



Polished Stone Value Interlaboratory Precision Study 2011



Report to NZTA
14 March 2011

PSV Interlaboratory Precision Study



Joint study by Roading NZ and CETANZ

Organised by Downer and Higgins

Analysis by Higgins Group



Objectives

- Ensure all laboratories are operating to a satisfactory level of precision
- Determine precision limits of PSV test for NZ laboratories
- Develop functional relationship between precision and PSV level (if any).



Experimental Design

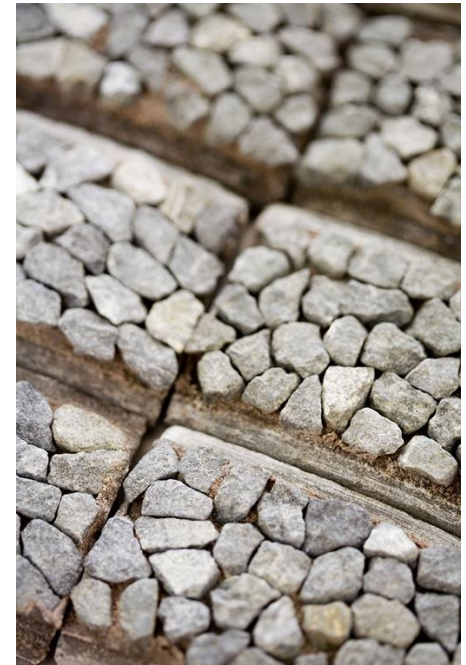
Method: BS EN1097-8:2009

Results analysed using ISO5725-2

Number of Laboratories, $p = 5$

- Downer Laboratory (Auckland)
- Fulton Hogan Laboratory (Christchurch)
- Higgins Laboratory (Napier)
- Opus Central Laboratories (Wellington)
- VicRoads (Melbourne)

Replication, $n = 2$



Experimental Design

Aggregate was selected to represent low, moderate and high PSV values, $k = 3$

- Holcim Aggregates, Hastings
- Fulton Hogan, Motohoura
- Fulton Hogan, Blackhead

Alluvial Greywacke
Weathered Greywacke
Fine Grained Basalt



Definitions - Repeatability

Repeatability: “... independent test results are obtained with the same method on identical test items in the same laboratory by the same operator using the same equipment within short intervals of time.” (ISO5725-1)

Repeatability Limit: “The value less than or equal to which the absolute difference between two test results obtained under repeatability conditions may be expected to be with a probability of 95%.” (ISO5725-1)



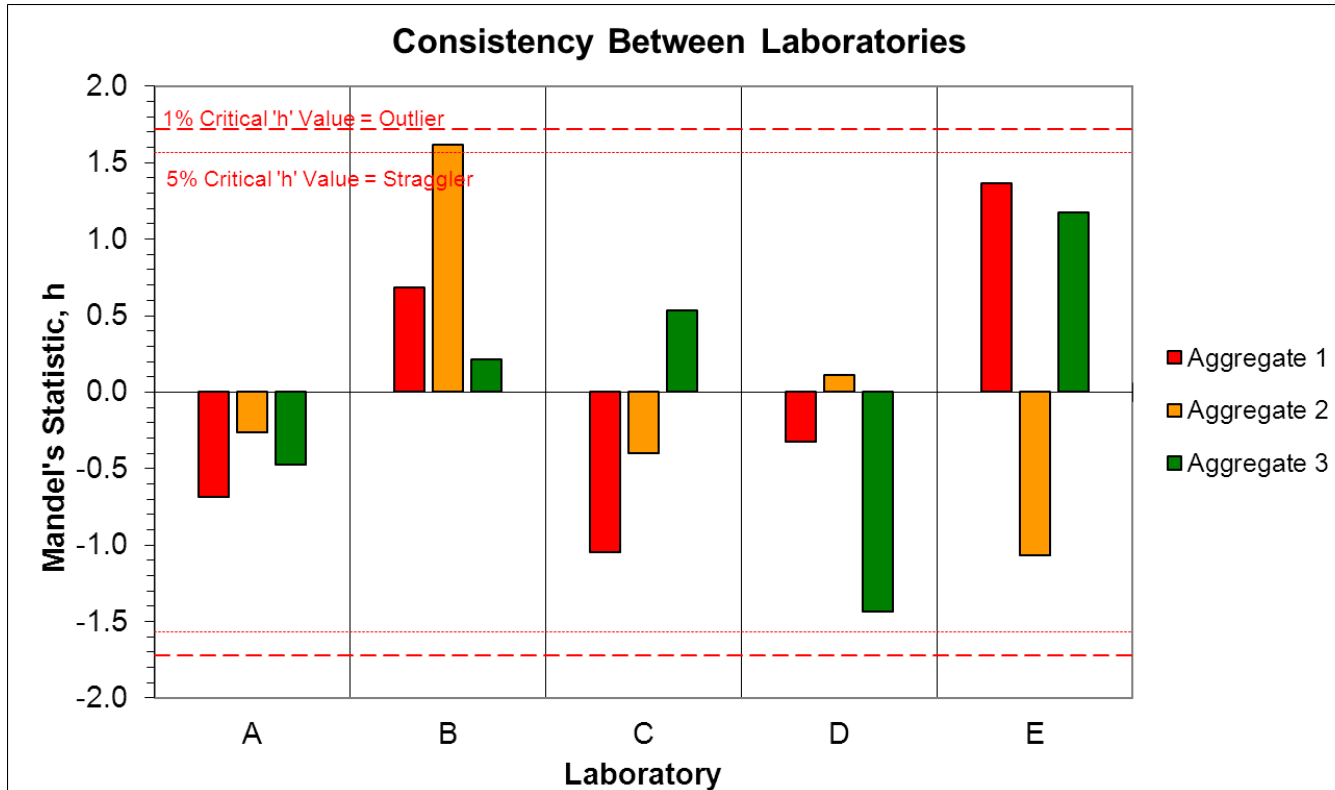
Definitions - Reproducibility

Reproducibility: “... test results are obtained with the same method on identical test items in different laboratory with different operator using different equipment.” (ISO5725-1)

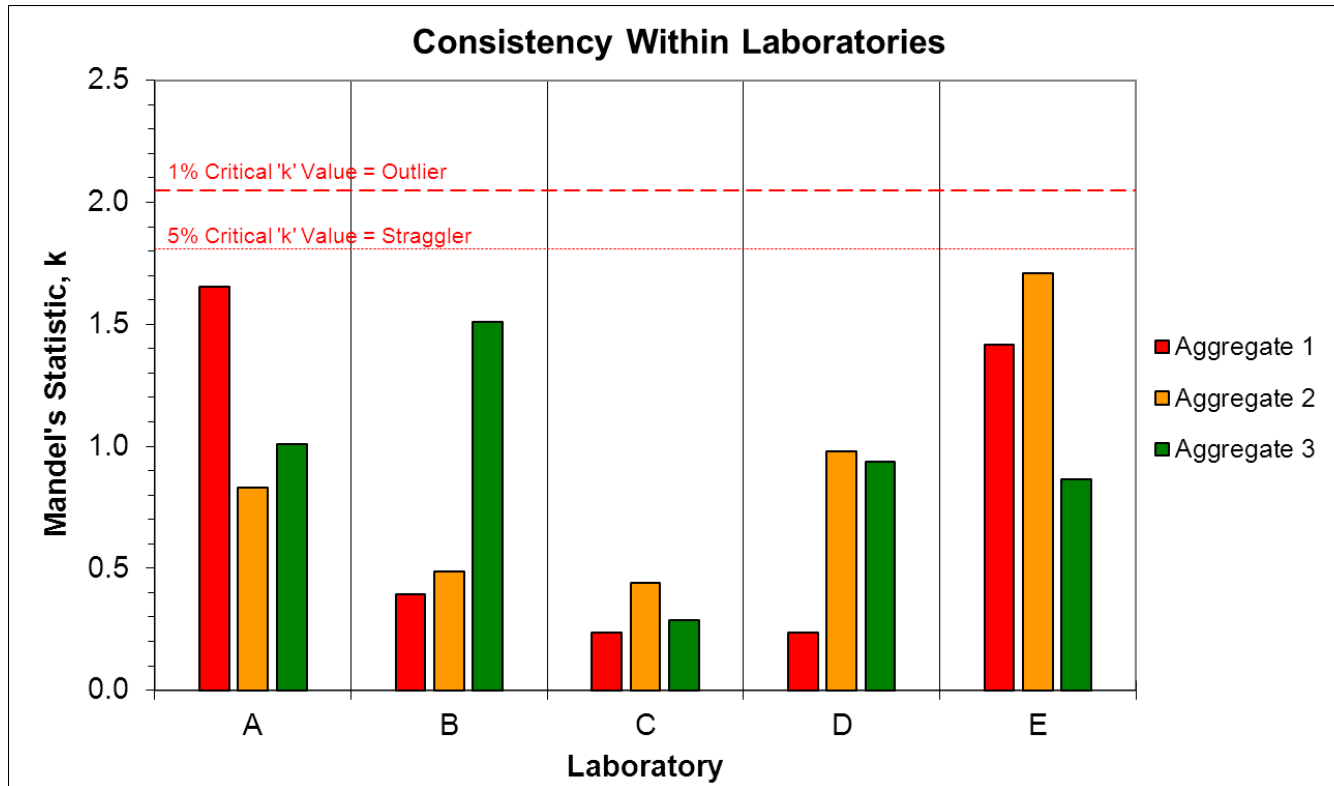
Reproducibility Limit: “The value less than or equal to which the absolute difference between two test results obtained under reproducibility conditions may be expected to be with a probability of 95%.” (ISO5725-1)



Detection of Outliers



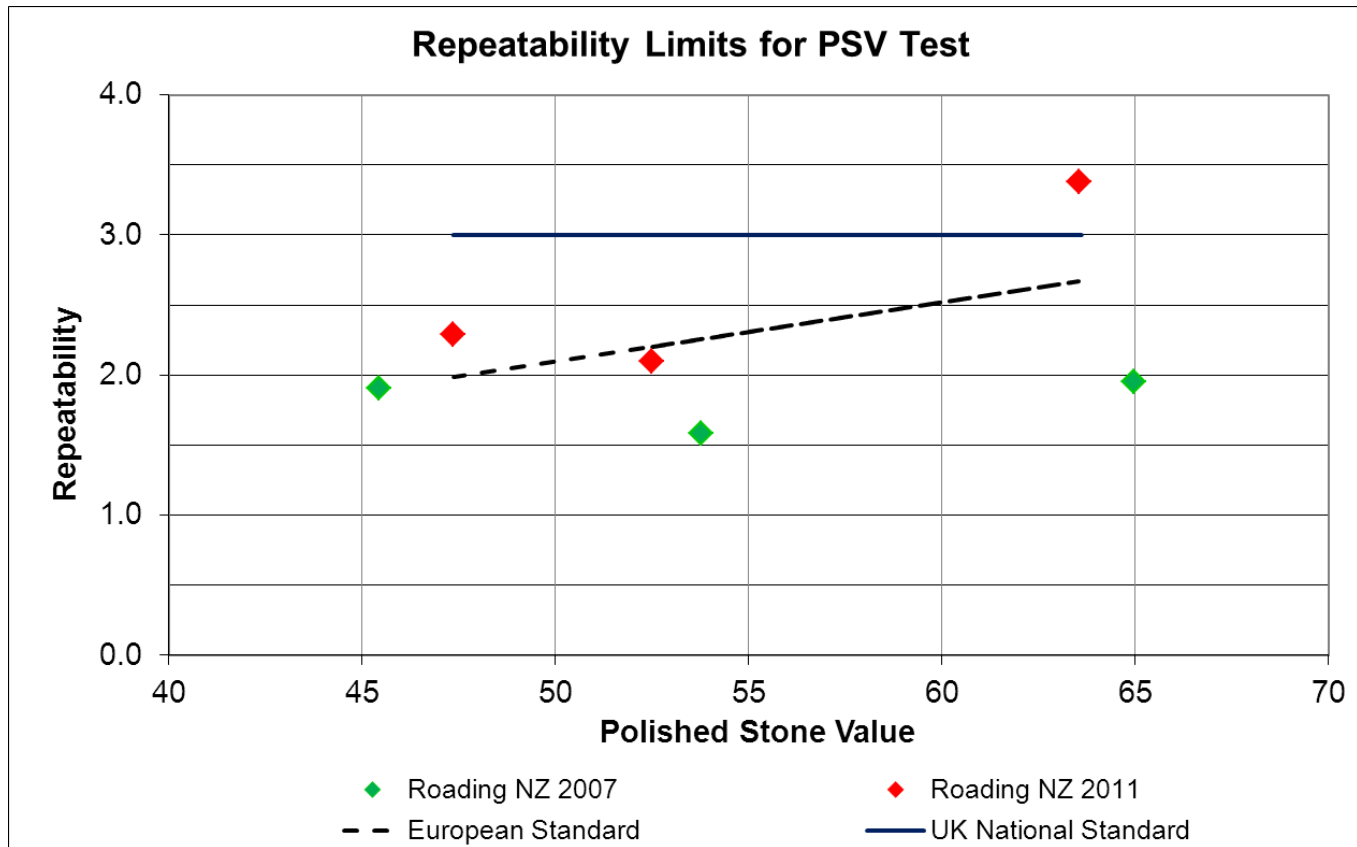
Detection of Outliers



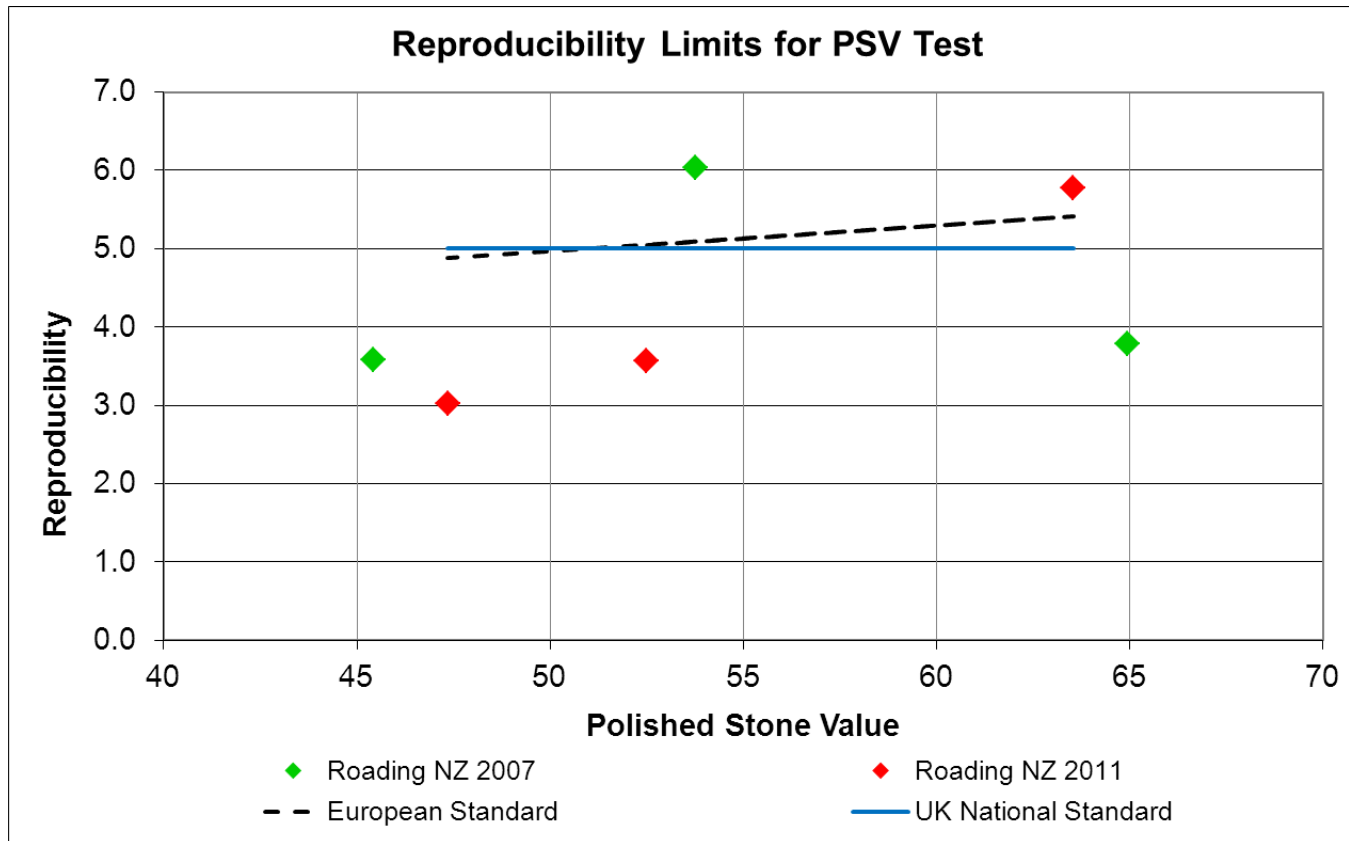
Results

	Aggregate 1	Aggregate 2	Aggregate 3
Average PSV	52.5	63.5	47.4
Repeatability St. Deviation	0.75	1.21	0.82
Limit of Repeatability	2.1	3.4	2.3
Reproducibility St. Deviation	1.27	2.06	1.08
Limit of Reproducibility	3.6	5.8	3.0

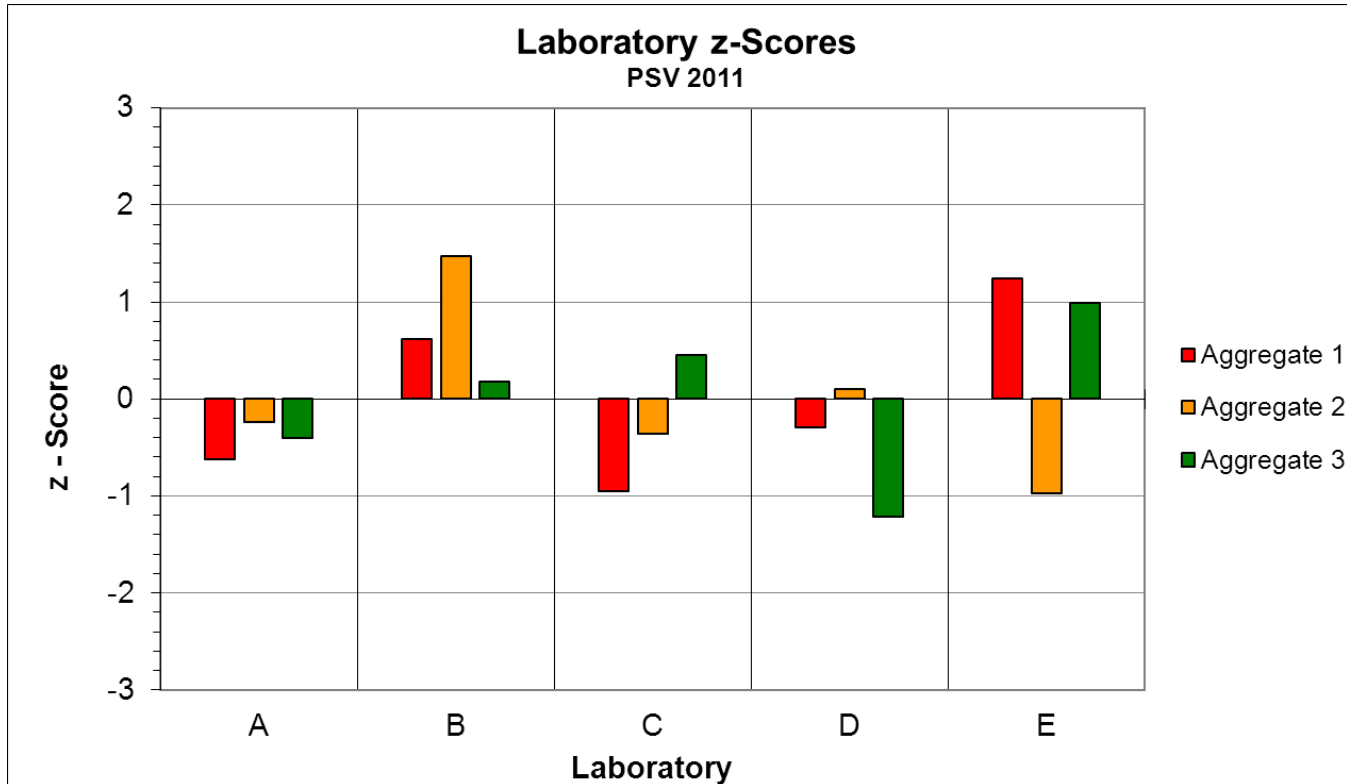
Precision Functional Relationships



Precision Functional Relationships



Laboratory Bias



Interpreting z-scores:

$-2 > z > 2$: straggler. Warning signal to laboratory

$-3 > z > 3$: outlier. Laboratory is operating with bias.

Conclusions

- All laboratories in Australia and New Zealand are operating to a satisfactory level of precision.
- No bias detected amongst the laboratories
- Precision is similar to UK and European standards
 - Repeatability ~ 3
 - Reproducibility ~ 5
- These results have implications for NZTA T/10
 - Uncertainty of measurement of PSV can affect estimation of skid resistance by 0.05 ESC
 - Reproducibility should be taken into account when assessing stockpile compliance.

