



TECHNICAL REPORT ON
CONE PENETRATION, PLASTIC LIMIT AND PLASTICITY INDEX
TEST PROFICIENCY 2015

CETANZ Technical Report	TR 6
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Associated Test Method(s)	NZS4407:1991 3.2, 3.3 & 3.4

CONE PENETRATION, PLASTIC LIMIT AND PLASTICITY INDEX TEST PROFICIENCY 2015

1. Introduction

In 2015, CETANZ organised and ran an inter-laboratory proficiency scheme on the Cone Penetration, Plastic Limit and Plasticity Index tests, designed to achieve the following outcomes:

1. Provide results that should enable participants to improve their performance.
2. Provide information relevant for calculation of uncertainty.
3. Identify problems with, or between, laboratories.
4. Potentially identify needs for test method improvement.

The following Laboratories participated in the scheme:

Central Testing Services - Alexandra
Coffey Geotechnics NZ Ltd
Downer Auckland Laboratory
Downer Christchurch Laboratory
Fulton Hogan Laboratory - Auckland
Fulton Hogan Laboratory - Canterbury
Fulton Hogan Laboratory - Waikato
EnviroLab Geotest Ltd
Higgins - Palmerston North
Holcim Bombay
OPUS International Consultants - Auckland
OPUS International Consultants - Christchurch
OPUS International Consultants - Gisborne
OPUS International Consultants - New Plymouth
OPUS Research
OPUS International Consultants - Rotorua
OPUS International Consultants - Tauranga
OPUS International Consultants - Wanganui
OPUS International Consultants - Whangarei
Test Lab - Wanganui
Winstone Aggregate Ltd - Auckland Laboratory
Winstone Aggregate Ltd - Wellington Laboratory
Stevenson Laboratory

To ensure anonymity of results each laboratory was assigned a unique identifier by Keith Towl of IANZ. All participating Laboratories returned results.

2. Sample Preparation & Instruction

Each Laboratory was sent two aggregate test samples of approximately 8kg each, enough for a technician to complete one Cone Penetration Limit, Plastic Limit and Plasticity Index test on each sample. Each Laboratory was given the option to request additional samples for additional technicians or Uncertainty of Measurement calculations.

The samples supplied were:

- PAP 6 material from Stevenson – Drury Quarry
- GAP20 material from Stevenson – Huntly Quarry

Bulk field samples were taken from the respective quarries and split down by Stevenson Laboratory to provide test samples. The test samples were labelled A (PAP 6) and B (GAP 20).

Laboratories were instructed to carry out preparation and testing as per NZS 4407:1991: test methods 3.2, 3.3 & 3.4 and to ensure all testing was carried out on the fraction passing the 425µm test sieve. All Laboratories were instructed to ensure that only technicians that were deemed proficient were to complete the testing.

3. Results

Laboratory I.D.	Balance Used	Water Reduction Method	Water Used	IANZ Accredited	Equilibration Period	(Operator A) Sample A			(Operator B) Sample A			(Operator A) Sample B			(Operator B) Sample B		
						Cone Penetration Limit	Plastic Limit	Plasticity Index	Cone Penetration Limit	Plastic Limit	Plasticity Index	Cone Penetration Limit	Plastic Limit	Plasticity Index	Cone Penetration Limit	Plastic Limit	Plasticity Index
						<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>	<i>nearest 0.1dp</i>
1	0.01g	Filtration	Tap	Yes	24hrs min	21.4	NP	NP				34.6	21.0	13.6			
2	0.01g	Filtration	Distilled	Yes	*	19.7	14.7	5.0	19.6	NP	NP	32.9	15.3	17.6	32.6	18.5	14.1
3	0.001g	Filtration	Distilled	Yes	24hrs min	20.1	17.2	2.9	20.2	15.3	4.9	32.6	19.1	13.5	32.0	16.4	15.6
4	0.001g	Evaporation & Filtration	Distilled	Yes	7 days	21.3	NP	NP				34.4	19.6	14.8			
5	0.001g	Evaporation	Distilled	Yes	16hrs min	20.2	NP	NP				32.3	17.5	14.8			
6	0.0001g	Filtration	Tap	Yes	24hrs min	20.2	NP	NP				32.0	17.9	14.1			
7	0.001g	Evaporation	Distilled	Not Reported	24hrs min	19.7	NP	NP				31.2	17.1	14.1			
8	0.0001g	Evaporation	Distilled	Yes	24hrs min	19.1	NP	NP				32.5	18.2	14.3			
9	0.001g	Evaporation	Tap	Yes	16hrs min	25.0	17.4	7.6				32.2	17.0	15.2			
10	0.001g	Evaporation	Distilled	Yes	24hrs min	21.2	NP	NP				34.0	16.3	17.7			
11	0.0001g	Evaporation & Filtration	Tap	Yes	24hrs min	20.7	NP	NP	21.4	NP	NP	32.5	17.9	14.6	32.7	17.9	14.8
12	0.001g	Evaporation & Filtration	Distilled	Yes	24hrs min	20.6	17.9	2.7				32.8	19.1	13.7			
13	0.001g	Evaporation	Tap	Yes	Not Reported	21.2	3.3	17.9				34.7	19.9	14.8			
14	0.001g	Evaporation	Tap	Yes	24hrs min	21.3	NP	NP	21.5	NP	NP	35.4	20.7	14.7	33.5	19.8	13.7
15	0.001g	Evaporation & Filtration	Tap	Yes	24hrs min	19.6	NP	NP				31.8	18.5	13.3			
16	0.001g	Evaporation & Filtration	Tap	Yes	24hrs min	20.3	NP	NP				32.0	20.2	11.8			
17	0.0001g	Evaporation	Distilled	Yes	12hrs min	25.6	19.4	6.2	23.2	17.7	5.5	36.8	25.0	11.8	36.2	20.5	15.7
18	0.01g	Evaporation	Distilled	No	24hrs min	19.3	NP	NP				31.6	18.4	13.2			
19	0.001g	Evaporation	Tap	Yes	24hrs min	20.2	NP	NP				31.7	17.8	13.9			
20	0.001g	Evaporation	Tap	Yes	24hrs min	19.5	NP	NP				30.4	16.6	13.8			
21	0.001g	Evaporation	Tap	Not Reported	24hrs min	19.6	NP	NP	19.3	NP	NP	30.8	18.0	12.8	29.9	17.8	12.1
22	0.001g	Evaporation	Deionised	Yes	24hrs min	20.7	14.3	6.4				34.6	17.5	17.1			
23	0.001g	Evaporation & Filtration	Distilled	No	7 days	22.0	NP	NP				27.2	15.5	11.7			

CETANZ:
 Operator A - 19+ hrs Spl A
 Operator A - 24+ Hrs Spl B
 Operator B - 16 min hrs Spl A & B

CETANZ:
 Operator B - Distilled

CETANZ:
 Operator B - Distilled

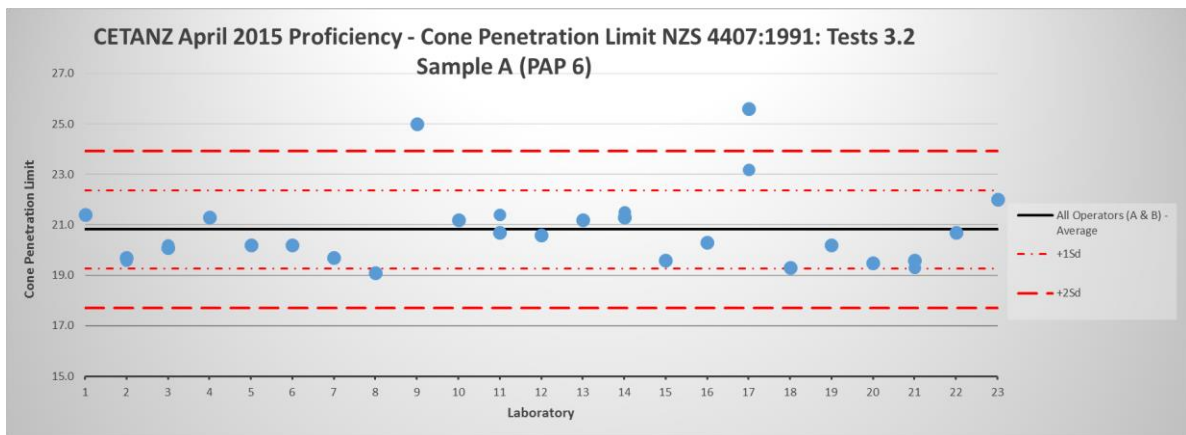
4. Analysis

For the purpose of analysis, all results, including the duplicate test data provided by some of the participants, have been tabulated. Each participant will need to undertake their own analysis on the data provide to gauge their own performance.

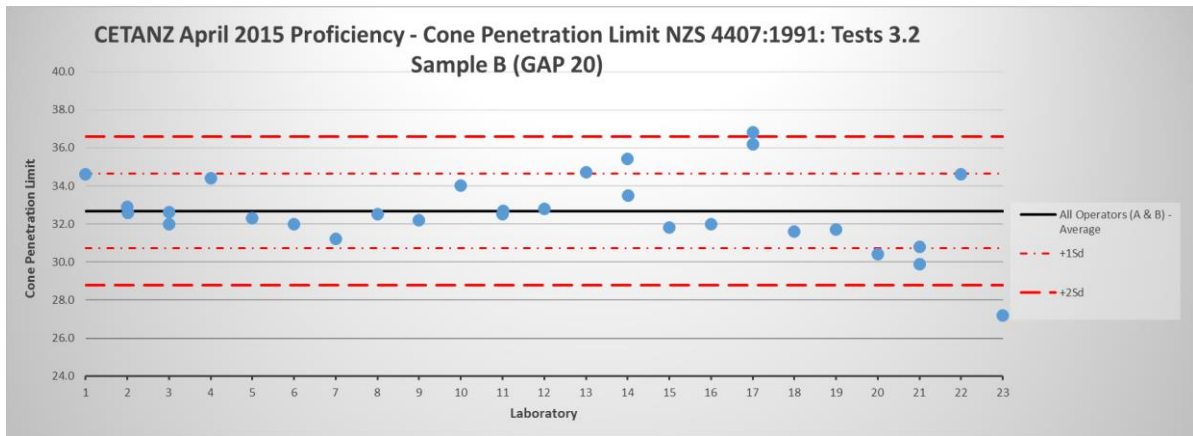
The graphs provided, only display result plots versus simple Average, ± 1 Standard Deviation and ± 2 Standard Deviation limits.

Plastic Limits or Plasticity Index has not been plotted for Sample A due to the test results being mostly Non Plastic and therefore impossible to graphically represent.

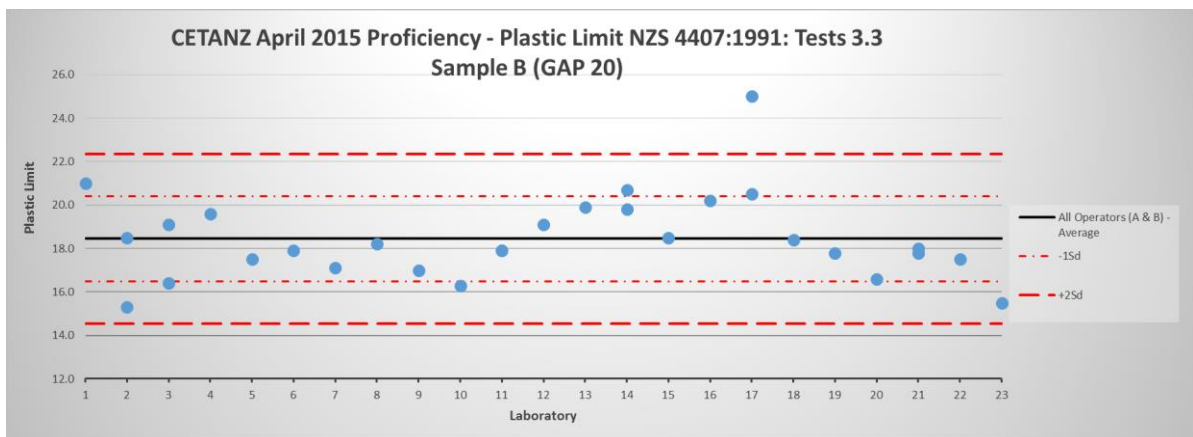
Graph 1



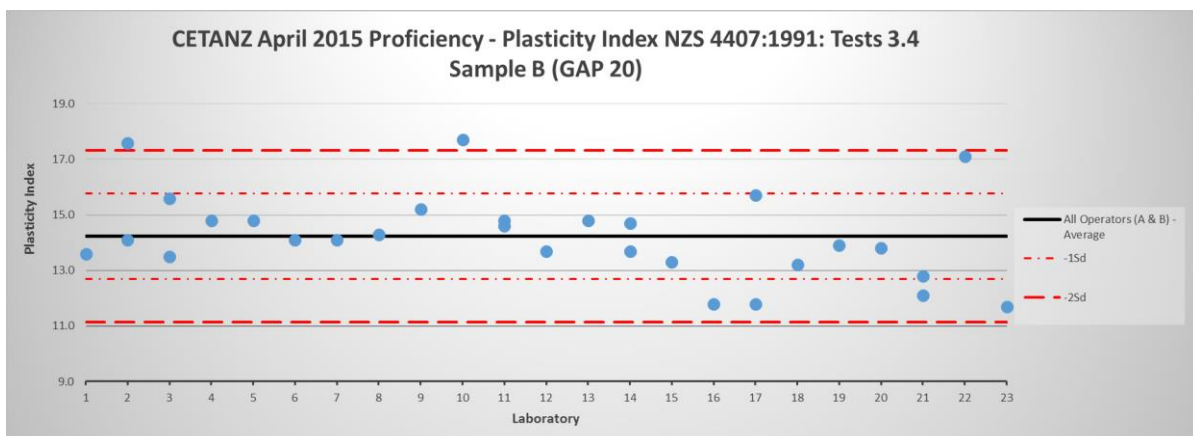
Graph 2



Graph 3



Graph 4



5. Conclusions

The results seem to indicate the possibility of a relatively large amount of variation for both types of sample tested. More advanced analysis is required, but initial indications are that the variation or reproducibility could be as high as ± 7 Plasticity Index. Given that current Plasticity Limits for premium basecourse are "5" or "Non-Plastic", this data would seem to indicate that an issue exists and further work should be done.

6. Further action

Advise stakeholders of proficiency data and arrange for more in-depth analysis and publication of results.

7. Referenced Documents

NZS 4407:1991: Part 2 tests 3.2, 3.3 & 3.4.

8. Disclaimer

The information in this publication is to encourage high standards within the civil engineering testing industry. The information is intended as a technical report for CETANZ members only and in no way purports to be a robust statistical analysis. CETANZ cannot accept any liability of any sort for unsatisfactory site or laboratory work carried out by Companies who are members of CETANZ or organisations who claim to be following this report. CETANZ assumes no responsibility for any loss which may arise from reliance on the report and disclaims all liability accordingly. Specialist and/or legal advice should always be sought on any specific problem or matter.