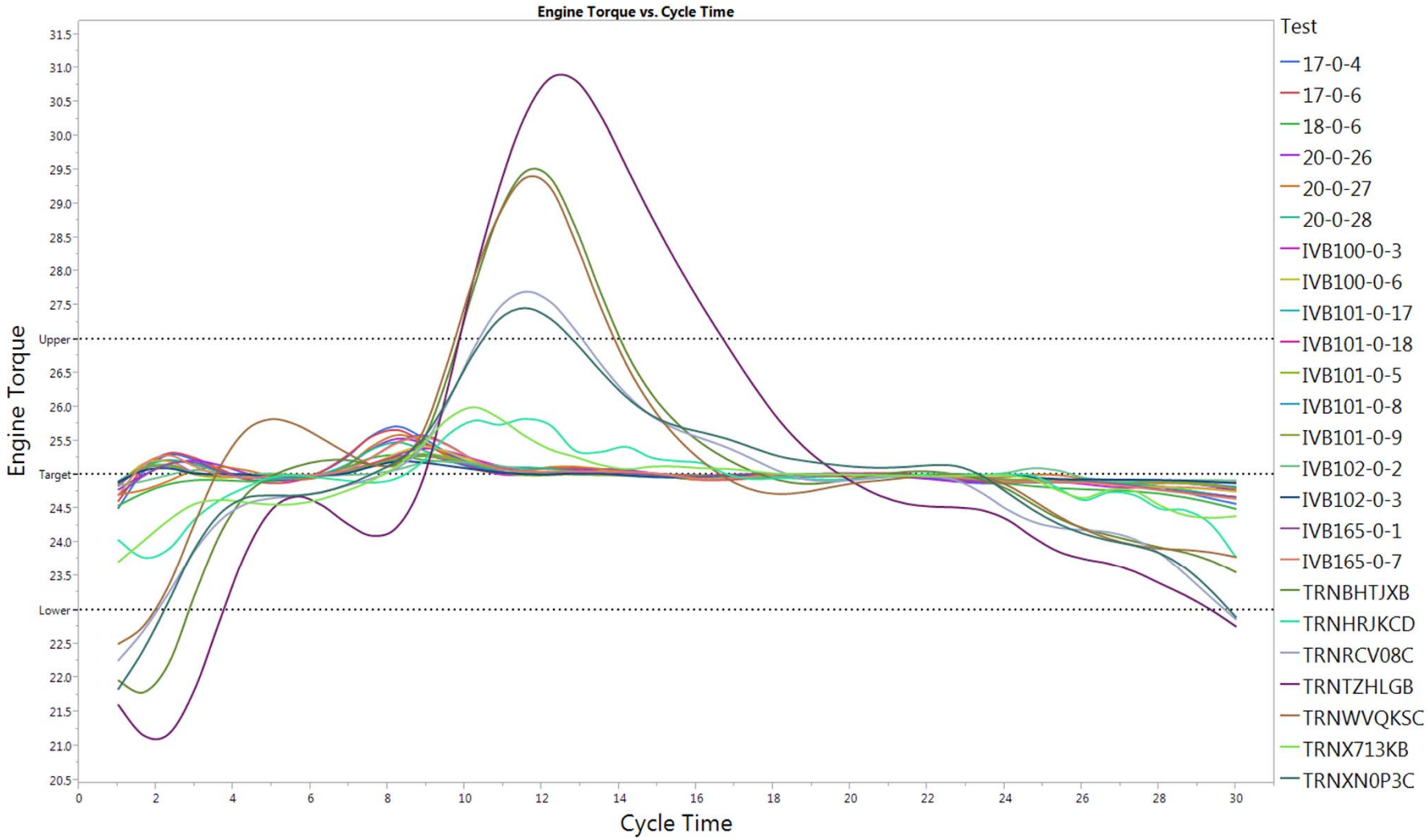
Next Steps for Engine Speed QI

1. Determine if all 30 seconds are desirable or some alternative frequency and/or method.
2. Determine which tests represent the latest and greatest control to determine targets for ramps (larger prove-out set can still be used to determine possible variability around those targets).
3. Determine goals for QI.
4. Calculate new targets and limits.
5. Review and approve new targets and limits.

Other Parameters

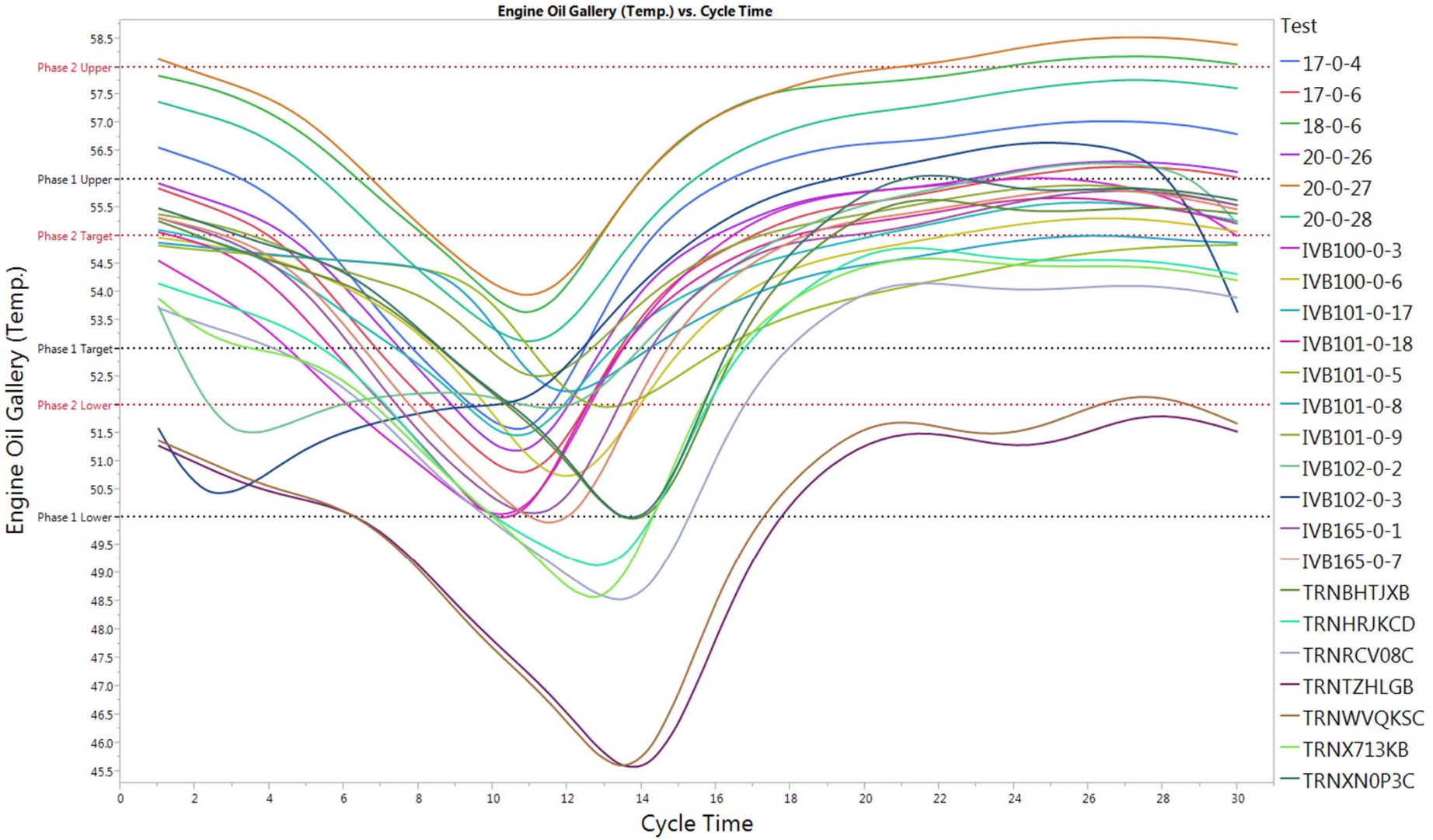
Engine Torque

Suggested:
One target with one upper and lower limit



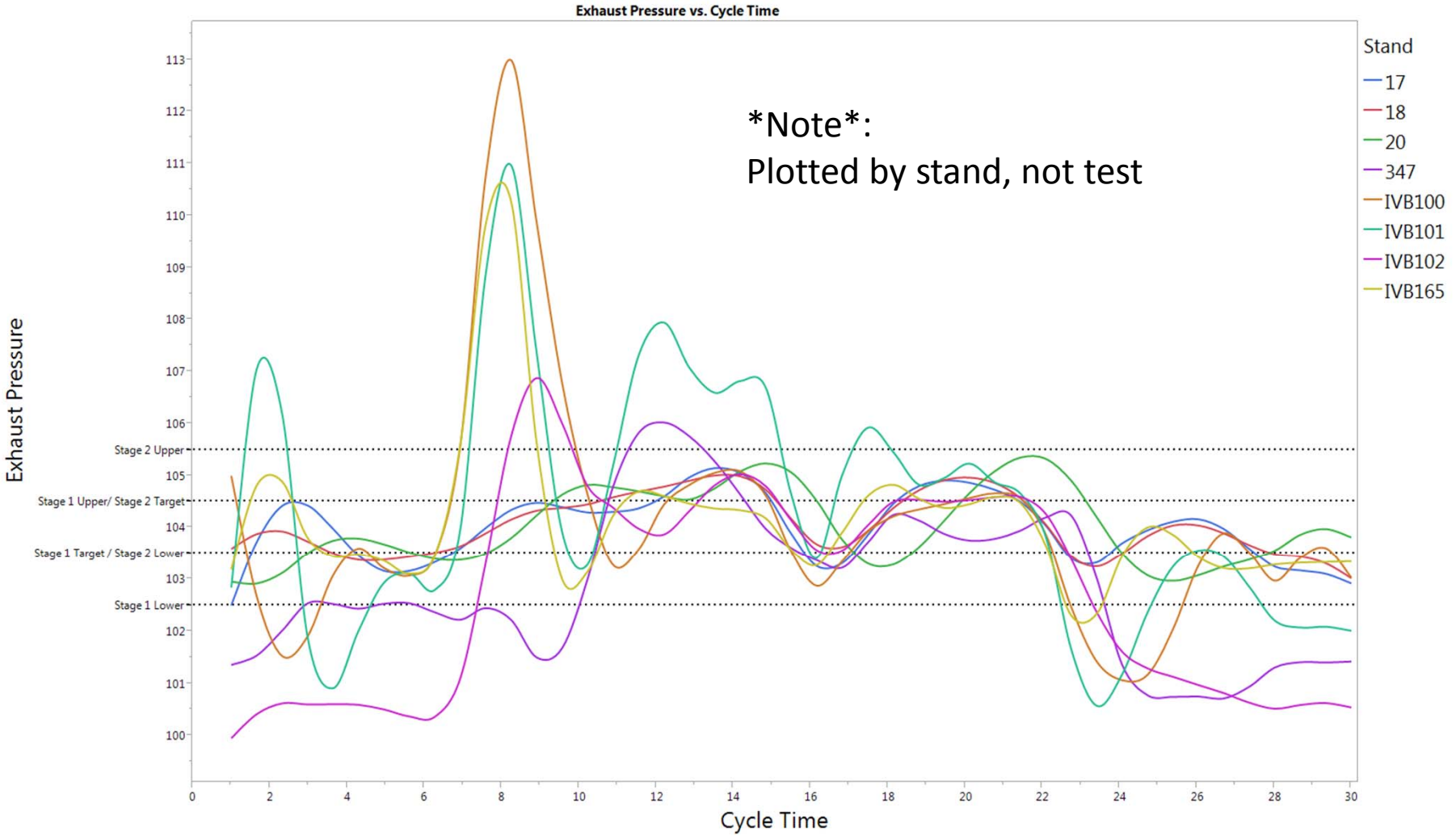
Oil Gallery Temp.

Suggested:
Sample twice per cycle, once to determine if sufficiently low, once to determine if sufficiently high



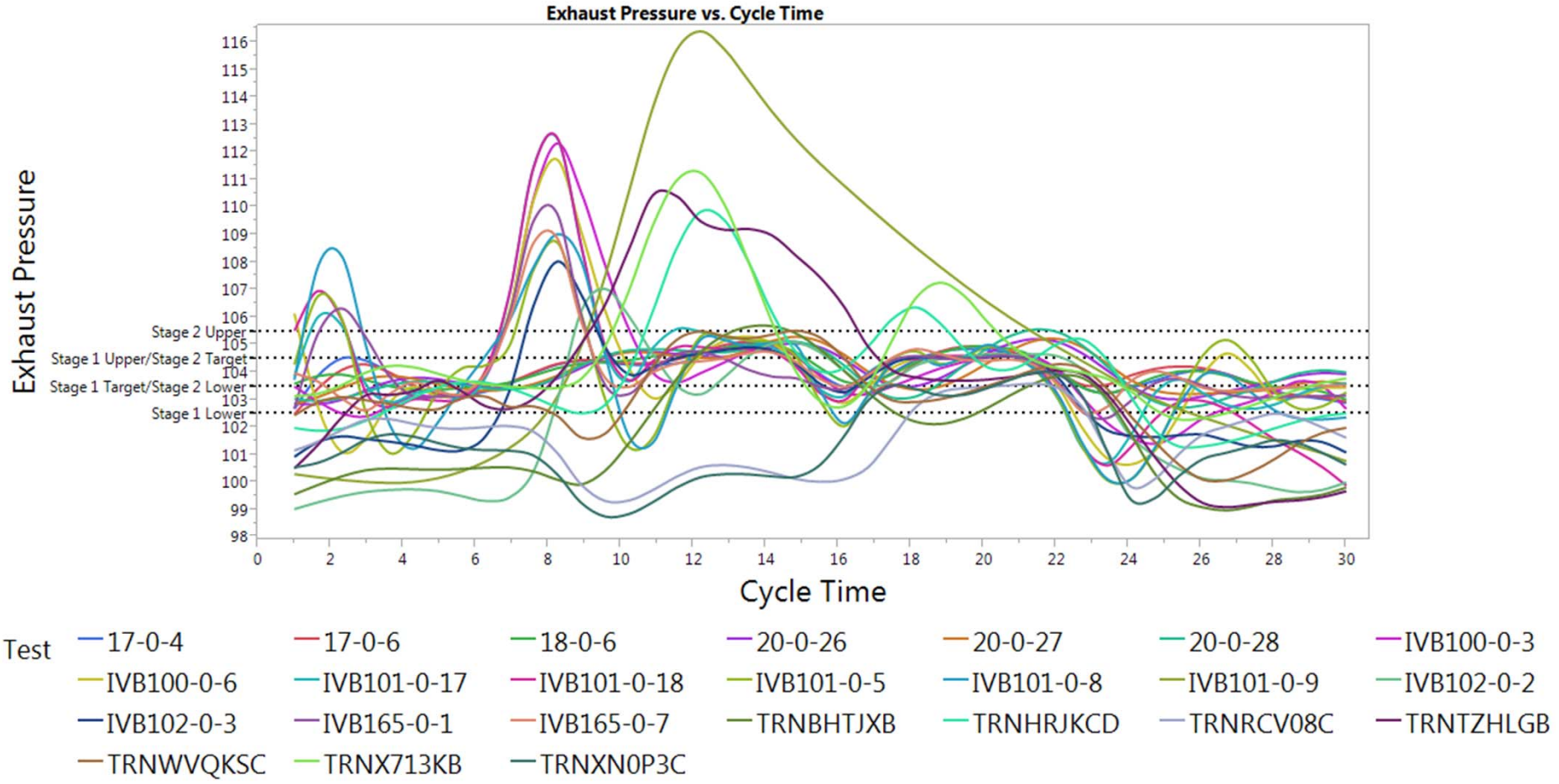
Exhaust Back Pressure

Suggested:
Sample twice per cycle, once to determine if sufficiently low, once to determine if sufficiently high



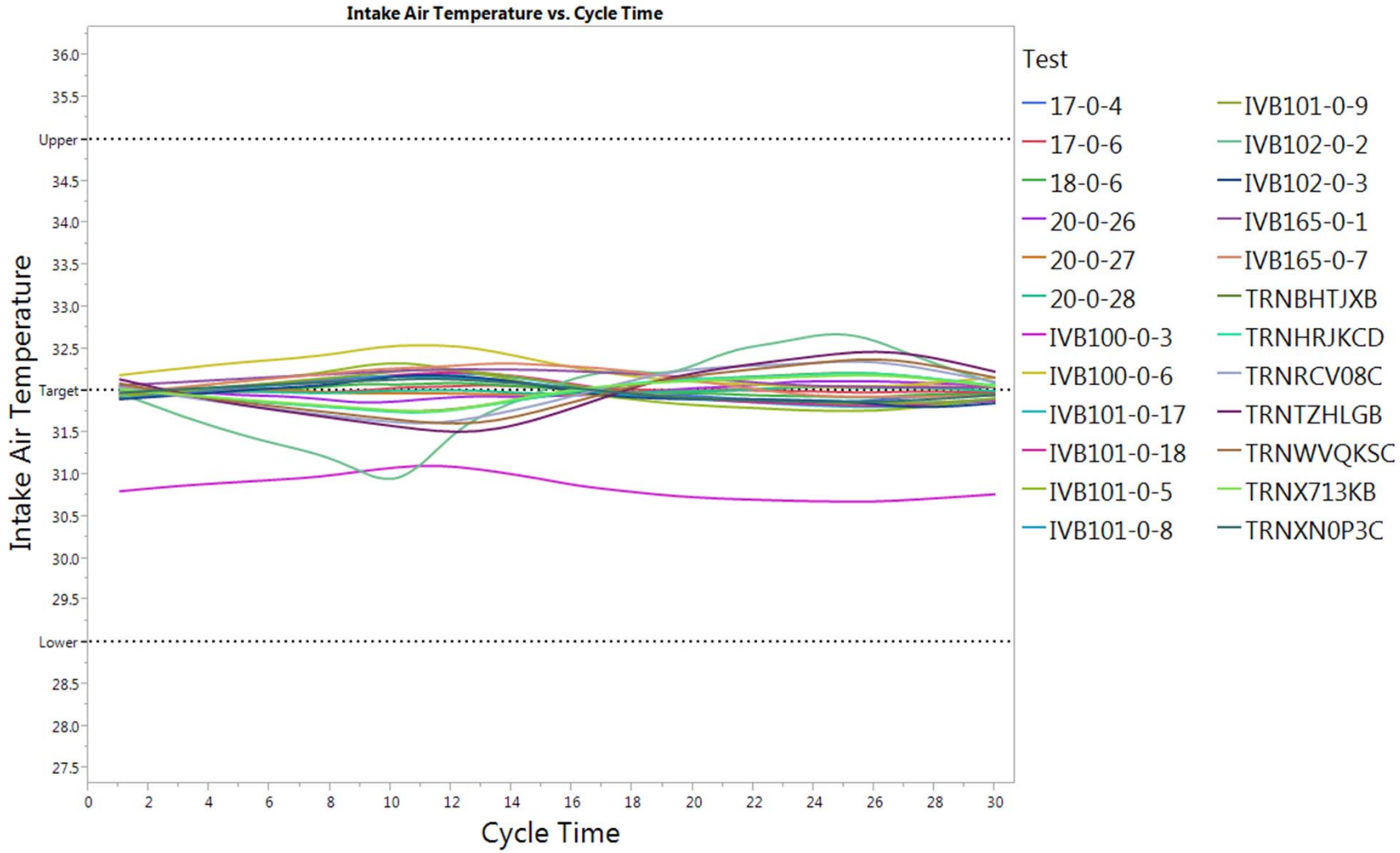
Exhaust Back Pressure

Suggested:
One target, one upper and lower limit



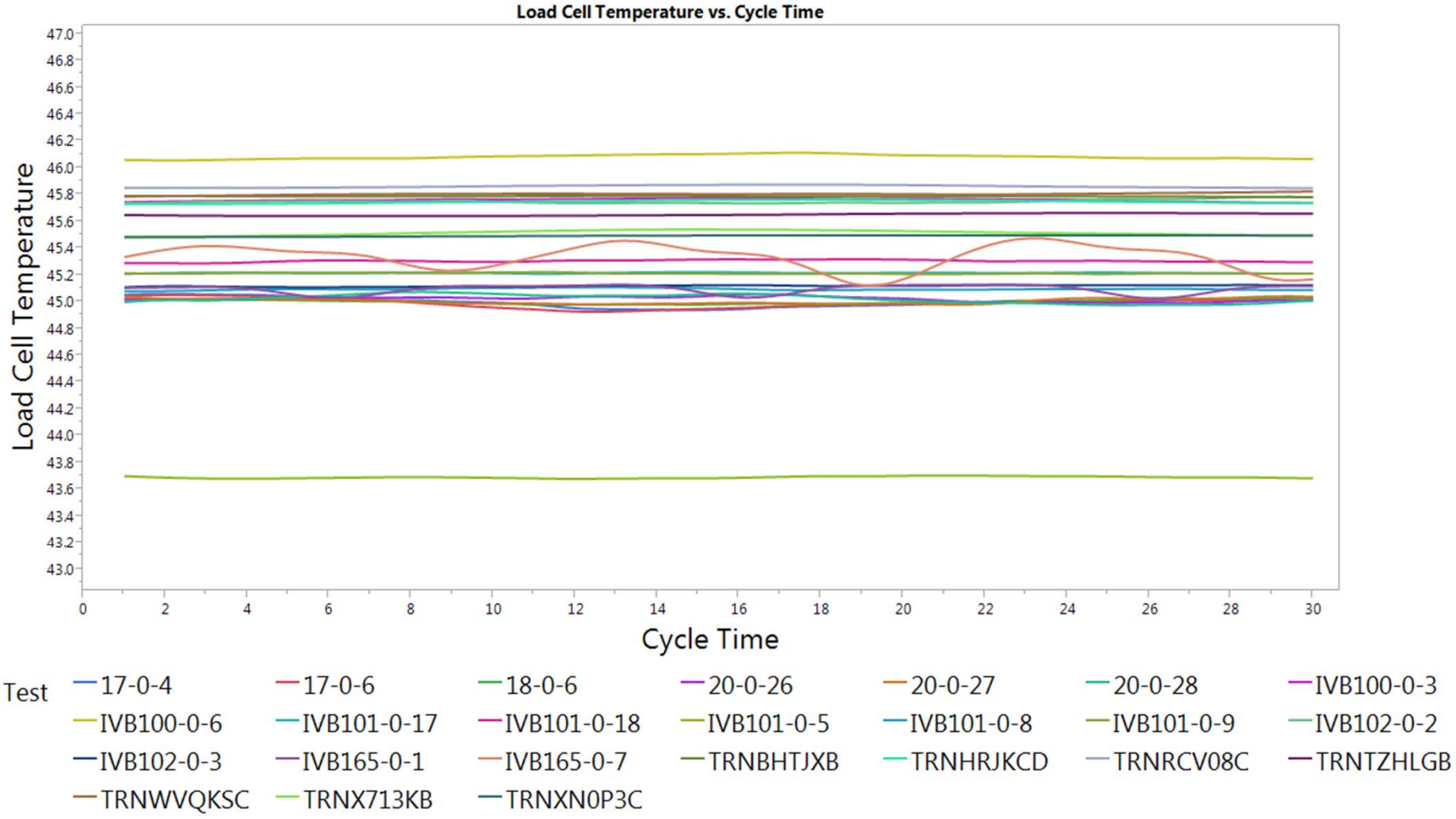
Intake Air Temp.

Suggested:
One target, one upper and lower limit



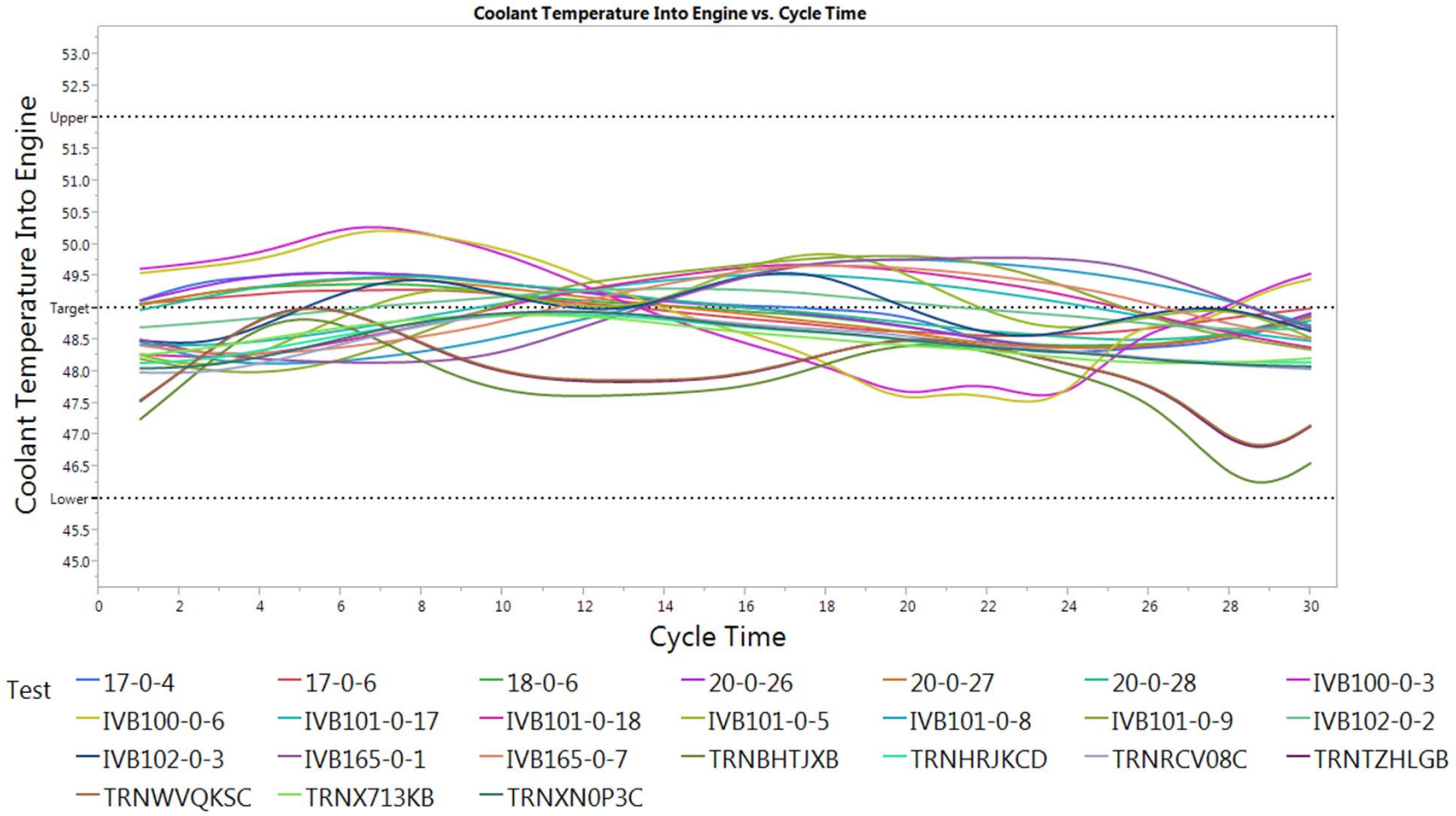
Load Cell Temp.

Suggested:
One target, one upper and lower limit



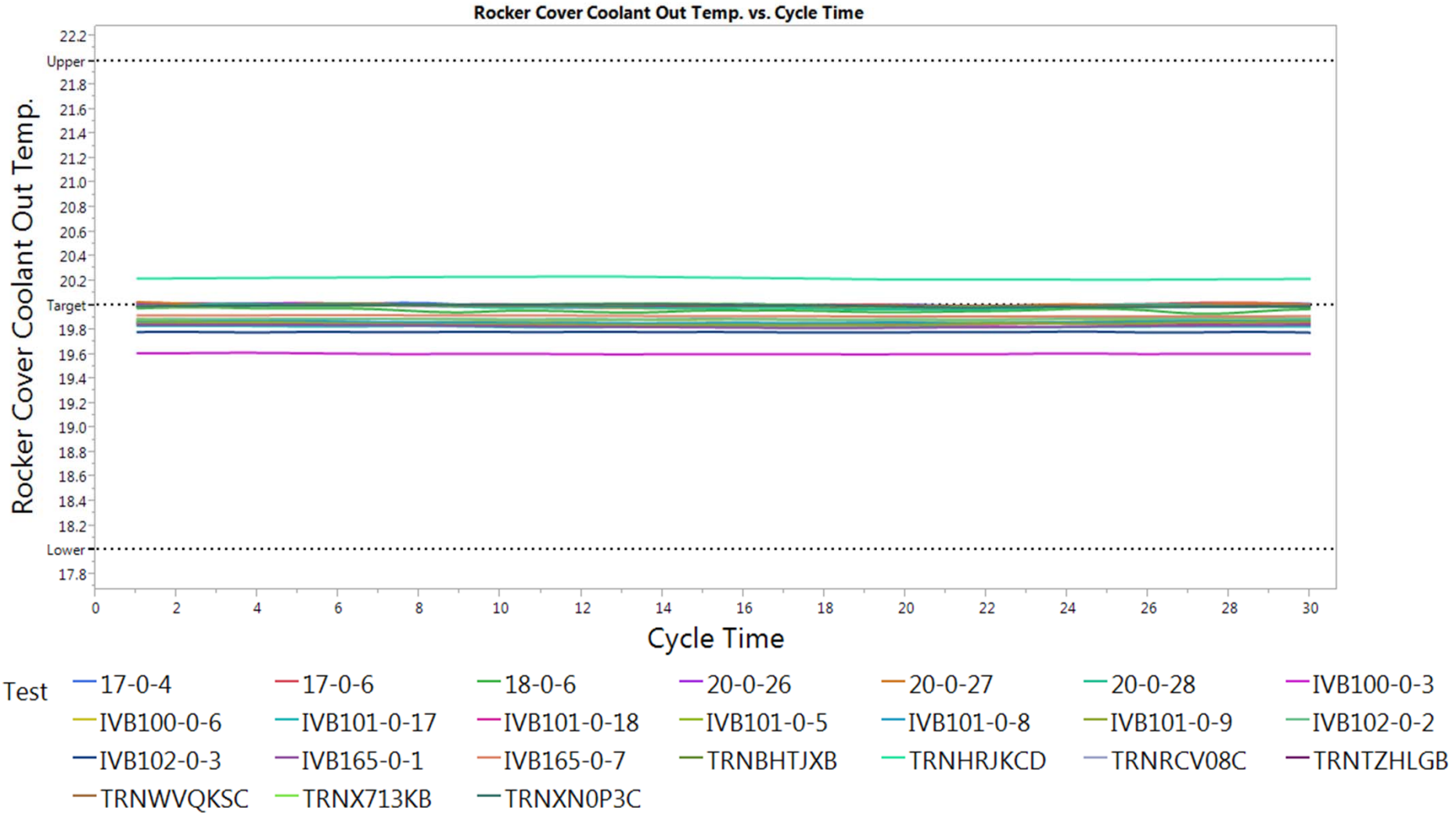
Coolant Temp. In

Suggested:
One target, one upper and lower limit



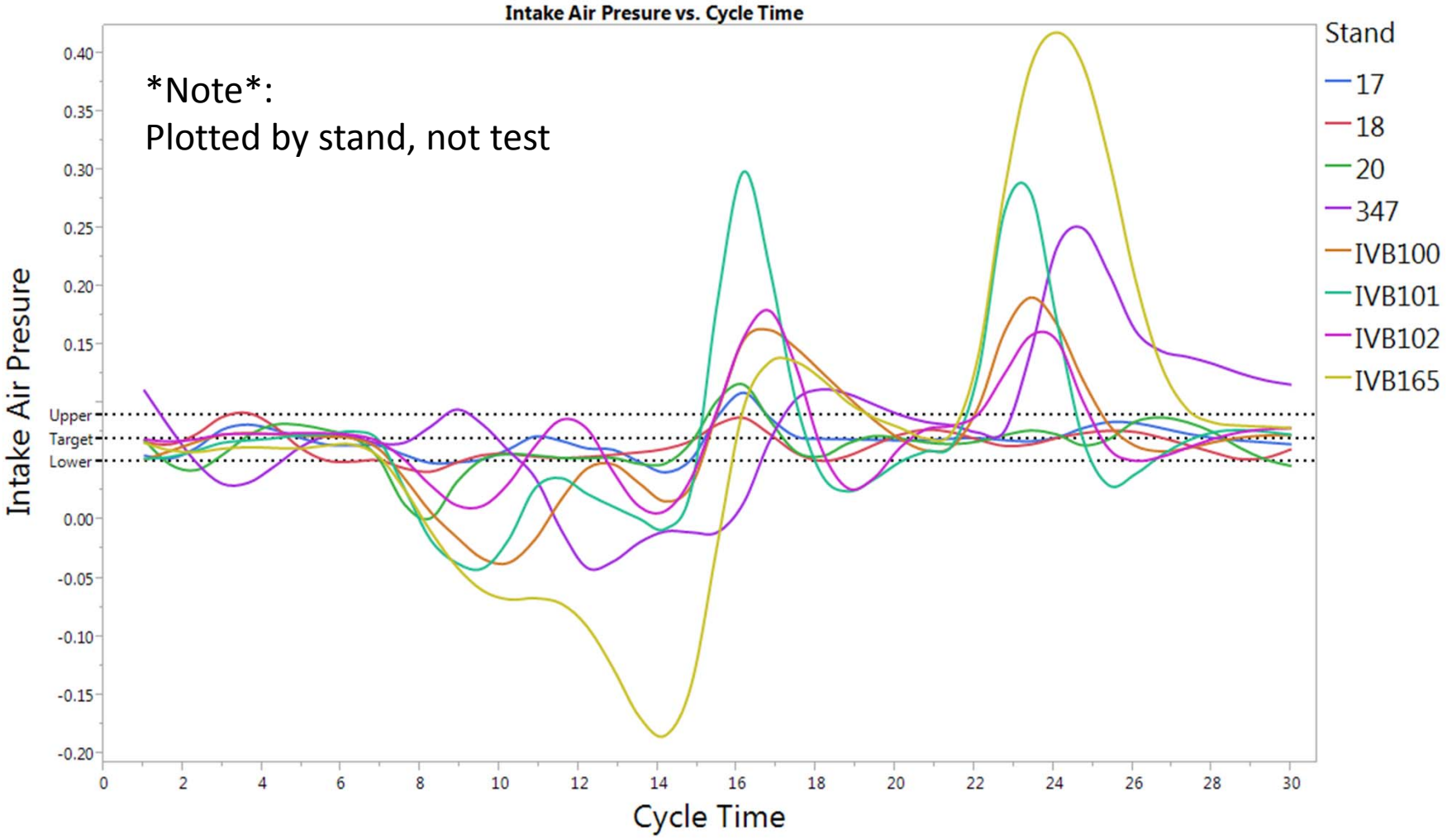
RAC Coolant Temp. Out

Suggested:
One target, one upper and lower limit



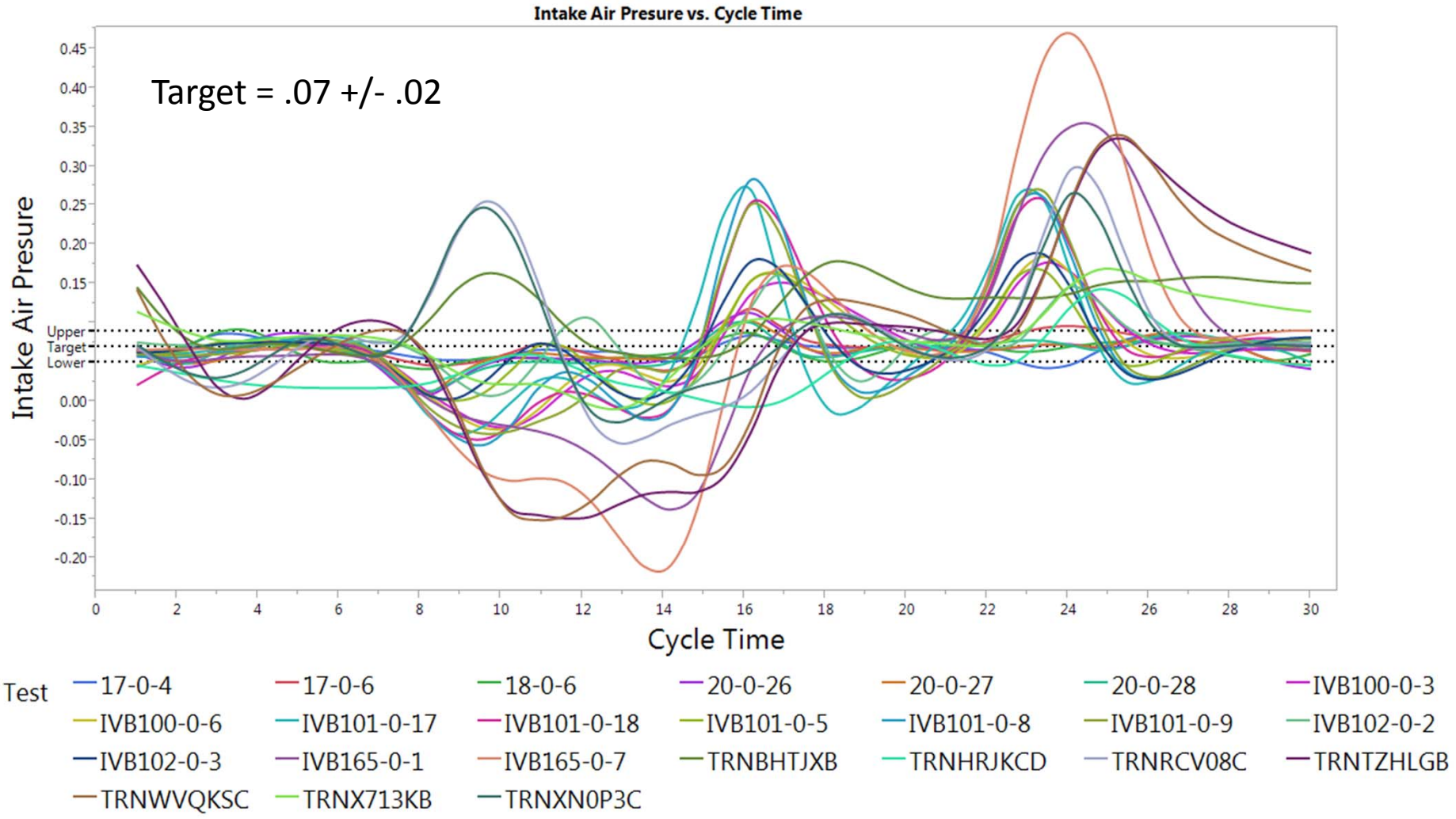
Intake Air Pressure

Suggested:
One target, one upper and lower limit



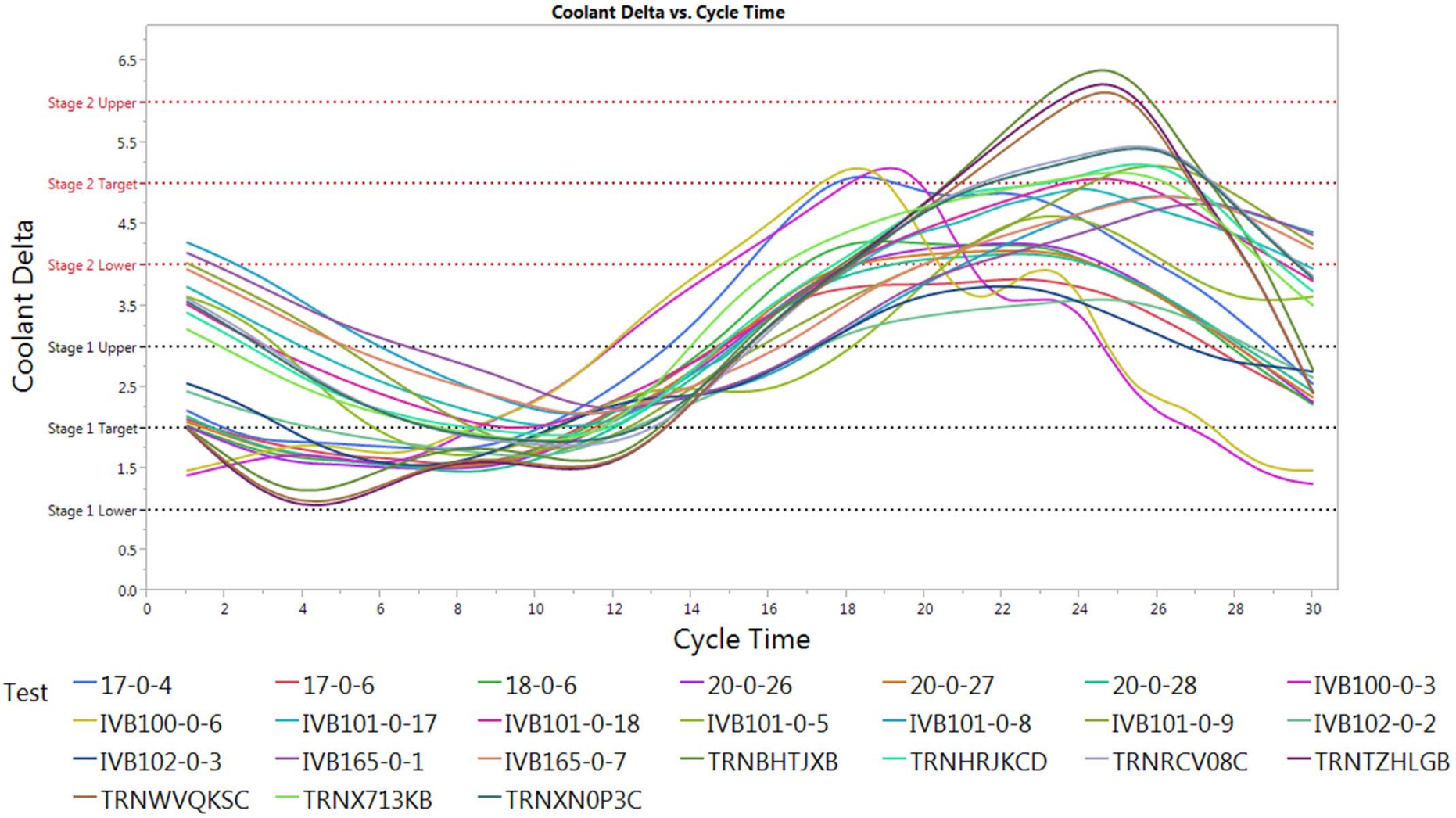
Intake Air Pressure

Suggested:
One target, one upper and lower limit



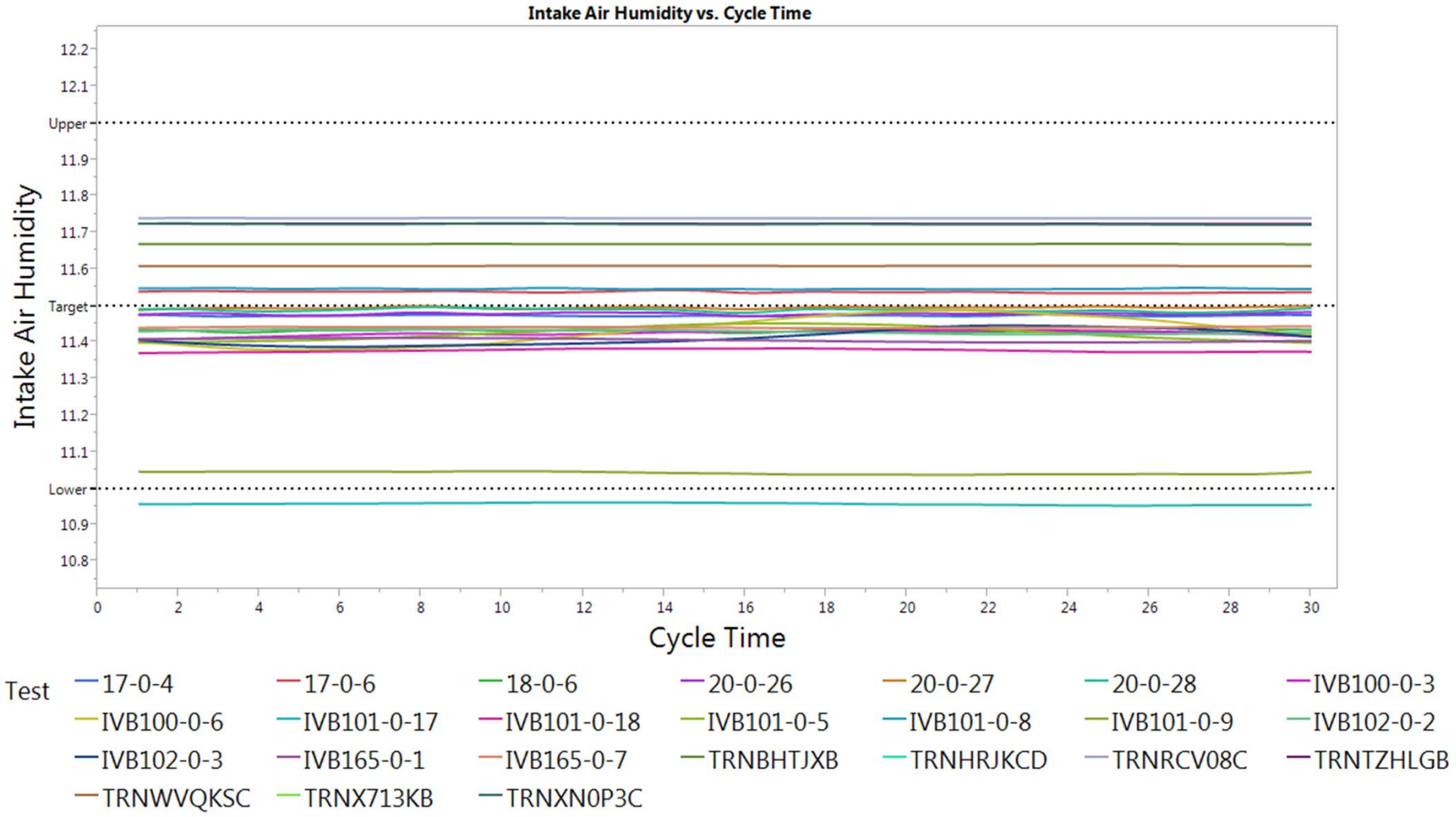
Coolant Delta

Suggested:
Sample twice per cycle, once to determine if sufficiently low, once to determine if sufficiently high



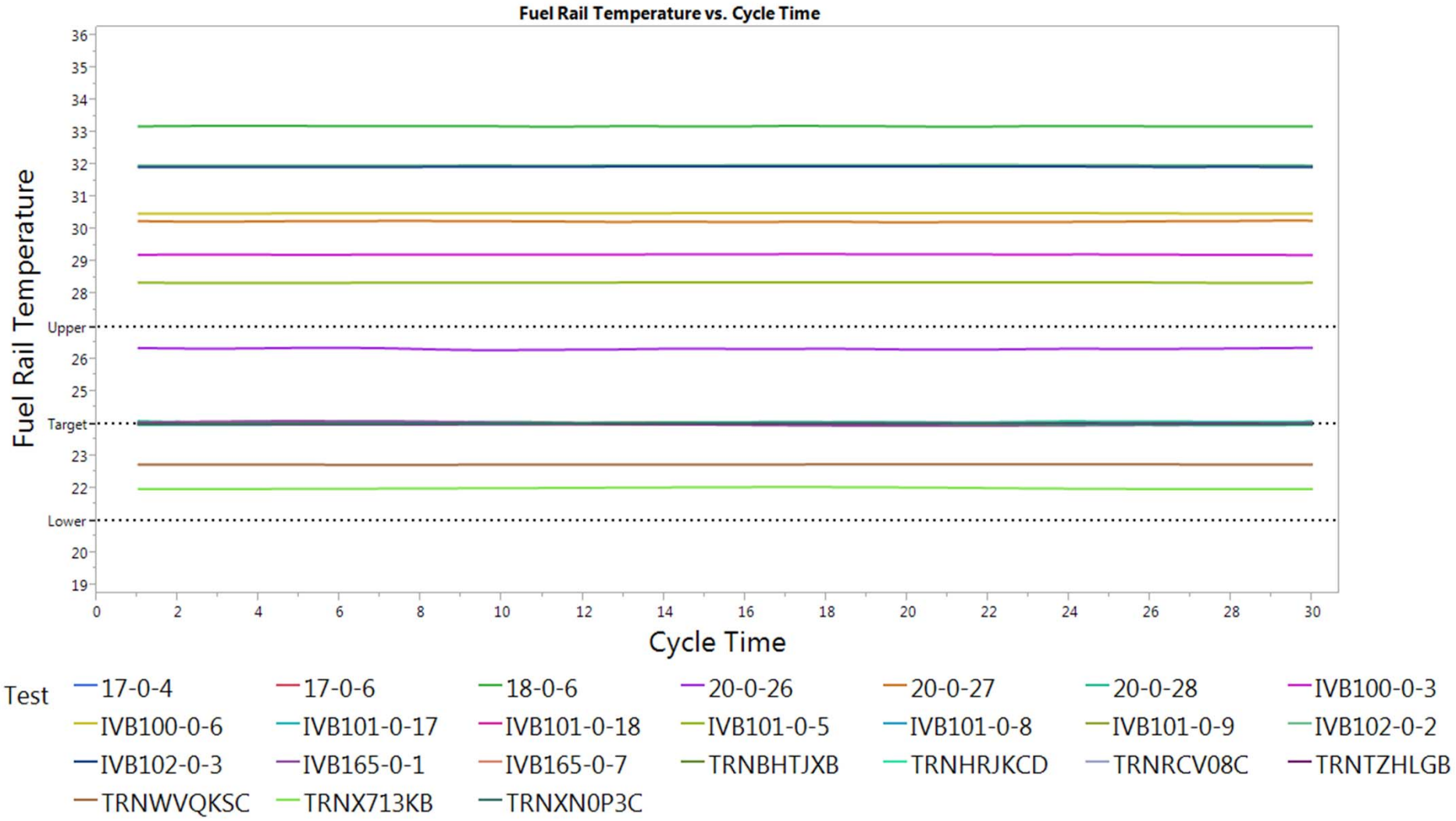
Intake Air Humidity

Suggested:
One target, one upper and lower limit



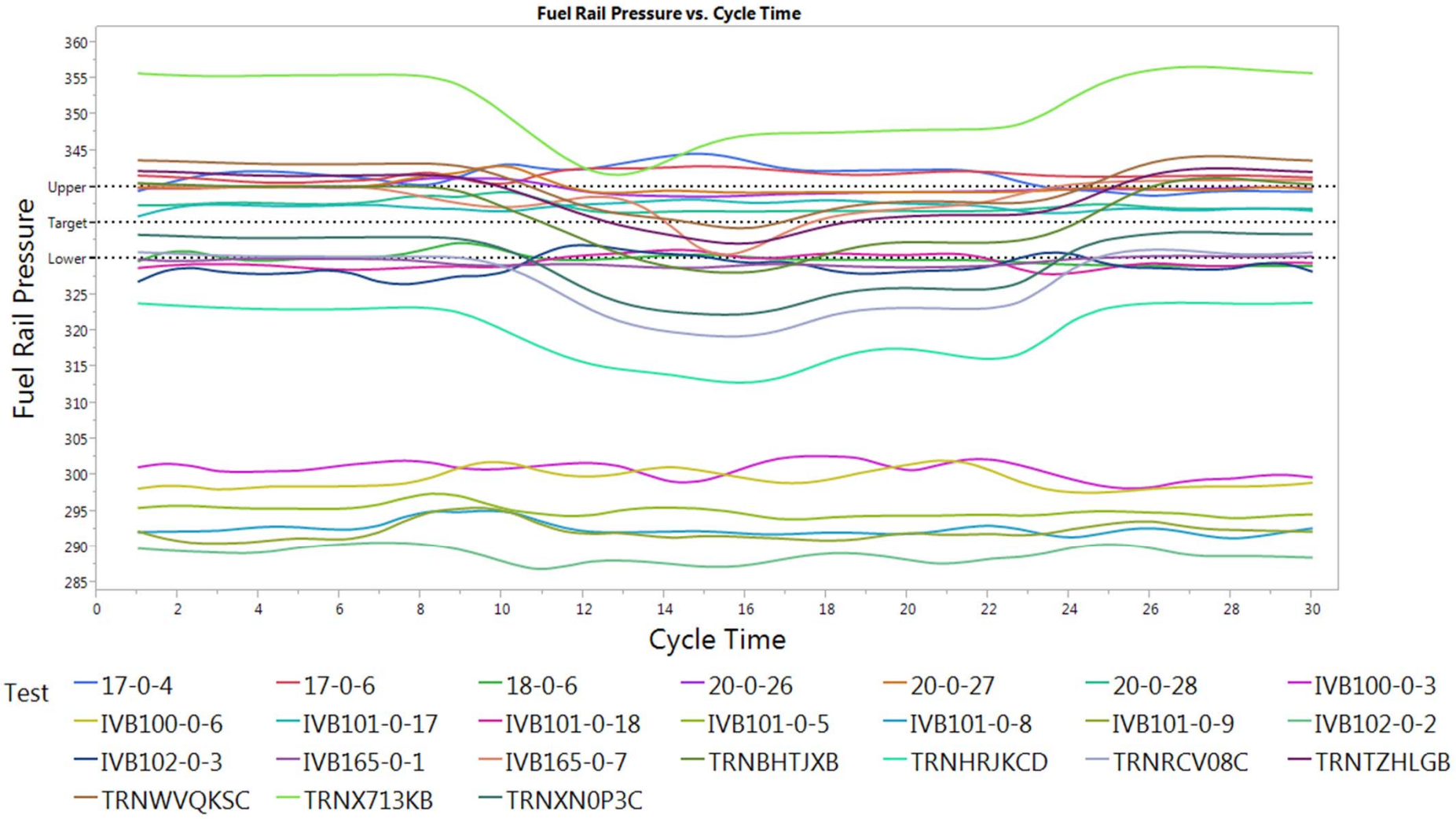
Fuel Rail Temp.

Suggested:
One target, one upper and lower limit



Fuel Rail Pressure

Suggested:
One target, one upper and lower limit



Attachment 6

Sequence IVB Task Force
and
Sequence IV Surveillance Panel
March 30, 2016
10:00AM – 6:00PM
Southwest Research Institute
San Antonio, TX

Motions and Action Items

As Recorded at the Meeting by Bill Buscher

1) Action Item – OHT to work with Toyota to provide the manufacturing specifications (i.e. stiffness and manufacturing tolerances) for the three Toyota OEM motor mounts used on the Sequence IVB Golden Stand.

2) Action Item – Intertek to create a calibration curve for the OHT dipstick and modified oil pan.

3) Action Item – Add rocker cover coolant flow rate control (control valve, PID controller and set point) to the Sequence IVB test. Labs to obtain flow rate data to define a set point. SwRI will take the lead in creating the set up for this Golden Stand addition.

4) Action Item – Lubrizol to add the OBD2 data to the Sequence IVB operational data Excel template previously created for prove-out data review. This will allow for review of this data during and after the precision matrix.

5) Motion – The Sequence IVB Task Force and Sequence IV Surveillance Panel approves the inclusion the following procedural process improvements into the precision matrix tests:

- Each precision matrix stand will start the precision matrix with a new engine assembly, a new clutch assembly and new motor mounts. Prior to the start of the precision matrix the only runtime that this engine and these components will experience is the break-in and aging for Si pacification.
- Will use the OHT modified oil pan, which will improve the oil drain effectiveness for the flushes and end of test drain.
- Will add a 5th flush, which will be an oil pan flush without the engine running. This flush will be conducted prior to the 4 flushes with the engine running. For the precision matrix this flush will use EF-411.
- ifm SM8000 magnetic-inductive flow meters will be added to the Sequence IVB Golden Stand for engine and rocker cover coolant flow rate measurement.
- Will change from engine coolant delta temperature control (2°C for Stage 1 and 5°C for Stage 2) to engine coolant flow rate control (75 lpm for Stage 1 and 45 lpm for Stage 2). This will include a linear 8 second ramp from 45 to 75 lpm between stages 1 and 2.
- Will add rocker cover coolant flow rate control (set-point to be defined).
- Will add data acquisition of a predefined set of OBD2 parameters, at a 1 Hz logging rate.

Bill Buscher / Eric Liu / Passed 14 – 0 – 1

6) Action Item – SwRI to provide the labs the coolant flow operational data so that all three precision matrix labs can mimic SwRI's coolant flow ramps during transitions.

7) Action Item – Sequence IVB Test Development Team to finalize the procedure for the 5th flush, as indicated in the passing motion above.

8) Action Item – Sequence IV Surveillance Panel chair to request to Toyota that Afton and ExxonMobil be added to the Sequence IVB Test Development Team as of 3/30/16, since those companies are contemplating the purchase of Sequence IVB Golden Stands. The chair will also ask Toyota for feedback on when they believe the test development team will be disbanded and the surveillance panel will assume full control of the Sequence IVB test.

9) Action Item – SwRI will complete a scoping test currently running on stand 19 with engine coolant flow control, Intertek will conduct a scoping test on stand 102 with engine coolant flow control, and Lubrizol will conduct a scoping test on stand 347 with engine coolant flow control prior to the start of the precision matrix. SwRI will also conduct a repeat test on stand 17 with engine coolant flow control and Intertek will conduct a test on stand 165 with engine coolant flow control. All tests will be conducted on ASTM REO 1006-2. All tests will be conducted with engine coolant

flow rate set points of 75 lpm for Stage 1 and 45 lpm for Stage 2 and engine coolant flow rate ramping defined from SwRI's operational data from test 17-0-10.

10) Action Item – Eric Liu to provide his Qi Excel spreadsheet to the precision matrix labs to evaluate their operational data for Qi performance.

11) Action Item – Precision matrix labs to review the "variable upper and lower QI limits concept" with their computer data acquisition staff to evaluate whether or not it is possible or realistic to incorporate this concept for Sequence IVB operational data validity determination. If it is possible, determine what the lead time to incorporate this will be. Labs to have this evaluation completed by Wednesday, 4/6/16.

12) Motion – The Sequence IVB Task Force and Sequence IV Surveillance Panel approves the Sequence IVB test as ready for precision matrix testing and recommends proceeding with the precision matrix, including the original three matrix labs, Intertek (stands 100 and 101), SwRI (stands 19 and 20) and Lubrizol (stand 347), the original precision matrix design and the procedural process improvements approved in motion # 5 from today's meeting.
Teri Kowalski / Bill Buscher / Passed 6 – 5 – 4

13) Action Item – Negative voters on motion # 12 from today's meeting to provide comments on their negative votes to the Sequence IV Surveillance Panel chair, for distribution, by the end of business on Friday, 4/1/16.

Rich Grundza

From: Campbell, Bob <Bob.Campbell@AftonChemical.com>
Sent: Friday, April 01, 2016 8:54 AM
To: Bill Buscher Intertek
Cc: 'lindenjim@jlindenconsulting.com' (lindenjim@jlindenconsulting.com); 'Teri Kowalski (TEMA TTC)'; Glaenzer, Dave
Subject: Afton IVB Negative Comments

Afton's negative vote on the Sequence IVB being ready for matrix testing stems from several areas of concern.

1~The recent result from SwRI stand 17 indicates that controlling coolant flow rather than delta T may potentially be a large severity lever and could bring the severe stands more in line with the DOE stands. We certainly support the adoption of this new control strategy and the additional testing on this procedure. We believe waiting for these additional data points from SwRI stands 17/19, IAR stand 102 and Lz stand 347 are prudent for validating the severity lever prior to proceeding to matrix testing. If Lz stand 347 produces a result closer to the DOE stands, we would be reasonably assured that the severity differences are explained by the varying coolant flow and would be more agreeable to proceeding to matrix testing. If the Lz stand repeats at its current severity level, and SwRI stand 17 repeats at its new, lower severity level, we believe there is something else driving severity that the group needs to understand prior to precision matrix testing.

2~While the Golden Stand concept appears good, it hasn't proven to eliminate severity and precision differences. We would like to see some provisions put into place to allow labs to modify the stands slightly if the current design doesn't meet the reference acceptance bands. We believe the Golden Stand concept potentially "ties the hands" of the labs should severity or precision issues arise. We would like the group to address this through the procedure rather than requiring the lab to continually bring proposed modifications to the surveillance panel for approval. This process in the past has proven very inefficient and can potentially eliminate the ability for a lab to calibrate. With the amount of investment required for this installation and its support, this really isn't a palatable option for the labs.

3~If the severity level remains unchanged, we are not comfortable with the current severity differences between the stands. While we agree that the matrix design should properly estimate the tests "true" precision, allowing stands that operate at nominally 2x the severity of others seems out of line with our ultimate goal of a level playing field. We are concerned that if the current severity drivers aren't better understood, the potential to unknowingly influence candidates is high, which could potentially allow poor fluids to pass, or vice versa.

4~We fully recognize and applaud the efforts of Toyota and the entire development team throughout the process and recognize the difficulties of developing such a test. We also intend on purchasing a Golden Stand and participating in the future development team/surveillance panel activities to both deliver and maintain the IVB through the life of GF6.

Bob Campbell

Rich Grundza

From: Mileti, Christopher <Christopher.Mileti@Lubrizol.com>
Sent: Friday, April 01, 2016 11:10 AM
To: Bill Buscher Intertek
Cc: Brys, Jerome; Matasic, James; Evans, Gail; OMalley, Kevin
Subject: RE: Material and Call-in/Web Conference Info for the 3/30/16 Joint Sequence IV Surveillance Panel / Sequence IVB Task Force Meeting

Good morning Bill,

Here are the supporting comments for Lubrizol's negative vote on Motion #12:

1. The recent data collected at SWRI regarding the potentially strong correlation between **coolant flow rate** and overall **test severity** may provide an opportunity to significantly reduce the current stand-to-stand variability.

2. The IVB Task Force has a technical responsibility to confirm these SWRI findings (which will take a relatively short amount of time).

3. A confirmation of this correlation will provide the IVB Task Force with an unprecedented opportunity to improve the overall precision of the IVB test prior to the Precision Matrix.

4. Lubrizol would like to revisit Motion #12 after the SWRI data is confirmed (or disproven) and any resulting stand upgrades are implemented and validated.

Thanks.

Chris Mileti

Mechanical Testing Department
Phone: 440-347-2521
Cell: 440-227-2385
Fax: 440-347-4096

From: Bill Buscher Intertek [mailto:william.buscher@intertek.com]
Sent: Wednesday, March 30, 2016 7:29 PM
To: NON-LZ LOPEZ AL ; 'Liu, Eric' ; NON-LZ LANG PATRICK ; 'Clark, Sidney L.' ; 'SATOSHI HIRANO' ; 'Teri Kowalski (TEMA TTC)' ; 'lindenjim@jlindenconsulting.com' ; 't-sagawa@mail.nissan.co.jp' ; 'stephen.fields@nissan-usa.com' ; 'Romano, Ron (R.)' ; Tang Haiying (FCA) (haiying.tang@fcagroup.com) ; 'bruce.matthews@gm.com' ; 'Mark Sutherland' ; 'Dan Lanctot' ; 'Clayton Knight' ; 'dhbowden@ohtech.com' ; 'Jason Bowden (jhbowden@OHTech.com)' ; 'Matthew Bowden' ; 'Adam Bowden' ; 'fmf@astmtmc.cmu.edu' ; 'jac@astmtmc.cmu.edu' ; 'Rich Grundza' ; 'Rieth, Ryan' ; 'Ritchie, Andrew' ; 'Farnsworth,

Gordon' ; 'Kaustav Sinha' ; 'Dave.Glaenzer@aftonchemical.com' ; 'Ed.Altman@aftonchemical.com' ; 'Bob.Campbell@aftonchemical.com' ; Brys, Jerome ; 'tlcaudill@ashland.com' ; 'Scott.Lindholm@shell.com' ; 'Jeff Hsu' ; 'Hapjthom@aol.com' ; 'BuschWA@aol.com' ; 'Mike McMillan' ; 'Chris Castanien (Chris.Castanien@nesteoil.com)' ; 'Amol Savant' ; OMalley, Kevin ; 'ray.seiz@infineum.com' ; NON-LZ CHADWICK MARTIN ; Rajakumar, Allison ; Buchanan, Jessica ; Scinto, Phil ; 'Dvorak, Todd' ; 'Jo Martinez' ; 'Doyle Boese' ; 'Affinito, Ricardo E' ; NON-LZ LOCHTE MIKE ; 'jofran.pastor@infineum.com' ; 'Marks, Brian T' ; 'Stockwell, Robert T' ; 'Lieu, Valerie H' ; Mileti, Christopher ; Kimberly Bennett ; NON-LZ GLASER JOHN ; Mourhatch, Ramoun ; Kostan, Travis G. ; Rais, Khaled ; Karin.Haumann@shell.com; Mark Adams ; Salvesen, Clifford R ; Smith, Jordan Cesar ; OMalley, Kevin ; Matasic, James ; Karin Haumann
Subject: RE: Material and Call-in/Web Conference Info for the 3/30/16 Joint Sequence IV Surveillance Panel / Sequence IVB Task Force Meeting

Motions and action items from today's meeting are attached. Please address the last action item, which I've also copied to this email below, by the end of this week.

Action Item – Negative voters on motion # 12 from today's meeting to provide comments on their negative votes to the Sequence IV Surveillance Panel chair, for distribution, by the end of business on Friday, 4/1/16.

William A. Buscher III
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obtained at our website: http://www.intertek.com/terms/ Should you have any difficulty obtaining these from the web site, please contact us immediately and we will send a copy by return.

From: Bill Buscher Intertek
Sent: Tuesday, March 29, 2016 8:21 PM
To: Alfonso Lopez Intertek; 'Liu, Eric'; 'Lang, Patrick M.'; 'Clark, Sidney L.'; 'SATOSHI HIRANO'; 'Teri Kowalski (TEMA TTC)'; 'lindenjim@jlindenconsulting.com'; 't-sagawa@mail.nissan.co.jp'; 'stephen.fields@nissan-usa.com'; 'Romano, Ron (R.)'; Tang Haiying (FCA) (haiying.tang@fcagroup.com); 'bruce.matthews@gm.com'; 'Mark Sutherland'; 'Dan Lanctot'; 'Clayton Knight'; 'dhbowden@ohtech.com'; 'Jason Bowden (jhbowden@OHTech.com)'; 'Matthew Bowden'; 'Adam Bowden'; 'fmf@astmtmc.cmu.edu'; 'jac@astmtmc.cmu.edu'; 'Rich Grundza'; 'Rieth, Ryan'; 'Ritchie, Andrew'; 'Farnsworth, Gordon'; 'Kaustav Sinha'; 'Dave.Glaenzer@aftonchemical.com'; 'Ed.Altman@aftonchemical.com'; 'Bob.Campbell@aftonchemical.com'; 'Brys, Jerome'; 'tlcaudill@ashland.com'; 'Scott.Lindholm@shell.com'; 'Jeff Hsu'; 'Hapjthom@aol.com'; 'BuschWA@aol.com'; 'Mike McMillan'; 'Chris Castanien (Chris.Castanien@nesteoil.com)'; 'Amol Savant'; 'Kevin.OMalley@lubrizol.com'; 'ray.seiz@infineum.com'; Martin Chadwick Intertek; 'Allison Rajakumar'; 'Jessica Buchanan'; 'Phil Scinto'; 'Dvorak, Todd'; 'Jo Martinez'; 'Doyle Boese'; 'Affinito, Ricardo E'; 'Lochte, Michael D.'; 'jofran.pastor@infineum.com'; 'Marks, Brian T'; 'Stockwell, Robert T'; 'Lieu, Valerie H'; 'Mileti, Christopher'; Kimberly Bennett; John Glaser Intertek; Mourhatch, Ramoun; Kostan, Travis G.; Rais, Khaled; Karin.Haumann@shell.com; Mark Adams; Salvesen, Clifford R; Smith, Jordan Cesar; Kevin OMalley; James Matasic; Karin Haumann
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First, click: https://join.loopup.com/h6rrQO

Or, if you are offline, dial in:
(by joining, you agree to the privacy policy at loopup.com)
Participant Access Code: 2954887#
USA: +1 (877) 746-4263
Additional dial-in numbers:
UK (Local): +44 (0) 20 7019 0492

Service provided by LoopUp

Regards,

William A. Buscher III
Chairman, Sequence IV Surveillance Panel
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Cell: 210-240-8990
Email: william.buscher@intertek.com

Valued Quality. Delivered.

Rich Grundza

From: Salvesen, Clifford R <clifford.r.salvesen@exxonmobil.com>
Sent: Monday, April 04, 2016 9:32 AM
To: Bill Buscher Intertek
Subject: RE: Material and Call-in/Web Conference Info for the 3/30/16 Joint Sequence IV Surveillance Panel / Sequence IVB Task Force Meeting

Hi Bill,

Sorry for the delay, my laptop had connectivity issues at the airport Friday, and had to go to IT this morning.

XOM comments from the negative vote:
-The IVB development is progressing well, but the coolant flow issue identified offers a chance to explain some of the severity variation between and sometimes within labs. With SWRI, IAR, and LZ all running follow-up tests, starting Precision Matrix seems premature. The data from the coolant flow runs should be available in the next two weeks, and if it looks promising we can move ahead with the PM at that time with more confidence.

Any questions, let me know.

Thanks,

Cliff

From: Bill Buscher Intertek [mailto:william.buscher@intertek.com]
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Regards,

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