Cat Aeration Task Force Additional Prove Out Testing Proposal

PC-11 Statisticians Task Force
July 1, 2014

Testing:

1. Demonstrate repeatability, reproducibility and discrimination in the Cat Aeration test
   - Demonstration does not imply acceptance
   - The level of rigor used to investigate precision and discrimination is up to the task force
   - Task force (and ultimately API, ACC and EMA) will have to agree whether test results support adequate precision and discrimination

2. Assess engine hours effect even though effect not expected to be observed over ~100 to ~250 engine hours

3. Prior to start of testing:
   - Labs will have broken in their engines using the same procedure
   - Engines will have been used approximately the same amount of hours (~75 to 100 hrs; TBD)

4. The same test procedure will be used to conduct testing

5. Task force indicated there is enough oil for:
   - Four 1005 tests
   - Five High Aeration tests

Testing:

1. Two of the MOA requirements for test acceptance:
    1. “Each oil used to demonstrate discrimination has a minimum of two valid test results in the most current test procedure. The Test Development Task Force must approve these results.”

    2. “Each Matrix Lab has run at least two operationally valid tests (shakedown runs are eligible) using the Test Matrix procedure. Shakedown runs are full-length, operationally valid runs on oils such as potential candidate or research oils. The Test Development Task Force will determine if these test results are satisfactory in terms of precision, Lubricant Test Monitoring System (LTMS) impact, and reasonable agreement among the results from each lab.”

Proposed Testing Protocol:

	Test 1	Test 2	Test 3
Lab 1	HA	1005	HA
Lab 2	HA	1005	HA
Lab 3	1005	HA	1005

1. Each lab tests one of the oils twice for repeatability
2. Each lab tests both oils for discrimination
3. Each oil tested at all three labs to evaluate reproducibility

Comments:

1. Oil selection:
    1. Using the low aeration (LA) oil and high aeration (HA) oil:
        - Better chance of supporting test discrimination
            - This is based on 1 test result per oil which may not be true indication of its performance
        - Evaluates test repeatability over a wider range of Aeration

    2. Given this set of testing is likely to be the last, using oils we have more experience with (like 1005) may provide less risk.

    3. Three oils (HA, 1005 and LA) could be used to balance the tradeoffs, but 4 tests per stand would be preferred.

More Comments:

1. Ultimately, it is up to the task force (and subsequently ACC, EMA and API) to accept whether or not the test results demonstrate a satisfactory level of repeatability, reproducibility and discrimination.

2. Even though these tests have been put together as best as possible to assess repeatability, reproducibility, discrimination and an engine hours effect, a statistical analysis of this data will need to be used with caution.
   - Discrimination oil is only run once at each lab
   - Repeatability is based on 2 tests at each lab
     - Within lab, repeatability is affected by any engine hours effect

More Comments:

1. Less testing would meet bare minimum requirements with less statistical rigor.
2. More testing will improve the statistical analysis, but it's a balance of:
   - Timing
   - Oil quantities
   - Level of data needed to accept test into the Matrix vs. the rigor of the Matrix
   - Amount of hours on engines going into the Matrix

3. A benefit of the proposed design is the ability to augment it if needed.
   - A 4th and even 5th test per lab will help the statistical analysis if desired.
   - Additional testing can be decided upon review of the first 3 tests per lab.
   - Example:

STOP: Review results & decided if more testing desired

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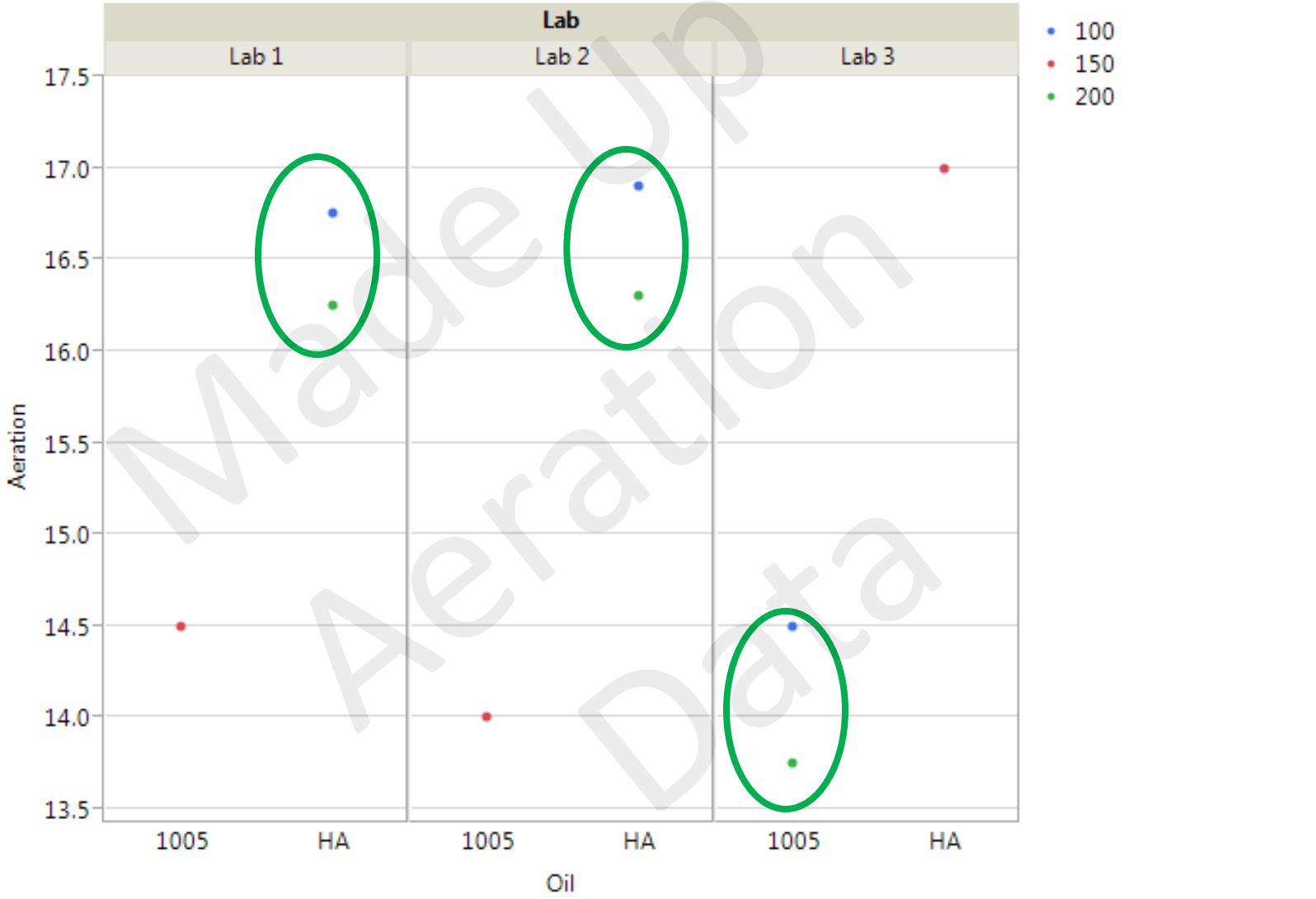
	Test 1	Test 2	Test 3	Test 4	Test 5
Lab 1	HA	1005	HA	1005	HA
Lab 2	HA	1005	HA	1005	HA
Lab 3	1005	HA	1005	HA	1005

A third oil could be included in test 4 or 5 depending on test results of prior data

Questions?
Comments?

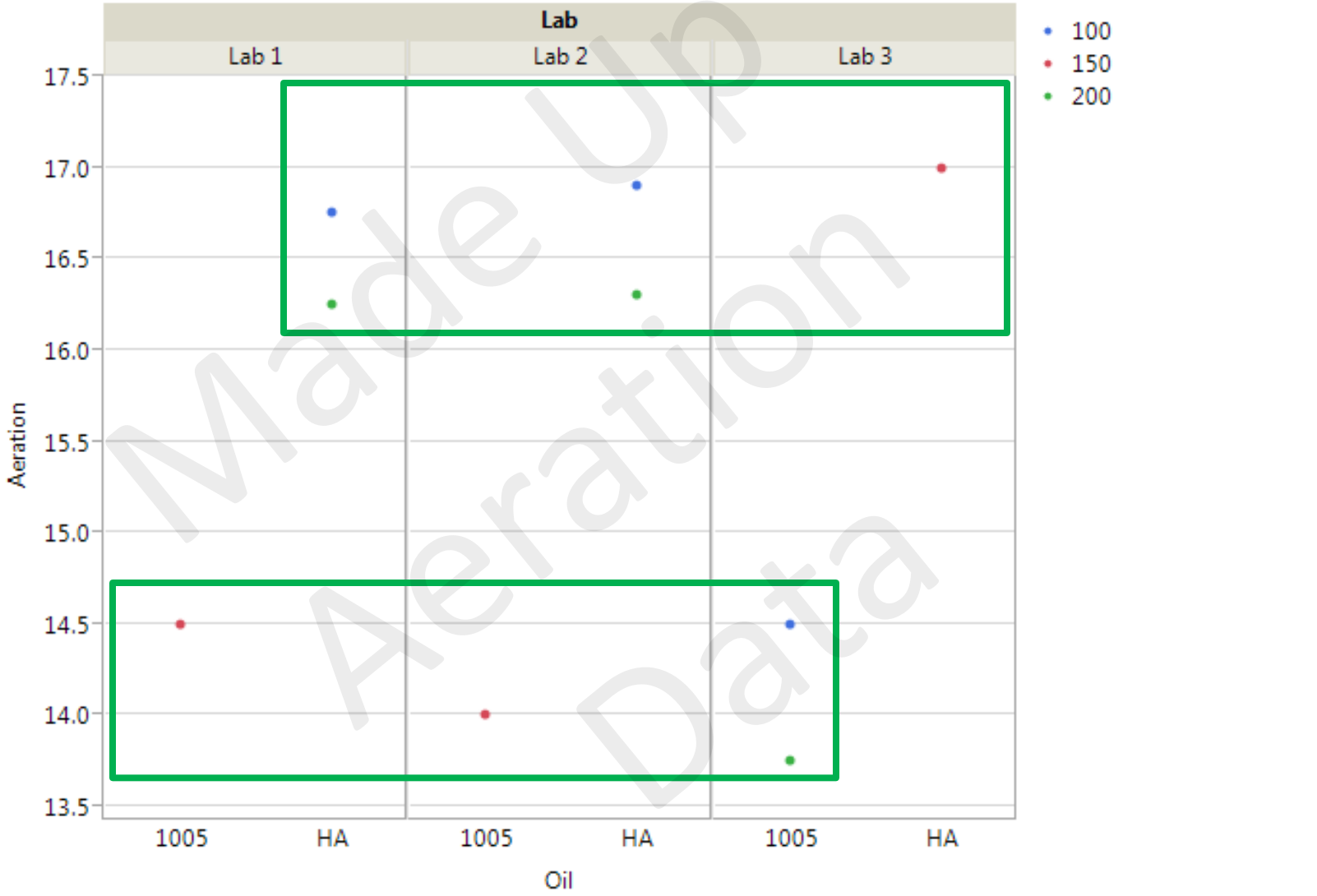
Appendix

Repeatability



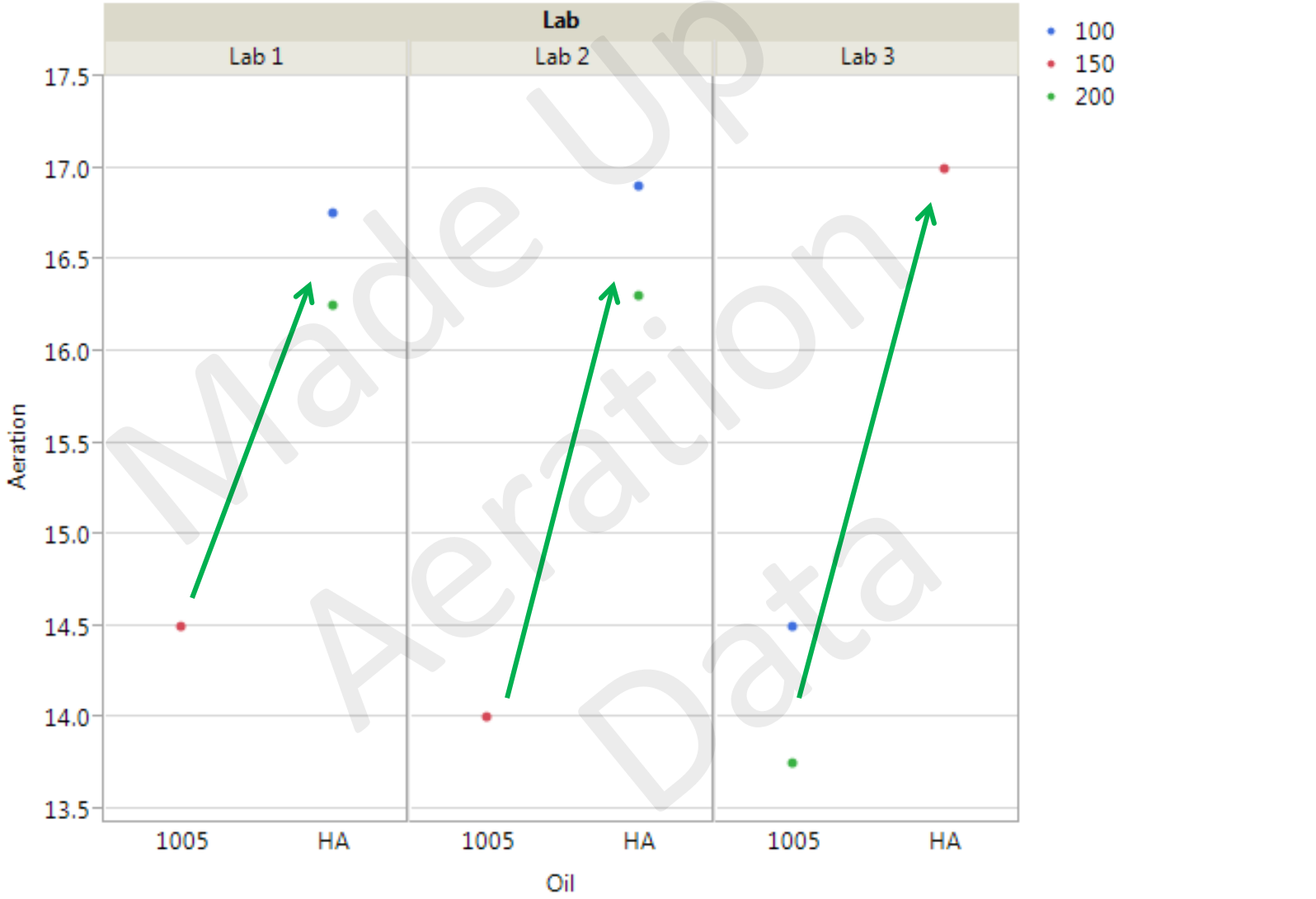
Each lab tests one of the oils twice

Reproducibility



Each oil tested across labs

Discrimination



Each oil tested at each lab