ENERGY STAR
Residential Dishwasher Cleaning Performance
Draft 2 Test Method Stakeholder Webinar

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ENERGY STAR Program

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Residential Dishwashers

- ENERGY STAR Version 5.0 Residential Dishwasher Specification took effect on January 20, 2012

- EPA intends to add the ENERGY STAR Test Method for Determining Residential Dishwasher Cleaning Performance (in development) to the test requirements for the future Version 6.0 specification

Cleaning Performance Test Method Development History

Event	Date	Description
Phase 1 Testing	June – August 2011	Investigative testing: • AHAM DW-1-2009 • IEC 60436 Ed. 3.1 • DOE test procedure using extra-heavy soil load
Preliminary Webinar	September 19, 2011	Presented results from Phase 1 and solicited feedback from stakeholders
Phase 2 Testing	September – October 2011	Investigative testing on standard dishwashers using DOE test procedure and IEC scoring method
Draft 1 Test Method Publish/Webinar	February 2012	Published Draft 1 Test Method that tied cleaning performance to DOE test procedure
Phase 3 Testing	April 2012 – July 2012	Discussed in today's webinar
Draft 2 Test Method Publish/Webinar	October 2012	Discussed in today's webinar

Webinar Objective

- Review Phase 3 testing approach and results
- Discuss stakeholder feedback on the Draft 1 Test Method published in February 2012
- Discuss Draft 2 Test Method

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Phase 3 Testing Objectives

- Validate Draft 1 Test Method on compact dishwashers
- Investigate revisions suggested by stakeholder comments
- Investigate reproducibility of test method by:
  - Testing standard dishwashers at an external lab and comparing results with those obtained in Phase 2
  - Testing compact dishwashers at 2 external labs and comparing results

Units Tested

	Phase 2 Testing	Phase 3 Testing	
	DOE's Internal Lab	External Lab 1	External Lab 2
Compact Dishwashers		✓ (2 UUTs)	✓ (2 UUTs)
IEC Reference Dishwasher	✓	✓	
Standard Dishwashers	✓ (9 UUTs)		✓ (4 UUTs)

Note: UUT is unit under test

Test Plan

	Phase 2	Phase 3
Preconditioning Cycles	2 for soil-sensing DWs 1 for non-soil sensing DWs	
Test Cycles	Heavy, medium, light cycles per DOE test procedure in Appendix C	
Repeatability	3 test series on each UUT with filter cleaning and clean-up cycles between each test series	
Scoring Method	IEC 60436 scoring method	IEC 60436 scoring method AHAM DW-1 scoring method
Calculation	Per-cycle cleaning metrics at each soil load Weighted performance metric	Per-cycle cleaning performance score (CPS_i) at each soil load

Note: DOE updated the name of the per-cycle cleaning metric in the Draft 1 Test Method to per-cycle cleaning performance score (CPS_i) in the Draft 2 Test Method for clarification

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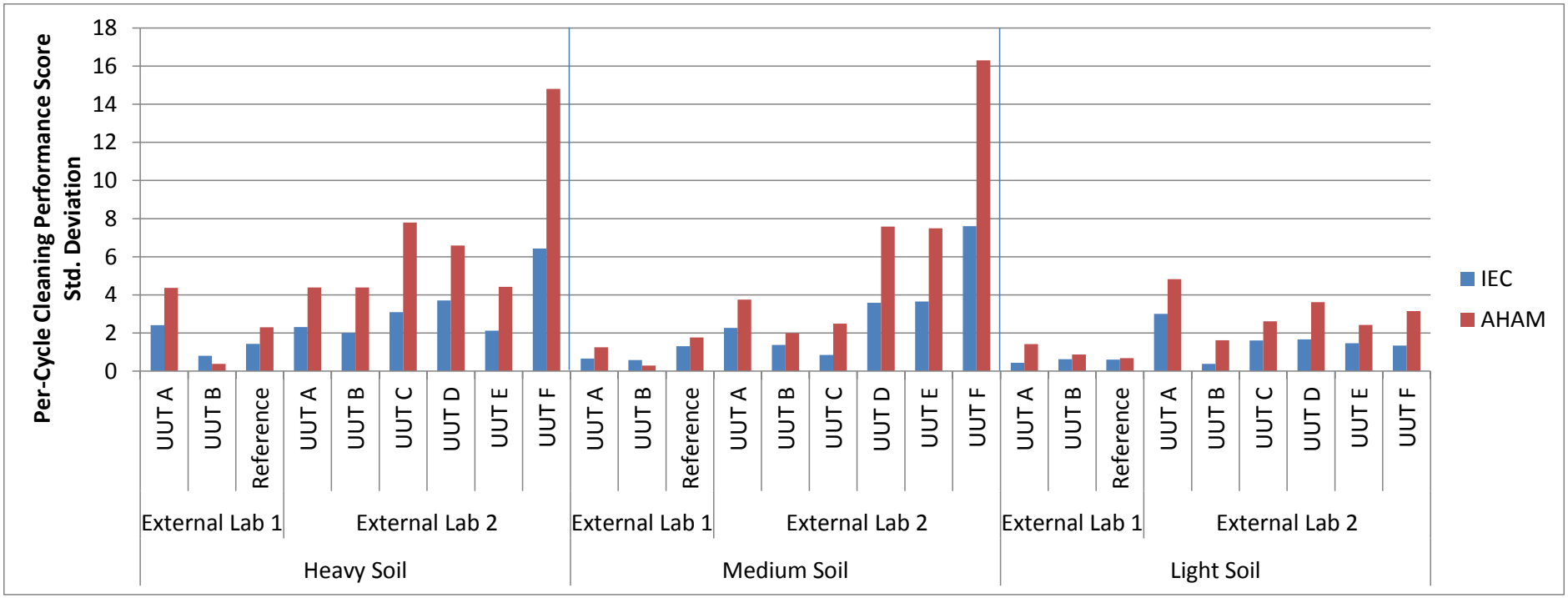
Comments – Scoring Method

Stakeholders noted that:

- Mixing and matching soiling procedures and scoring techniques from different test procedures is a concern
- AHAM DW-1 scoring method is the best method to use because U.S. technicians have more experience than with the IEC scoring method
- Flatware should also be scored to avoid circumvention of the test method

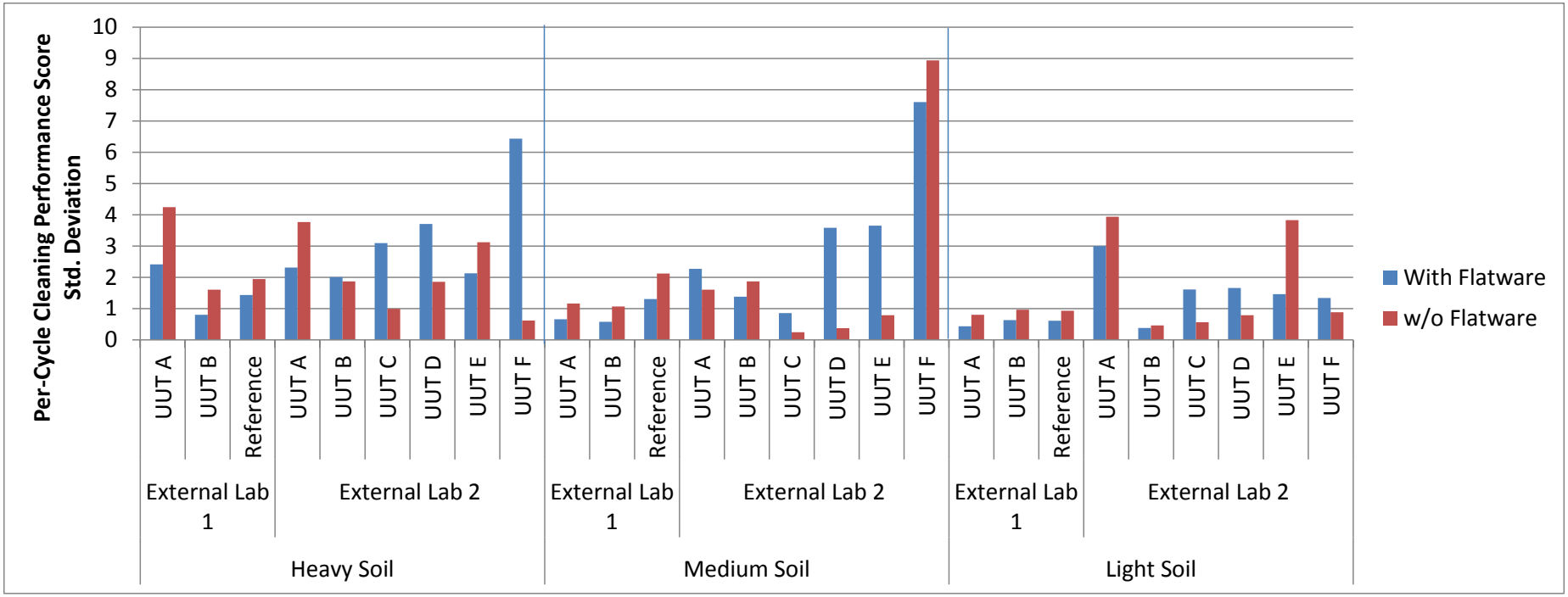
Results – IEC vs. AHAM Scoring

- Average standard deviation of IEC Scores = 2
- Average standard deviation of AHAM Scores = 4
- IEC scoring method maintained in Draft 2



Results – Flatware Scoring

- Average standard deviation of IEC scores w/ FW = 2
- Average standard deviation of IEC scores w/o FW = 2
- Flatware scoring is proposed in Draft 2



Conclusions – Scoring Method

- Score all items, including flatware, according to Table 1 in section 6.7.1 of IEC 60436

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Comments – Repeatability and Reproducibility

Stakeholders commented that:

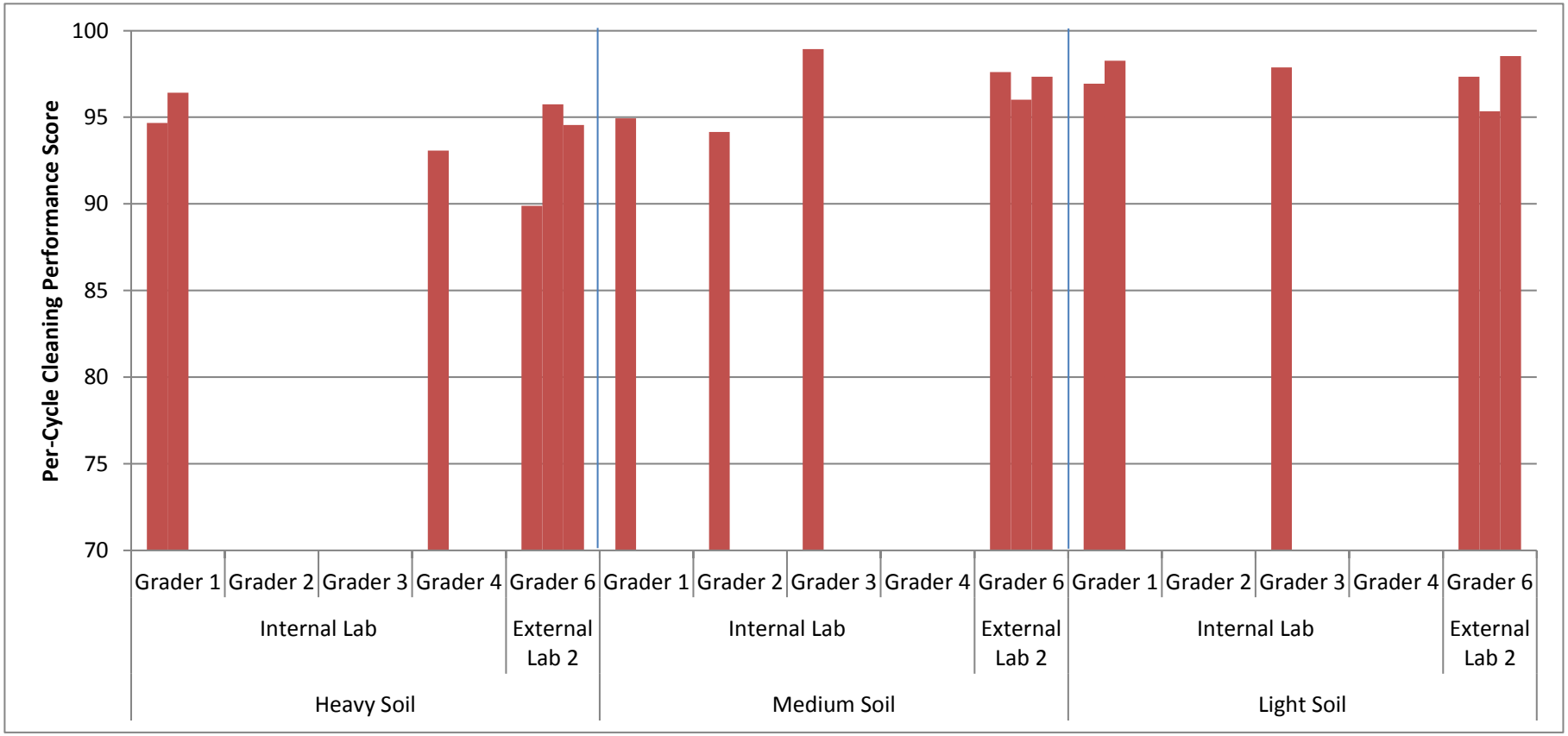
- The test method should be repeatable and reproducible
- DOE should organize and oversee a round robin testing program with manufacturer and third party test facilities

Results – Test Method Reproducibility

- Compared test results among DOE's internal lab and two external labs to determine test method reproducibility
- Test method is reproducible as long as the UUT operates consistently
  - Some units trigger variable cycle responses to a given soil load from test to test
  - Different cycle responses led to inconsistent cleaning performance, observed at multiple test labs

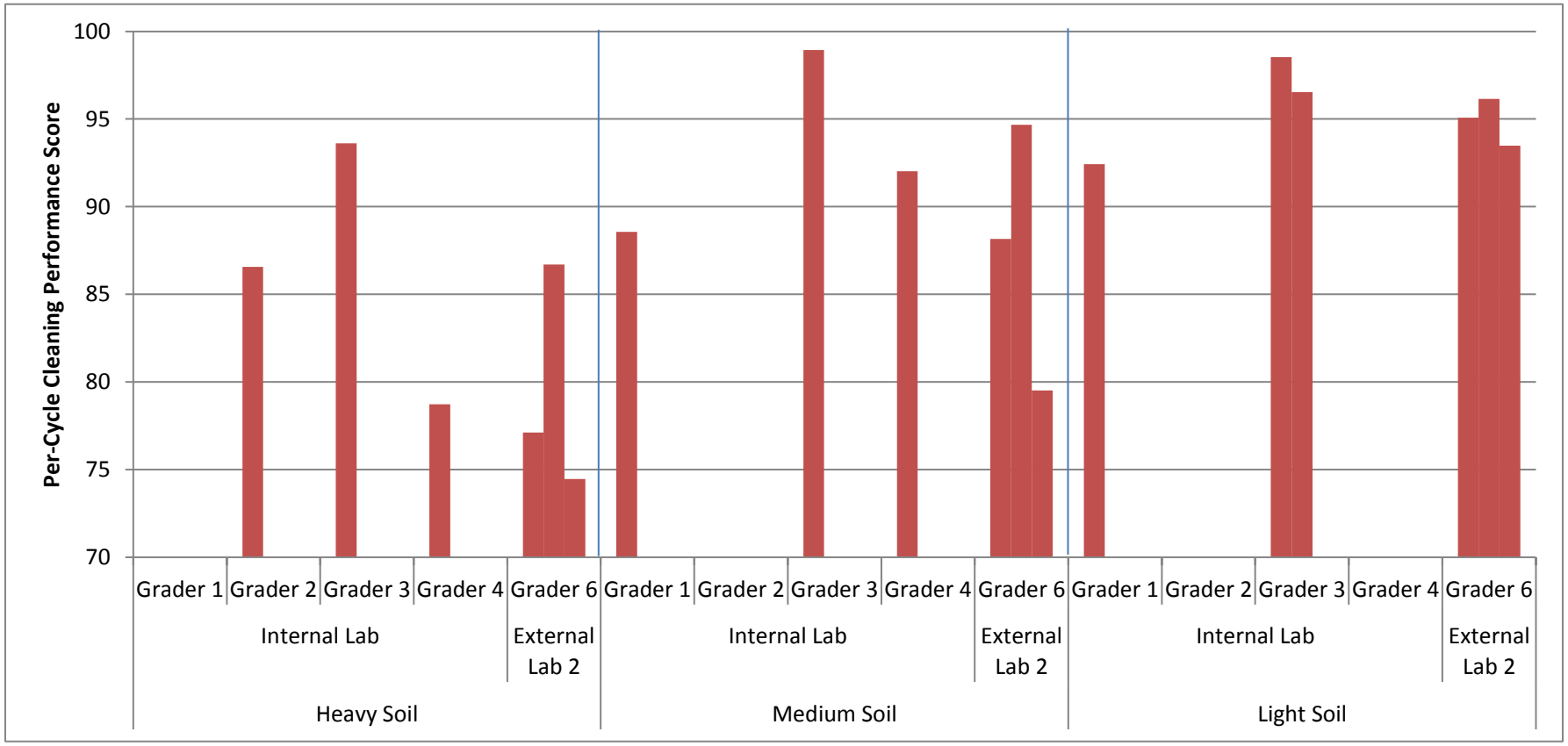
Results – Reproducibility with Consistent Operation

UUT C showed consistent energy and water use from test-to-test and consistent cleaning performance



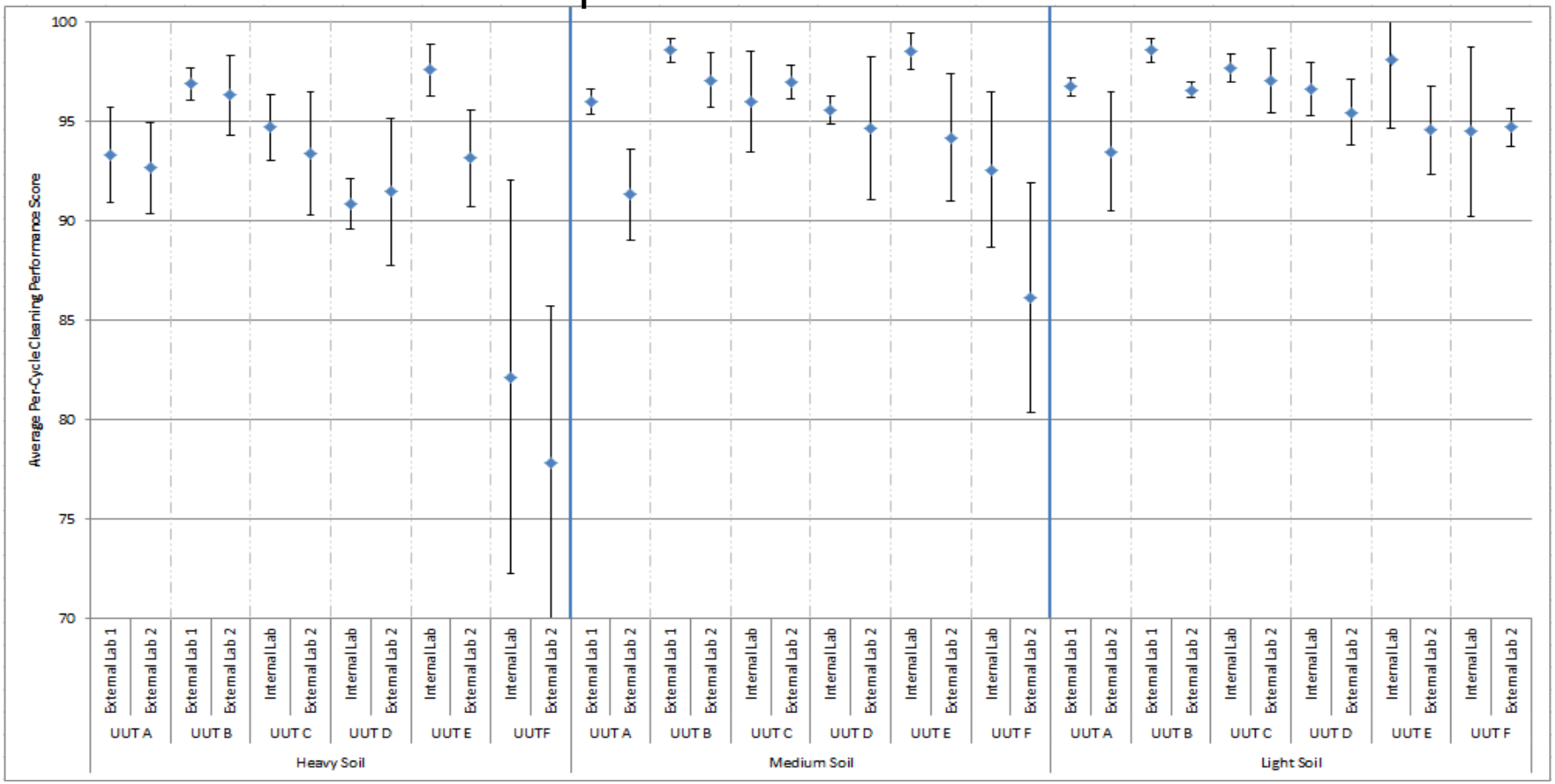
Results – Reproducibility with Inconsistent Operation

UUT F is an example of a dishwasher with inconsistent operation and cleaning performance at a given soil load

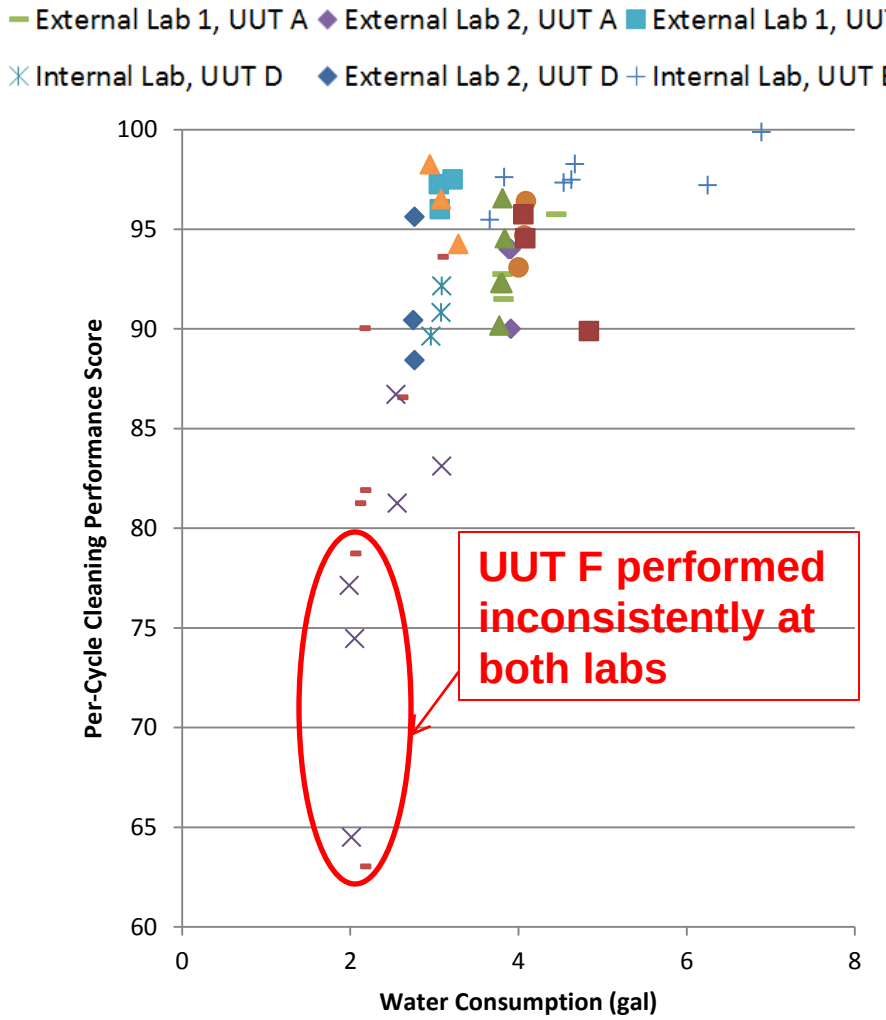


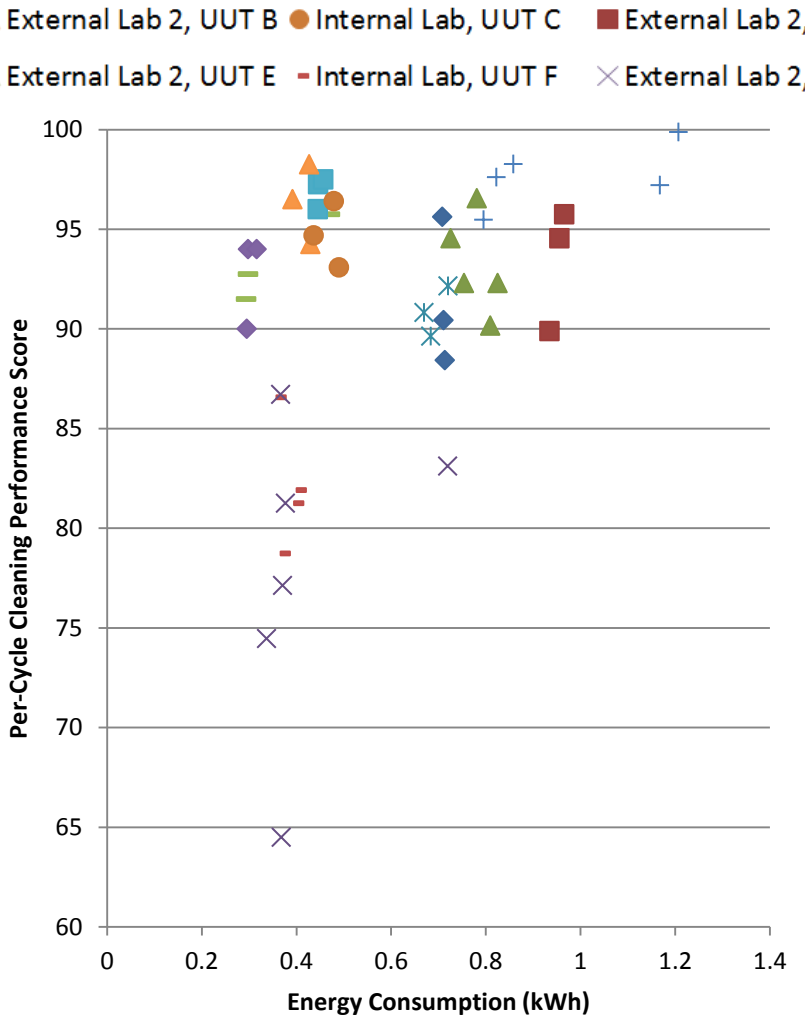
Results – Reproducibility of all UUTs

Average score of each UUT at each lab
Error bars represent the standard deviation



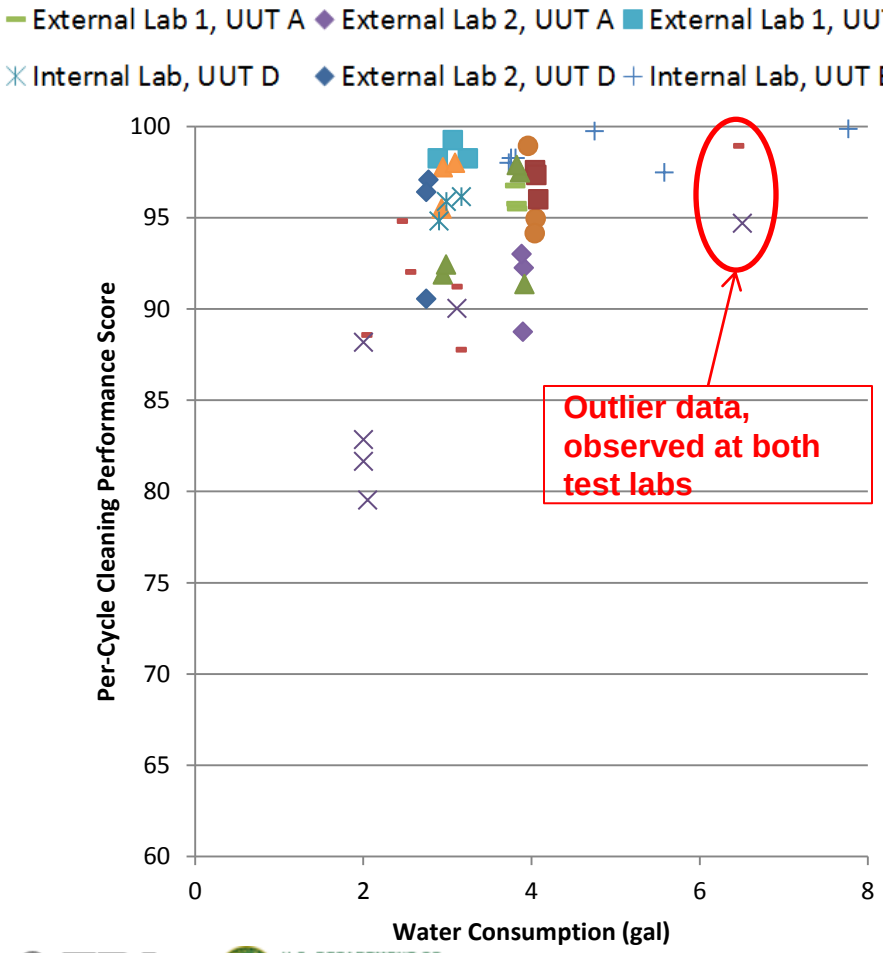
Results – Heavy Soil vs. Energy and Water Consumption

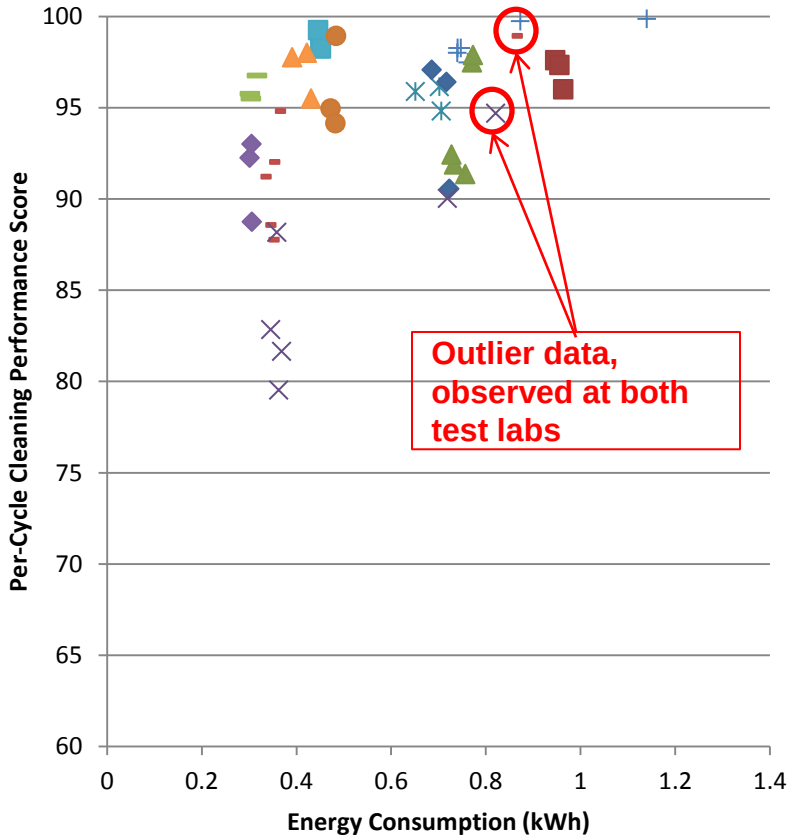




Results – Medium Soil vs. Energy and Water Consumption

UUT F had occasional high energy and water use at both test labs





Conclusions – Repeatability and Reproducibility

- The test method is repeatable and reproducible provided the UUT operates consistently
- If a UUT cleans inconsistently, the test method captures this variability
- If a UUT intermittently triggers higher energy and water use, cleaning performance for these outlier cycles may be higher than typical

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Sampling Plan

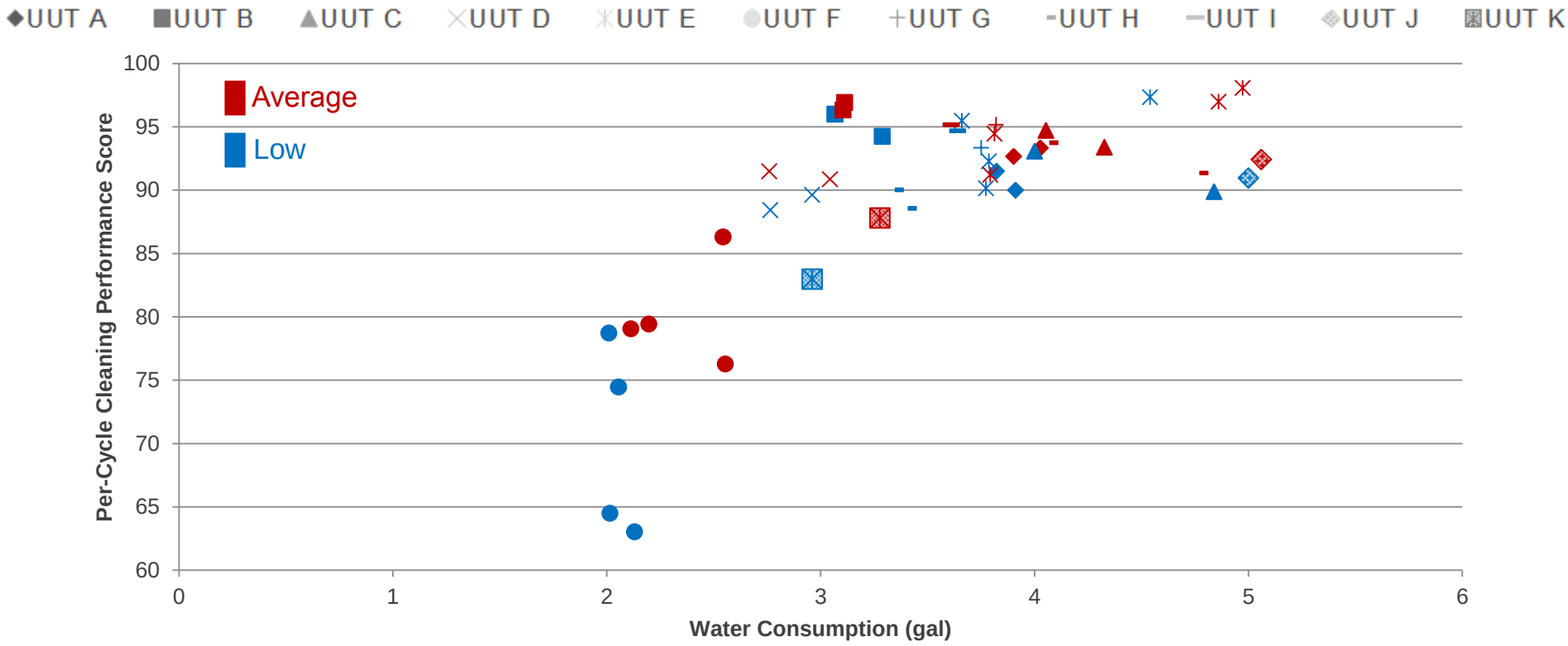
- DOE proposes a sampling plan in the Draft 2 Test Method
  - Sampling plan will be moved to ENERGY STAR Version 6.0 specification
  - Currently included in Draft 2 Test Method to solicit feedback from stakeholders
  - Only applicable for the cleaning performance test method

Proposed Sampling Plan

	Soil-sensing Dishwashers	Non-soil sensing Dishwashers
Number of UUTs to be Tested	At least 3	At least 1
Number of Test Series on each UUT	1	1
Reported Values for Qualification	Lowest CPS_i at each soil load	• 1 UUT – calculated CPS_i at each soil load • > 1 UUT – average CPS_i at each soil load

Results – Average and Lowest Scores vs. Water Consumption for Heavy Soil

Lowest scores more clearly identify the poor-performing units



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Referenced DOE Test Procedure

- September 14, 2012 - DOE issued a final rule establishing a new dishwasher test procedure (10 CFR Part 430, Subpart B, Appendix C1)
  - Must be used to demonstrate compliance with Federal standards on May 30, 2013

- Draft 2 Test Method references Appendix C1
  - Will be in effect when ENERGY STAR Version 6.0 specification for dishwashers becomes effective

Test Setup

	Draft 1	Stakeholder Comment	Draft 2
Setup	Appendix C	-	Appendix C1
Cleaning Performance Rating Conditions	Stated requirement specified in IEC 60436	Reference industry standard; do not state requirement	References IEC 60436
Water Hardness	Stated requirement specified in AHAM DW-1 -1992	Reference industry standard; do not state requirement	References AHAM DW-1-2010

Test Cycles

	Draft 1	Stakeholder Comment	Draft 2
Preconditioning Cycles	Two preconditioning cycles	Specify same requirement as DOE test procedure	References Appendix C1
Test Cycles	• Appendix C for soil-sensing units • Soil loads from Appendix C for non-soil sensing units	Specify only one soil-load cycle for non-soil sensing units	• Appendix C1 for soil-sensing units* • Soil loads from Appendix C1 for non-soil sensing units*
Loading Requirements	Follow manufacturer instructions; alternate clean and soiled items	Clarify that schematics are examples only, and that manufacturer instructions should be used	Included clarification; follow manufacturer instructions while alternating clean and soiled items

* Note that Appendix C1 revises the definition of soil-sensing and non-soil-sensing dishwashers

Scoring and Calculation

	Draft 1	Stakeholder Comments	Draft 2
Scoring	Score all items excluding flatware using IEC 60436	• Flatware items should be scored • AHAM DW-1 scoring is preferred	Score all items including flatware using IEC 60436
Calculation	• Calculation of per-cycle cleaning metric at each soil load • Calculation of performance metric from equally weighted cleaning metrics	• No performance metric • Per-cycle cleaning metrics should not be equally weighted • One minimum performance requirement at each soil load should be used for qualification	Calculation of CPS_i at each soil load

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Next Steps

Date	Milestone
September 19, 2011	Initial stakeholder webinar
February 17, 2012	Draft 1 Test Method distributed
February 27, 2012	Stakeholder webinar to discuss Draft 1 Test Method
March 26, 2012	Draft 1 comment period ends
October 9, 2012	**Draft 2 Test Method distributed**
October 16, 2012	**Stakeholder webinar to discuss Draft 2 Test Method**
November 9, 2012	**Draft 2 comment period ends**
January 2013	Draft Final Test Method published
April 2013	Final Test Method published

Contact Information

Please send any additional comments to appliances@energystar.gov or contact:

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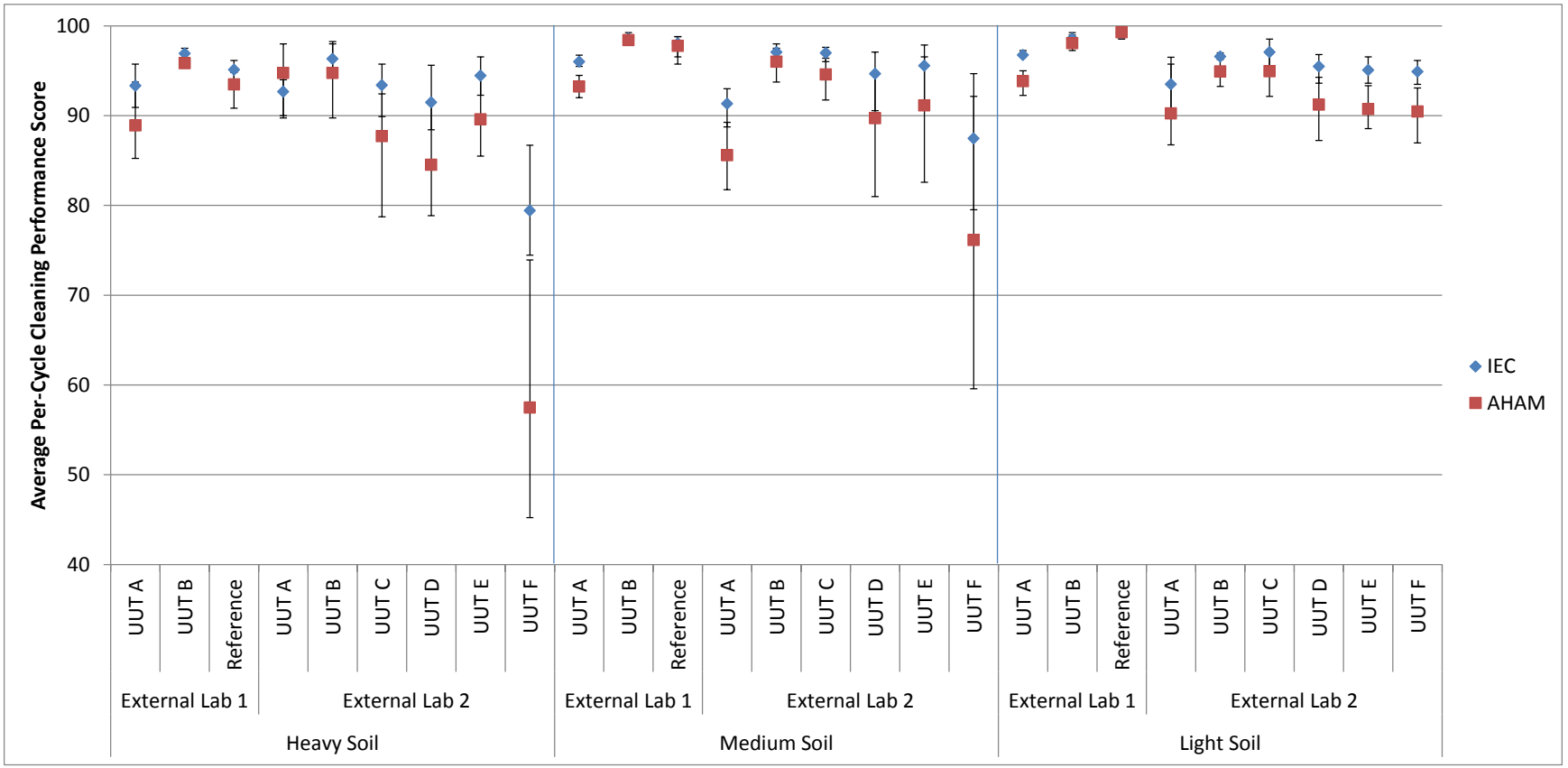
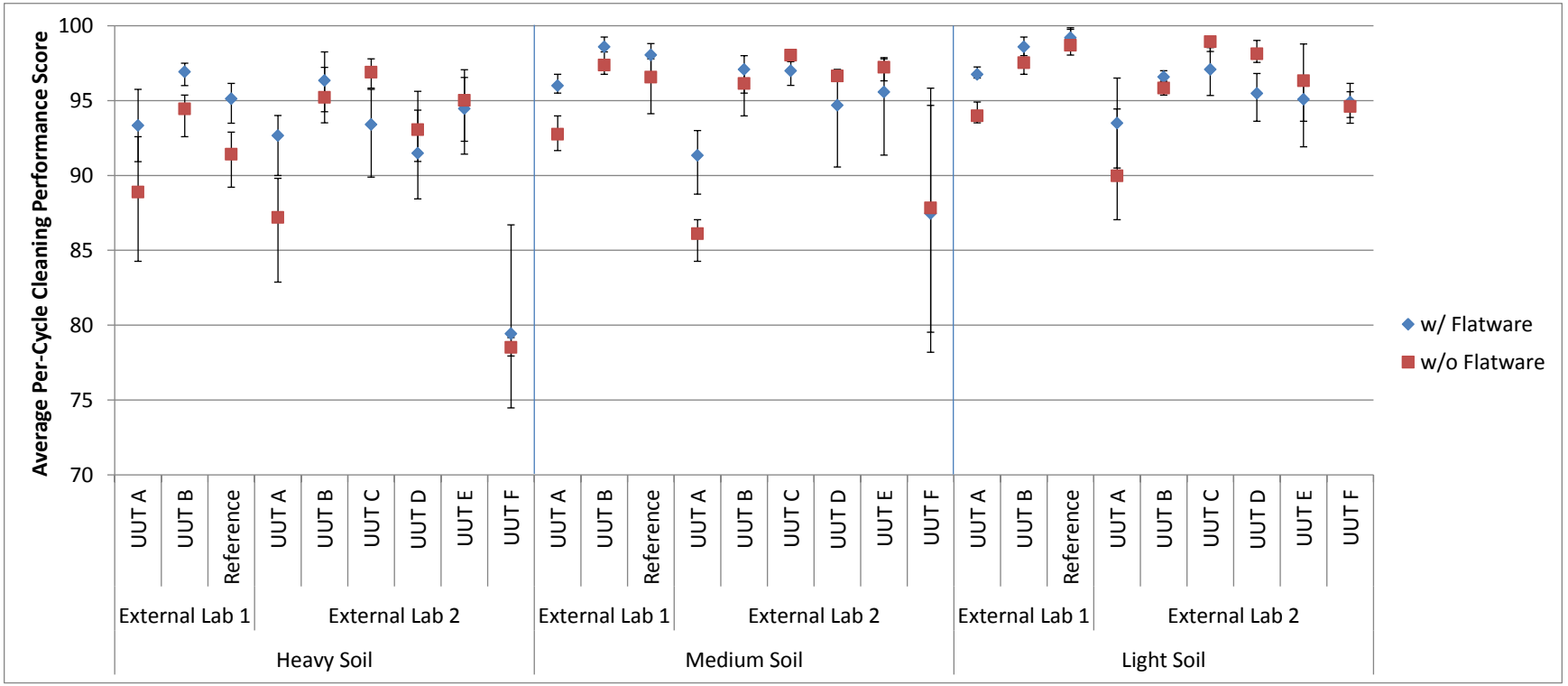
Additional Information

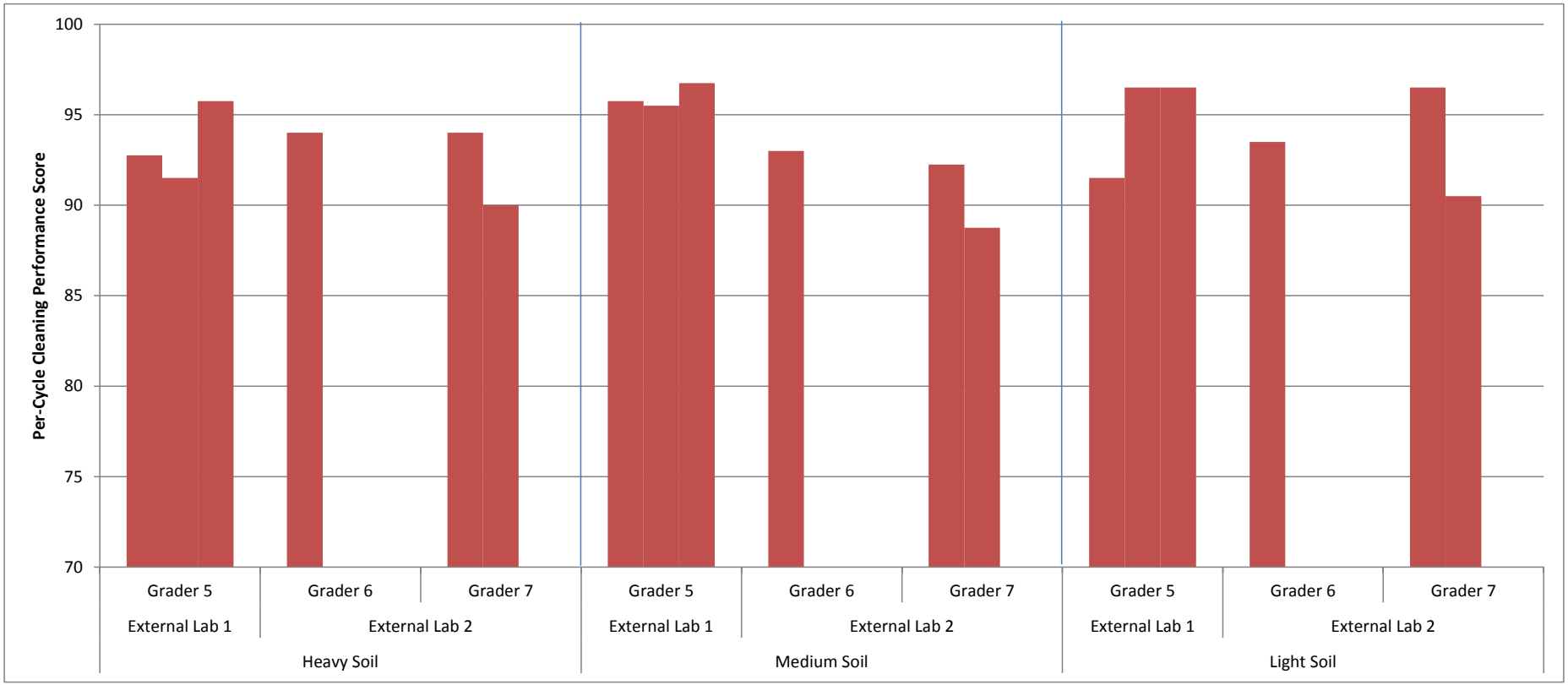
Repeatability of IEC vs. AHAM Scoring Method



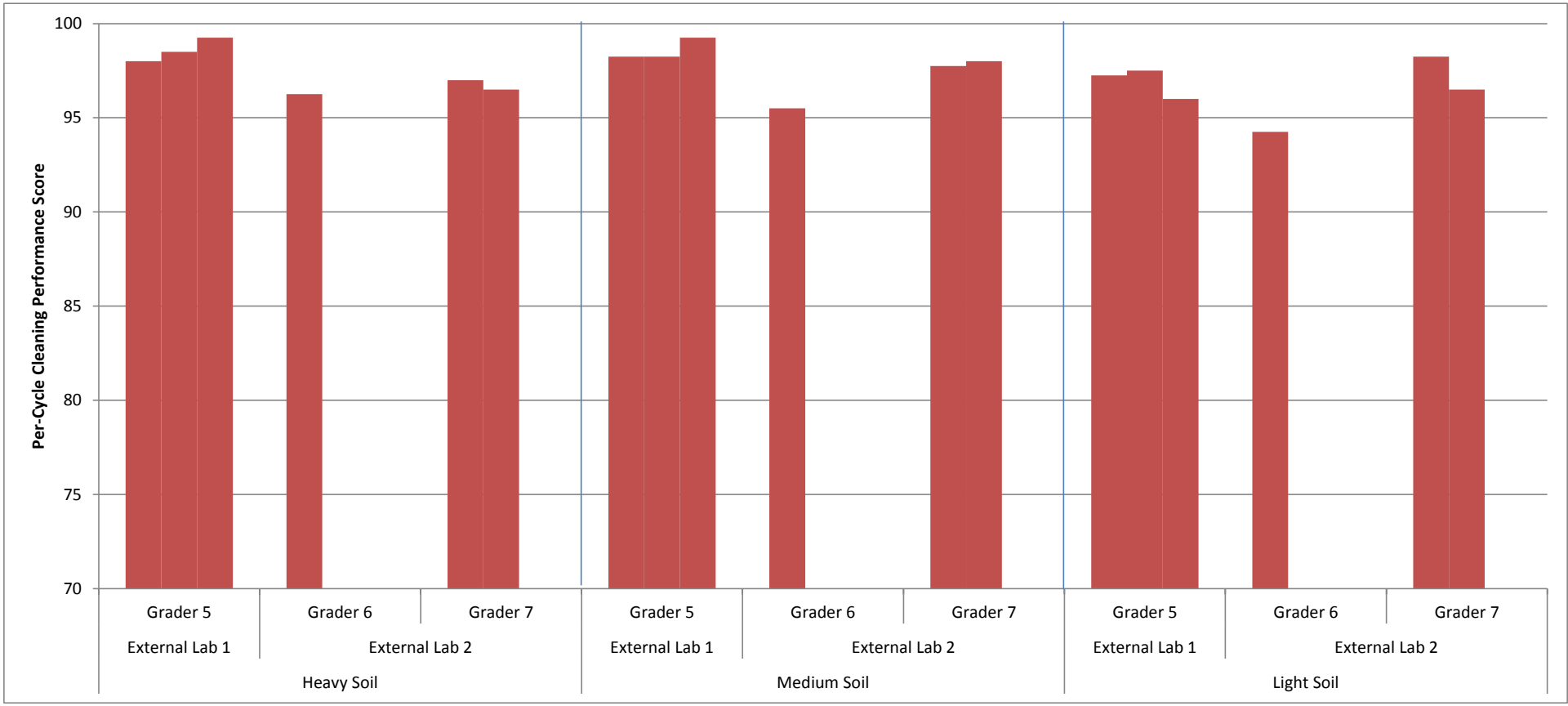
Scoring of Flatware Items



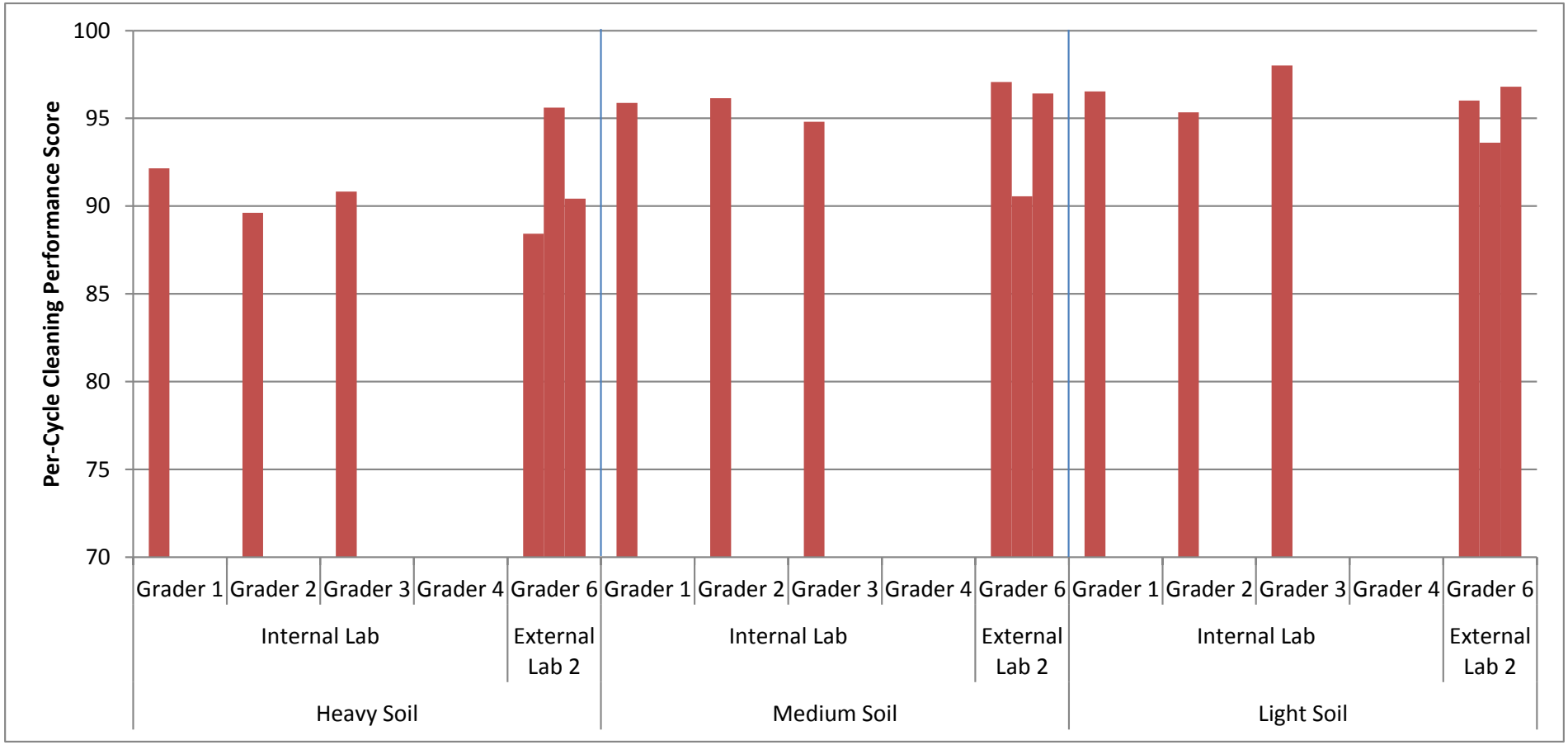
Reproducibility of UUT A



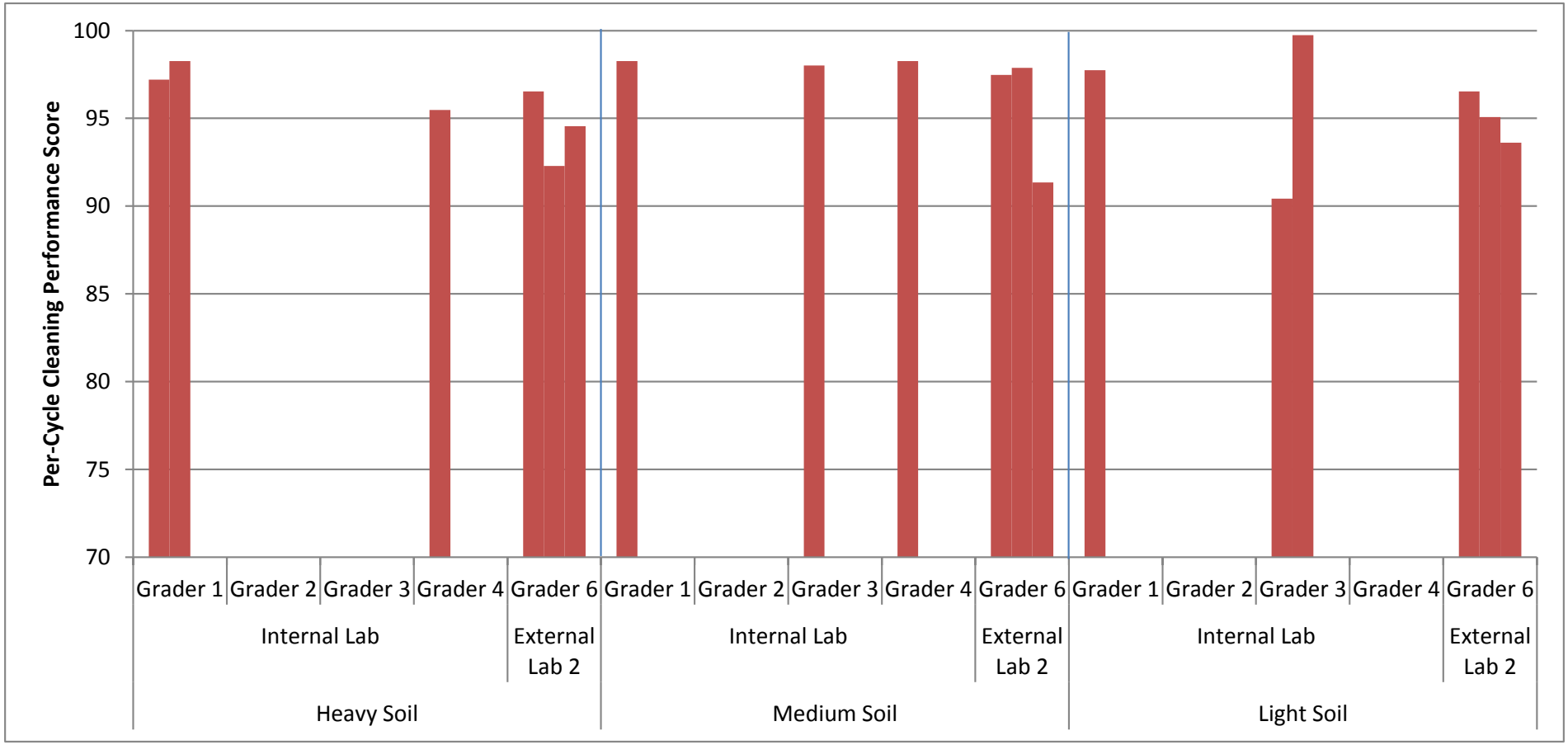
Reproducibility of UUT B



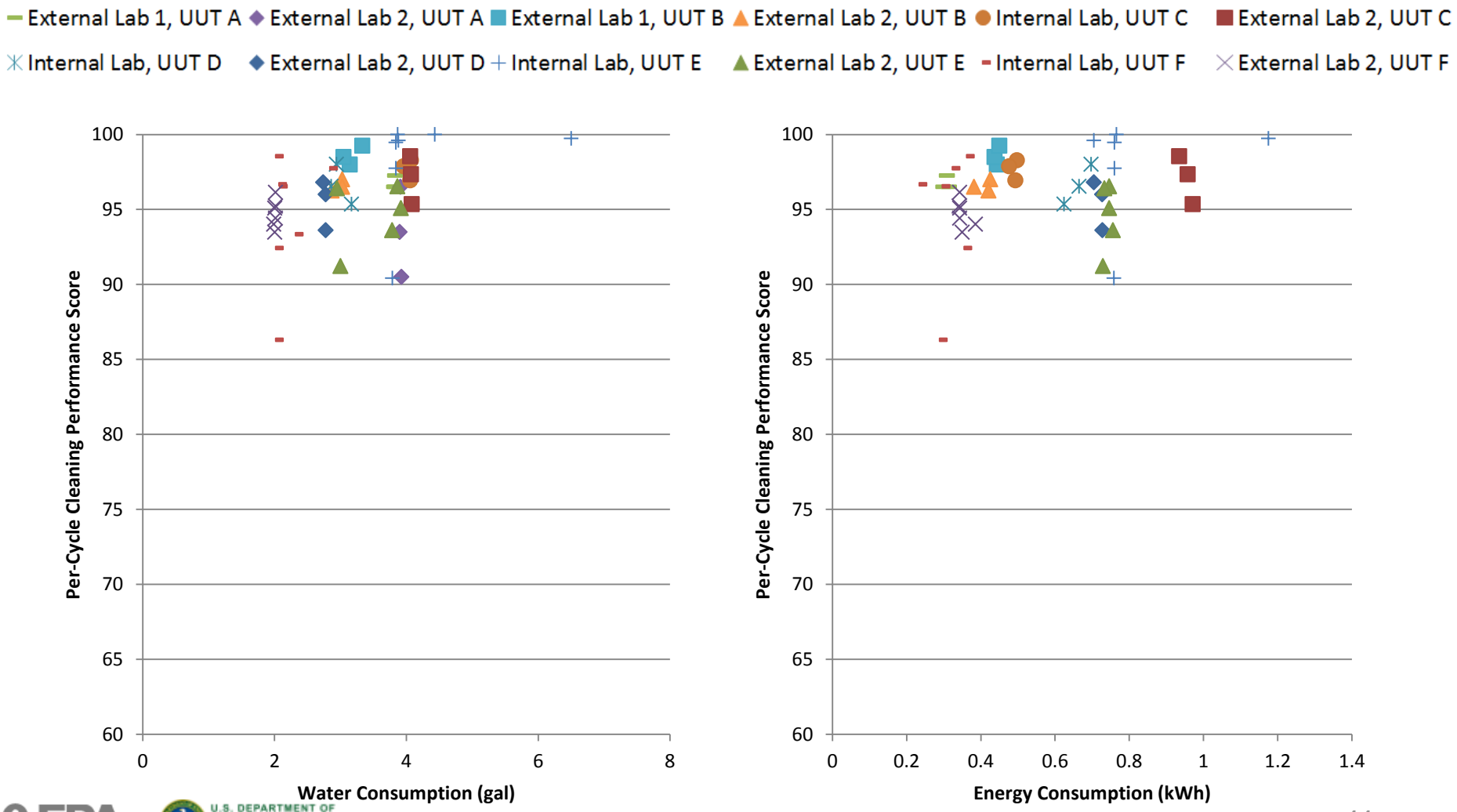
Reproducibility of UUT D



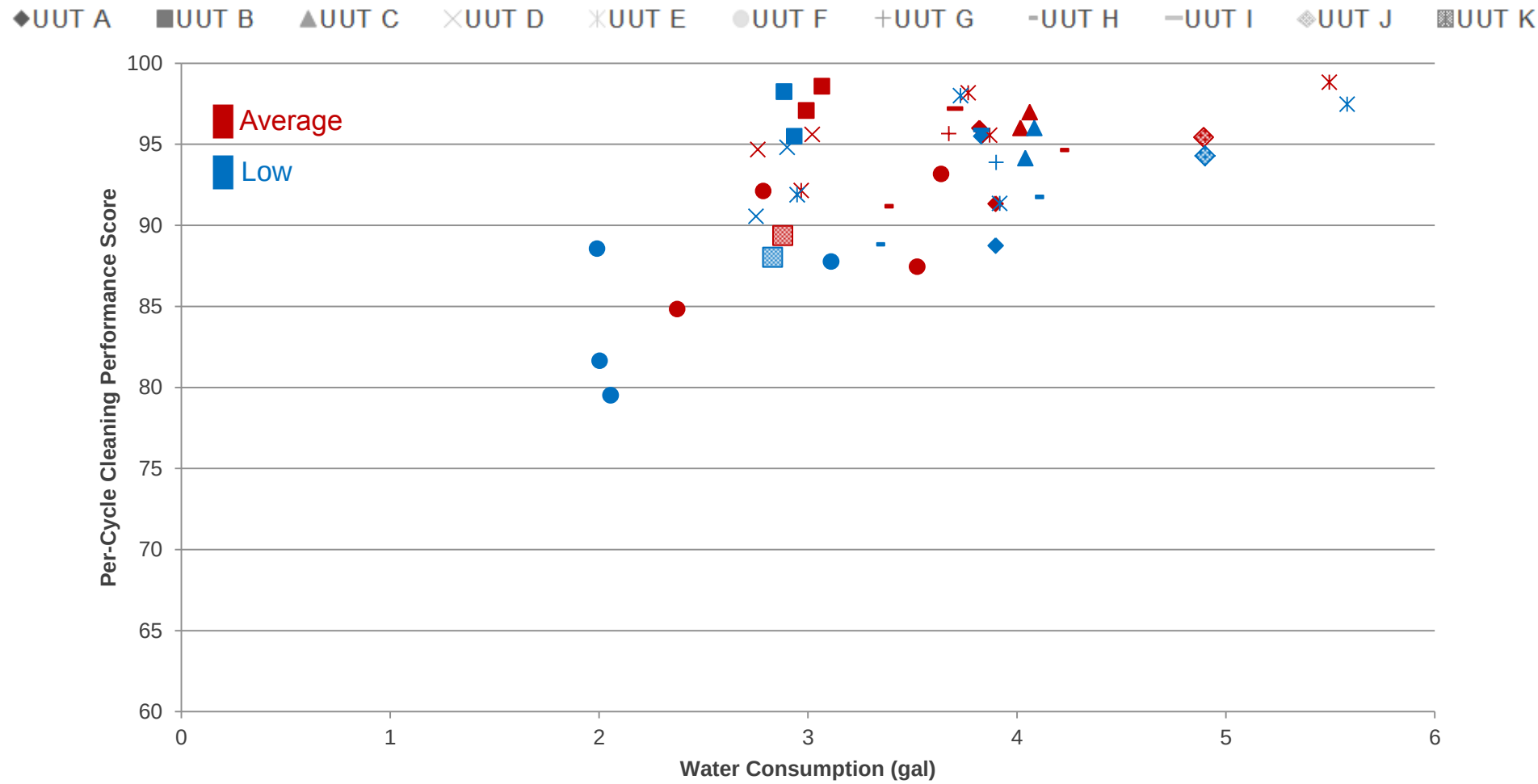
Reproducibility of UUT E



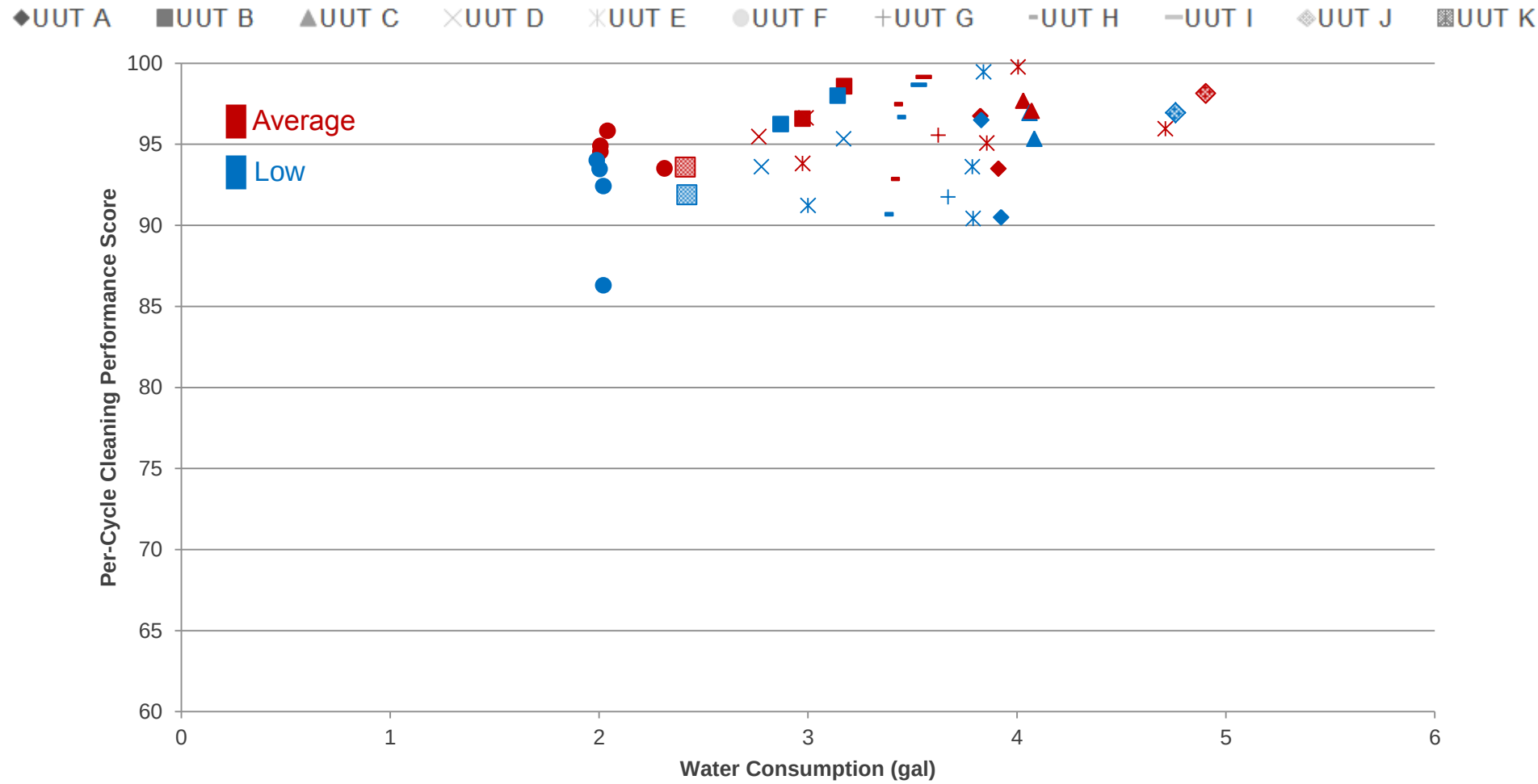
Light Soil Load



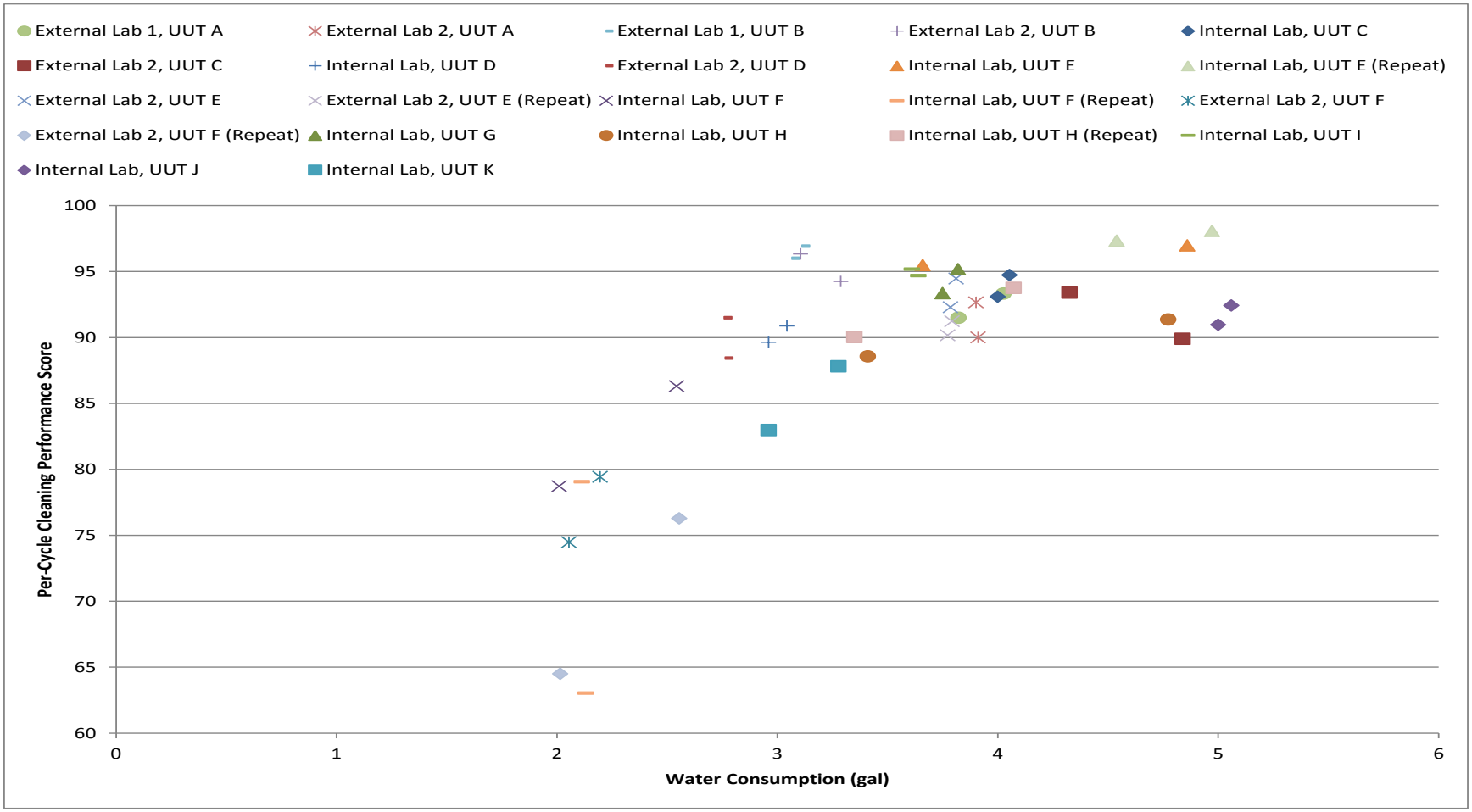
Average and Lowest Scores vs. Water Consumption – Medium Soil Load



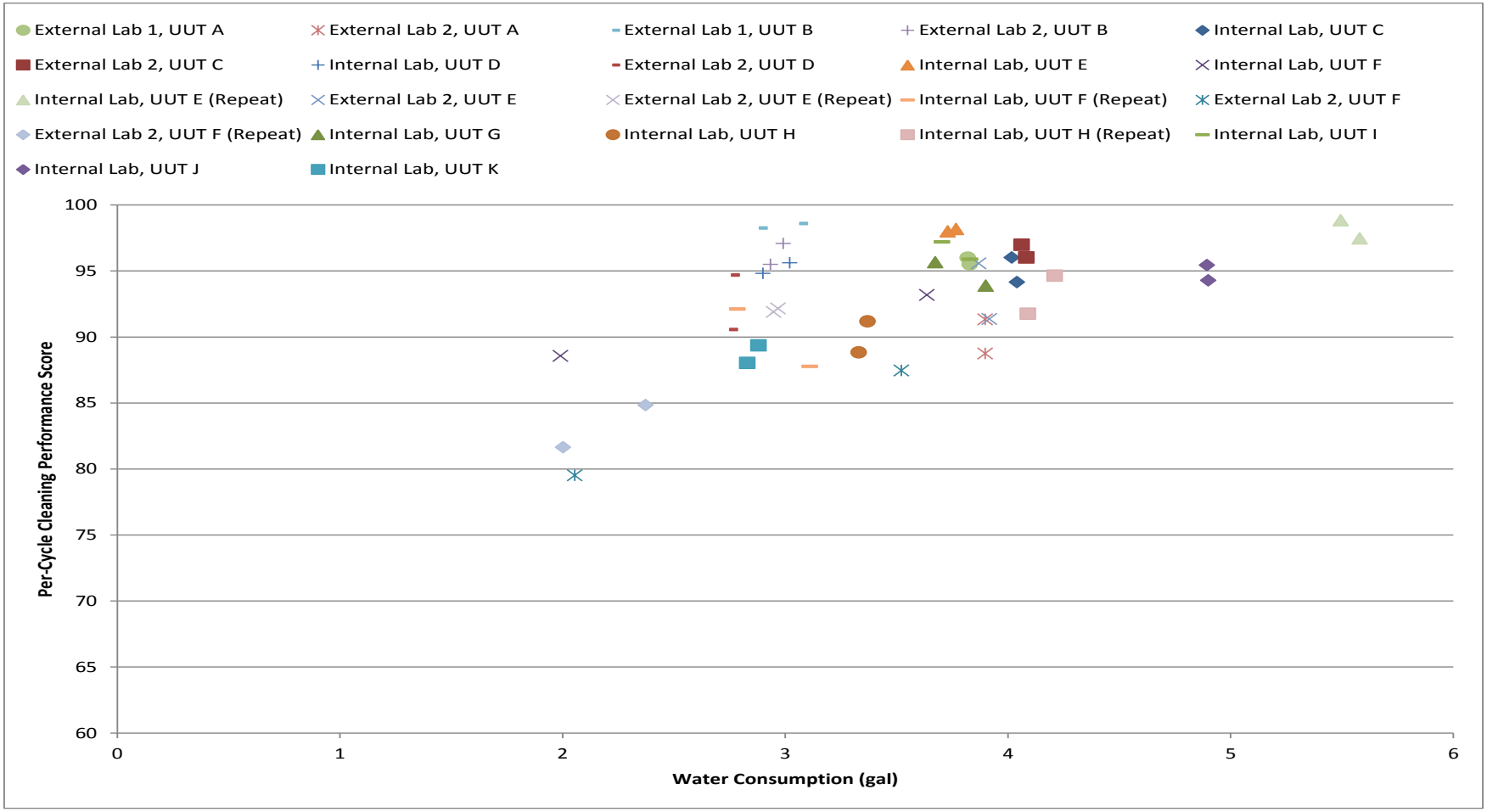
Average and Lowest Scores vs. Water Consumption – Light Soil Load



Average and Lowest Scores for each UUT at each Lab – Heavy Soil Load



Average and Lowest Scores for each UUT at each Lab – Medium Soil Load



Average and Lowest Scores for each UUT at each Lab – Light Soil Load