

Seq. III Surveillance Panel
November 8, 2013
Teleconference Meeting Minutes

Attendance

The attendance is shown in Attachment 1.

Seq. III Cylinder Head Task Force Report

The main purpose of the teleconference was to review and consider the report (**Attachment 2**) of the task force that was led by Sid Clark. GM has requested panel approval before they place an order and move the work to the machine shop. It was noted that the race shop is not currently processing any heads (in case there is an opportunity to update the remaining heads).

A small matrix of prove out tests was run to examine the suitability of Stellite material for intake and exhaust valve seat inserts. Pat Lang reviewed the report. The TF recommends the use of the Stellite seat inserts for Seq. III testing. Pat Lang moved, Ed Altman (via proxy to Dave Glaenzer) seconded to approve the use of the Stellite seat insert material for IIIG and IIIF and to instruct GM to move forward with the processing of the material.

Discussion of Motion - Charlie Leverett was concerned about the short notice for the call as well as some issues with the data (copper level and mild cam wear were noted). Please note that just prior to the meeting, several panel members sent information/analyses to the panel; these are shown, in no particular order, in **Attachment 3**.

Copper - Sid Clark stated that piston pin bushings, engine bearings, camshaft thrust plate, and oil pump gears are places the copper could be coming from and he suspects it may be the piston pin bushing sourcing the copper due to being stressed slight more from the consistent compression pressures. Dave Glaenzer asked Martin if he would look into the issue some more and Martin agreed. Pat reminded that copper levels are a concentration and changes in oil consumption may be contributing to the difference.

Mild ACLW - Robert Stockwell was concerned that the oil 438 results were the most mild ever seen. He stated his belief that valve train dynamics may have been impacted by the new seat insert material and could be impacting severity. His main concern was to have people prepare for the face-to-face meeting in a few weeks to discuss this issue in greater depth. Rich Grundza sent some plots by cam batch and noted frequent mild excursions began in 2010. His concern is that severity adjustments may no longer adequately capture lab bias given the recent data. Jason Bowden was asked if there has been any change to the lifters and Jason stated he believed there has been no change. Jason also reminded the panel that during the 2010 severity examination, which looked at several components, the panel found no hardware or

process changes. Curious readers may review the ACLW TF report, which is included in April 2010 meeting minutes, at the following link:

<ftp://ftp.astmtmc.cmu.edu/docs/gas/sequenceiii/minutes/2010/TeleconferenceMinutes20100408.pdf> .

Dave Glaenzer stated that ACLW severity issue will be a major agenda item at the next meeting. Charlie asked if it was worthwhile to have industry statisticians review the prove out data prior to the face-to-face meeting. Dave agreed and will send out a request. Rich Grundza will examine the TMC database for any negative wear values for fixing. It was noted that this motion does not cover implementation/introduction into live test -- it only give direction to GM to go ahead with the processing change.

The question was called by the chair and the motion passed unanimously.

Current Inventory Levels

Robert Stockwell moved, Charlie Leverett second, that GM also restart manufacturing head as currently used (to avoid a potential shortage while waiting the new heads). At this point a frantic and wide-ranging discussion broke out, for which the secretary could simply not record fast enough. At the end of the discussion, Robert withdrew the motion and the topic will be discussed at the next meeting; Dave Glaenzer will survey the labs about their inventories of heads.

The meeting concluded at approximately 3:10 pm.

Quorum = 10 VOTING MEMBERS

Attachment 1

ASTM Sequence III Surveillance Panel (~~18~~ Voting members)

date: 11/08/13

20

| Name/Address | Phone/Fax/Email | | Signature |
|--------------|-----------------|--|-----------|
|--------------|-----------------|--|-----------|

| | | | |
|---|--|----------------------|--|
| Ed Altman Afton Chemical Corporation 500 Spring Street Richmond, VA 23219 USA | 804-788-5279 804-788-6358 ed.altman@aftonchemical.com | Voting Member | Present <input checked="" type="checkbox"/> <i>Represented by D. GLAENZER</i> |
|---|--|----------------------|--|

| | | | |
|---|--|-------------------|----------------------------------|
| Art Andrews ExxonMobil Products Research 600 Billingsport Rd. Paulsboro, NJ 08066 USA | 856-224-3013 arthur.t.andrews@exxonmobil.com | Non-Voting Member | Present <input type="checkbox"/> |
|---|--|-------------------|----------------------------------|

| | | | |
|---|--|-------------------|--|
| Zack Bishop Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249-3423 USA | 210-877-0223 210-690-1959 zbishop@tei-net.com | Non-Voting Member | Present <input checked="" type="checkbox"/> <i>VOTING</i> |
|---|--|-------------------|--|

| | | | |
|---|--|-------------------|---|
| Doyle Boese Infineum 1900 E. Linden Avenue Linden, NJ 07036 USA | 908-474-3176 908-474-3637 doyle.boese@infineum.com | Non-Voting Member | Present <input checked="" type="checkbox"/> |
|---|--|-------------------|---|

| | | | |
|--|--|-------------------|----------------------------------|
| Adam Bowden OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 USA | 440-354-7007 440-354-7080 adbowden@ohtech.com | Non-Voting Member | Present <input type="checkbox"/> |
|--|--|-------------------|----------------------------------|

| | | | |
|---|--|----------------------|---|
| Jason Bowden OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 USA | 440-354-7007 440-354-7080 jhbowden@ohtech.com | Voting Member | Present <input checked="" type="checkbox"/> <i>[Signature]</i> |
|---|--|----------------------|---|

| | | | |
|---|--|-------------------|---|
| Dwight H. Bowden OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 USA | 440-354-7007 440-354-7080 dhbowden@ohtech.com | Non-Voting Member | Present <input checked="" type="checkbox"/> |
|---|--|-------------------|---|

R. STOCKWELL, GM
M. BOWDEN, OHT
A. SCHWEITZER, IAR
A. SWITZER, IAR

C. CASTADEN, LZ
S. STAPP, Chev. Paul
Voting Member 06/27/13

| Name/Address | Phone/Fax/Email | | Signature |
|---|--|-------------------|---|
| Matt Bowden OH Technologies, Inc. 9300 Progress Parkway P.O. Box 5039 Mentor, OH 44061-5039 USA | 440-354-7007 440-354-7080 mjbowden@ohtech.com | Non-Voting Member | Present _____ |
| Jerome A. Brys Lubrizol Corp. 29400 Lakeland Blvd. Wickliffe, Ohio 44092 USA | 440 347-2631 jerome.brys@lubrizol.com | Non-Voting Member | Present <input checked="" type="checkbox"/> _____ |
| Bill Buscher III Southwest Research Institute 6220 Culebra Road P.O. Box 28510 San Antonio, TX 78228 USA | 210-522-6802 210-684-7523 william.buscher@swri.org | Non-Voting Member | Present _____ |
| Bob Campbell Afton Chemical Corporation 500 Spring Street Richmond, VA 23219 USA | 804-788-5340 804-788-6358 bob.campbell@aftonchemical.com | Non-Voting Member | Present _____ |
| Chris Castanien The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA | 440-347-2973 440-944-8112 cca@lubrizol.com | Non-Voting Member | Present _____ |
| Timothy L. Caudill Ashland Oil Inc. 22 nd & Front Streets Ashland, KY 41101 USA | 606-329-1960 x5708 606-329-2044 tlcaudill@ashland.com | Voting Member | Present _____ |
| Martin Chadwick Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238 USA | 210-706-1543 210-684-6074 martin.chadwick@intertek.com | Non-Voting Member | Present <input checked="" type="checkbox"/> _____ |

ASTM Sequence III Surveillance Panel (19 Voting members)

date: 11/08/13

| Name/Address | Phone/Fax/Email | | Signature |
|---|--|-------------------|--|
| Jeff Clark Sequence III Secretary ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 USA | 412-365-1032 412-365-1047 jac@atc-erc.org | Non-Voting Member | Present <input checked="" type="checkbox"/> |
| Sid Clark Southwest Research 50481 Peggy Lane Chesterfield, MI 48047 USA | 586-873-1255 Sidney.L.Clark@swri.org | Non-Voting Member | Present <input checked="" type="checkbox"/> |
| Todd Dvorak Afton Chemical Corporation P.O. Box 2158 Richmond, VA 23218-2158 USA | 804-788- 6367 804-788- 6388 todd.dvorak@aftonchemical.com | Non-Voting Member | Present <input type="checkbox"/> |
| Frank Farber ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 USA | 412-365-1030 412-365-1047 fmf@astmtmc.cmu.edu | Non-Voting Member | Present <input type="checkbox"/> |
| Gordon R. Farnsworth Infineum RR # 5 Box 211 Montrose, PA 18801 USA | 570-934-2776 570-934-0141 gordon.farnsworth@infineum.com | Non-Voting Member | Present <input checked="" type="checkbox"/> <i>ANDY RITCHIE VOTE</i> |
| Joe Franklin Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238 USA | 210-523-4671 210-523-4607 joe.franklin@intertek.com | Non-Voting Member | Present <input type="checkbox"/> |
| David L. Glaenzer Afton Chemical Corporation 500 Spring Street P.O. Box 2158 Richmond, VA 23218-2158 USA | 804-788-5214 804-788-6358 dave.glaenzer@aftonchemical.com Surveillance Panel Chairman | Non-Voting Member | Present <input checked="" type="checkbox"/> |

ASTM Sequence III Surveillance Panel (19 Voting members)


date: 11/08/13

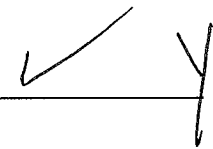
| Name/Address | Phone/Fax/Email | | Signature |
|---|--|-------------------|--|
| Richard Grundza ASTM Test Monitoring Center 6555 Penn Avenue Pittsburgh, PA 15206 USA | 412-365-1031 412-365-1047 reg@astmtmc.cmu.edu | Voting Member | Present <input checked="" type="checkbox"/> Y |
| Tracey King Haltermann Solutions MI USA | 947-517-4107 tking@jhaltermann.com | Voting Member | Present <input checked="" type="checkbox"/> |
| Clayton Knight Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249-3423 USA | 210-690-1958 210-690-1959 cknight@tei-net.com | Voting Member | Present <u>ZACK</u> <input checked="" type="checkbox"/> <u>VOTE</u> |
| Teri Kowalski Toyota Motor North America, Inc. 1555 Woodridge Ann Arbor, MI 48105 | 734-995-4032 734-995-9049 teri.kowalski@tema.toyota.com | Voting Member | Present _____ |
| Patrick Lang Southwest Research Institute 6220 Culebra Road P.O. Box 28510 San Antonio, TX 78228 USA | 210-522-2820 210-684-7523 plang@swri.edu | Voting Member | Present <input checked="" type="checkbox"/> Y |
| Walter Lerche GM M/C 482-A30-C71 100 Renaissance Center Detroit, MI 48265 USA | 313-667-1918 313-667-4095 walt.lerche@gm.com | Non-Voting Member | Present _____ |
| Charlie Leverett Intertek Automotive Research 5404 Bandera Road San Antonio, TX 78238 USA | 210-647-9422 210-523-4607 charlie.leverett@intertek.com | Voting Member | Present <input checked="" type="checkbox"/> Y |
| Josephine G. Martinez Chevron Oronite Company LLC 100 Chevron Way Richmond, CA 94802 USA | 510-242-5563 510-242-3173 jogm@chevrontexaco.com | Voting Member | Present <input checked="" type="checkbox"/> Y |

ASTM Sequence III Surveillance Panel (19 Voting members)

date: 11/08/13

| Name/Address | Phone/Fax/Email | | Signature |
|--|--|-------------------|---|
| Bruce Matthews GM Powertrain Mail Code 483-730-472 823 Jocyn Avenue Pontiac, MI 48340 USA | 248-830-9197 248-857-4441 bruce.matthews@gm.com Test Sponsor Representative | Voting Member | Present <input checked="" type="checkbox"/> _____ Y |
| Mike McMillan | mmcmillan123@comcast.net | Non-Voting Member | Present _____ |
| Timothy Miranda BP Castrol Lubricants USA 1500 Valley Road Wayne, NJ 07470 USA | 973-305-3334 973-686-4039 Timothy.Miranda@bp.com | Voting Member | Present <input checked="" type="checkbox"/> _____ Y |
| Mark Mosher ExxonMobil Technology Co. Billingsport Road Paulsboro, NJ 08066 USA | 856-224-2132 856-224-3628 mark.r.mosher@exxonmobil.com | Voting Member | Present <input checked="" type="checkbox"/> _____ Y |
| Siamak Moshiri Cad Railway Industries Ltd. 155 Montreal – Toronto Highway H8S 1B4 Montreal, QC CANADA | 1-634-3131, ext. 412 smoshiri@cadrail.ca | Non-Voting Member | Present _____ |
| Bob Olree 5388 Hill 23 Drive Flint, MI 48507 USA | 248-689-3078 olree@netzero.net | Non-Voting Member | Present _____ |
| Christian Porter Afton Chemical Corp. 500 Spring Street Richmond, VA 23219 USA | 804-788-5837 804-788-6358 christian.porter@aftonchemical.com | Non-Voting Member | Present _____ |
| Phil Rabbat BASF Corporation 500 White Plains Road Tarrytown, NY 10591-9005 USA | 914-785-2217 914-785-3681 phil.rabbat@basf.com | Non-Voting Member | Present _____ |

| Name/Address | Phone/Fax/Email | Member Type | Signature |
|---|--|-------------------|---|
| Allison Rajakumar The Lubrizol Corporation Drop 152A 29400 Lakeland Blvd. Wickliffe, OH 44092 USA | 440-347-4679 440-347-2014 Allison.Rajakumar@Lubrizol.com | Non-Voting Member | Present _____ |
| Scott Rajala Idemitsu Lubricants America Corp. | srajala@ilacorp.com | Non-Voting Member | Present _____ |
| Andrew Ritchie Infineum 1900 East Linden Avenue P.O. Box 735 Linden, NJ 07036 USA | 908-474-2097 908-474-3637 Andrew.Ritchie@Infineum.com | Voting Member | Present _____  |
| Ron Romano Ford Motor Company Diagnostic Service Center II Room 410. 1800 Fairlane Drive Allen Park, MI 48101 USA | 313-845-4068 313-32-38042 rromano@ford.com | Voting Member | Present _____ |
| Jim Rutherford Chevron Oronite Company LLC 100 Chevron Way Richmond, CA 94802 USA | 510-242-3410 510-242-3173 jaru@chevrontexaco.com | Non-Voting Member | Present _____ |
| Philip R. Scinto The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA | 440-347-2161 440-347-9031 prs@lubrizol.com | Non-Voting Member | Present _____ |
| Greg Shank Volvo | 301-790-5817 greg.shank@volvo.com | Voting Member | Present _____ |

| Name/Address | Phone/Fax/Email | | Signature |
|---|--|-------------------|---|
| Thomas Smith Valvoline P.O. Box 14000 Lexington, KY 40512-1400 USA | 859-357-2766 859-357-7084 trsmith@ashland.com PCEOCP Chair | Voting Member | Present _____ |
| Don Smolenski GM | 248-255-7892 donald.j.smolenski@gm.com | Non-Voting Member | Present _____ |
| Mark Sutherland Test Engineering, Inc. 12718 Cimarron Path San Antonio, TX 78249-3423 USA | msutherland@tei-net.com | Non-Voting Member | Present _____ |
| Adam Sworski Ashland Oil Inc. 22 nd & Front Streets Ashland, KY 41101 USA | aesworski@ashland.com | Non-Voting Member | Present _____ |
| George Szappanos The Lubrizol Corporation 29400 Lakeland Boulevard Wickliffe, OH 44092 USA | 440-347-2352 440-347-4096 greg.seman@lubrizol.com | Voting Member | Present _____  |
| Haiying Tang Chrysler LLC USA | 248-512-0593 ht146@chrysler.com | Voting Member | Present _____ |
| Ben O. Weber Southwest Research Institute 6220 Culebra Road P.O. Box 28510 San Antonio, TX 78228 USA | 210-522-5911 210-684-7530 bweber@swri.edu Sub-Committee D02.B01 Chair | Non-Voting Member | Present _____ |

Name/Address Phone/Fax/Email Signature

Tom Wingfield
Chevron Phillips Chemical Co.

wingftm@cpchem.com

Non-Voting Member Present _____

06/27/13

06/27/13

ATTACHMENT 2

Sequence III Cylinder Head Task Force

Stellite Valve Seat Insert
Background

Prove-out Test Data

Surveillance Panel Recommendation

Background

- April 2013
 - SwRI presented research test data to the Sequence III Surveillance Panel demonstrating that Stellite valve seat inserts in Sequence III G testing reduces compression loss and intake valve recession.
- August 2013
 - Sequence III Surveillance Panel forms the Cylinder Head Task Force to investigate use of Stellite seat inserts in both the intake and exhaust positions in Sequence III testing.

Background

- September 2013
 - Task Force receives small batch of Stellite seats manufactured according to dedicated prints for the 3800 cylinder heads.
 - Chevy Performance processes 20 cylinder heads through Schwartz Machine for prove-out testing.
- October 2013
 - Four prove-out tests conducted on TMC assigned reference oils.

Background

- October 31 2013
 - Cylinder head task force reviews test data, and unanimously agrees on recommending to the Sequence III Surveillance Panel, that new cylinder head castings with Stellite seat inserts installed in both the intake and exhaust positions be used in Sequence III testing.

Cylinder Head Task Force Recommendation

Motion – The Cylinder Head Task Force has conducted prove-out testing, reviewed the valve seat recession, compression and test result data from the recent industry donated tests, agrees the Stellite Seats provide better sealing and durability, and endorses their use in Sequence III testing.

Motion made by Charlie Leverett, IAR

Seconded by Robert Stockwell, GM

Motion passed unanimously

Example Data Comparison from Lab D

| Lab D | | | | | | | |
|---|--------------|------------|----------|---|--------------|------------|-----------|
| Cyl. Head Run Oil 435-2, EOT 10/12/2013 | | | | Reference Test Oil 435-2, EOT 9/28/2013 | | | |
| | | Yi | | Target | Yi | | |
| | WPD | 0.052 | 3.62 | 3.59 | 3.54 | -0.086 | |
| | PVIS | 0.769 | 226.3 | 178.4 | 175.9 | -0.045 | |
| | ACLW | -4.257 | 12.2 | 33.1 | 10.9 | -4.738 | |
| Stellite Compression | | | | Reference Compression | | | |
| Cylinder # | Pre -test | Post-test | Loss | Cylinder # | Pre -test | Post-test | Loss |
| 1 | 210 | 200 | 10 | 1 | 210 | 170 | 40 |
| 2 | 210 | 205 | 5 | 2 | 210 | 112 | 98 |
| 3 | 210 | 198 | 12 | 3 | 215 | 199 | 16 |
| 4 | 210 | 208 | 2 | 4 | 210 | 190 | 20 |
| 5 | 210 | 201 | 9 | 5 | 210 | 200 | 10 |
| 6 | 210 | 205 | 5 | 6 | 210 | 115 | 95 |
| AVG | 210 | 203 | 7 | AVG | 211 | 164 | 47 |
| Stellite Valve Recession (inches) | | | | Reference Valve Recession (inches) | | | |
| 1 Intake | 0.002 | | | 1 Intake | 0.010 | | |
| 1 Exhaust | 0.001 | | | 1 Exhaust | 0.001 | | |
| 2 Intake | 0.002 | | | 2 Intake | 0.003 | | |
| 2 Exhaust | 0.001 | | | 2 Exhaust | 0.001 | | |
| 3 Intake | 0.003 | | | 3 Intake | 0.058 | | |
| 3 Exhaust | 0.000 | | | 3 Exhaust | 0.001 | | |
| 4 Intake | 0.003 | | | 4 Intake | 0.001 | | |
| 4 Exhaust | 0.001 | | | 4 Exhaust | 0.004 | | |
| 5 Intake | 0.000 | | | 5 Intake | 0.038 | | |
| 5 Exhaust | 0.003 | | | 5 Exhaust | 0.001 | | |
| 6 Intake | 0.002 | | | 6 Intake | 0.004 | | |
| 6 Exhaust | 0.001 | | | 6 Exhaust | 0.002 | | |
| AVG | 0.002 | | | AVG | 0.010 | | |

Data Summary

Pre-test Compression (psi)

| Cylinder | Lab A | Lab B | Lab D | Lab G |
|----------------|------------|------------|------------|------------|
| 1 | 190 | 160 | 210 | 190 |
| 2 | 198 | 160 | 210 | 190 |
| 3 | 203 | 165 | 210 | 195 |
| 4 | 194 | 165 | 210 | 190 |
| 5 | 195 | 165 | 210 | 190 |
| 6 | 200 | 165 | 210 | 190 |
| Average | 197 | 163 | 210 | 191 |

Post-test Compression (psi)

| Cylinder | Lab A | Lab B | Lab D | Lab G |
|----------------|------------|------------|------------|------------|
| 1 | 195 | 175 | 200 | 175 |
| 2 | 190 | 180 | 205 | 170 |
| 3 | 195 | 180 | 198 | 170 |
| 4 | 195 | 185 | 208 | 170 |
| 5 | 190 | 170 | 201 | 170 |
| 6 | 190 | 180 | 205 | 170 |
| Average | 193 | 178 | 203 | 171 |

Compression Loss (psi)

| Cylinder | Lab A | Lab B | Lab D | Lab G |
|----------------|----------|------------|----------|-----------|
| 1 | -5 | -15 | 10 | 15 |
| 2 | 8 | -20 | 5 | 20 |
| 3 | 8 | -15 | 12 | 25 |
| 4 | -1 | -20 | 2 | 20 |
| 5 | 5 | -5 | 9 | 20 |
| 6 | 10 | -15 | 5 | 20 |
| Average | 4 | -15 | 7 | 20 |

Data Summary

Post-test Valve Seat Recession (inches)

| Valve Position | Lab A | Lab B | Lab D | Lab G |
|----------------|--------------|--------------|-------|--------------|
| Cyl. 1 Intake | 0.001 | Not Recorded | 0.002 | 0.012 |
| Cyl. 1 Exhaust | 0.003 | | 0.001 | 0.005 |
| Cyl. 2 Intake | 0.000 | | 0.002 | 0.004 |
| Cyl. 2 Exhaust | 0.001 | | 0.001 | 0.009 |
| Cyl. 3 Intake | 0.003 | | 0.003 | 0.003 |
| Cyl. 3 Exhaust | 0.003 | | 0.000 | 0.005 |
| Cyl. 4 Intake | 0.002 | | 0.003 | 0.001 |
| Cyl. 4 Exhaust | 0.002 | | 0.001 | 0.005 |
| Cyl. 5 Intake | 0.002 | | 0.000 | 0.006 |
| Cyl. 5 Exhaust | 0.002 | | 0.003 | 0.008 |
| Cyl. 6 Intake | 0.002 | | 0.002 | 0.009 |
| Cyl. 6 Exhaust | 0.002 | | 0.001 | 0.001 |
| Average | 0.002 | | | 0.002 |

TMC Data Summary

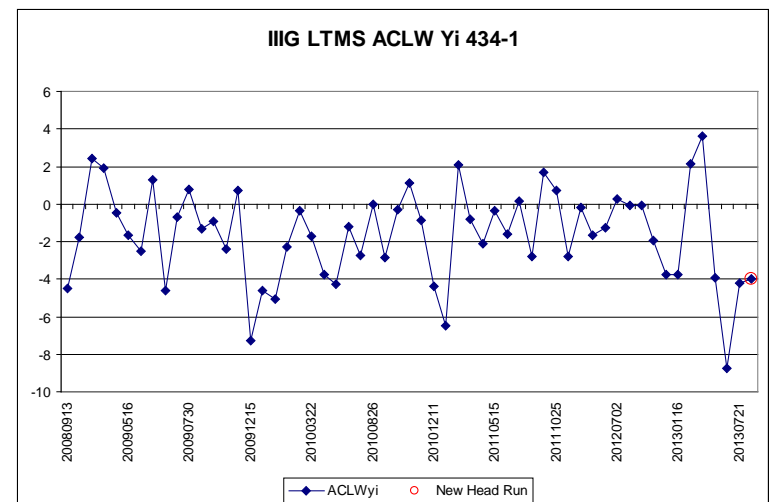
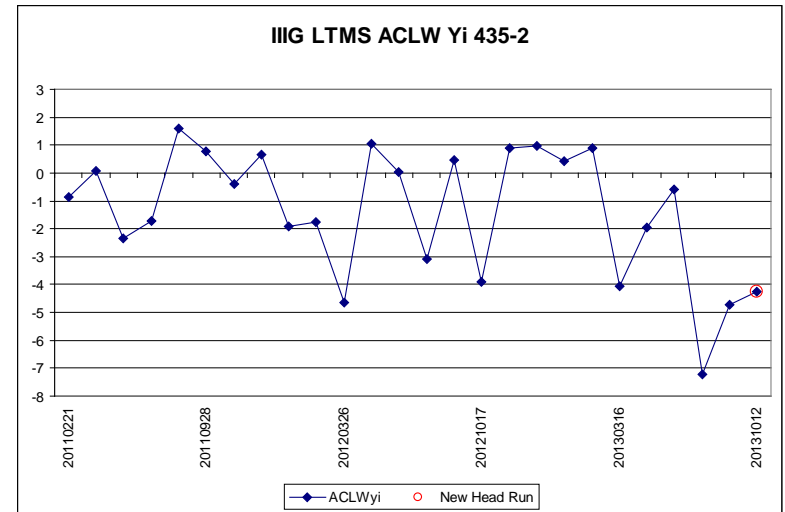
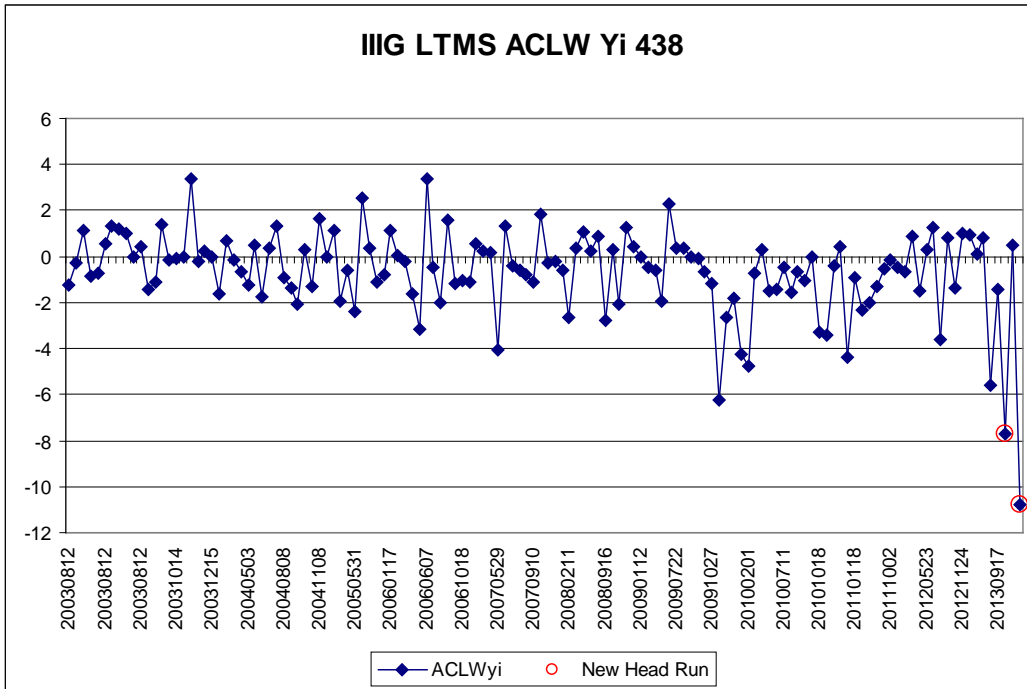
| Lab A | | | | | | |
|--------------------|---------|-------|--------|-----------------------|--------|------|
| Cylinder Head Test | | | 434-1 | Recent Reference Test | | |
| | Yi | | Target | | Yi | |
| WPD | -1.156 | 3.69 | 4.80 | N/A | N/A | WPD |
| PVIS | 2.376 | 282.0 | 178.4 | N/A | N/A | PVIS |
| ACLW | -4.006 | 14.4 | 33.1 | N/A | N/A | ACLW |
| Lab B | | | | | | |
| Cylinder Head Test | | | 438 | Recent Reference Test | | |
| | Yi | | Target | | Yi | |
| WPD | -1.091 | 2.84 | 3.20 | 2.96 | -0.728 | WPD |
| PVIS | -1.095 | 79.6 | 96.5 | 92.4 | -0.252 | PVIS |
| ACLW | -7.678 | 3.6 | 17.8 | 19.8 | 0.501 | ACLW |
| Lab D | | | | | | |
| Cylinder Head Test | | | 435 | Recent Reference Test | | |
| | Yi | | Target | | Yi | |
| WPD | 0.052 | 3.62 | 3.59 | 3.54 | -0.086 | WPD |
| PVIS | 0.769 | 226.3 | 178.4 | 175.9 | -0.045 | PVIS |
| ACLW | -4.257 | 12.2 | 33.1 | 10.9 | -4.738 | ACLW |
| Lab G | | | | | | |
| Cylinder Head Test | | | 438 | Recent Reference Test | | |
| | Yi | | Target | | Yi | |
| WPD | -1.485 | 2.71 | 3.20 | 2.83 | -1.121 | WPD |
| PVIS | 0.546 | 106.4 | 96.5 | 93.4 | -0.190 | PVIS |
| ACLW | -10.757 | 1.9 | 17.8 | 13.2 | -1.447 | ACLW |

Surveillance Panel Required Action

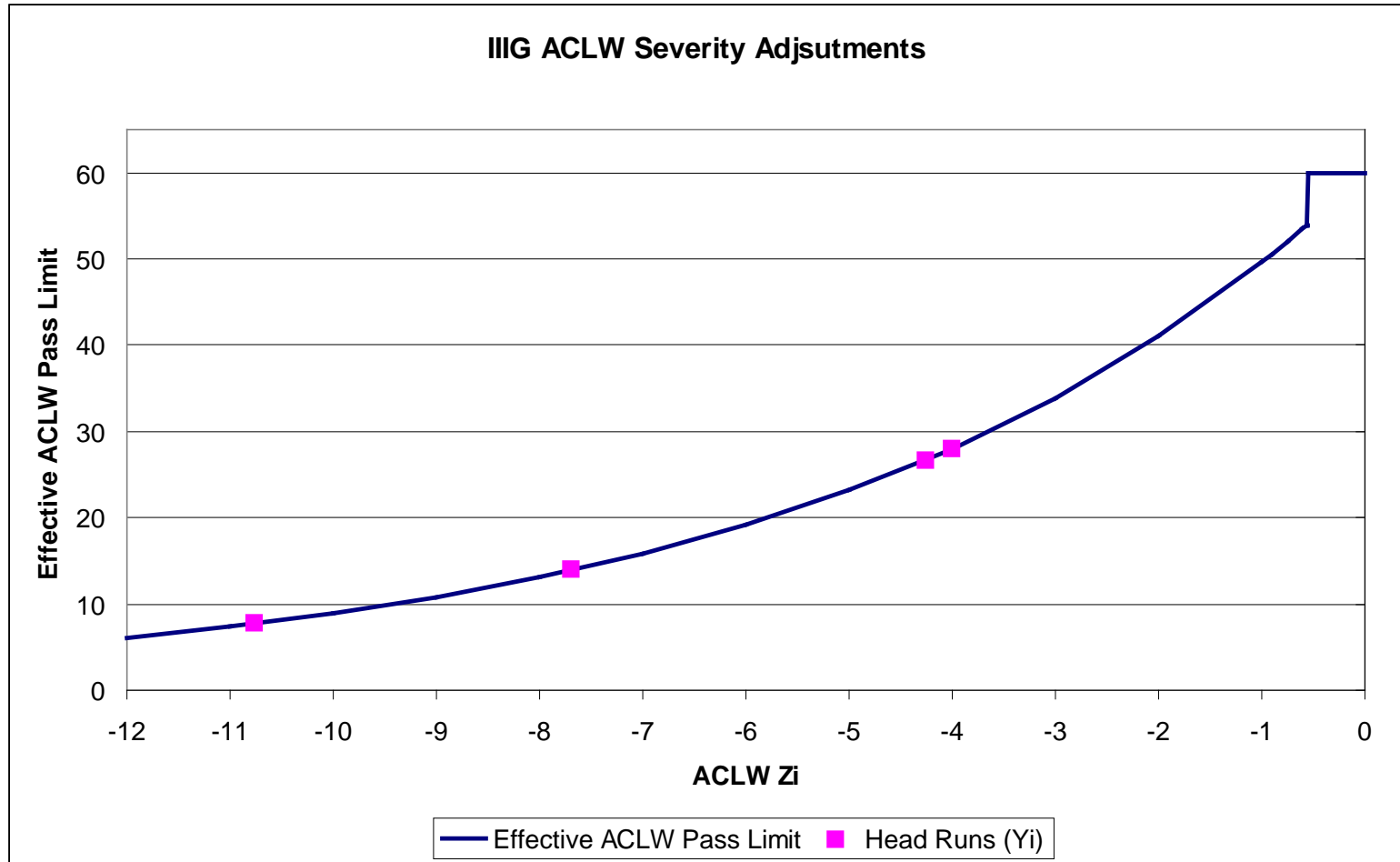
- Surveillance Panel approval of the Cylinder Head Task Force Recommendation
 - General Motors is requiring surveillance panel approval prior to placing the order for a large batch of Stellite seat material
 - There is a long lead time involved in procuring the seat material
 - This material is needed in order to move forward with the processing of cylinder heads through Chevy Performance

ATTACHMENT 3

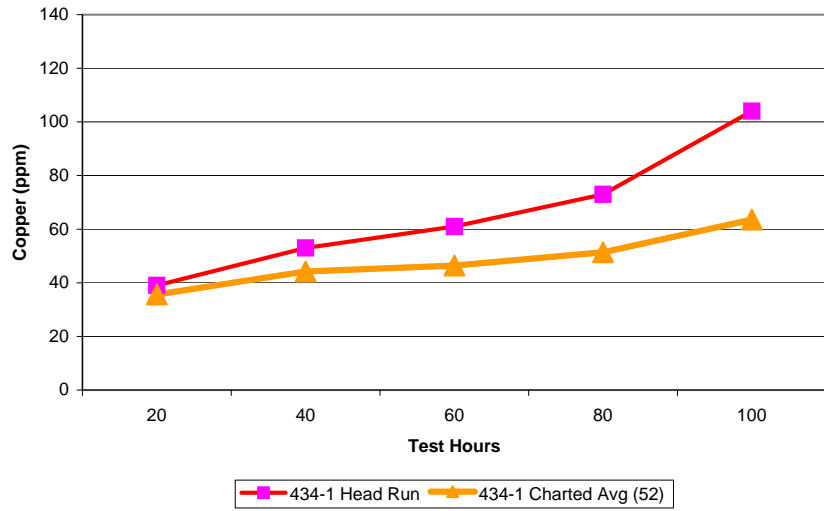
Recent head evaluation runs produced the two mildest 438 results ever for ACLW



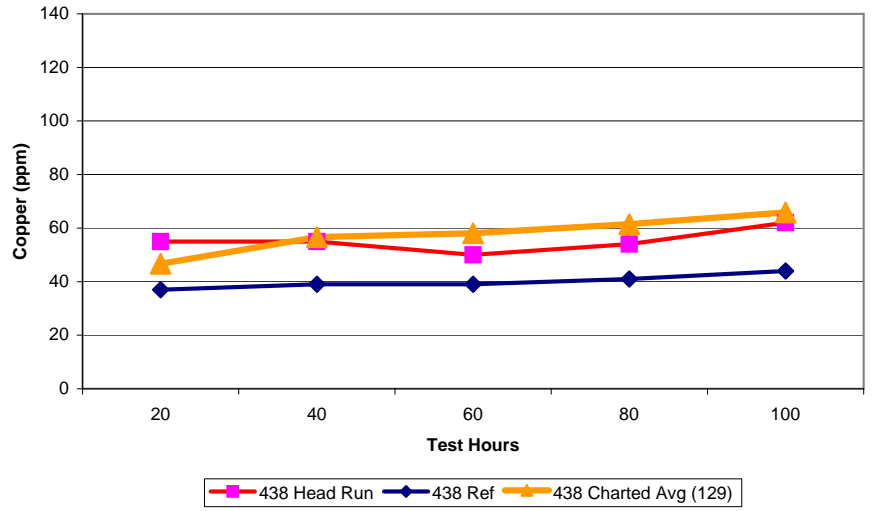
Recent ACLW performance could result in severity adjustments that are large enough to impact the ability to pass candidates



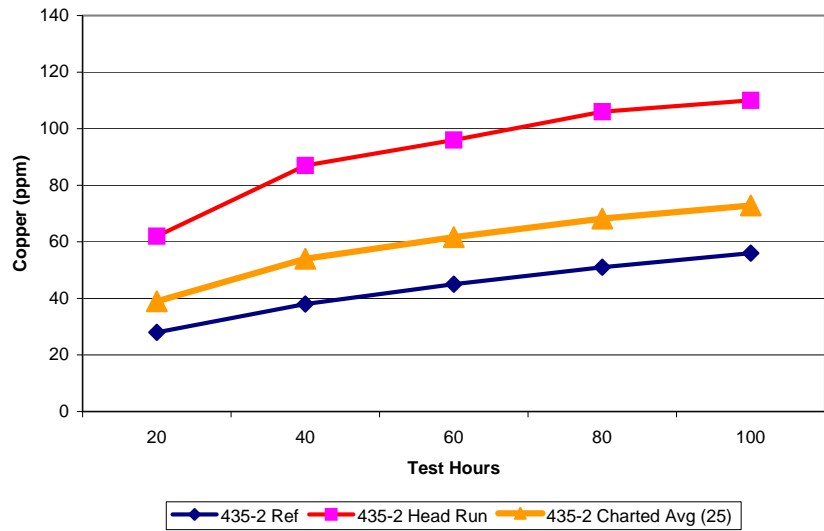
IIIG Head Evaluation Runs Copper - Lab A



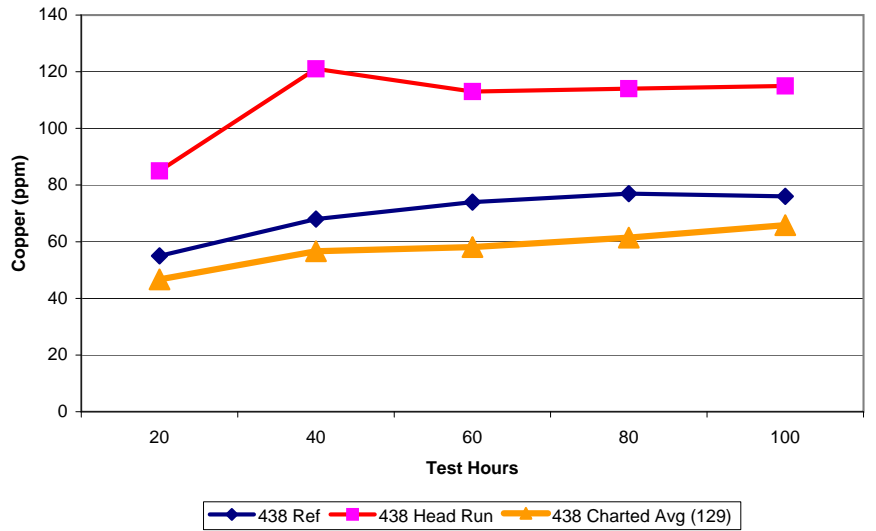
IIIG Head Evaluation Runs Copper - Lab B

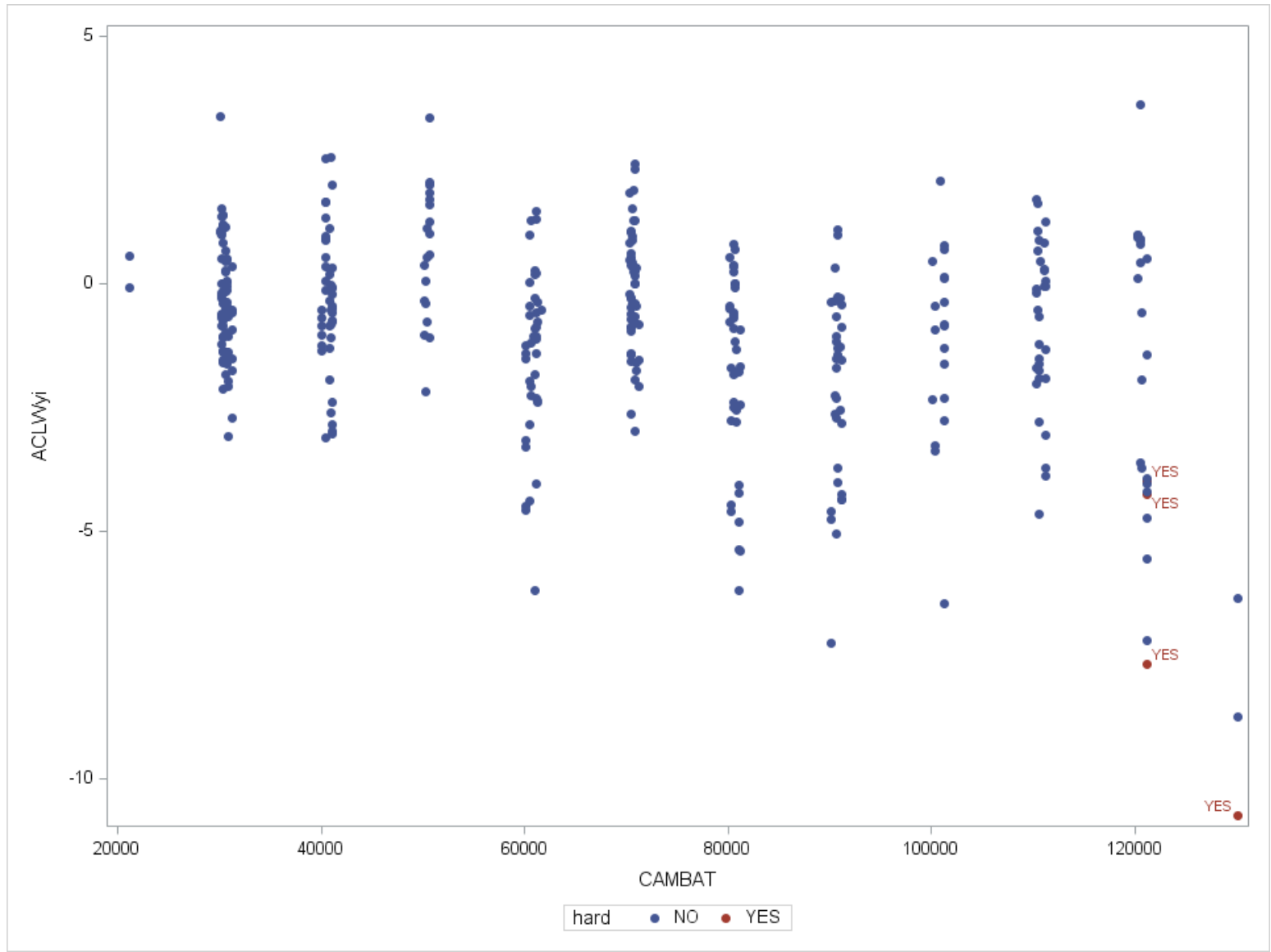


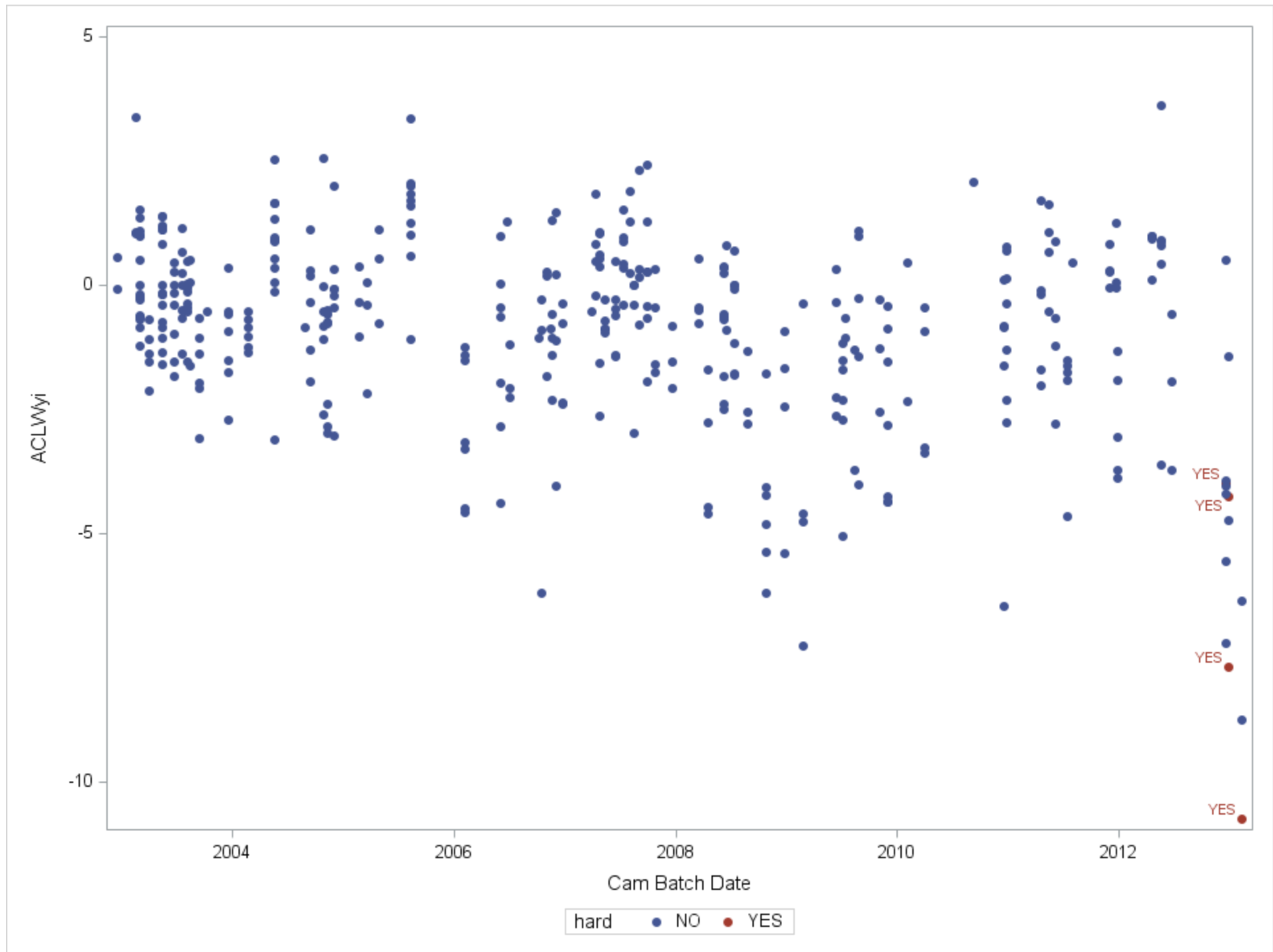
IIIG Head Evaluation Runs Copper - Lab D

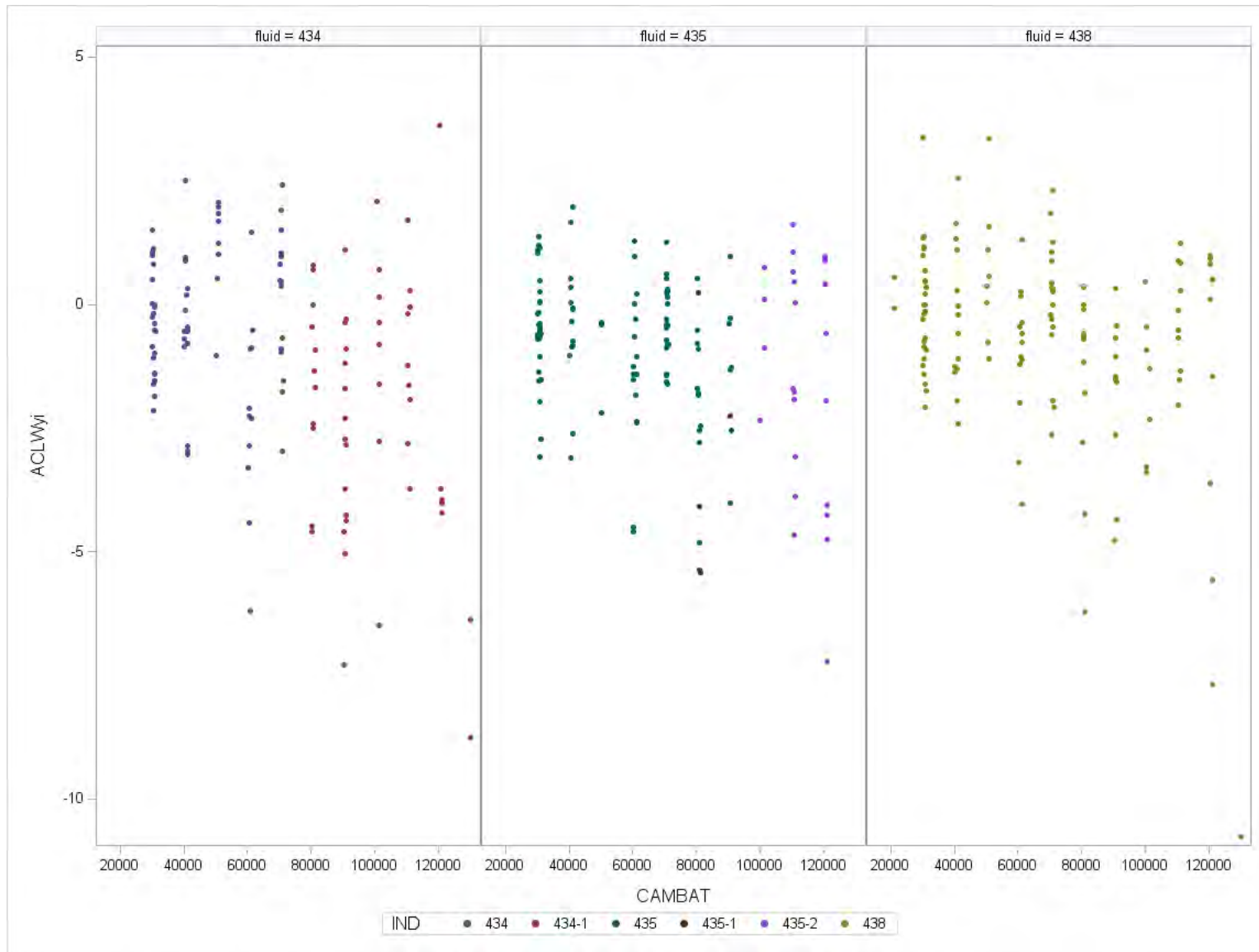


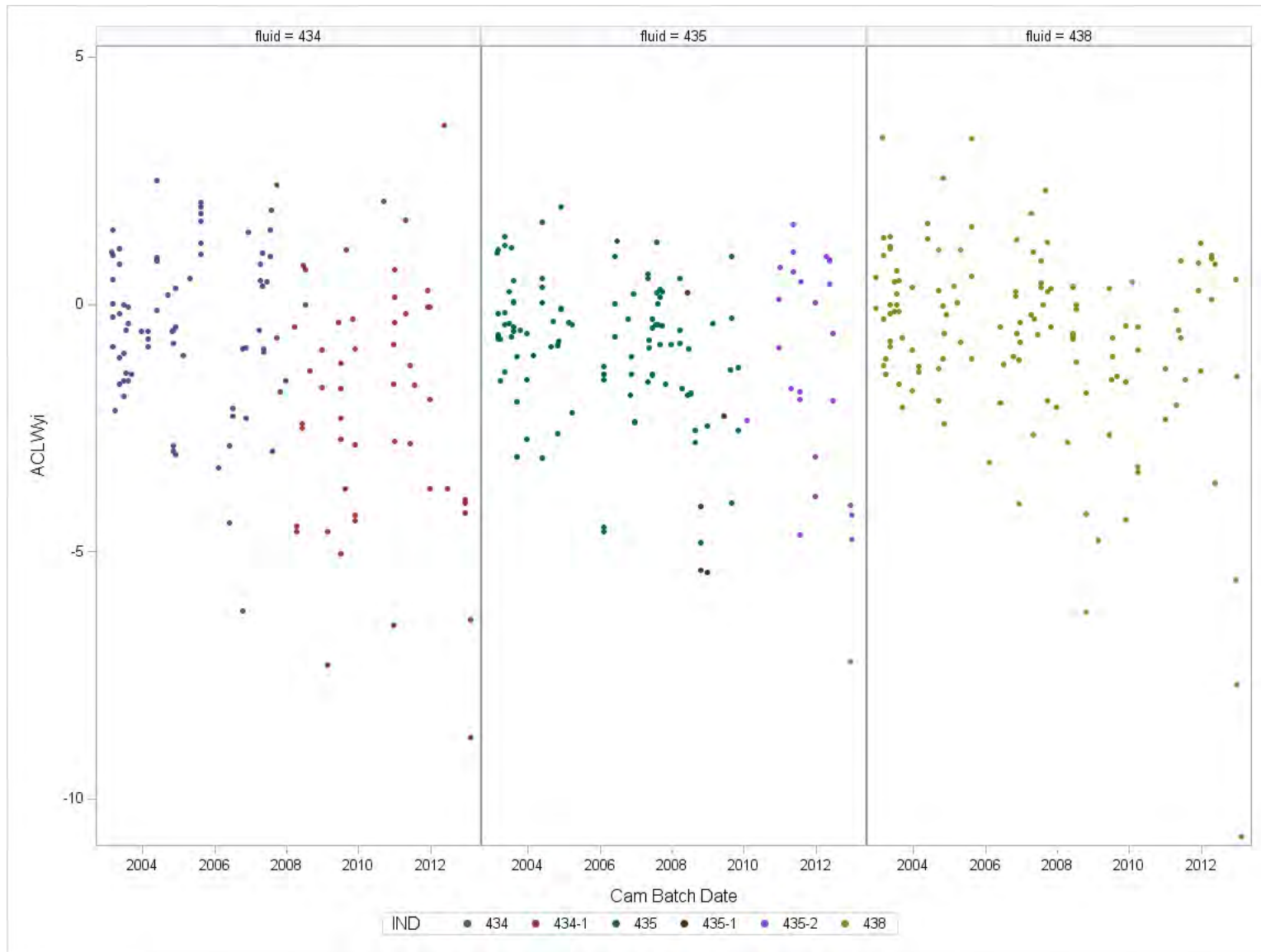
IIIG Head Evaluation Runs Copper - Lab G

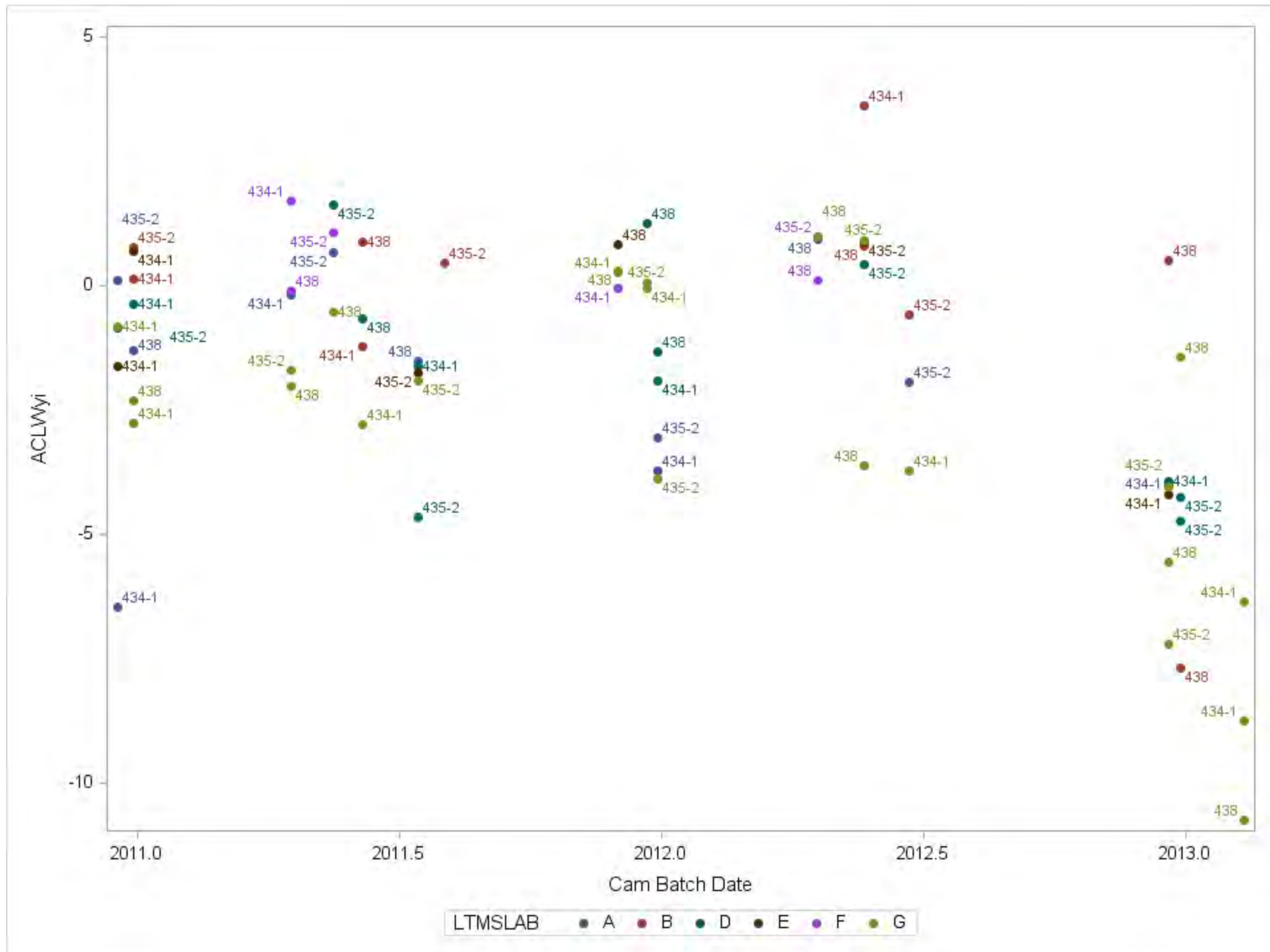


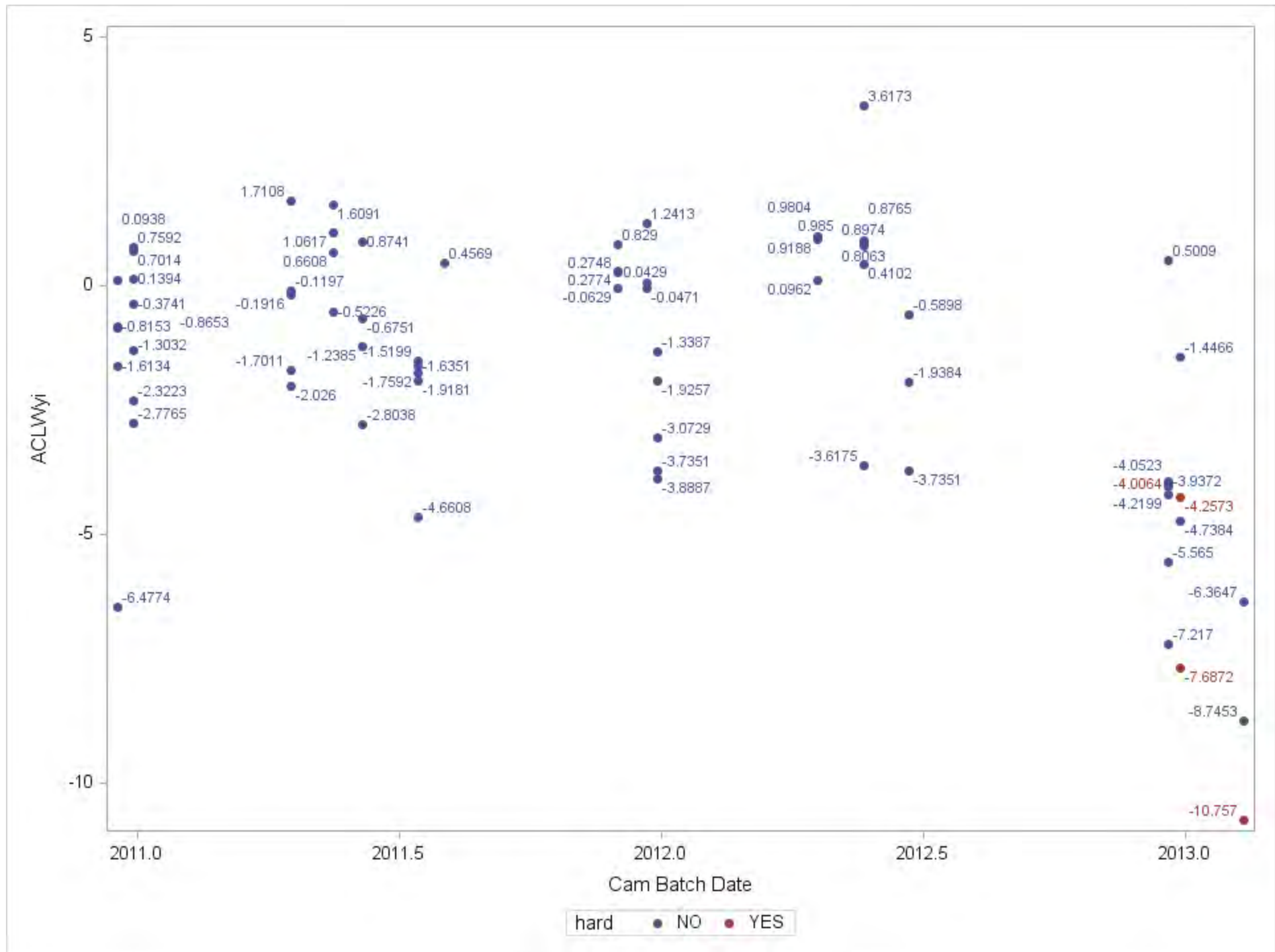


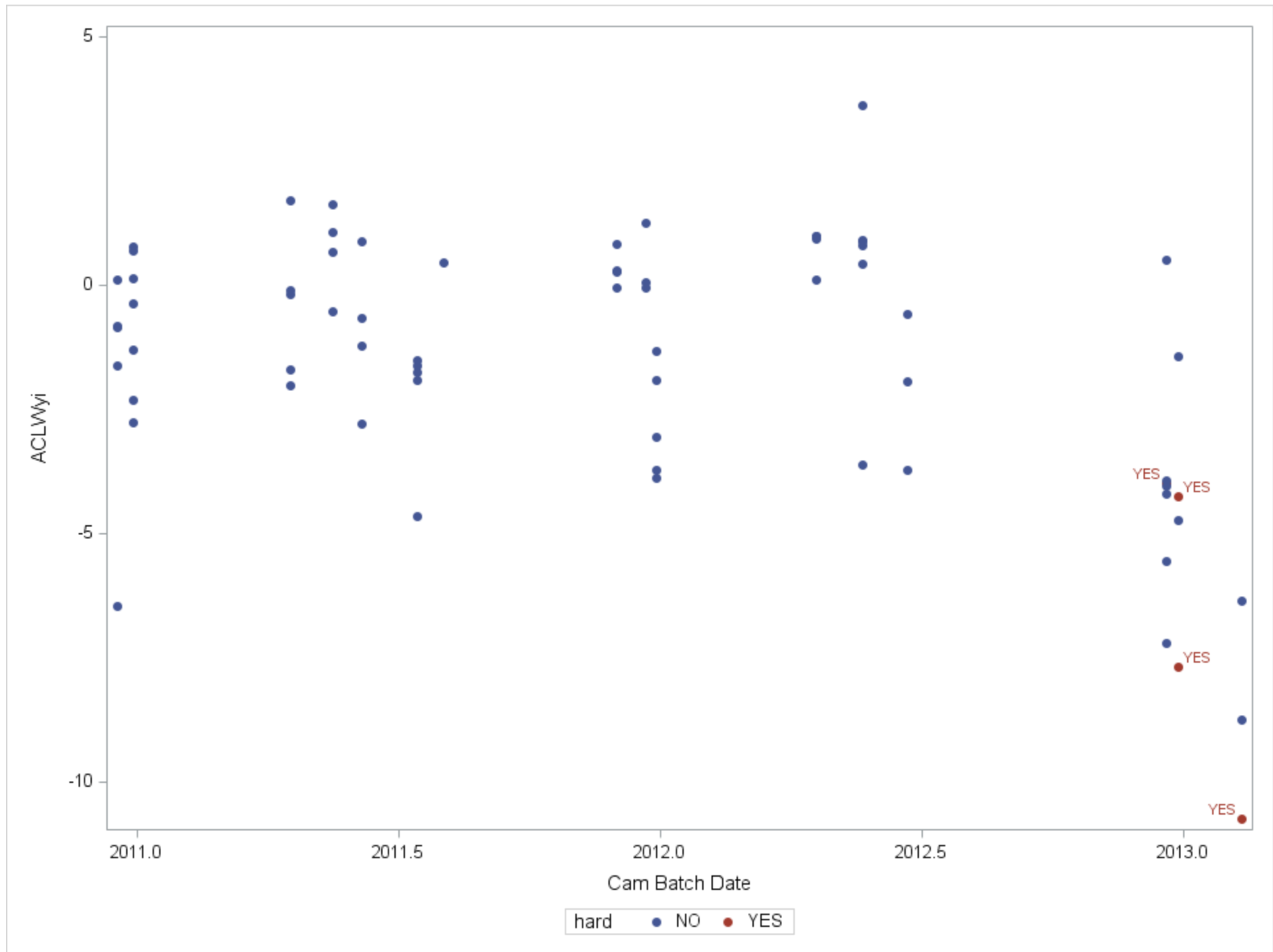




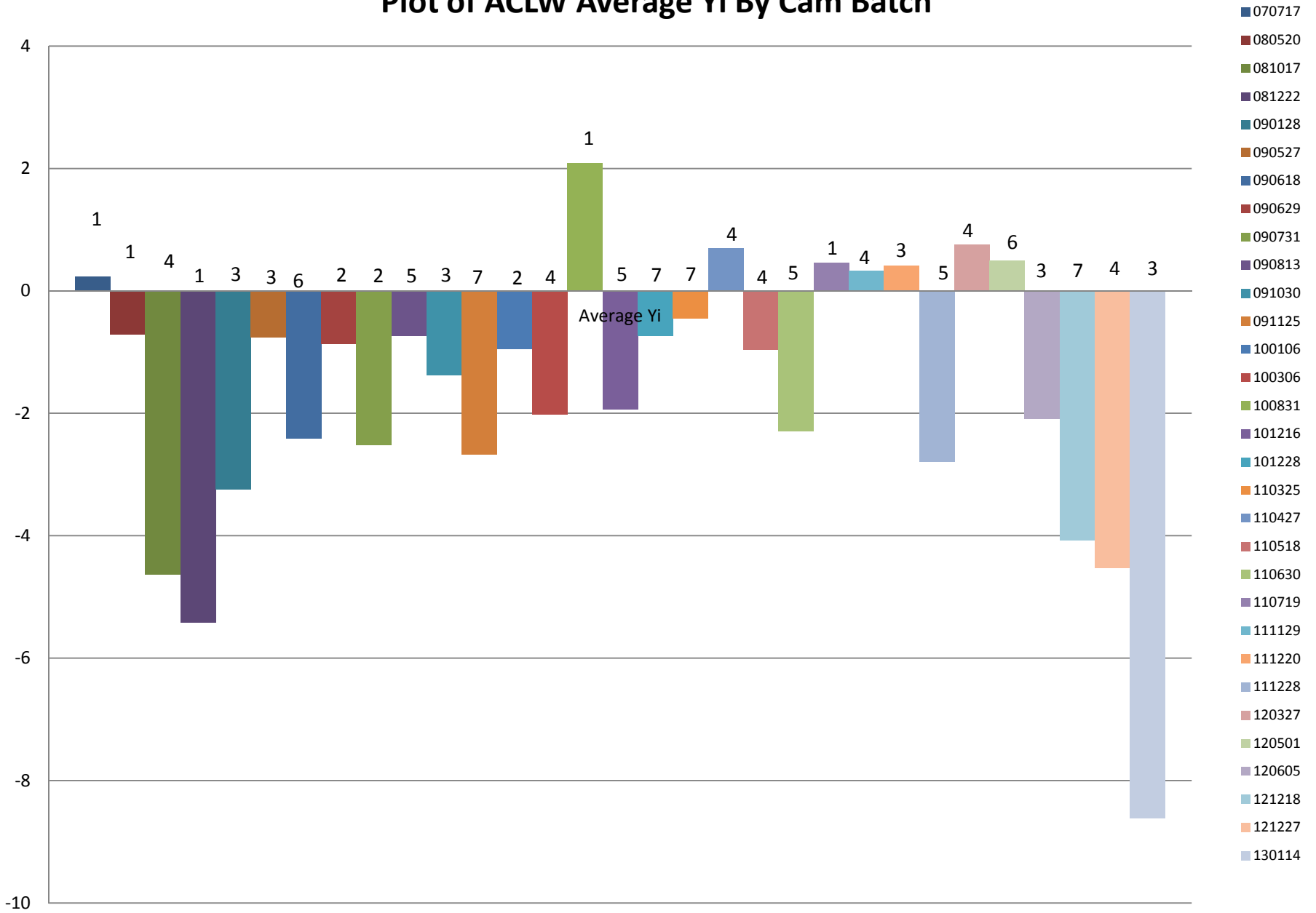








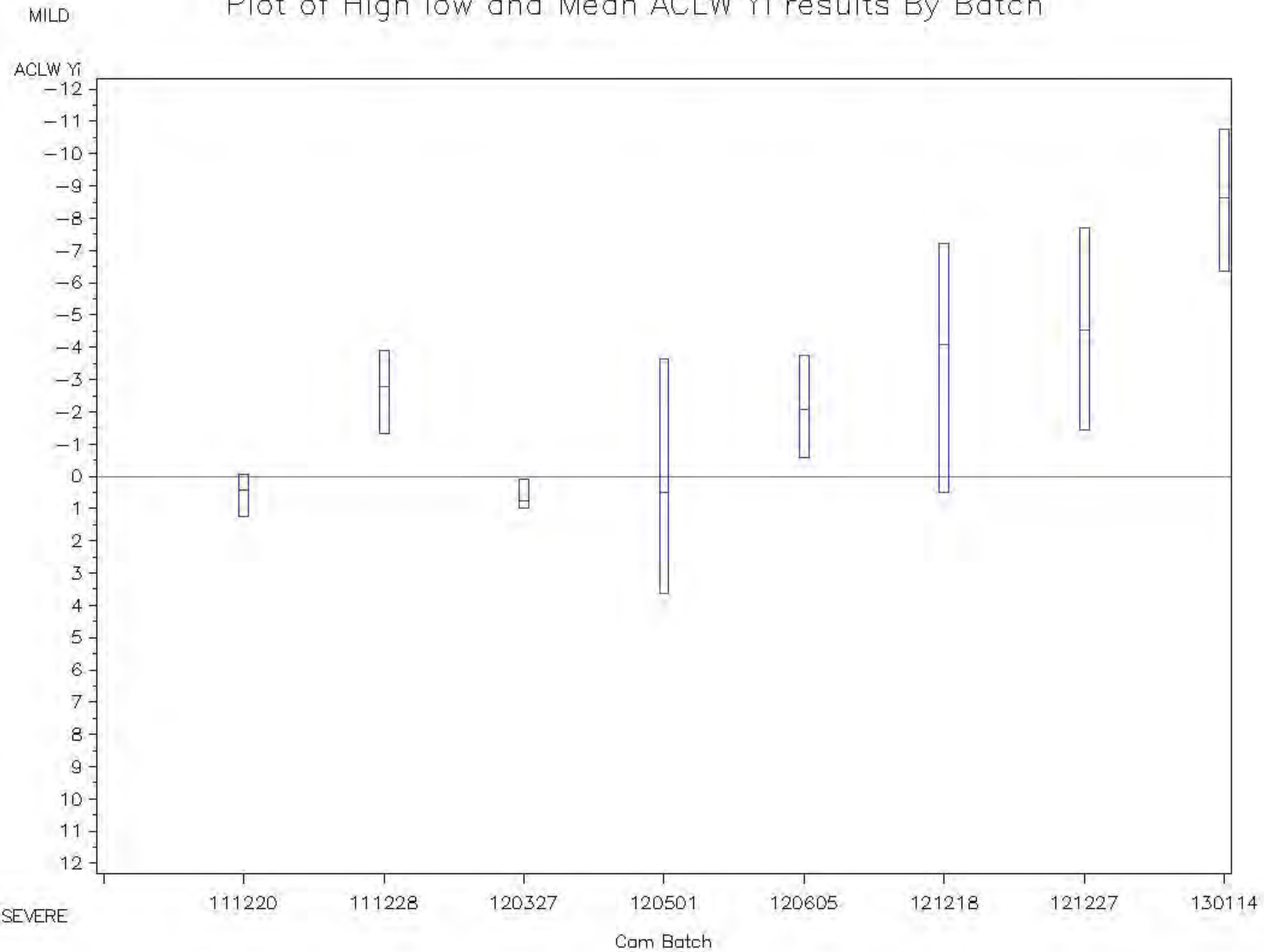
Plot of ACLW Average Y_i By Cam Batch



Cobalt Base Alloys

| LEJ Alloy | J3 | J6 | J10 | J21 |
|------------------|---|---------------------|--|-------------------|
| Similar to: | Stellite 3 ® | Stellite 6 ® | Triballoy style="maspacerun: yes"> T-400 ® | Stellite 21 ® |
| Carbon | 2.45 | 1.20 | 0.08 max. | 0.25 |
| Silicon | 1.5 max. | 1.5 max. | x:num="x:num">2.5 | 1.0 max. |
| Manganese | 1.0 max. | 1.0 max. | x:str="-">- | 1.0 max. |
| Chromium | 30.0 | 29.0 | x:num="x:num">8.0 | 27.0 |
| Molybdenum | - | 1.5 max. | x:num="x:num">20.0 | 5.55 |
| Tungsten | 12.5 | 4.5 | x:str="-">- | - |
| Vanadium | - | x:str="-">- | x:str="-">- | x:str="-">- |
| Iron | 3.0 max. | 3.0 max. | x:str="-">- | 3.0 max. |
| Nickel | 3.0 max. | 3.0 max. | x:str="-">- | 2.55 |
| Cobalt | Balance | Balance | Balance | Balance |
| Typical Hardness | 57 Rc | 48 Rc | 54 Rc | 33 Rc |
| Applications | Heavy duty, intake and exhaust, diesel and natural gas. | Heavy duty exhaust. | Heavy duty intake, diesel and natural gas. | Ball valve seats. |

Plot of High low and Mean ACLW Yi results By Batch



From: [Martin Chadwick Intertek](#)
To: [Rich Grundza](#); [Glaenzer, Dave](#); [Adam Bowden](#); [Adam Sworski](#); [Addison Schweitzer Intertek](#); [Allison Rajakumar](#); [Andy Ritchie](#); [Angela Willis](#); [Arthur Andrews](#); [Ben Weber](#); [Bill Buscher](#); [Bob Campbell](#); [Bob Olree](#); [Bob Salgueiro](#); [Bruce Matthews](#); [Charlie Leverett Intertek](#); [Chris Castanien](#); [Chris Taylor](#); [Christian Porter](#); [Clayton Knight](#); [Doyle Boese](#); [Dwight Bowden](#); [Ed Altman](#); [Elisa Santos](#); [Frank Farber](#); [George Szappanos](#); [Gordon Farnsworth](#); [Haiying Tang](#); [Irwin Goldblatt](#); [James Carter](#); [Jason Bowden](#); [Jason Holmes](#); [Jeff Clark](#); [Jerry Brys](#); [Jessica Buchanan](#); [Jim Rutherford](#); [Jo Martinez](#); [Joe Franklin Intertek](#); [Kaustav Sinha](#); [Mark Mosher](#); [Mark Sutherland](#); [Matt Bowden](#); [Mike McMillan](#); [Pat Lang](#); [Phil Davies](#); [Phil Rabbat](#); [Phil Scinto](#); [Robert Bacchi](#); [Robert Stockwell](#); [Ron Romano](#); [Scott Rajala](#); [Scott Stap](#); [sidney.clark@swri.org](#); [Teri Kowalski](#); [Thom Smith](#); [Tim Caudill](#); [Timothy Miranda](#); [Todd Dvorak](#); [Tracey King](#); [Walt Lerche](#); [Zach Bishop](#)
Cc: [Campbell, Bob](#)
Subject: RE: ACLW
Date: Friday, November 08, 2013 1:43:04 PM

I agree that the long term trend in ACLW has been mild and cam batch and/or cam pour code could point to a potential cause. However, models of (Lab, Oil, Heads, and Cam Batch) or (Lab, Oil, Heads, and Cam Pour Code) both suggest that the new heads could be milder for ACLW. This may provide some motivation for additional research before they are accepted across the board. The potential differences in cam batches may be reaching a point that some additional action is required to avoid increasing the rate of candidate failures through excessive severity adjustments independent of the use of the new heads.

In the results below Chart = H is the four head runs and CHART = Y is charted reference tests.

General Linear Model: lnACLW versus IND, CHART, LTMSLAB, CAMBAT

| Factor | Type | Levels | Values |
|---------|-------|--------|--|
| IND | fixed | 3 | 434-1, 435-2, 438 |
| CHART | fixed | 2 | H, Y |
| LTMSLAB | fixed | 6 | A, B, D, E, F, G |
| CAMBAT | fixed | 6 | 120327, 120501, 120605, 121218, 121227, 130114 |

Analysis of Variance for lnACLW, using Adjusted SS for Tests

| Source | DF | Seq SS | Adj SS | Adj MS | F | P |
|---------|----|---------|--------|--------|------|-------|
| IND | 2 | 2.4073 | 2.0964 | 1.0482 | 4.97 | 0.025 |
| CHART | 1 | 3.2894 | 0.6851 | 0.6851 | 3.25 | 0.095 |
| LTMSLAB | 5 | 4.1993 | 1.0286 | 0.2057 | 0.98 | 0.468 |
| CAMBAT | 5 | 4.2572 | 0.8514 | 0.8514 | 4.04 | 0.020 |
| Error | 13 | 2.7392 | 2.7392 | 0.2107 | | |
| Total | 26 | 16.8924 | | | | |

S = 0.459031 R-Sq = 83.78% R-Sq(adj) = 67.57%

General Linear Model: lnACLW versus IND, CHART, LTMSLAB, CAMPOURC

| Factor | Type | Levels | Values |
|----------|-------|--------|-------------------|
| IND | fixed | 3 | 434-1, 435-2, 438 |
| CHART | fixed | 2 | H, Y |
| LTMSLAB | fixed | 6 | A, B, D, E, F, G |
| CAMPOURC | fixed | 4 | 15, 16, 17, 18 |

Analysis of Variance for lnACLW, using Adjusted SS for Tests

| Source | DF | Seq SS | Adj SS | Adj MS | F | P |
|----------|----|---------|--------|--------|------|-------|
| IND | 2 | 2.5577 | 1.9254 | 0.9627 | 4.31 | 0.022 |
| CHART | 1 | 4.3621 | 0.7617 | 0.7617 | 3.41 | 0.074 |
| LTMSLAB | 5 | 3.3352 | 1.8375 | 0.3675 | 1.65 | 0.175 |
| CAMPOURC | 3 | 3.7883 | 3.7883 | 1.2628 | 5.66 | 0.003 |
| Error | 33 | 7.3643 | 7.3643 | 0.2232 | | |
| Total | 44 | 21.4076 | | | | |

S = 0.472399 R-Sq = 65.60% R-Sq(adj) = 54.13%

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