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NZ Transport Agency Waka Kotahi

NZTA T28: 2024 Proficiency Interlaboratory Study

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NZTA T28: 2024 PROFICIENCY INTERLABORATORY STUDY

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NZ Transport Agency Waka Kotahi

WSP
Research & Innovation Centre
33 The Esplanade, Petone
PO Box 30 845, Lower Hutt 5040
Wellington, New Zealand
+64 4 587 0600
wsp.com/nz

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	NAME	DATE	SIGNATURE
Prepared by:	Matt Sharp	05-09-2024	
Reviewed by:	Jeremy Wu Portly Griffiths	05-09-2024	
Approved by:	Louise Malcolm	06-09-2024	

WSP
Research & Innovation Centre
33 The Esplanade, Petone
PO Box 30 845, Lower Hutt 5040
Wellington, New Zealand
+64 4 587 0600
wsp.com/nz

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ABBREVIATIONS

OWC	Optimum water content
WC	Water content
MDD	Maximum dry density
NZTA	New Zealand Transport Agency
ILS	Interlaboratory study

1 Introduction

This report summarises the results of the proficiency testing interlaboratory study of *NZTA T28: 2024 Test Method for the Determination of the Dry Density and Water Content Relationship of Aggregate (Draft v6.1)*. The study was conducted between May and August 2024 by WSP NZ with the support of the NZ Transport Agency Waka Kotahi and the Civil Engineering Testing Association of New Zealand (CETANZ).

1.1 Study Purpose and Design

This study had three objectives:

1. Assess the participating laboratories ("labs") proficiency in performing the prescribed test method and if the amended procedure has improved the reproducibility of the test over the current test method *NZS 4402: 1986 Test 4.1.3*.
2. Assess the impact (if any) of using a clamping system for the mould used in the prescribed test method.
3. Assess the impact (if any) of taking water content measurements before compaction (via a subsample) vs. after compaction in the prescribed test method.

Labs were provided with two AP40 aggregate samples conforming to *TNZ M/4:2006*. The two samples were from separate sources and chosen for their known difference in material composition.

For each aggregate sample, the labs were required to complete two *NZTA T28: 2024 (Draft)* MDD-OWC curves:

1. Using a mould clamped to the loading frame base plate – with water content measurements taken before and after compaction
2. Using a mould unclamped to the loading frame base plate – with water content measurements taken before and after compaction

The current test method does not mandate a clamping system for the mould.

A total of 18 labs who had the equipment prescribed in the test method (hammer and frame) agreed to participate in the study and received the samples.

For each sample, the labs were required to complete the *NZTA T28: 2024 ILS Results Return Sheet* (Appendix A3)

2 Methods and Analyses

2.1 Test Method

The test method used by the labs was the *NZTA T28: 2024 Test Method for the Determination of the Dry Density and Water Content Relationship of Aggregate (Draft v6.1)* with additional instructions provided in *ILS - NZTA T28: 2024 - Notes for participating laboratories*.

Both of these documents can be found in Appendix A1 and A2 respectively.

The reported results were verified by a recalculation of the correction factor (NZTA T28: 2024 Section 6) which was applied to the reported test measurements and an analysis of the resulting curve. In the event of any discrepancies in the reported vs. verified result, the verified result was used in the analysis.

2.2 Analyses

A summary of the analyses undertaken is provided in Table 2.1 and further detailed in Sections 2.2.1 to 2.2.4.

Table 2.1: Summary of analyses

Objective	Analysis of the proposed test method
Proficiency and Reproducibility	Z-score and Uncertainty of Measurement o MDD (clamped) o OWC (clamped) o MDD (unclamped) o OWC (unclamped)
Impact of clamping	Paired sample t-tests o MDD - clamped vs unclamped. o OWC - clamped vs unclamped.
Impact of water content (WC) measurements	Paired sample t-tests o OWC – WC measured before vs. after (clamped). o OWC – WC measured before vs. after (unclamped).

2.2.1 Proficiency of NZTA T28: 2024 (Draft v6.1)

The proficiency analyses were measured via Z-scores per lab and uncertainty of measurement using the CETANZ 'Uncertainty of Measurement Master Ver. 3 June 2022' calculator. Z-scores give a measure of how far a result is from a mean value and gives a score to each result relative to the other results in the group. A Z-score close to zero indicates good agreement with those from other labs, while a value greater than or equal to 3.0 is considered as an outlier.

2.2.2 Reproducibility of NZTA T28: 2024 (Draft v6.1)

The reproducibility, *R*, of the MDD and OWC results between-labs were calculated for both samples using the methodology specified in *ASTM E 691-23*. With each lab testing one curve per test configuration, repeatability within-labs, *r*, was not assessed.

2.2.3 *Impact of Clamping*

The impact on the mean MDD and OWC results from clamping vs. not clamping the mould to the base of the hammer frame was evaluated using paired sample t-tests, with the null hypothesis (H_{0c}) that the means of the two groups (μ_{1c} and μ_{2c}) would be equal (i.e. clamping has no impact) e.g:

$$H_{0c}: \mu_{1c} = \mu_{2c}$$

This analysis provided a p-value which is a statistical measurement to validate the hypothesis, where the lower the p-value the greater the level of statistical significance. In this study, a p-value greater than 0.05 signifies the null hypothesis is validated (clamping has no impact), while a p-value less than or equal to 0.05 signifies the null hypothesis is rejected and the alternative hypothesis (H_{1c}) is validated (clamping has an impact).

2.2.4 *Effectiveness of Water Content Measurements*

The impact on the mean MDD and OWC results from taking water content measurements before vs. after compaction was evaluated using paired sample t-tests, with the null hypothesis (H_{0w}) that the means of the two groups (μ_{1w} and μ_{2w}) would be equal (the water content measurements have no impact) e.g:

$$H_{0w}: \mu_{1w} = \mu_{2w}$$

This analysis provided a p-value which is a statistical measurement to validate the hypothesis, where the lower the p-value the greater the level of statistical significance. In this study, a p-value greater than 0.05 signifies the null hypothesis is validated (the water content measurements have no impact), while a p-value less than or equal to 0.05 signifies the null hypothesis is rejected and the alternative hypothesis (H_{1w}) is validated (the water content measurements have an impact).

3 Results

The test information provided on all the return sheets from the participating labs is provided in Appendix B1. The tables of results for all test configurations for Samples 1 and 2 are provided in the Proficiency Results report in Appendix B2.

19 labs were initially contacted to participate however one was removed as a participating lab prior to the study (Lab 12). Of the 18 participating labs, three did not return a result (Lab 6, 14, and 16), and two were rejected due to insufficient information in the Return Sheet to allow for the verification of the results (Lab 13 and 18). The results from the remaining 13 labs were used for the analyses. Additional notes on the data quality is detailed in Section 4.3.

3.1 Proficiency of NZTA T28: 2024 (Draft v6.1)

The summarised results, averages and the corresponding Z-scores from the labs for the *NZTA T28: 2024 (Draft v6.1)* test method are provided in Table 3.1. The Z-scores are charted in Figure 3.1 and Figure 3.2.

The data in these tables and figures correspond to the test conditions of the mould clamped to the base plate, and water contents measurement after compaction, as mandated by *NZTA T28: 2024 (Draft v6.1)*.

Table 3.1: NZTA T28: 2024 (Draft v6.1) laboratory results and Z-scores

	Lab test results				Z-scores			
	Sample 1		Sample 2		Sample 1		Sample 2	
Lab ID	MDD (T/m³)	OWC (%)	MDD (T/m³)	OWC (%)	MDD	OWC	MDD	OWC
1	2.35	5.5	2.36	4.4	0.17	-0.13	1.06	-1.19
2	2.28	6.0	2.29	4.6	-2.09	0.56	-0.84	-0.88
3	2.33	5.6	2.30	6.2	-0.47	0.01	-0.56	1.53
4	2.36	5.1	2.35	5.9	0.50	-0.67	0.79	1.08
5	2.37	7.3	2.30	4.3	0.82	2.33	-0.56	-1.34
7	2.34	5.2	2.34	5.4	-0.15	-0.54	0.52	0.33
8	2.31	6.4	2.26	5.7	-1.12	1.10	-1.65	0.78
9	2.33	6.0	2.27	4.5	-0.47	0.56	-1.38	-1.03
10	2.34	5.0	2.33	5.3	-0.15	-0.81	0.25	0.17
11	2.33	5.3	2.31	4.9	-0.47	-0.40	-0.29	-0.43
15	2.38	4.4	2.39	5.0	1.14	-1.63	1.88	-0.28
17	2.36	5.1	2.34	5.0	0.50	-0.67	0.52	-0.28
19	2.40	5.8	2.33	6.2	1.79	0.28	0.25	1.53
Max.	2.400	7.3	2.390	6.2				
Min.	2.280	4.4	2.260	4.3				
Range	0.12	2.9	0.13	1.9				
Average	2.34	5.59	2.32	5.18				
Std. dev.	0.031	0.73	0.037	0.66				
UoM	0.06	1.46	0.08	1.33				

|Z-score| < 1
1 ≤ |Z-score| < 2
2 ≤ |Z-score| < 3
|Z-score| ≥ 3

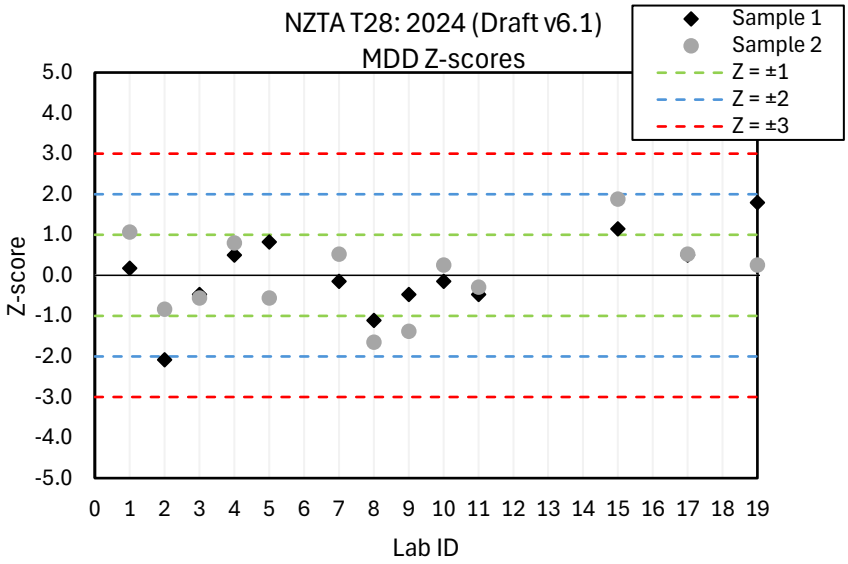


Figure 3.1: NZTA T28: 2024 (Draft v6.1) MDD Z-scores

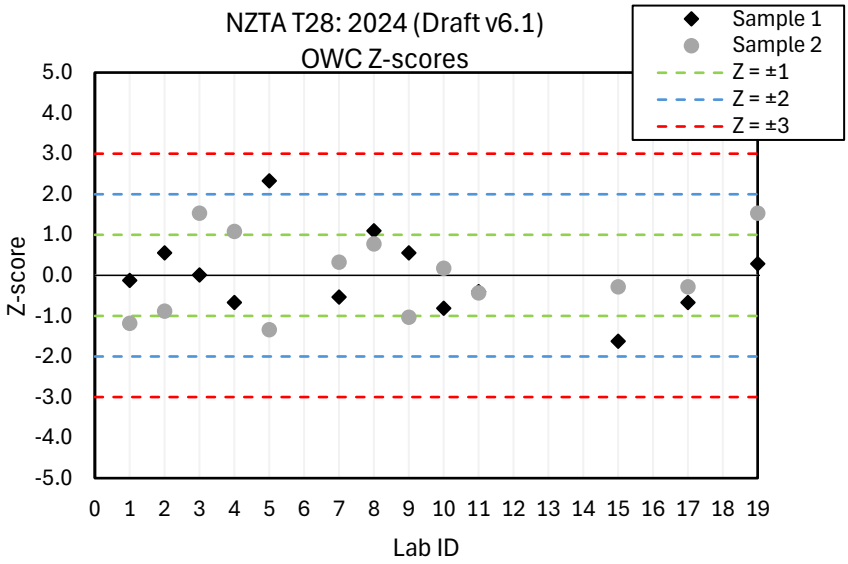


Figure 3.2: NZTA T28: 2024 (Draft v6.1) OWC Z-scores

Across both samples, 0 outliers (Z-score ≥ 3.0) were identified from the 13 results analysed for both the MDD and OWC results. For the MDD results, one had a Z-score ≥ 2.0 (Lab 2) for Sample 1 only, and one had an OWC Z-score ≥ 2.0 (Lab 5) for Sample 1 only, indicating an overall good performance was achieved by the participants analysed.

3.2 Reproducibility of NZTA T28: 2024 (Draft v6.1)

The reproducibility of *NZTA T28: 2024 (draft)* to determine the MDD and OWC for both samples is provided in Table 3.2 and Table 3.3. This data corresponds to the test conditions of the mould clamped to the base plate, and water contents measurement after compaction, as mandated by NZTA T28: 2024 (Draft v6.1).

In addition to Sample 1 and 2, the sample "TNZ6" has been included as a point of comparison from the *New Zealand Vibrating Hammer Compaction Test Interlaboratory Study* (Ball, 2008). TNZ6 was described as an AP40 aggregate sample conforming to TNZ M/4:2006 with a target 6% water content, the most closely matching sample 1 and 2.

Table 3.2: Dry density between-laboratories reproducibility. (*TNZ6* source: Ball, 2008)

Sample	Average Dry Density (T/m³)	Between-lab Std. Deviation, S_R	Reproducibility, *R*
Sample 1	2.344	0.031	**0.087**
Sample 2	2.321	0.037	**0.103**
TNZ6	*2.351*	*0.084*	***0.212***

Table 3.3: Water content between-laboratories reproducibility. (*TNZ6* source: Ball, 2008)

Sample	Average water content (%)	Between-lab Std. Deviation, S_R	Reproducibility, *R*
Sample 1	5.592	0.733	**2.053**
Sample 2	5.185	0.662	**1.853**
TNZ6	*4.853*	*0.798*	***2.233***

For both samples, a significant improvement in the reproducibility of the MDD results was observed, and a minor improvement of OWC results, compared to the TNZ6 sample. It should be noted however that this comparison is made across different studies with different sized datasets (28 labs in Ball, 2008 vs. 13 labs in this report,) and should be viewed as indicative only.

Ball noted that the reproducibilities produced in the 2008 study were significantly greater than precision specified in BS EN 13286-03 of 0.054 T/m^3 for a gravel sub-base. That would still apply for the reproducibility results of Sample 1 and 2 (0.087 and 0.103 T/m3 respectively), however BS EN 13286 was updated in 2021 and removed all precision data specifications for this test for reasons unknown.

Ball also noted that ASTM D7382-07 had not yet determined a reproducibility specification, and that remained the case when ASTM D7382 was updated in 2020.

As such, evaluation of reproducibility of the MDD and OWC results to existing standards are not possible. Once the method is finalised, a full repeatability and reproducibility study would be recommended.

3.3 Impact of Clamping

The results from the labs for clamped vs unclamped test configurations provided in Figure 3.3 to Figure 3.6, with Z-score comparisons in Appendix B2.

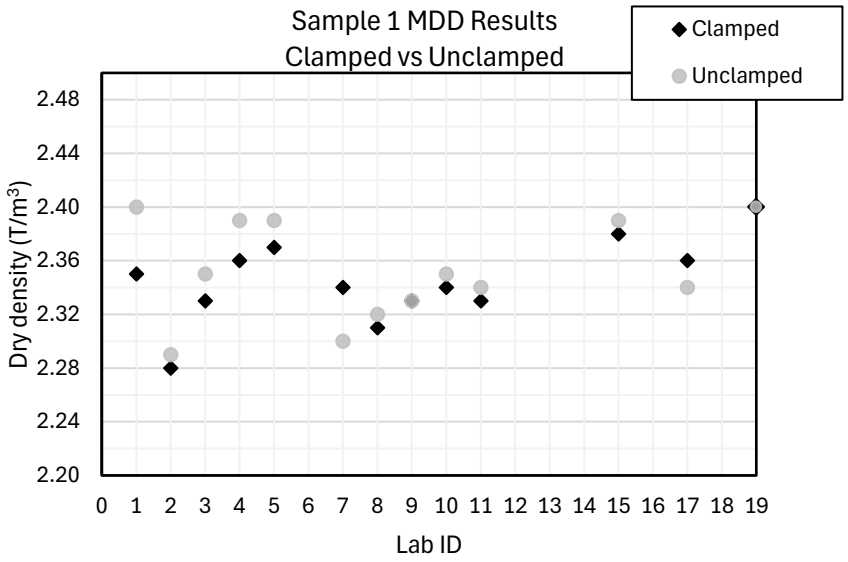


Figure 3.3: Sample 1 MDD Results Clamped vs Unclamped

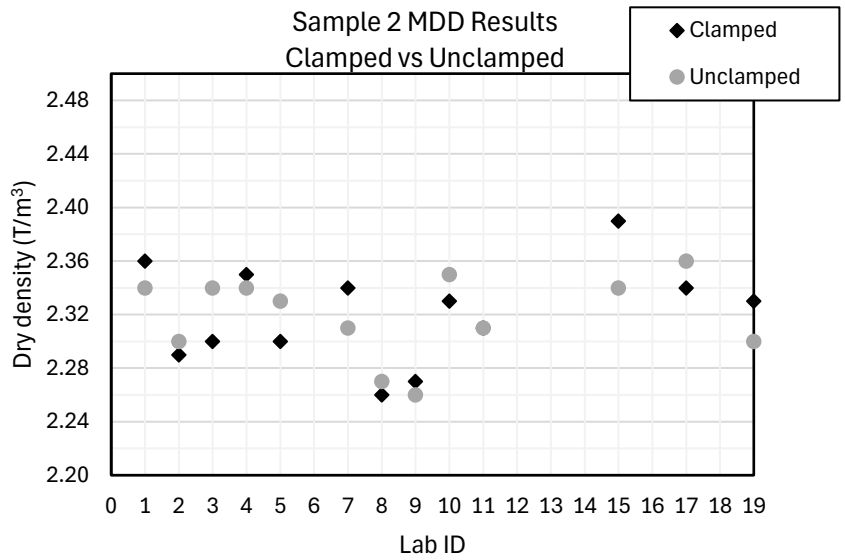


Figure 3.4: Sample 2 MDD Results Clamped vs Unclamped

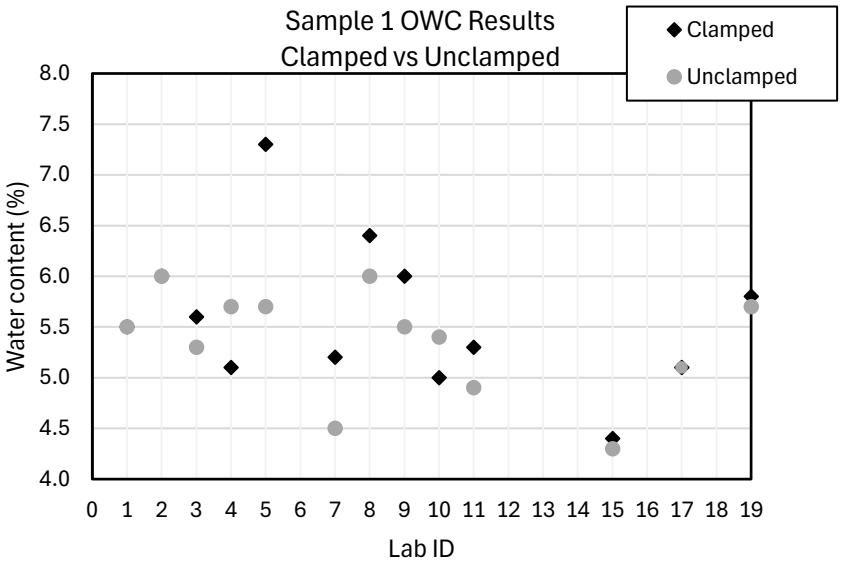


Figure 3.5: Sample 1 OWC Results Clamped vs Unclamped

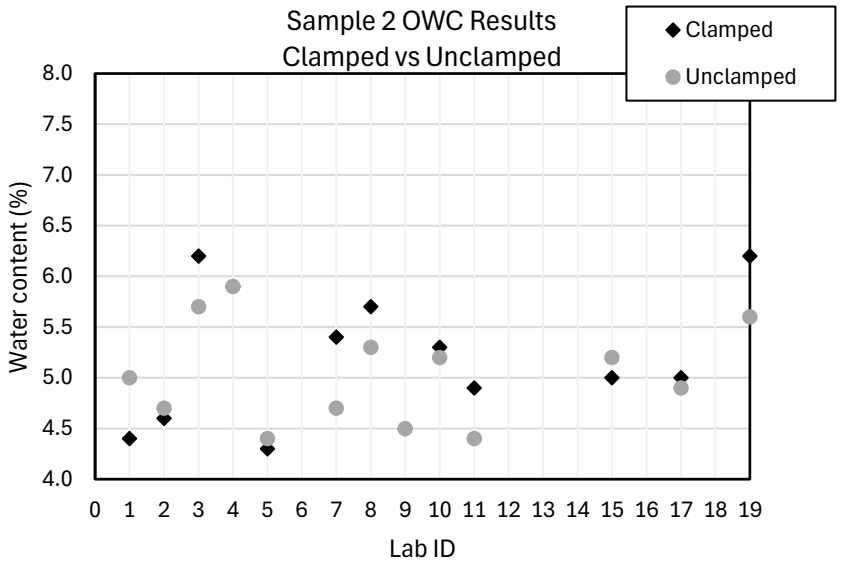


Figure 3.6: Sample 2 OWC Results Clamped vs Unclamped

Table 3.4: Paired sample t-tests results for Sample 1 clamped vs unclamped

Sample 1				
Objective	Test condition	Property	P-value	Significance
Impact of clamping	MDD - clamped vs unclamped	MDD before WC MDD after WC	0.25 0.19	0 0
	OWC - clamped vs unclamped	OWC before WC OWC after WC	0.68 0.14	0 0

Table 3.5: Paired sample t-tests results for Sample 2 clamped vs unclamped

Sample 2				
Objective	Test condition	Property	P-value	Significance
Impact of clamping	MDD - clamped vs unclamped	MDD before WC MDD after WC	0.58 0.84	0 0
	OWC - clamped vs unclamped	OWC before WC OWC after WC	0.25 0.18	0 0

In the significance column, 0 and 1 corresponds to H_{0c} and H_{1c} respectively. The results and corresponding p-values resulting from the paired sample t-tests for both MDD and OWC has determined there is no statistical significance between clamped and unclamped conditions for both Sample 1 and 2. Additionally, there is no clear trend in the standard deviations and uncertainties of measure (Appendix B2) that would indicate clamped or unclamped is more precise.

3.4 Impact of Water Content Measurements

The results from the labs for water contents taken before vs. after in all test configurations are provided in Figure 3.7 to Figure 3.10, with Z-score comparisons in Appendix B2.

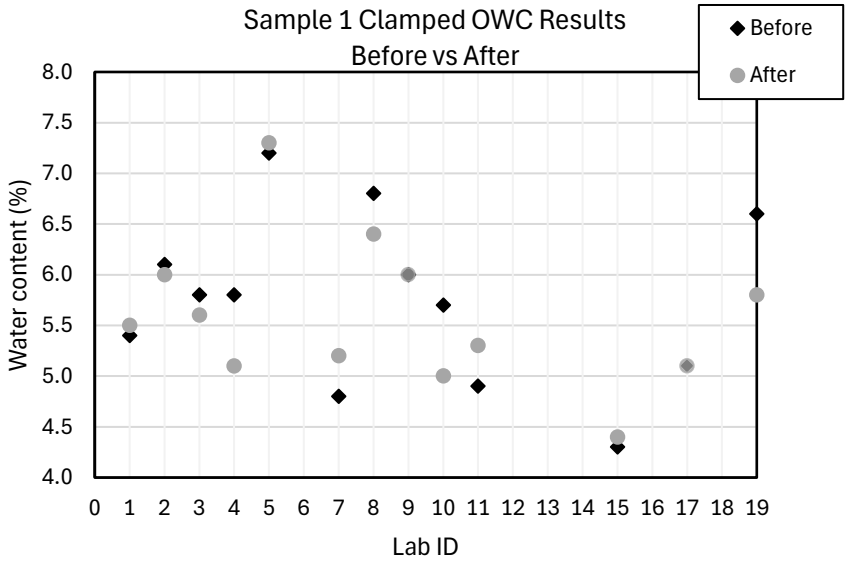


Figure 3.7: Sample 1 clamped OWC results – Before vs. After

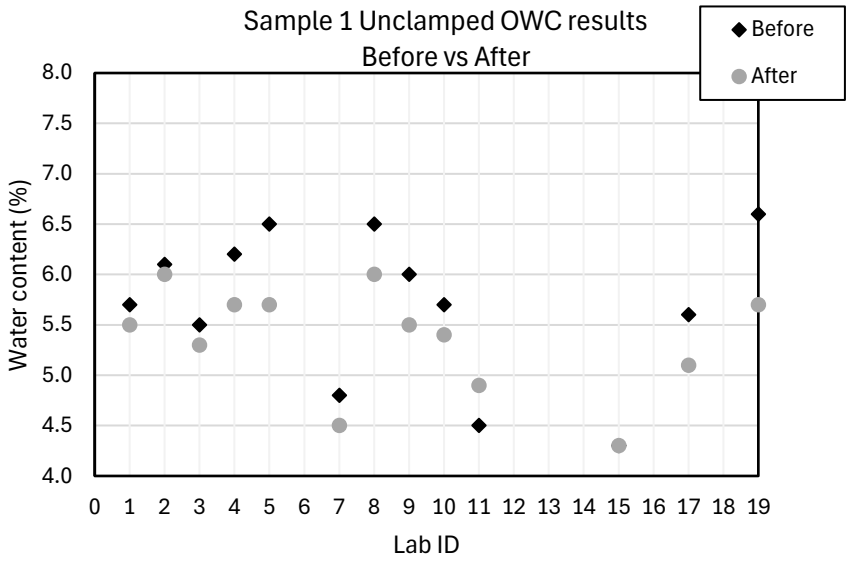


Figure 3.8: Sample 1 unclamped OWC results – Before vs. After

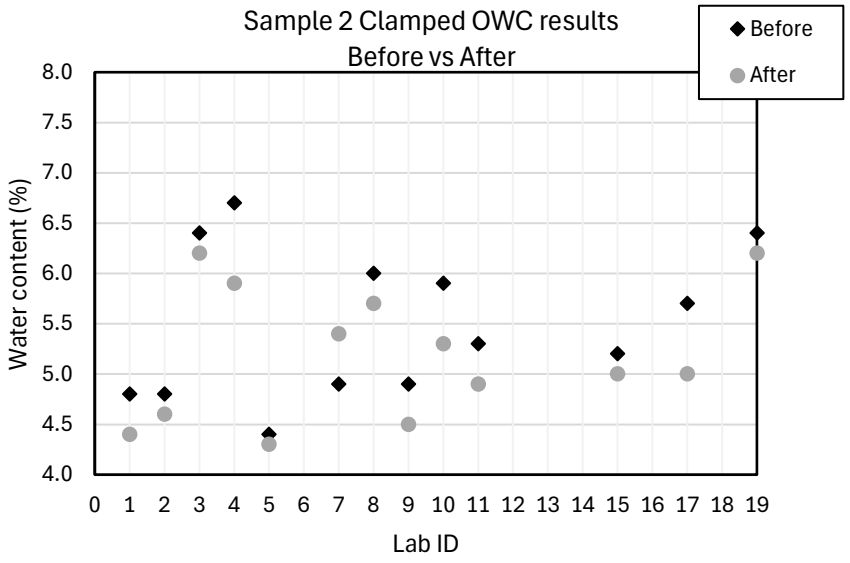


Figure 3.9: Sample 2 clamped OWC results – Before vs. After

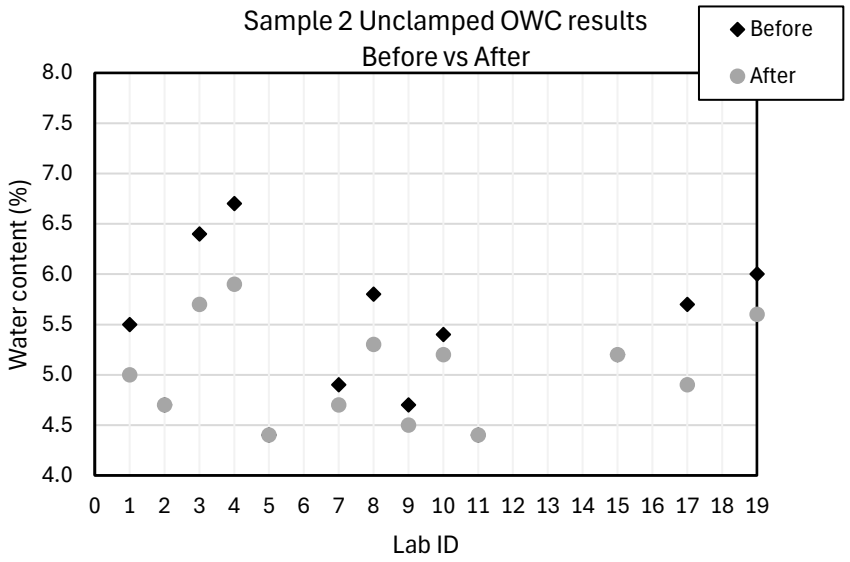


Figure 3.10: Sample 2 unclamped OWC results – Before vs. After

Table 3.6: Paired sample t-tests results for Sample 1 water content before vs after

Sample 1				
Objective	Test condition	Property	P-value	Significance
Impact of water content measurements	OWC – water measured before vs. after (clamped)	OWC clamped	0.24	0
	OWC – water measured before vs. after (unclamped)	OWC unclamped	0.00	1

Table 3.7: Paired sample t-tests results for Sample 2 water content before vs after

Sample 2				
Objective	Test condition	Property	P-value	Significance
Impact of water content measurements	OWC – water measured before vs. after (clamped)	OWC clamped	0.00	1
	OWC – water measured before vs. after (unclamped)	OWC unclamped	0.00	1

In the significance column, 0 and 1 correspond to H_{0w} and H_{1w} respectively. The results and corresponding p-values resulting from the paired sample t-tests for OWC has determined there is statistical significance between water contents taken before vs. after for all conditions tested, with the exception of Sample 1 under the clamped condition.

Across all conditions tested, the OWC results have a smaller standard deviations and uncertainties of measure (Appendix B2) where water contents are measured after compaction.

4 Conclusions and Notes

4.1 Key Findings:

- In evaluating the overall performance of *NZTA T28: 2024 Test Method (Draft v6.1)*, across both samples, 0 outliers (Z-score > 3.0) were identified from the 13 results analysed for both the MDD and OWC results. For the MDD results, one had a Z-score ≥ 2.0 (Lab 2) for Sample 1 only, and one had an OWC Z-score ≥ 2.0 (Lab 5) for Sample 1 only, indicating an overall good performance was achieved by the participants analysed.
- A significant improvement in the reproducibility of the MDD results and a minor improvement of OWC results was observed for both samples compared to previous studies.
- In evaluating the impact of clamping, it was determined that there is no statistical significance between the clamped and unclamped conditions tested.
- In evaluating the impact of water content measurements take before vs. after compaction, it was determined that there was a statistical significance over most test configurations.

4.2 Recommendations:

- While the use of a system to clamp the mould to the baseplate would be considered good practice to restrict the mould from wandering or jumping (any movement of the mould means a loss in compaction energy), the data analysed in this study has shown no statistical significance between clamped and unclamped conditions, and no clear difference in standard deviations and uncertainties of measure to recommended either clamped or unclamped moulds being used in *NZTA T28: 2024*.
- Water contents should be taken after compaction – the data demonstration there was statistical impact, and water contents taken after compaction had a smaller standard deviation and uncertainty of measurement across all test configurations.
- Accreditation for this test method will be required.
- Based on the outcomes of this study and consultation with the industry, a full repeatability and reproducibility study on the finalised test methodology be carried out.
- Consideration should be given towards replacing the mandated hammer in any final version of *NZTA T28: 2024* with general hammer specifications, in the event that the mandated hammer is discontinued or altered by the manufacture without warning.

4.3 Data Quality

Of the 18 participating labs (after the removal of Lab 12), three did not return a result (Lab 6, 14, and 16), and two (Lab 13 and 18) were rejected due to insufficient information in the Return Sheet to

allow for the verification of the results (this information was unable to be provided when contacted). The results from the remaining 13 labs were used for the analyses.

- The participating laboratory sample size is smaller than normally required for a robust interlaboratory study, due in part to the requirement in the test method of the specific hammer model and frame, of which there are a limited number in New Zealand. As a comparison, Ball (2008) received data from 33 of 34 participating labs and used the results from 28 labs, rejecting 5.
- Of the 13 labs that returned results of sufficient quality, there remained some issues of note:
    - Labs 1 and 15 reported using tampers with a foot diameter of 145.3 and 145.05 mm respectively, slightly smaller than the specified 148 ± 2 mm diameter. Their respective results did not fall outside the range of results and remained within one standard deviation of the remaining results averages, so these results were not rejected. Lab 18 also used a 145.05 mm diameter foot, however Lab 18 results had already been rejected due to missing information as mentioned above.
    - Lab 1 reported using a hammer weight of 36.6 kg, slightly heavier than the specified 35 ± 1 kg. As above, Lab 1 results were not rejected as the results were mostly within one standard deviation of the remaining results averages.
    - Analysis of all MDD/OWC data reported found that Labs 4, 5, 11 produced some curves with ill-defined peaks which would normally require further data points on the curve.
- The T28 test method introduces additional steps in obtaining MDD/OWC results in comparison to *NZS 4402: 1986 Test 4.1.3*, such as obtaining the solid densities and water contents of the aggregate splits at 26.5 mm, and more notably the application of a correction factor applied to the results. While this does increase the complexity of the test and may have contributed to difficulties some laboratories had in performing the method correctly, the method is not considered to be overly complex or beyond the capability of accredited laboratories.

References

ASTM Standard D7382-20 *Standard Test Methods for Determination of Maximum Dry Unit Weight and Water Content Range for Effective Compaction of Granular Soils Using a Vibrating* Hammer

ASTM Standard Practice E 691-23 *Standard Practice for Conducting an Interlaboratory Study to Determine the Precision of a Test Method*

Ball, G F A. 2008. *New Zealand Vibrating Hammer Compaction Test Interlaboratory Study*. Opus Central Laboratories. Wellington.

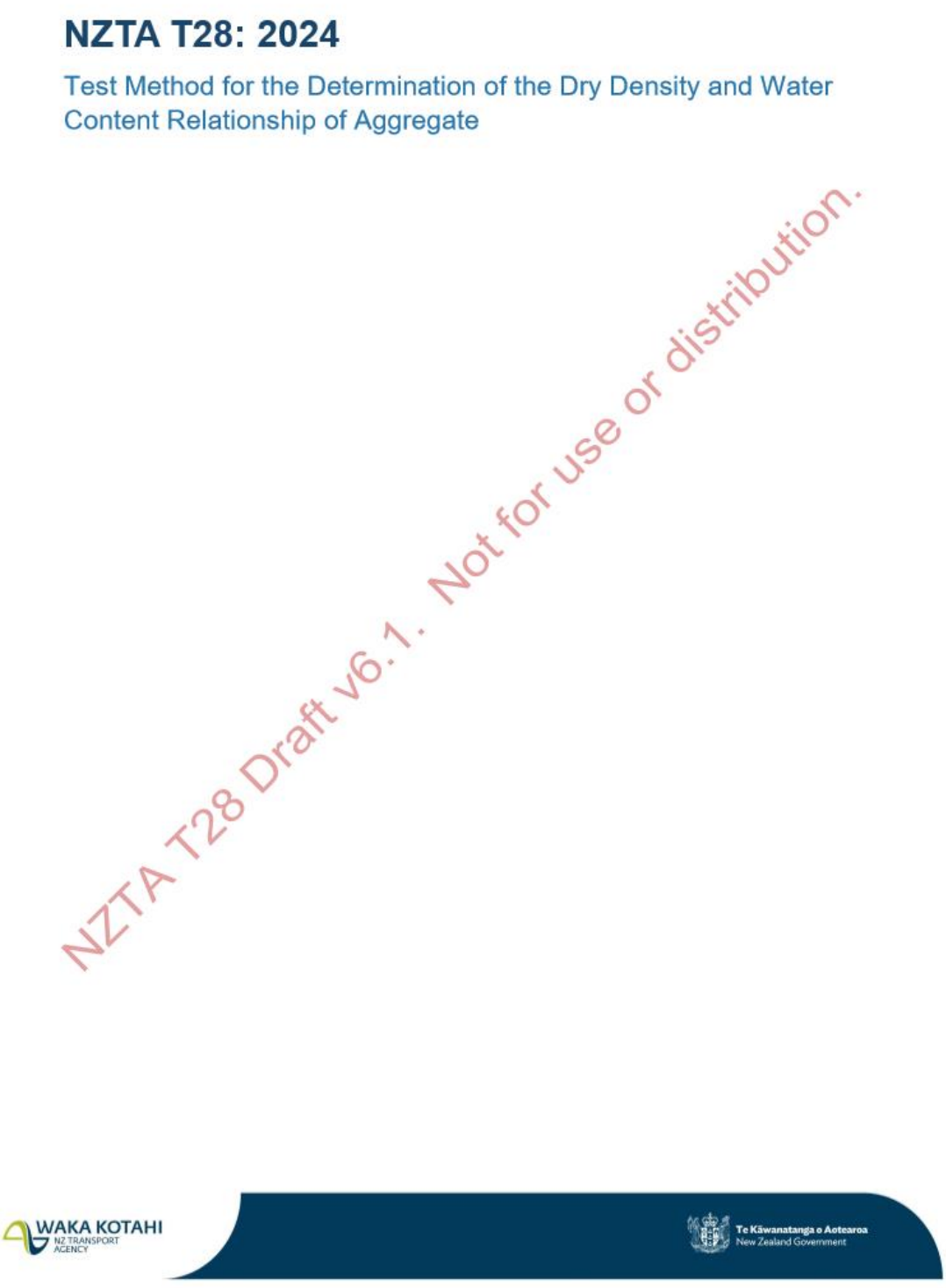
British Standard BS EN 13286-4:2021 *Unbound and Hydraulically Bound Mixtures. Test Methods for Laboratory Reference Density and Water Content. Vibrating Hammer*

New Zealand Standard 4402: 1986 Test 4.1.3 *New Zealand Vibrating Hammer Compaction Test*

TNZ B/02. 2005. *Specification for Construction of Unbound Granular Pavement Layers*. Transit New Zealand.

Appendix A

A.1 NZTA T28: 2024 Test Method for the Determination of the Dry Density and Water Content Relationship of Aggregate Draft v6.1



1 Scope

This method covers the determination of the maximum dry density and optimum water content for an aggregate. The fraction passing a 26.5mm test sieve is compacted by an electrically operated vibrating hammer compactor, over a range of water contents and the dry density determined. The dry density for the whole material is corrected to allow for any material coarser than 26.5mm.

2 Related Documents

(a) Standards New Zealand NZS 4402 Methods of Testing Soil for Civil Engineering Purposes.

(b) Standards New Zealand NZS 4407 Methods of Sampling and Testing Road Aggregates.

3 Sampling

Obtain a representative field sample of the aggregate using the procedure of NZS 4407 section 2, sub-method 2.4.6.3.2 or 2.4.6.4 as appropriate to the stockpile construction, or sub-method 2.4.7 if samples are obtained from freshly spread layers, or sub-method 2.4.8 if samples are obtained from road pavements.

4 Apparatus

The following apparatus is required:

(a) A non-corrodible cylindrical metal mould complying with the requirements of NZS 4407 test 3.15 (figure 16), adjusted if necessary by the use of an appropriate spacer, to give a specimen height of 125mm to 127mm. The mould shall be provided with a perforated metal baseplate and a metal extension collar of nominal depth 60mm.

Note: A split mould shall not be used.

(b) If required, a metal spacer 150mm +0mm, -0.5mm diameter of thickness appropriate to give the required specimen height, with a detachable handle. Refer to NZS 4407 test 3.15 (figure 16) for a drawing of the spacer.

Note: The spacer is required for use in a CBR mould so that the specimen height is 125mm to 127mm after compaction. If a 127mm height mould is used the spacer is not needed.

(c) A Hikoki H60MC electric vibrating hammer. It shall be fitted with an hour meter that records the total working hours of the hammer. The hammer shall be discarded and replaced after 100 hours operation.

(d) A loading frame to support the apparatus and provide a vertical static downward mass of 35kg ± 1kg, including the clamp assembly, vibrating hammer and tamper.

The loading frame shall consist of a metal clamp assembly to firmly hold the vibrating hammer. The clamp assembly shall be supported by two parallel guide rods perpendicular to the base plate and move freely without any appreciable binding. The loading frame shall be designed to securely hold the clamp assembly and vibrating hammer to allow insertion and removal of the mould prior to, and following specimen compaction. See Figure 2 and Figure 3.

Note: Traditional cantilever-type loading frames such as in NZS 4402 test 4.1.3 figure 4.1.4 are not compliant with this test method.

The loading frame shall have a steel baseplate at least 25mm thick and clamping arrangements for the mould such that it is rigidly coupled to the baseplate throughout the test. The loading frame shall hold the vibrating hammer perpendicular to the test specimen at all times during the test.

The steel baseplate shall be level and rigidly fastened to a concrete pedestal at least 150mm thick and both wider and deeper than the baseplate or a building concrete floor slab.

(e) A steel tamper with a circular foot with a diameter of 148mm ± 2mm. The shaft of the tamper must fit the vibrating hammer tool socket. See Figure 4.

(f) A balance readable and accurate to 1g or better.

(g) A timing device readable and accurate to 1s.

(h) 26.5mm and 9.50mm test sieves and receiver.

(i) A large tray (a convenient size is 600mm x 500mm x 80mm).

(j) At least 6 small trays (a convenient size is 300mm x 300mm x 80mm).

(k) At least 8 heavy grade plastics bags or other suitable air-tight, non-corrodible containers.

(l) Heavy grade plastic discs cut to accurately fit within the cylindrical mould. Plastic thickness of 0.125mm has been found to be satisfactory.

(m) A steel rule readable and accurate to 0.5mm.

(n) A straight-edge.

(o) Apparatus for water content determination as specified in NZS 4407 Test 3.1.

5 Procedure

5.1 Particle Size Distribution

Obtain a representative test sample from the field sample and determine the particle size distribution using the method of NZS 4407 Test 3.8.1.

The maximum dry density and optimum water content testing is conditional on the particle size distribution compliance with the relevant standard. Do not continue if the aggregate is not compliant.

5.2 Aggregate Solid Density

Obtain a representative test sample from the field sample and determine the aggregate solid density using the method of NZS 4407 Test 3.7, as follows:

(a) Sieve the test sample over the 26.5mm test sieve.

(b) Determine the solid density of the aggregate fraction retained on the 26.5mm sieve, the "coarse aggregate fraction" ρ_c using the method of NZS 4407 Test 3.7.2.

(c) Determine the solid density of the aggregate fraction passing the 26.5mm sieve, the "fine aggregate fraction" ρ_f using the method of NZS 4407 Test 3.7.1.

(d) Calculate the combined solid density ρ_s of the aggregate using the formula:

$$\rho_s = \frac{1}{\frac{Pc}{100 \times \rho_c} + \frac{P_f}{100 \times \rho_f}}$$

Where: ρ_c = the solid density of the coarse aggregate fraction

P_c = the percentage retained on the 26.5mm test sieve

ρ_f = the solid density of the fine aggregate fraction

P_f = the percentage passing the 26.5mm test sieve.

5.3 Dry Density and Water Content Relationship

5.3.1 Sample Preparation

(a) Obtain a representative sub-sample from the field sample. Sieve the sub-sample over the 26.5mm test sieve. At least 80kg of aggregate passing the 26.5mm sieve will be required.

(b) Take a representative test sample of the aggregate retained on the 26.5mm test sieve and determine the water content w_c using the method of NZS 4407 test 3.1.

(c) Take a representative test sample of the aggregate passing the 26.5mm test sieve and determine the water content w_f using the method of NZS 4407 test 3.1.

(d) Thoroughly mix the aggregate fraction passing the 26.5mm sieve in the large tray. Break down aggregations of material so that, with the exception of individual particles, all material would pass a 9.50mm test sieve.

Lumps of cohesive materials may require cutting or breaking up by hand. Take care during sample preparation to minimise drying. Maintain the material as close as possible to the natural water content.

(e) Representatively divide the aggregate fraction into test samples of sufficient volume for the test. It is recommended that 8 test samples are prepared to allow for repeat testing.

(f) Assess the range of water contents required for the test. Within this range, adjust the water content of the individual test samples by removing or adding water to provide a series of samples at different water content which span the estimated optimum water content (OWC). Make at least two test samples wetter than OWC and at least three test samples drier than OWC.

The material, when received, may be at a water content above or below the optimum value. Aggregates with a water content greater than the optimum value shall be carefully dried to the desired water content. Control of water loss can be achieved by comparative weighing during drying. Drying may be accomplished with a current of warm air, but whatever method is used, regular stirring is essential to prevent over-drying of any part of the surface of the aggregate. Do not use a drying oven to reduce the water content.

A sample, any part of which has been accidentally over-dried, must not be used unless it can be shown that such drying has no effect on its compaction characteristics.

Aggregates with a water content less than the optimum will require water to be added. Add water as a fine spray to each sample and thoroughly mix. Control of the amount of water to be added can be achieved by comparative weighing during wetting.

Place each test sample in a heavy grade plastics bag or airtight container, seal to minimise the air space between the container and the aggregate (see Note (a)).

(g) For natural aggregate materials containing no stabilising binder subject to curing, cure overnight (at least 12 hours) in a cool place. For aggregate materials containing a stabilising binder compact the test specimens immediately.

5.3.2 Test Procedure

(a) Determine the internal diameter of the mould to 0.5mm or better by taking at least four measurements evenly spaced around the mould circumference. Calculate the mean internal diameter of the mould over the portion to be occupied by the specimen, and record (d).

Place a straight edge across the top of the extension collar. Measure the depth from the straight edge to the surface of the spacer to 0.5mm (or base of mould if the spacer is not used) and record. Take at least 6 readings around the mould; calculate the mean height and record (h_1).

(b) Check that the test mould assembly is clean and dry and that the parts fit together properly. Lightly oil the inside of the mould, baseplate and spacer, and fit the spacer (if used) inside the mould with the lifting handle socket downwards. Place a plastic disc in the base of the mould.

(c) Weigh the mould, extension collar, baseplate, plastic disc and spacer to 1g and record (M_1).

(d) Clamp the assembled mould on the baseplate of the loading frame with the vibrating hammer withdrawn to allow free access to the mould.

(e) Take one of the test samples, thoroughly mix and take enough of the test sample to half fill the mould when compacted and reseal the bag or container. Take care to minimise segregation of the aggregate while filling the mould. Level the surface and place one or two plastic discs on top of the specimen.

(f) Assemble the vibrating hammer with the tamper inside the mould so that the vibrating hammer is in a position for operation. Operate the hammer for 180 ± 10 seconds. Remove the vibrating hammer and tamper from the mould. The height of the aggregate in the mould should be within ± 6mm of half the mould height (i.e. 63mm ± 6mm).

(g) Remove the plastic discs and add more aggregate so that when compacted the specimen just protrudes into the extension collar. Level the surface, place one (or two) plastic discs on top of the specimen and repeat step (f).

(h) Remove the mould assembly from the loading frame and clean any aggregate from the outside of the mould. Remove the plastic discs from the upper surface of the specimen. Scrape any fine aggregate slurry within the mould back on to the test specimen and level the surface.

(i) Place a straight-edge across the top of the extension collar, measure the depth from the straight-edge to the surface of the specimen to 0.5mm and record. Take at least 6 readings around the mould, all at least 15mm from the side of the mould. Record the 6 readings and calculate the mean height and record (h_2).

(j) Weigh the mould assembly, complete with sample, to 1g and record (M_2).

(k) Remove all of the compacted aggregate from the mould and place it on a tray and determine the water content using NZS 4407 test 3.1. Record the water content as (w_f).

(l) Treat each of the remaining test samples as specified in (e) to (k) inclusive above.

6 Calculations

(a) Calculate the bulk density ρ_{fw} of each compacted specimen of the aggregate fine fraction using the formula:

$$\rho_{fw} = \frac{4000(M_2 - M_1)}{\pi d^2 (h_1 - h_2)} \quad (t/m^3)$$

Where:
- M_1 = mass of the mould, collar, spacer and baseplate (g)
- M_2 = mass of the mould, collar, spacer, baseplate and soil (g)
- d = mean internal diameter of the mould (mm)
- h_1 = mean height from the top of the mould base (or top of the spacer if used) to the top of the collar (mm)
- h_2 = mean height from the top of the soil to the top of the collar (mm)

(b) Calculate the dry density for the aggregate fraction passing 26.5mm ρ_f from the formula:

$$\rho_f \frac{100\rho_{fw}}{100 + w_f} \quad (t/m^3)$$

Where: w_f = water content of the fine aggregate fraction (%)

(c) Calculate the corrected water content for the aggregate (combined coarse and fine fractions) using the following formula:

$$w_{corr} = (w_c P_c) + (w_f P_f) \quad (\%)$$

Where: w_{corr} = corrected water content of combined coarse and fine aggregate fractions (%)

W_c = water content of coarse aggregate fraction expressed as a decimal

W_f = water content of fine aggregate fraction expressed as a decimal

P_c = percentage of aggregate retained on the 26.5mm sieve as determined by the particle size distribution test

P_f = percentage of aggregate passing the 26.5mm sieve as determined by the particle size distribution test

(d) Calculate the corrected dry density for the aggregate ρ_{corr} (combined coarse and fine fractions) using the following formula:

$$\rho_{corr} = \frac{100\rho_f\rho_c}{\rho_f P_c + \rho_d P_f} \quad (t/m^3)$$

(e) Plot the corrected dry densities (ρ_{corr}) obtained in the series of determinations against the corresponding water contents (w). Draw a smooth curve fitting the resulting points and determine the position of the maximum (ρ_{dmax}) on this curve.

(f) Calculate the maximum dry density as a percentage of the solid density using the following formula:

$$R = \frac{\rho_{dmax}}{\rho_s} \times 100 \quad (\%)$$

(g) Plot the air voids lines at 0%, 5% and 10% using the formula below to calculate the density water content relationship for the various air voids contents (see note (b)).

$$\rho_d = \frac{1 - \frac{V_a}{100}}{\frac{1}{\rho_s} + \frac{w}{100\rho_w}} \quad (t/m^3)$$

Where: ρ_d = dry density of aggregate (t/m³)

ρ_w = density of water (t/m³)

V_a = volume of air voids in the aggregate, expressed as a percentage of the total volume of undried materials including voids

ρ_s = solid density of aggregate (t/m³)

w = water content (%)

7 Reporting

7.1.1 Report the Following Results:

(a) The aggregate particle size distribution.

(b) The solid density of the aggregate ρ_s in t/m³ to the nearest 0.01t/m³.

(c) The maximum dry density (the dry density corresponding to the maximum point on the water content/dry density curve) ρ_{dmax} in t/m³ to the nearest 0.01t/m³.

(d) The dry density and air voids curves shall be included in the test report.

(e) The maximum dry density R as a percentage of the solid density.

(f) The optimum water content (the water content corresponding to the maximum dry density on the water content/dry density curve) (%) to the nearest 0.2% for values below 5% to the nearest 0.5% for values from 5% to 10%, and to the nearest whole number for values exceeding 10%.

Note: If the values of maximum dry density and optimum water content cannot be clearly determined from the curve, this fact shall be reported.

7.1.2 Report the Following Information

(a) Origin and description of the aggregate tested.

(b) The history of the sample, for example, natural state, air-dried, oven-dried, or unknown.

(c) Date and time of test.

(d) Any observations relevant to the test including but not limited to loss of material during testing, segregation, aggregate breakdown.

8 Precision and Bias

8.1 Precision

The repeatability standard deviation has not been determined under laboratory conditions with the same test method in the same laboratory by the same operator with the same equipment in the shortest practical period of time using test specimens taken at random from a single quantity of source material.

8.2 Bias

There are presently no accepted reference values for this test method, therefore, bias cannot be determined.

9 Notes

(a) When the aggregate is stored in sealed containers water may condense on the container walls. The aggregate sub-samples shall be packed tightly into the container to minimize air space and reduce the problem of condensation.

(b) The zero air voids line is a valuable aid to the correct drawing of the compaction curve. At water contents above optimum water content, the compaction curve should asymptotically approach the zero air voids line but should never cross it. Should any of the plotted dry density/ water content values be to the right of the zero air voids line, an error has occurred, either in the value of the solid density used, or in the compaction test. The 5% and 10% air voids lines can enable estimation of the air voids present in the compacted soil.

Figure 1: Example of a Dry Density, Water Content Curve with Air Voids Curves Included

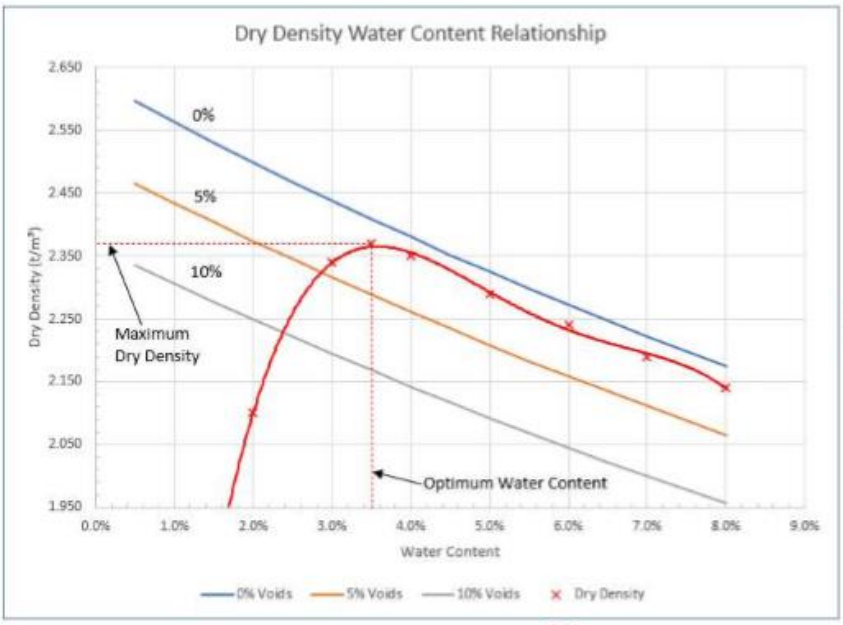


Figure 2: Vibrating Hammer and Loading Frame

Figure 3: Loading Frame General Arrangement

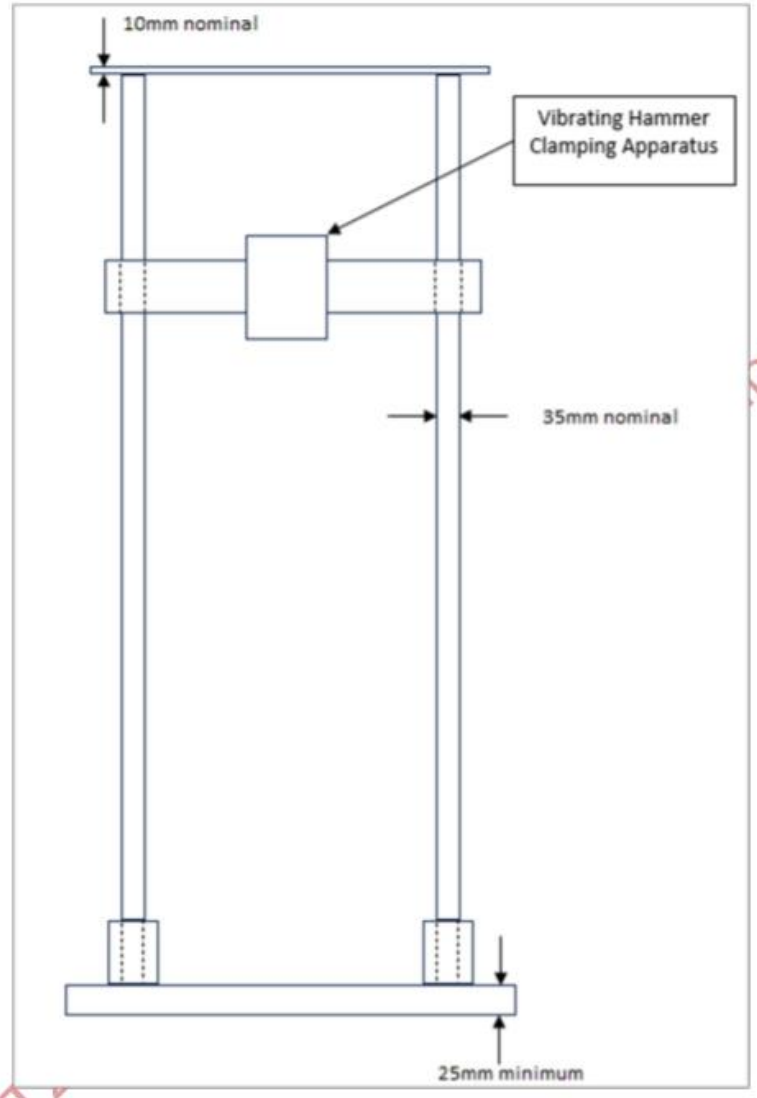
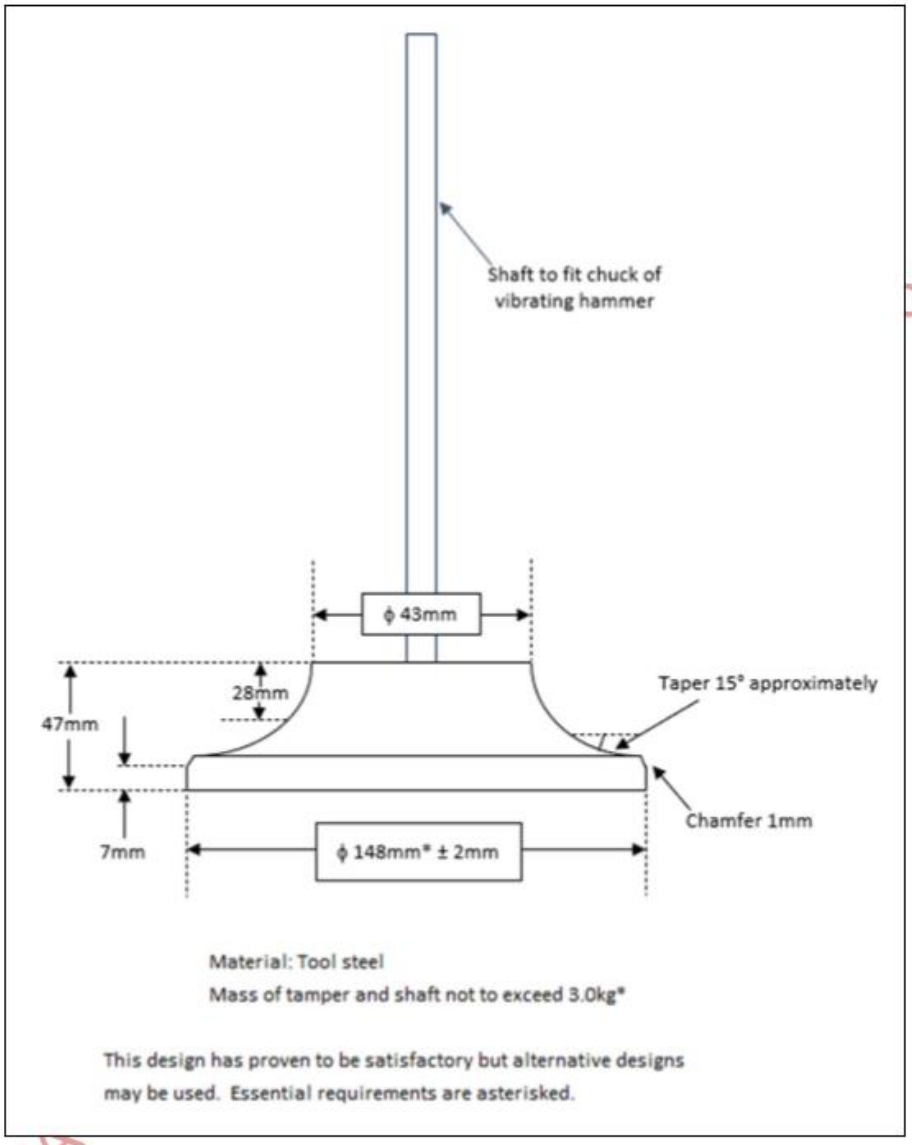


Figure 4: Tamper for the Vibrating Hammer Compaction Test



A.2 ILS – NZTA T28: 2024 – Notes for Participating Laboratories

ILS - NZTA T28: 2024 - Notes for participating laboratories

Thank you for agreeing to be part of the Interlab. This study is hopefully going to be the last piece in the puzzle that NZTA needs to bring in the long-awaited replacement for 4402 4.1.3.

Sample 1 has been dispatched and you should be receiving 6 x 25kg bags soon if you do not have them already. Sample 2 will be coming shortly. Hopefully you are already getting your frame modifications sorted – my engineer took a day to do it.

I've gone through the draft method (v6.1). Below is my notes on anything I think may be slightly different for this study of and request for a few things that we need to help with the final reporting and analysis.

3 Sampling. Sample 1 is Waotu Quarry AP40, sampled by me 06/05/24. Sample 2 will be Stevensons Drury Quarry AP40 (thanks Trevor) – unknown sample date as yet. WSP Rotorua Lab staff split and have randomized the bags.

4 (c) Hikoki H60MC – This can also be a Hitachi H60MC. As we do not know the hours of existing hammers, could you please let me know when you purchased the hammer, and how many 4.1.3, ITS, UCS RLT tests that you have done on that hammer to the best of your ability. From that we will be able to get a rough (ok, very rough) estimation of hammer hours.
4 (d) Loading Frame – for the mass, please remove the clamp assembly, hammer and tamper and use this for the 35 +/- 1kg. Do not do this in the frame. Please let me know your total mass.
4 (e) Please let me know the diameter of your foot.

5.1 PSD – The % passing the 26.5mm sieve will be emailed soon.
5.2 SDs –The test split at 26.5mm has been discussed with IANZ. We can endorse them using the different split if we have a note stating the departure. Results will be emailed soon.

5.3.1 (a) Use the whole supplied (≈150kG) sample in the split.
5.3.1 (e) and (f) Make each subsample large enough to be able to do 2 compaction points and one pre compaction MC on each of the subsamples.
5.3.2 (d) to (l) For each subsample take a MC before compaction then compact one point with the mould clamped to the base and one point without the mould clamped.

6 and 7 Calculate the results as per the draft method 4 times – Clamped / Pre-test MC, Clamped / After test MC, Unclamped / Pre-test MC, Unclamped / After test MC.

Please email your reports and invoice to me along with the notes requested above in 4(c) (d) and (e) above as soon as you can.

Once again, thanks,

Portly

A.3 NZTA T28: 2024 ILS Results Return Sheet

NZTA T28: 2024 ILS Results Return Sheet

'Waotu M4'

Mass of Hammer, Tamper and Sliding hammer clamp	kg	
Steel Tamping foot Diameter	mm	
Date of purchase of hammer	MM/YY	
Approximate no of MDD tests done using the hammer	No.	
Approximate no of CBR tests done using the hammer	No.	
Approximate no of ITS tests done using the hammer	No.	
Approximate no of UCS tests done using the hammer	No.	
Mean Internal Diameter of Mould	mm	
Mean Height of Mould - Collar to base / spacer	mm	
Mass of Mould, Collar and Spacer (if any)	g	
Moisture Content - at Split > 26.5mm	%	
Moisture Content - At Split <26.5mm	%	

PSD - % Retained 26.5	11.222
PSD - % Passing 26.5	88.778
Aggregate SD	2.7277
Coarse SD (NZS4407:3.7.2)	2.71
Fine SD (NZS4407:3.7.1)	2.73

Test Results		1	2	3	4	5	6	7	8
Mean Height of Top of sample to top of Mould and Collar - Clamped Sample	mm								
Mass of Mould, Collar, Spacer(if any) and sample - Clamped Sample	g								
Mean Height of Top of sample to top of Mould and Collar - Un-Clamped Sample	mm								
Mass of Mould, Collar, Spacer(if any) and sample - Un-Clamped Sample	g								
Moisture content - Before compaction	%								
Moisture Content - After compaction Clamped	%								
Moisture Content - After compaction Unclamped	%								

Final Results	Clamped - Before MC	Clamped - After MC	Un-clamped - Before MC	Un-clamped - After MC
MDD				
OMC				

NZTA T28: 2024 ILS Results Return Sheet

Stevensons Drury AP40

Mass of Hammer, Tamper and Sliding hammer clamp	kg	
Steel Tamping foot Diameter	mm	
Date of purchase of hammer	MM/YY	
Approximate no of MDD tests done using the hammer	No.	
Approximate no of CBR tests done using the hammer	No.	
Approximate no of ITS tests done using the hammer	No.	
Approximate no of UCS tests done using the hammer	No.	
Mean Internal Diameter of Mould	mm	
Mean Height of Mould - Collar to base / spacer	mm	
Mass of Mould, Collar and Spacer (if any)	g	
Moisture Content - at Split > 26.5mm	%	
Moisture Content - At Split <26.5mm	%	

PSD - % Retained 26.5	10.52645101
PSD - % Passing 26.5	89.47354899
Aggregate SD	2.7153
Coarse SD (NZS4407:3.7.2)	2.71
Fine SD (NZS4407:3.7.1)	2.72

Test Results		1	2	3	4	5	6	7	8
Mean Height of Top of sample to top of Mould and Collar - Clamped Sample	mm								
Mass of Mould, Collar, Spacer(if any) and sample - Clamped Sample	g								
Mean Height of Top of sample to top of Mould and Collar - Un-Clamped Sample	mm								
Mass of Mould, Collar, Spacer(if any) and sample - Un-Clamped Sample	g								
Moisture content - Before compaction	%								
Moisture Content - After compaction Clamped	%								
Moisture Content - After compaction Unclamped	%								

Final Results	Clamped - Before MC	Clamped - After MC	Un-clamped - Before MC	Un-clamped - After MC
MDD				
OMC				

Appendix B

B.1 Return sheet test information

Sample 1 return sheet summary (as reported)

Lab ID	Mass of hammer, tamper and sliding hammer clamp	Steel tamping foot diameter	Hammer date of purchase	Approx. no. of MDD tests done using hammer	Approx. no. of CBR tests done using the hammer	Approx. no. of ITS tests done using the hammer	Approx. no. of UCS tests done using the hammer	Mean internal diameter of mould	Mean height of mould - collar to base/spacer	Mean mass of mould, collar and spacer (if any)
	kg	mm	Month-Yr	No.	No.	No.	No.	mm	mm	g
Lab 1	36.6	145.3						151.1	178.9	8091.9
Lab 2								151.99	178	7458
Lab 3	34.228	149.1	Apr-24	0	0	0	0	152	177.5	7915
Lab 4	35.1	149	Jun-23	150	150	22	40	150.9	178	7770
Lab 5	34.346	149.1	Dec-23	2	4	0	0	152.0	177.3	7373.0
Lab 6										
Lab 7	35	149	May-24	0	0	0	0	152.2	177.5	9728.8
Lab 8	34.6	150		0	0	0	0	152	210.5	8001.4
Lab 9	35.343	149.2	Oct-21	142	154	~450		152.0	176.3	0.0
Lab 10	34	145.1	2019	>100	>100	0	0	151.77	177.33	7322.0
Lab 11	34.486	150	Nov-23	0	0	0	0	151.5	177.5	13619.0
Lab 13	14746	149	May-23	59	140	120	3	152	176.5	11168
Lab 14										
Lab 15	35.219	145.05	Jun-24	200	172	155	72	152.04	176.36	8334
Lab 16										
Lab 17	34135.6	148.92	Jun-24	0	0	0	0	149.6	183.6	12292.9
Lab 18	34594.4	145.02	Jun-24	2	0	0	0	151.8	178.0	7325.4
Lab 19	34.7	149		1	0	0	0	152.4	183.7	7223.0

Sample 2 return sheet summary (as reported)

Lab ID	Mass of hammer, tamper and sliding hammer clamp	Steel tamping foot diameter	Hammer date of purchase	Approx. no. of MDD tests done using hammer	Approx. no. of CBR tests done using the hammer	Approx. no. of ITS tests done using the hammer	Approx. no. of UCS tests done using the hammer	Mean internal diameter of mould	Mean height of mould - collar to base/spacer	Mean mass of mould, collar and spacer (if any)
	kg	mm	Month-Yr	No.	No.	No.	No.	mm	mm	g
Lab 1	36.6	145.3						151.1	178.9	8091.9
Lab 2								151.99	178	7458
Lab 3	34.228	149.1	Apr-24	0	0	0	0	152	177.5	7920
Lab 4	35.1	149	Jun-23	152	150	22	40	151.5	177	7759
Lab 5	34.346	149.1	Dec-23	2	4	0	0	152.0	177.3	7373.0
Lab 6										
Lab 7	35	149	May-24	0	183	0	0	152.2	177.5	9690.7
Lab 8	34.6	152		2	0	0	0	152	209.7	8002.5
Lab 9	35.343	149.2	Oct-21					152.0	176.3	0.0
Lab 10	34	145.1	2019	>100	>100	0	0	151.76	177.33	7329.0
Lab 11	34.486	150	Nov-23	2	0	0	0	151.5	177.5	13619.0
Lab 13	14746	149	May-23	59	140	120	3	152	176.5	11168
Lab 14										
Lab 15	35.219	145.05	Jun-24	200	172	155	72	152.04	176.36	8334
Lab 16										
Lab 17	34135.6	148.92	Jun-24	2	0	0	0	149.6	183.6	12289.1
Lab 18	34594.4	145.02	Jun-24	4	0	0	0	151.8	178.0	7325.4
Lab 19	34.7	149		1	0	0	0	152.4	183.6	7223.0

B.2 T28 Proficiency Results Report

PROFICIENCY RESULTS

NZTA T28: 2024 - Sample 1

Results Summary

		Clamped Sample		Unclamped Sample	
		After compaction Moisture Content	Before compaction Moisture Content	After compaction Moisture Content	Before compaction Moisture Content
Ave MDD	(t/m³)	2.34	2.34	2.35	2.35
Ave OMC	(%)	5.59	5.73	5.35	5.69
Range MDD	(t/m³)	0.120	0.110	0.110	0.115
Range OMC	(%)	2.9	2.9	1.7	2.3
U-o-M MDD	(t/m³)	0.06	0.07	0.08	0.07
U-o-M OMC	(%)	1.46	1.68	1.06	1.52

Thanks to the participating labs -

- Whangerei, Auckland, Hamilton, Tauranga, Rotorua, Gisborne, Napier, New Plymouth, Wanganui, Petone.
- Auckland
- Auckland
- Auckland , Kapiti
- Auckland, Tauranga
- Wanganui
- Captif - Christchurch
- Christchurch

Cover

Page 1 of 20 pages.

PROFICIENCY RESULTS
NZTA T28: 2024 - Sample 1

Clamped Sample

	MC After compaction		MC Before compaction	
Lab No.	MDD (t/m³)	OMC (%)	MDD (t/m³)	OMC (%)
1	2.35	5.5	2.37	5.4
2	2.28	6.0	2.28	6.1
3	2.33	5.6	2.32	5.8
4	2.36	5.1	2.36	5.8
5	2.37	7.3	2.37	7.2
7	2.34	5.2	2.35	4.8
8	2.31	6.4	2.31	6.8
9	2.33	6.0	2.30	6.0
10	2.34	5.0	2.33	5.7
11	2.33	5.3	2.34	4.9
15	2.38	4.4	2.39	4.3
17	2.36	5.1	2.34	5.1
19	2.40	5.8	2.38	6.6

Un-Clamped Sample

	MC After compaction		MC Before compaction	
Lab No.	MDD (t/m³)	OMC (%)	MDD (t/m³)	OMC (%)
1	2.40	5.5	2.40	5.7
2	2.29	6.0	2.29	6.1
3	2.35	5.3	2.35	5.5
4	2.39	5.7	2.38	6.2
5	2.39	5.7	2.37	6.5
7	2.30	4.5	2.31	4.8
8	2.32	6.0	2.31	6.5
9	2.33	5.5	2.32	6.0
10	2.35	5.4	2.34	5.7
11	2.34	4.9	2.35	4.5
15	2.39	4.3	2.39	4.3
17	2.34	5.1	2.33	5.6
19	2.40	5.7	2.38	6.6

PROFICIENCY RESULTS
NZTA T28: 2024 - Sample 1

	MDD - Clamped		MDD - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
Max	2.40	2.39	2.40	2.40
Min	2.28	2.28	2.29	2.29
Range	0.12	0.11	0.11	0.12
Average	2.34	2.34	2.35	2.35
St Dev	0.031	0.033	0.04	0.04

Individual Labs Results

Lab ID#	MDD - Clamped		MDD - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
1	2.35	2.37	2.40	2.40
2	2.28	2.28	2.29	2.29
3	2.33	2.32	2.35	2.35
4	2.36	2.36	2.39	2.38
5	2.37	2.37	2.39	2.37
7	2.34	2.35	2.30	2.31
8	2.31	2.31	2.32	2.31
9	2.33	2.30	2.33	2.32
10	2.34	2.33	2.35	2.34
11	2.33	2.34	2.34	2.35
15	2.38	2.39	2.39	2.39
17	2.36	2.34	2.34	2.33
19	2.40	2.38	2.40	2.38

Z- Scores

Lab ID#	MDD - Clamped		MDD - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
1	0.17	0.87	1.24	1.49
2	-2.09	-1.87	-1.66	-1.76
3	-0.47	-0.66	-0.08	0.08
4	0.50	0.56	0.97	0.92
5	0.82	0.87	0.97	0.64
7	-0.15	0.26	-1.40	-1.05
8	-1.12	-0.96	-0.87	-1.05
9	-0.47	-1.26	-0.61	-0.77
10	-0.15	-0.35	-0.08	-0.21
11	-0.47	-0.05	-0.34	0.08
15	1.14	1.47	0.97	1.21
17	0.50	-0.05	-0.34	-0.49
19	1.79	1.17	1.24	0.92

Z Score

(-1 to 1)
(-2 to -1 and 1 to 2))
(-3 to -2 and 2 to 3)
(>-3 and >3)

As a guide any Z score less than (-2) or greater than (+2) should be investigated further. It is up to the individual labs to determine if their results require any further

PROFICIENCY RESULTS
NZTA T28: 2024 - Sample 1

	OMC - Clamped		OMC - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
Max	7.3	7.2	6.0	6.6
Min	4.4	4.3	4.3	4.3
Range	2.9	2.9	1.7	2.3
Average	5.59	5.73	5.35	5.69
St Dev	0.72	0.84	0.53	0.76

Individual Labs Results

Lab ID#	OMC - Clamped		OMC - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
1	5.50	5.40	5.50	5.70
2	6.00	6.10	6.00	6.10
3	5.60	5.80	5.30	5.50
4	5.10	5.80	5.70	6.20
5	7.25	7.20	5.70	6.50
7	5.20	4.80	4.50	4.80
8	6.40	6.80	6.00	6.50
9	6.00	6.00	5.50	6.00
10	5.00	5.70	5.40	5.70
11	5.30	4.90	4.90	4.50
15	4.40	4.30	4.30	4.30
17	5.10	5.10	5.10	5.60
19	5.80	6.60	5.70	6.60

Z- Scores

Lab ID#	MDD - Clamped		MDD - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
1	-0.12	-0.40	0.28	0.01
2	0.57	0.44	1.22	0.54
3	0.02	0.08	-0.10	-0.25
4	-0.68	0.08	0.65	0.67
5	2.30	1.76	0.65	1.07
7	-0.54	-1.11	-1.62	-1.18
8	1.12	1.28	1.22	1.07
9	0.57	0.32	0.28	0.41
10	-0.81	-0.04	0.09	0.01
11	-0.40	-0.99	-0.86	-1.58
15	-1.64	-1.71	-1.99	-1.84
17	-0.68	-0.75	-0.48	-0.12
19	0.29	1.04	0.65	1.20

Z Score
(-1 to 1)
(-2 to -1 and 1 to 2))
(-3 to -2 and 2 to 3)
(>-3 and >3)

As a guide any Z score less than (-2) or greater than (+2) should be investigated further. It is up to the individual labs to determine if their results require any further

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 MDD - Clamped, MC taken after compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	2.35		2	2.28	0.005
2		1	2.35		3	2.33	0.000
3		1	2.35		4	2.36	0.000
4		1	2.35		5	2.37	0.000
5		1	2.35		7	2.34	0.000
6		1	2.35		8	2.31	0.002
7		1	2.35		9	2.33	0.000
8		1	2.35		10	2.34	0.000
9		1	2.35		11	2.33	0.000
10		1	2.35		15	2.38	0.001
11		1	2.35		17	2.36	0.000
12		1	2.35		19	2.40	0.002
13		2	2.28		3	2.33	0.003
14		2	2.35		4	2.36	0.000
15		2	2.35		5	2.37	0.000
16		2	2.35		7	2.34	0.000
17		2	2.35		8	2.31	0.002
18		2	2.35		9	2.33	0.000
19		2	2.28		10	2.34	0.004
20		2	2.28		11	2.33	0.003
21		2	2.28		15	2.38	0.010
22		2	2.28		17	2.36	0.006
23		2	2.28		19	2.40	0.014
24		3	2.33		4	2.36	0.001
25		3	2.33		5	2.37	0.002
26		3	2.33		7	2.34	0.000
27		3	2.33		8	2.31	0.000
28		3	2.33		9	2.33	0.000
29		3	2.33		10	2.34	0.000
30		3	2.33		11	2.33	0.000
31		3	2.33		15	2.38	0.002
32		3	2.33		17	2.36	0.001
33		3	2.33		19	2.40	0.005
34		4	2.36		5	2.37	0.000
35		4	2.36		7	2.34	0.000
36		4	2.36		8	2.31	0.002
37		4	2.36		9	2.33	0.001
38		4	2.36		10	2.34	0.000
39		4	2.36		11	2.33	0.001
40		4	2.36		15	2.38	0.000
41		4	2.36		17	2.36	0.000
42		4	2.36		19	2.40	0.002
43		5	2.37		7	2.34	0.001
44		5	2.37		8	2.31	0.004
45		5	2.37		9	2.33	0.002
46		5	2.37		10	2.34	0.001
47		5	2.37		11	2.33	0.002
48		5	2.37		15	2.38	0.000
49		5	2.37		17	2.36	0.000
50		5	2.37		19	2.40	0.001

51		7	2.34		8	2.31	0.001
52		7	2.34		9	2.33	0.000
53		7	2.34		10	2.34	0.000
54		7	2.34		11	2.33	0.000
55		7	2.34		15	2.38	0.002
56		7	2.34		17	2.36	0.000
57		7	2.34		19	2.40	0.004
58		8	2.31		9	2.33	0.000
59		8	2.31		10	2.34	0.001
60		8	2.31		11	2.33	0.000
61		8	2.31		15	2.38	0.005
62		8	2.31		17	2.36	0.002
63		8	2.31		19	2.40	0.008
64		9	2.33		10	2.34	0.000
65		9	2.33		11	2.33	0.000
66		9	2.33		15	2.38	0.002
67		9	2.33		17	2.36	0.001
68		9	2.33		19	2.40	0.005
69		10	2.34		11	2.33	0.000
70		10	2.34		15	2.38	0.002
71		10	2.34		17	2.36	0.000
72		10	2.34		19	2.40	0.004
73		11	2.33		15	2.38	0.002
74		11	2.33		17	2.36	0.001
75		11	2.33		19	2.40	0.005
76		15	2.38		17	2.36	0.000
77		15	2.38		19	2.40	0.000
78		17	2.36		19	2.40	0.002

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	2.3469	*Standard Deviation*	0.029155
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±0.0583

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 MDD - Clamped, MC taken before compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	2.37		2	2.28	0.008
2		1	2.37		3	2.32	0.003
3		1	2.37		4	2.36	0.000
4		1	2.37		5	2.37	0.000
5		1	2.37		7	2.35	0.000
6		1	2.37		8	2.31	0.004
7		1	2.37		9	2.30	0.005
8		1	2.37		10	2.33	0.002
9		1	2.37		11	2.34	0.001
10		1	2.37		15	2.39	0.000
11		1	2.37		17	2.34	0.001
12		1	2.37		19	2.38	0.000
13		2	2.28		3	2.32	0.002
14		2	2.28		4	2.36	0.006
15		2	2.28		5	2.37	0.008
16		2	2.28		7	2.35	0.005
17		2	2.28		8	2.31	0.001
18		2	2.28		9	2.30	0.000
19		2	2.28		10	2.33	0.003
20		2	2.28		11	2.34	0.004
21		2	2.28		15	2.39	0.012
22		2	2.28		17	2.34	0.004
23		2	2.28		19	2.38	0.010
24		3	2.32		4	2.36	0.002
25		3	2.32		5	2.37	0.003
26		3	2.32		7	2.35	0.001
27		3	2.32		8	2.31	0.000
28		3	2.32		9	2.30	0.000
29		3	2.32		10	2.33	0.000
30		3	2.32		11	2.34	0.000
31		3	2.32		15	2.39	0.005
32		3	2.32		17	2.34	0.000
33		3	2.32		19	2.38	0.004
34		4	2.36		5	2.37	0.000
35		4	2.36		7	2.35	0.000
36		4	2.36		8	2.31	0.002
37		4	2.36		9	2.30	0.004
38		4	2.36		10	2.33	0.001
39		4	2.36		11	2.34	0.000
40		4	2.36		15	2.39	0.001
41		4	2.36		17	2.34	0.000
42		4	2.36		19	2.38	0.000
43		5	2.37		7	2.35	0.000
44		5	2.37		8	2.31	0.004
45		5	2.37		9	2.30	0.005
46		5	2.37		10	2.33	0.002
47		5	2.37		11	2.34	0.001
48		5	2.37		15	2.39	0.000
49		5	2.37		17	2.34	0.001
50		5	2.37		19	2.38	0.000

51		7	2.35		8	2.31	0.002
52		7	2.35		9	2.30	0.003
53		7	2.35		10	2.33	0.000
54		7	2.35		11	2.34	0.000
55		7	2.35		15	2.39	0.002
56		7	2.35		17	2.34	0.000
57		7	2.35		19	2.38	0.001
58		8	2.31		9	2.30	0.000
59		8	2.31		10	2.33	0.000
60		8	2.31		11	2.34	0.001
61		8	2.31		15	2.39	0.006
62		8	2.31		17	2.34	0.001
63		8	2.31		19	2.38	0.005
64		9	2.30		10	2.33	0.001
65		9	2.30		11	2.34	0.002
66		9	2.30		15	2.39	0.008
67		9	2.30		17	2.34	0.002
68		9	2.30		19	2.38	0.006
69		10	2.33		11	2.34	0.000
70		10	2.33		15	2.39	0.004
71		10	2.33		17	2.34	0.000
72		10	2.33		19	2.38	0.002
73		11	2.34		15	2.39	0.003
74		11	2.34		17	2.34	0.000
75		11	2.34		19	2.38	0.002
76		15	2.39		17	2.34	0.003
77		15	2.39		19	2.38	0.000
78		17	2.34		19	2.38	0.002

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	2.3415	*Standard Deviation*	0.033088
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±0.0662

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 MDD - Un-clamped, MC taken after compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	2.40		2	2.29	0.012
2		1	2.40		3	2.35	0.002
3		1	2.40		4	2.39	0.000
4		1	2.40		5	2.39	0.000
5		1	2.40		7	2.30	0.010
6		1	2.40		8	2.32	0.006
7		1	2.40		9	2.33	0.005
8		1	2.40		10	2.35	0.002
9		1	2.40		11	2.34	0.004
10		1	2.40		15	2.39	0.000
11		1	2.40		17	2.34	0.004
12		1	2.40		19	2.40	0.000
13		2	2.29		3	2.35	0.004
14		2	2.29		4	2.39	0.010
15		2	2.29		5	2.39	0.010
16		2	2.29		7	2.30	0.000
17		2	2.29		8	2.32	0.001
18		2	2.29		9	2.33	0.002
19		2	2.29		10	2.35	0.004
20		2	2.29		11	2.34	0.002
21		2	2.29		15	2.39	0.010
22		2	2.29		17	2.34	0.002
23		2	2.29		19	2.40	0.012
24		3	2.35		4	2.39	0.002
25		3	2.35		5	2.39	0.002
26		3	2.35		7	2.30	0.003
27		3	2.35		8	2.32	0.001
28		3	2.35		9	2.33	0.000
29		3	2.35		10	2.35	0.000
30		3	2.35		11	2.34	0.000
31		3	2.35		15	2.39	0.002
32		3	2.35		17	2.34	0.000
33		3	2.35		19	2.40	0.002
34		4	2.39		5	2.39	0.000
35		4	2.39		7	2.30	0.008
36		4	2.39		8	2.32	0.005
37		4	2.39		9	2.33	0.004
38		4	2.39		10	2.35	0.002
39		4	2.39		11	2.34	0.003
40		4	2.39		15	2.39	0.000
41		4	2.39		17	2.34	0.003
42		4	2.39		19	2.40	0.000
43		5	2.39		7	2.30	0.008
44		5	2.39		8	2.32	0.005
45		5	2.39		9	2.33	0.004
46		5	2.39		10	2.35	0.002
47		5	2.39		11	2.34	0.003
48		5	2.39		15	2.39	0.000
49		5	2.39		17	2.34	0.003
50		5	2.39		19	2.40	0.000

51		7	2.30		8	2.32	0.000
52		7	2.30		9	2.33	0.001
53		7	2.30		10	2.35	0.003
54		7	2.30		11	2.34	0.002
55		7	2.30		15	2.39	0.008
56		7	2.30		17	2.34	0.002
57		7	2.30		19	2.40	0.010
58		8	2.32		9	2.33	0.000
59		8	2.32		10	2.35	0.001
60		8	2.32		11	2.34	0.000
61		8	2.32		15	2.39	0.005
62		8	2.32		17	2.34	0.000
63		8	2.32		19	2.40	0.006
64		9	2.33		10	2.35	0.000
65		9	2.33		11	2.34	0.000
66		9	2.33		15	2.39	0.004
67		9	2.33		17	2.34	0.000
68		9	2.33		19	2.40	0.005
69		10	2.35		11	2.34	0.000
70		10	2.35		15	2.39	0.002
71		10	2.35		17	2.34	0.000
72		10	2.35		19	2.40	0.002
73		11	2.34		15	2.39	0.003
74		11	2.34		17	2.34	0.000
75		11	2.34		19	2.40	0.004
76		15	2.39		17	2.34	0.003
77		15	2.39		19	2.40	0.000
78		17	2.34		19	2.40	0.004

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	2.3531	*Standard Deviation*	0.038190
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±0.0764

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 MDD - Un-clamped, MC taken after compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	2.40		2	2.29	0.013
2		1	2.40		3	2.35	0.002
3		1	2.40		4	2.38	0.000
4		1	2.40		5	2.37	0.001
5		1	2.40		7	2.31	0.008
6		1	2.40		8	2.31	0.008
7		1	2.40		9	2.32	0.006
8		1	2.40		10	2.34	0.004
9		1	2.40		11	2.35	0.002
10		1	2.40		15	2.39	0.000
11		1	2.40		17	2.33	0.005
12		1	2.40		19	2.38	0.000
13		2	2.29		3	2.35	0.004
14		2	2.29		4	2.38	0.009
15		2	2.29		5	2.37	0.007
16		2	2.29		7	2.31	0.001
17		2	2.29		8	2.31	0.001
18		2	2.29		9	2.32	0.001
19		2	2.29		10	2.34	0.003
20		2	2.29		11	2.35	0.004
21		2	2.29		15	2.39	0.011
22		2	2.29		17	2.33	0.002
23		2	2.29		19	2.38	0.009
24		3	2.35		4	2.38	0.001
25		3	2.35		5	2.37	0.000
26		3	2.35		7	2.31	0.002
27		3	2.35		8	2.31	0.002
28		3	2.35		9	2.32	0.001
29		3	2.35		10	2.34	0.000
30		3	2.35		11	2.35	0.000
31		3	2.35		15	2.39	0.002
32		3	2.35		17	2.33	0.000
33		3	2.35		19	2.38	0.001
34		4	2.38		5	2.37	0.000
35		4	2.38		7	2.31	0.005
36		4	2.38		8	2.31	0.005
37		4	2.38		9	2.32	0.004
38		4	2.38		10	2.34	0.002
39		4	2.38		11	2.35	0.001
40		4	2.38		15	2.39	0.000
41		4	2.38		17	2.33	0.002
42		4	2.38		19	2.38	0.000
43		5	2.37		7	2.31	0.004
44		5	2.37		8	2.31	0.004
45		5	2.37		9	2.32	0.003
46		5	2.37		10	2.34	0.001
47		5	2.37		11	2.35	0.000
48		5	2.37		15	2.39	0.000
49		5	2.37		17	2.33	0.002
50		5	2.37		19	2.38	0.000

51		7	2.31		8	2.31	0.000
52		7	2.31		9	2.32	0.000
53		7	2.31		10	2.34	0.001
54		7	2.31		11	2.35	0.002
55		7	2.31		15	2.39	0.008
56		7	2.31		17	2.33	0.000
57		7	2.31		19	2.38	0.005
58		8	2.31		9	2.32	0.000
59		8	2.31		10	2.34	0.001
60		8	2.31		11	2.35	0.002
61		8	2.31		15	2.39	0.008
62		8	2.31		17	2.33	0.000
63		8	2.31		19	2.38	0.005
64		9	2.32		10	2.34	0.000
65		9	2.32		11	2.35	0.001
66		9	2.32		15	2.39	0.005
67		9	2.32		17	2.33	0.000
68		9	2.32		19	2.38	0.004
69		10	2.34		11	2.35	0.000
70		10	2.34		15	2.39	0.003
71		10	2.34		17	2.33	0.000
72		10	2.34		19	2.38	0.002
73		11	2.35		15	2.39	0.002
74		11	2.35		17	2.33	0.000
75		11	2.35		19	2.38	0.001
76		15	2.39		17	2.33	0.004
77		15	2.39		19	2.38	0.000
78		17	2.33		19	2.38	0.002

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Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	2.3473	*Standard Deviation*	0.035621
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±0.0712

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 OMC - Clamped, MC taken after compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	5.50		2	6.00	0.250
2		1	5.50		3	5.60	0.010
3		1	5.50		4	5.10	0.160
4		1	5.50		5	7.25	3.063
5		1	5.50		7	5.20	0.090
6		1	5.50		8	6.40	0.810
7		1	5.50		9	6.00	0.250
8		1	5.50		10	5.00	0.250
9		1	5.50		11	5.30	0.040
10		1	5.50		15	4.40	1.210
11		1	5.50		17	5.10	0.160
12		1	5.50		19	5.80	0.090
13		2	6.00		3	5.60	0.160
14		2	6.00		4	5.10	0.810
15		2	6.00		5	7.25	1.563
16		2	6.00		7	5.20	0.640
17		2	6.00		8	6.40	0.160
18		2	6.00		9	6.00	0.000
19		2	6.00		10	5.00	1.000
20		2	6.00		11	5.30	0.490
21		2	6.00		15	4.40	2.560
22		2	6.00		17	5.10	0.810
23		2	6.00		19	5.80	0.040
24		3	5.60		4	5.10	0.250
25		3	5.60		5	7.25	2.723
26		3	5.60		7	5.20	0.160
27		3	5.60		8	6.40	0.640
28		3	5.60		9	6.00	0.160
29		3	5.60		10	5.00	0.360
30		3	5.60		11	5.30	0.090
31		3	5.60		15	4.40	1.440
32		3	5.60		17	5.10	0.250
33		3	5.60		19	5.80	0.040
34		4	5.10		5	7.25	4.623
35		4	5.10		7	5.20	0.010
36		4	5.10		8	6.40	1.690
37		4	5.10		9	6.00	0.810
38		4	5.10		10	5.00	0.010
39		4	5.10		11	5.30	0.040
40		4	5.10		15	4.40	0.490
41		4	5.10		17	5.10	0.000
42		4	5.10		19	5.80	0.490
43		5	7.25		7	5.20	4.203
44		5	7.25		8	6.40	0.722
45		5	7.25		9	6.00	1.563
46		5	7.25		10	5.00	5.063
47		5	7.25		11	5.30	3.803
48		5	7.25		15	4.40	8.123
49		5	7.25		17	5.10	4.623
50		5	7.25		19	5.80	2.103

51		7	5.20		8	6.40	1.440
52		7	5.20		9	6.00	0.640
53		7	5.20		10	5.00	0.040
54		7	5.20		11	5.30	0.010
55		7	5.20		15	4.40	0.640
56		7	5.20		17	5.10	0.010
57		7	5.20		19	5.80	0.360
58		8	6.40		9	6.00	0.160
59		8	6.40		10	5.00	1.960
60		8	6.40		11	5.30	1.210
61		8	6.40		15	4.40	4.000
62		8	6.40		17	5.10	1.690
63		8	6.40		19	5.80	0.360
64		9	6.00		10	5.00	1.000
65		9	6.00		11	5.30	0.490
66		9	6.00		15	4.40	2.560
67		9	6.00		17	5.10	0.810
68		9	6.00		19	5.80	0.040
69		10	5.00		11	5.30	0.090
70		10	5.00		15	4.40	0.360
71		10	5.00		17	5.10	0.010
72		10	5.00		19	5.80	0.640
73		11	5.30		15	4.40	0.810
74		11	5.30		17	5.10	0.040
75		11	5.30		19	5.80	0.250
76		15	4.40		17	5.10	0.490
77		15	4.40		19	5.80	1.960
78		17	5.10		19	5.80	0.490

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Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	5.5885	*Standard Deviation*	0.728145
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±1.4563

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD NZTA T28: 2024 MDD - Clamped, MC taken before compaction

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	5.40		2	6.10	0.490
2		1	5.40		3	5.80	0.160
3		1	5.40		4	5.80	0.160
4		1	5.40		5	7.20	3.240
5		1	5.40		7	4.80	0.360
6		1	5.40		8	6.80	1.960
7		1	5.40		9	6.00	0.360
8		1	5.40		10	5.70	0.090
9		1	5.40		11	4.90	0.250
10		1	5.40		15	4.30	1.210
11		1	5.40		17	5.10	0.090
12		1	5.40		19	6.60	1.440
13		2	6.10		3	5.80	0.090
14		2	6.10		4	5.80	0.090
15		2	6.10		5	7.20	1.210
16		2	6.10		7	4.80	1.690
17		2	6.10		8	6.80	0.490
18		2	6.10		9	6.00	0.010
19		2	6.10		10	5.70	0.160
20		2	6.10		11	4.90	1.440
21		2	6.10		15	4.30	3.240
22		2	6.10		17	5.10	1.000
23		2	6.10		19	6.60	0.250
24		3	5.80		4	5.80	0.000
25		3	5.80		5	7.20	1.960
26		3	5.80		7	4.80	1.000
27		3	5.80		8	6.80	1.000
28		3	5.80		9	6.00	0.040
29		3	5.80		10	5.70	0.010
30		3	5.80		11	4.90	0.810
31		3	5.80		15	4.30	2.250
32		3	5.80		17	5.10	0.490
33		3	5.80		19	6.60	0.640
34		4	5.80		5	7.20	1.960
35		4	5.80		7	4.80	1.000
36		4	5.80		8	6.80	1.000
37		4	5.80		9	6.00	0.040
38		4	5.80		10	5.70	0.010
39		4	5.80		11	4.90	0.810
40		4	5.80		15	4.30	2.250
41		4	5.80		17	5.10	0.490
42		4	5.80		19	6.60	0.640
43		5	7.20		7	4.80	5.760
44		5	7.20		8	6.80	0.160
45		5	7.20		9	6.00	1.440
46		5	7.20		10	5.70	2.250
47		5	7.20		11	4.90	5.290
48		5	7.20		15	4.30	8.410
49		5	7.20		17	5.10	4.410
50		5	7.20		19	6.60	0.360

51		7	4.80		8	6.80	4.000
52		7	4.80		9	6.00	1.440
53		7	4.80		10	5.70	0.810
54		7	4.80		11	4.90	0.010
55		7	4.80		15	4.30	0.250
56		7	4.80		17	5.10	0.090
57		7	4.80		19	6.60	3.240
58		8	6.80		9	6.00	0.640
59		8	6.80		10	5.70	1.210
60		8	6.80		11	4.90	3.610
61		8	6.80		15	4.30	6.250
62		8	6.80		17	5.10	2.890
63		8	6.80		19	6.60	0.040
64		9	6.00		10	5.70	0.090
65		9	6.00		11	4.90	1.210
66		9	6.00		15	4.30	2.890
67		9	6.00		17	5.10	0.810
68		9	6.00		19	6.60	0.360
69		10	5.70		11	4.90	0.640
70		10	5.70		15	4.30	1.960
71		10	5.70		17	5.10	0.360
72		10	5.70		19	6.60	0.810
73		11	4.90		15	4.30	0.360
74		11	4.90		17	5.10	0.040
75		11	4.90		19	6.60	2.890
76		15	4.30		17	5.10	0.640
77		15	4.30		19	6.60	5.290
78		17	5.10		19	6.60	2.250

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	5.7308	*Standard Deviation*	0.841458
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±1.6829

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 OMC - Un-clamped, MC taken after compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	5.50		2	6.00	0.250
2		1	5.50		3	5.30	0.040
3		1	5.50		4	5.70	0.040
4		1	5.50		5	5.70	0.040
5		1	5.50		7	4.50	1.000
6		1	5.50		8	6.00	0.250
7		1	5.50		9	5.50	0.000
8		1	5.50		10	5.40	0.010
9		1	5.50		11	4.90	0.360
10		1	5.50		15	4.30	1.440
11		1	5.50		17	5.10	0.160
12		1	5.50		19	5.70	0.040
13		2	6.00		3	5.30	0.490
14		2	6.00		4	5.70	0.090
15		2	6.00		5	5.70	0.090
16		2	6.00		7	4.50	2.250
17		2	6.00		8	6.00	0.000
18		2	6.00		9	5.50	0.250
19		2	6.00		10	5.40	0.360
20		2	6.00		11	4.90	1.210
21		2	6.00		15	4.30	2.890
22		2	6.00		17	5.10	0.810
23		2	6.00		19	5.70	0.090
24		3	5.30		4	5.70	0.160
25		3	5.30		5	5.70	0.160
26		3	5.30		7	4.50	0.640
27		3	5.30		8	6.00	0.490
28		3	5.30		9	5.50	0.040
29		3	5.30		10	5.40	0.010
30		3	5.30		11	4.90	0.160
31		3	5.30		15	4.30	1.000
32		3	5.30		17	5.10	0.040
33		3	5.30		19	5.70	0.160
34		4	5.70		5	5.70	0.000
35		4	5.70		7	4.50	1.440
36		4	5.70		8	6.00	0.090
37		4	5.70		9	5.50	0.040
38		4	5.70		10	5.40	0.090
39		4	5.70		11	4.90	0.640
40		4	5.70		15	4.30	1.960
41		4	5.70		17	5.10	0.360
42		4	5.70		19	5.70	0.000
43		5	5.70		7	4.50	1.440
44		5	5.70		8	6.00	0.090
45		5	5.70		9	5.50	0.040
46		5	5.70		10	5.40	0.090
47		5	5.70		11	4.90	0.640
48		5	5.70		15	4.30	1.960
49		5	5.70		17	5.10	0.360
50		5	5.70		19	5.70	0.000

51		7	4.50		8	6.00	2.250
52		7	4.50		9	5.50	1.000
53		7	4.50		10	5.40	0.810
54		7	4.50		11	4.90	0.160
55		7	4.50		15	4.30	0.040
56		7	4.50		17	5.10	0.360
57		7	4.50		19	5.70	1.440
58		8	6.00		9	5.50	0.250
59		8	6.00		10	5.40	0.360
60		8	6.00		11	4.90	1.210
61		8	6.00		15	4.30	2.890
62		8	6.00		17	5.10	0.810
63		8	6.00		19	5.70	0.090
64		9	5.50		10	5.40	0.010
65		9	5.50		11	4.90	0.360
66		9	5.50		15	4.30	1.440
67		9	5.50		17	5.10	0.160
68		9	5.50		19	5.70	0.040
69		10	5.40		11	4.90	0.250
70		10	5.40		15	4.30	1.210
71		10	5.40		17	5.10	0.090
72		10	5.40		19	5.70	0.090
73		11	4.90		15	4.30	0.360
74		11	4.90		17	5.10	0.040
75		11	4.90		19	5.70	0.640
76		15	4.30		17	5.10	0.640
77		15	4.30		19	5.70	1.960
78		17	5.10		19	5.70	0.360

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	5.3538	*Standard Deviation*	0.531965
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±1.0639

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD NZTA T28: 2024 OMC - Un-clamped, MC taken after compaction

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	5.70		2	6.10	0.160
2		1	5.70		3	5.50	0.040
3		1	5.70		4	6.20	0.250
4		1	5.70		5	6.50	0.640
5		1	5.70		7	4.80	0.810
6		1	5.70		8	6.50	0.640
7		1	5.70		9	6.00	0.090
8		1	5.70		10	5.70	0.000
9		1	5.70		11	4.50	1.440
10		1	5.70		15	4.30	1.960
11		1	5.70		17	5.60	0.010
12		1	5.70		19	6.60	0.810
13		2	6.10		3	5.50	0.360
14		2	6.10		4	6.20	0.010
15		2	6.10		5	6.50	0.160
16		2	6.10		7	4.80	1.690
17		2	6.10		8	6.50	0.160
18		2	6.10		9	6.00	0.010
19		2	6.10		10	5.70	0.160
20		2	6.10		11	4.50	2.560
21		2	6.10		15	4.30	3.240
22		2	6.10		17	5.60	0.250
23		2	6.10		19	6.60	0.250
24		3	5.50		4	6.20	0.490
25		3	5.50		5	6.50	1.000
26		3	5.50		7	4.80	0.490
27		3	5.50		8	6.50	1.000
28		3	5.50		9	6.00	0.250
29		3	5.50		10	5.70	0.040
30		3	5.50		11	4.50	1.000
31		3	5.50		15	4.30	1.440
32		3	5.50		17	5.60	0.010
33		3	5.50		19	6.60	1.210
34		4	6.20		5	6.50	0.090
35		4	6.20		7	4.80	1.960
36		4	6.20		8	6.50	0.090
37		4	6.20		9	6.00	0.040
38		4	6.20		10	5.70	0.250
39		4	6.20		11	4.50	2.890
40		4	6.20		15	4.30	3.610
41		4	6.20		17	5.60	0.360
42		4	6.20		19	6.60	0.160
43		5	6.50		7	4.80	2.890
44		5	6.50		8	6.50	0.000
45		5	6.50		9	6.00	0.250
46		5	6.50		10	5.70	0.640
47		5	6.50		11	4.50	4.000
48		5	6.50		15	4.30	4.840
49		5	6.50		17	5.60	0.810
50		5	6.50		19	6.60	0.010

51		7	4.80		8	6.50	2.890
52		7	4.80		9	6.00	1.440
53		7	4.80		10	5.70	0.810
54		7	4.80		11	4.50	0.090
55		7	4.80		15	4.30	0.250
56		7	4.80		17	5.60	0.640
57		7	4.80		19	6.60	3.240
58		8	6.50		9	6.00	0.250
59		8	6.50		10	5.70	0.640
60		8	6.50		11	4.50	4.000
61		8	6.50		15	4.30	4.840
62		8	6.50		17	5.60	0.810
63		8	6.50		19	6.60	0.010
64		9	6.00		10	5.70	0.090
65		9	6.00		11	4.50	2.250
66		9	6.00		15	4.30	2.890
67		9	6.00		17	5.60	0.160
68		9	6.00		19	6.60	0.360
69		10	5.70		11	4.50	1.440
70		10	5.70		15	4.30	1.960
71		10	5.70		17	5.60	0.010
72		10	5.70		19	6.60	0.810
73		11	4.50		15	4.30	0.040
74		11	4.50		17	5.60	1.210
75		11	4.50		19	6.60	4.410
76		15	4.30		17	5.60	1.690
77		15	4.30		19	6.60	5.290
78		17	5.60		19	6.60	1.000

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	5.6923	*Standard Deviation*	0.760383
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±1.5208

PROFICIENCY RESULTS

NZTA T28: 2024 - Sample 2

Results Summary

		Clamped Sample		Unclamped Sample	
		After compaction Moisture Content	Before compaction Moisture Content	After compaction Moisture Content	Before compaction Moisture Content
Ave MDD	(t/m³)	2.32	2.32	2.32	2.31
Ave OMC	(%)	5.18	5.49	5.02	5.37
Range MDD	(t/m³)	0.130	0.130	0.100	0.150
Range OMC	(%)	1.9	2.3	1.5	2.3
U-o-M MDD	(t/m³)	0.08	0.09	0.06	0.08
U-o-M OMC	(%)	1.33	1.49	0.96	1.49

Thanks to the participating labs -

- Whangerei, Auckland, Hamilton, Tauranga, Rotorua, Gisborne, Napier, New Plymouth, Wanganui, Petone.
- Auckland
- Auckland
- Auckland , Kapiti
- Auckland, Tauranga
- Wanganui
- Captif - Christchurch
- Christchurch

PROFICIENCY RESULTS
NZTA T28: 2024 - Sample 2

Clamped Sample

	MC After compaction		MC Before compaction	
Lab No.	MDD (t/m³)	OMC (%)	MDD (t/m³)	OMC (%)
1	2.36	4.4	2.35	4.8
2	2.29	4.6	2.28	4.8
3	2.30	6.2	2.29	6.4
4	2.35	5.9	2.35	6.7
5	2.30	4.3	2.29	4.4
7	2.34	5.4	2.35	4.9
8	2.26	5.7	2.26	6.0
9	2.27	4.5	2.27	4.9
10	2.33	5.3	2.30	5.9
11	2.31	4.9	2.30	5.3
15	2.39	5.0	2.39	5.2
17	2.34	5.0	2.33	5.7
19	2.33	6.2	2.38	6.4

Un-Clamped Sample

	MC After compaction		MC Before compaction	
Lab No.	MDD (t/m³)	OMC (%)	MDD (t/m³)	OMC (%)
1	2.34	5.0	2.33	5.5
2	2.30	4.7	2.29	4.7
3	2.34	5.5	2.32	6.4
4	2.34	5.9	2.32	6.7
5	2.33	4.4	2.33	4.4
7	2.31	4.7	2.31	4.9
8	2.27	5.3	2.26	5.8
9	2.26	4.5	2.25	4.7
10	2.35	5.2	2.33	5.4
11	2.31	4.4	2.31	4.4
15	2.34	5.2	2.40	5.2
17	2.36	4.9	2.34	5.7
19	2.30	5.6	2.27	6.0

PROFICIENCY RESULTS
NZTA T28: 2024 - Sample 2

	MDD - Clamped		MDD - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
Max	2.39	2.39	2.36	2.40
Min	2.26	2.26	2.26	2.25
Range	0.13	0.13	0.10	0.15
Average	2.32	2.32	2.32	2.31
St Dev	0.037	0.042	0.03	0.04

Individual Labs Results

Lab ID#	MDD - Clamped		MDD - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
1	2.36	2.35	2.34	2.33
2	2.29	2.28	2.30	2.29
3	2.30	2.29	2.34	2.32
4	2.35	2.35	2.34	2.32
5	2.30	2.29	2.33	2.33
7	2.34	2.35	2.31	2.31
8	2.26	2.26	2.27	2.26
9	2.27	2.27	2.26	2.25
10	2.33	2.30	2.35	2.33
11	2.31	2.30	2.31	2.31
15	2.39	2.39	2.34	2.40
17	2.34	2.33	2.36	2.34
19	2.33	2.38	2.30	2.27

Z- Scores

Lab ID#	MDD - Clamped		MDD - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
1	1.06	0.74	0.68	0.45
2	-0.84	-0.91	-0.63	-0.57
3	-0.56	-0.67	0.68	0.20
4	0.79	0.74	0.68	0.20
5	-0.56	-0.67	0.35	0.45
7	0.52	0.74	-0.30	-0.06
8	-1.65	-1.38	-1.60	-1.33
9	-1.38	-1.14	-1.93	-1.59
10	0.25	-0.44	1.00	0.45
11	-0.29	-0.44	-0.30	-0.06
15	1.88	1.69	0.68	2.24
17	0.52	0.27	1.33	0.71
19	0.25	1.45	-0.63	-1.08

Z Score

(-1 to 1)
(-2 to -1 and 1 to 2))
(-3 to -2 and 2 to 3)
(>-3 and >3)

As a guide any Z score less than (-2) or greater than (+2) should be investigated further.
It is up to the individual labs to determine if their results require any further

PROFICIENCY RESULTS
NZTA T28: 2024 - Sample 2

	OMC - Clamped		OMC - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
Max	6.2	6.7	5.9	6.7
Min	4.3	4.4	4.4	4.4
Range	1.9	2.3	1.5	2.3
Average	5.18	5.49	5.02	5.37
St Dev	0.66	0.74	0.48	0.74

Individual Labs Results

Lab ID#	OMC - Clamped		OMC - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
1	4.40	4.80	5.00	5.50
2	4.60	4.80	4.70	4.70
3	6.20	6.40	5.47	6.40
4	5.90	6.70	5.90	6.70
5	4.30	4.40	4.40	4.40
7	5.40	4.90	4.70	4.90
8	5.70	6.00	5.30	5.80
9	4.50	4.90	4.50	4.70
10	5.30	5.90	5.20	5.40
11	4.90	5.30	4.40	4.40
15	5.00	5.20	5.20	5.20
17	5.00	5.70	4.90	5.70
19	6.20	6.40	5.60	6.00

Z- Scores

Lab ID#	MDD - Clamped		MDD - Un-Clamped	
	MC After Compaction	MC Before Compaction	MC After Compaction	MC Before Compaction
1	-1.19	-0.94	-0.04	0.18
2	-0.88	-0.94	-0.67	-0.90
3	1.53	1.23	0.94	1.39
4	1.08	1.63	1.85	1.80
5	-1.34	-1.48	-1.31	-1.31
7	0.33	-0.80	-0.67	-0.63
8	0.78	0.69	0.59	0.58
9	-1.03	-0.80	-1.09	-0.90
10	0.17	0.55	0.38	0.04
11	-0.43	-0.26	-1.31	-1.31
15	-0.28	-0.40	0.38	-0.23
17	-0.28	0.28	-0.25	0.45
19	1.53	1.23	1.22	0.85

Z Score
(-1 to 1)
(-2 to -1 and 1 to 2))
(-3 to -2 and 2 to 3)
(>-3 and >3)

As a guide any Z score less than (-2) or greater than (+2) should be investigated further. It is up to the individual labs to determine if their results require any further

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 MDD - Clamped, MC taken after compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	2.36		2	2.29	0.005
2		1	2.36		3	2.30	0.004
3		1	2.36		4	2.35	0.000
4		1	2.36		5	2.30	0.004
5		1	2.36		7	2.34	0.000
6		1	2.36		8	2.26	0.010
7		1	2.36		9	2.27	0.008
8		1	2.36		10	2.33	0.001
9		1	2.36		11	2.31	0.002
10		1	2.36		15	2.39	0.001
11		1	2.36		17	2.34	0.000
12		1	2.36		19	2.33	0.001
13		2	2.29		3	2.30	0.000
14		2	2.36		4	2.35	0.000
15		2	2.36		5	2.30	0.004
16		2	2.36		7	2.34	0.000
17		2	2.36		8	2.26	0.010
18		2	2.36		9	2.27	0.008
19		2	2.29		10	2.33	0.002
20		2	2.29		11	2.31	0.000
21		2	2.29		15	2.39	0.010
22		2	2.29		17	2.34	0.002
23		2	2.29		19	2.33	0.002
24		3	2.30		4	2.35	0.003
25		3	2.30		5	2.30	0.000
26		3	2.30		7	2.34	0.002
27		3	2.30		8	2.26	0.002
28		3	2.30		9	2.27	0.001
29		3	2.30		10	2.33	0.001
30		3	2.30		11	2.31	0.000
31		3	2.30		15	2.39	0.008
32		3	2.30		17	2.34	0.002
33		3	2.30		19	2.33	0.001
34		4	2.35		5	2.30	0.003
35		4	2.35		7	2.34	0.000
36		4	2.35		8	2.26	0.008
37		4	2.35		9	2.27	0.006
38		4	2.35		10	2.33	0.000
39		4	2.35		11	2.31	0.002
40		4	2.35		15	2.39	0.002
41		4	2.35		17	2.34	0.000
42		4	2.35		19	2.33	0.000
43		5	2.30		7	2.34	0.002
44		5	2.30		8	2.26	0.002
45		5	2.30		9	2.27	0.001
46		5	2.30		10	2.33	0.001
47		5	2.30		11	2.31	0.000
48		5	2.30		15	2.39	0.008
49		5	2.30		17	2.34	0.002
50		5	2.30		19	2.33	0.001

51		7	2.34		8	2.26	0.006
52		7	2.34		9	2.27	0.005
53		7	2.34		10	2.33	0.000
54		7	2.34		11	2.31	0.001
55		7	2.34		15	2.39	0.003
56		7	2.34		17	2.34	0.000
57		7	2.34		19	2.33	0.000
58		8	2.26		9	2.27	0.000
59		8	2.26		10	2.33	0.005
60		8	2.26		11	2.31	0.003
61		8	2.26		15	2.39	0.017
62		8	2.26		17	2.34	0.006
63		8	2.26		19	2.33	0.005
64		9	2.27		10	2.33	0.004
65		9	2.27		11	2.31	0.002
66		9	2.27		15	2.39	0.014
67		9	2.27		17	2.34	0.005
68		9	2.27		19	2.33	0.004
69		10	2.33		11	2.31	0.000
70		10	2.33		15	2.39	0.004
71		10	2.33		17	2.34	0.000
72		10	2.33		19	2.33	0.000
73		11	2.31		15	2.39	0.006
74		11	2.31		17	2.34	0.001
75		11	2.31		19	2.33	0.000
76		15	2.39		17	2.34	0.003
77		15	2.39		19	2.33	0.004
78		17	2.34		19	2.33	0.000

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	2.3230	*Standard Deviation*	0.038351
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±0.0767

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 MDD - Clamped, MC taken before compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	2.35		2	2.28	0.005
2		1	2.35		3	2.29	0.004
3		1	2.35		4	2.35	0.000
4		1	2.35		5	2.29	0.004
5		1	2.35		7	2.35	0.000
6		1	2.35		8	2.26	0.008
7		1	2.35		9	2.27	0.006
8		1	2.35		10	2.30	0.003
9		1	2.35		11	2.30	0.003
10		1	2.35		15	2.39	0.002
11		1	2.35		17	2.33	0.000
12		1	2.35		19	2.38	0.001
13		2	2.28		3	2.29	0.000
14		2	2.28		4	2.35	0.005
15		2	2.28		5	2.29	0.000
16		2	2.28		7	2.35	0.005
17		2	2.28		8	2.26	0.000
18		2	2.28		9	2.27	0.000
19		2	2.28		10	2.30	0.000
20		2	2.28		11	2.30	0.000
21		2	2.28		15	2.39	0.012
22		2	2.28		17	2.33	0.003
23		2	2.28		19	2.38	0.010
24		3	2.29		4	2.35	0.004
25		3	2.29		5	2.29	0.000
26		3	2.29		7	2.35	0.004
27		3	2.29		8	2.26	0.001
28		3	2.29		9	2.27	0.000
29		3	2.29		10	2.30	0.000
30		3	2.29		11	2.30	0.000
31		3	2.29		15	2.39	0.010
32		3	2.29		17	2.33	0.002
33		3	2.29		19	2.38	0.008
34		4	2.35		5	2.29	0.004
35		4	2.35		7	2.35	0.000
36		4	2.35		8	2.26	0.008
37		4	2.35		9	2.27	0.006
38		4	2.35		10	2.30	0.003
39		4	2.35		11	2.30	0.003
40		4	2.35		15	2.39	0.002
41		4	2.35		17	2.33	0.000
42		4	2.35		19	2.38	0.001
43		5	2.29		7	2.35	0.004
44		5	2.29		8	2.26	0.001
45		5	2.29		9	2.27	0.000
46		5	2.29		10	2.30	0.000
47		5	2.29		11	2.30	0.000
48		5	2.29		15	2.39	0.010
49		5	2.29		17	2.33	0.002
50		5	2.29		19	2.38	0.008

51		7	2.35		8	2.26	0.008
52		7	2.35		9	2.27	0.008
53		7	2.35		10	2.30	0.003
54		7	2.35		11	2.30	0.003
55		7	2.35		15	2.39	0.002
56		7	2.35		17	2.33	0.000
57		7	2.35		19	2.38	0.001
58		8	2.26		9	2.27	0.000
59		8	2.26		10	2.30	0.002
60		8	2.26		11	2.30	0.002
61		8	2.26		15	2.39	0.017
62		8	2.26		17	2.33	0.005
63		8	2.26		19	2.38	0.014
64		9	2.27		10	2.30	0.001
65		9	2.27		11	2.30	0.001
66		9	2.27		15	2.39	0.014
67		9	2.27		17	2.33	0.004
68		9	2.27		19	2.38	0.012
69		10	2.30		11	2.30	0.000
70		10	2.30		15	2.39	0.008
71		10	2.30		17	2.33	0.001
72		10	2.30		19	2.38	0.006
73		11	2.30		15	2.39	0.008
74		11	2.30		17	2.33	0.001
75		11	2.30		19	2.38	0.006
76		15	2.39		17	2.33	0.004
77		15	2.39		19	2.38	0.000
78		17	2.33		19	2.38	0.002

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	2.3185	*Standard Deviation*	0.042671
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±0.0853

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 MDD - Un-clamped, MC taken after compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	2.34		2	2.30	0.002
2		1	2.34		3	2.34	0.000
3		1	2.34		4	2.34	0.000
4		1	2.34		5	2.33	0.000
5		1	2.34		7	2.31	0.001
6		1	2.34		8	2.27	0.005
7		1	2.34		9	2.26	0.006
8		1	2.34		10	2.35	0.000
9		1	2.34		11	2.31	0.001
10		1	2.34		15	2.34	0.000
11		1	2.34		17	2.36	0.000
12		1	2.34		19	2.30	0.002
13		2	2.30		3	2.34	0.002
14		2	2.30		4	2.34	0.002
15		2	2.30		5	2.33	0.001
16		2	2.30		7	2.31	0.000
17		2	2.30		8	2.27	0.001
18		2	2.30		9	2.26	0.002
19		2	2.30		10	2.35	0.003
20		2	2.30		11	2.31	0.000
21		2	2.30		15	2.34	0.002
22		2	2.30		17	2.36	0.004
23		2	2.30		19	2.30	0.000
24		3	2.34		4	2.34	0.000
25		3	2.34		5	2.33	0.000
26		3	2.34		7	2.31	0.001
27		3	2.34		8	2.27	0.005
28		3	2.34		9	2.26	0.006
29		3	2.34		10	2.35	0.000
30		3	2.34		11	2.31	0.001
31		3	2.34		15	2.34	0.000
32		3	2.34		17	2.36	0.000
33		3	2.34		19	2.30	0.002
34		4	2.34		5	2.33	0.000
35		4	2.34		7	2.31	0.001
36		4	2.34		8	2.27	0.005
37		4	2.34		9	2.26	0.006
38		4	2.34		10	2.35	0.000
39		4	2.34		11	2.31	0.001
40		4	2.34		15	2.34	0.000
41		4	2.34		17	2.36	0.000
42		4	2.34		19	2.30	0.002
43		5	2.33		7	2.31	0.000
44		5	2.33		8	2.27	0.004
45		5	2.33		9	2.26	0.005
46		5	2.33		10	2.35	0.000
47		5	2.33		11	2.31	0.000
48		5	2.33		15	2.34	0.000
49		5	2.33		17	2.36	0.001
50		5	2.33		19	2.30	0.001

51		7	2.31		8	2.27	0.002
52		7	2.31		9	2.26	0.003
53		7	2.31		10	2.35	0.002
54		7	2.31		11	2.31	0.000
55		7	2.31		15	2.34	0.001
56		7	2.31		17	2.36	0.002
57		7	2.31		19	2.30	0.000
58		8	2.27		9	2.26	0.000
59		8	2.27		10	2.35	0.006
60		8	2.27		11	2.31	0.002
61		8	2.27		15	2.34	0.005
62		8	2.27		17	2.36	0.008
63		8	2.27		19	2.30	0.001
64		9	2.26		10	2.35	0.008
65		9	2.26		11	2.31	0.003
66		9	2.26		15	2.34	0.006
67		9	2.26		17	2.36	0.010
68		9	2.26		19	2.30	0.002
69		10	2.35		11	2.31	0.002
70		10	2.35		15	2.34	0.000
71		10	2.35		17	2.36	0.000
72		10	2.35		19	2.30	0.003
73		11	2.31		15	2.34	0.001
74		11	2.31		17	2.36	0.002
75		11	2.31		19	2.30	0.000
76		15	2.34		17	2.36	0.000
77		15	2.34		19	2.30	0.002
78		17	2.36		19	2.30	0.004

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	2.3192	*Standard Deviation*	0.030875
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±0.0617

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 MDD - Un-clamped, MC taken after compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	2.33		2	2.29	0.002
2		1	2.33		3	2.32	0.000
3		1	2.33		4	2.32	0.000
4		1	2.33		5	2.33	0.000
5		1	2.33		7	2.31	0.000
6		1	2.33		8	2.26	0.005
7		1	2.33		9	2.25	0.006
8		1	2.33		10	2.33	0.000
9		1	2.33		11	2.31	0.000
10		1	2.33		15	2.40	0.005
11		1	2.33		17	2.34	0.000
12		1	2.33		19	2.27	0.004
13		2	2.29		3	2.32	0.001
14		2	2.29		4	2.32	0.001
15		2	2.29		5	2.33	0.002
16		2	2.29		7	2.31	0.000
17		2	2.29		8	2.26	0.001
18		2	2.29		9	2.25	0.002
19		2	2.29		10	2.33	0.002
20		2	2.29		11	2.31	0.000
21		2	2.29		15	2.40	0.012
22		2	2.29		17	2.34	0.002
23		2	2.29		19	2.27	0.000
24		3	2.32		4	2.32	0.000
25		3	2.32		5	2.33	0.000
26		3	2.32		7	2.31	0.000
27		3	2.32		8	2.26	0.004
28		3	2.32		9	2.25	0.005
29		3	2.32		10	2.33	0.000
30		3	2.32		11	2.31	0.000
31		3	2.32		15	2.40	0.006
32		3	2.32		17	2.34	0.000
33		3	2.32		19	2.27	0.002
34		4	2.32		5	2.33	0.000
35		4	2.32		7	2.31	0.000
36		4	2.32		8	2.26	0.004
37		4	2.32		9	2.25	0.005
38		4	2.32		10	2.33	0.000
39		4	2.32		11	2.31	0.000
40		4	2.32		15	2.40	0.006
41		4	2.32		17	2.34	0.000
42		4	2.32		19	2.27	0.002
43		5	2.33		7	2.31	0.000
44		5	2.33		8	2.26	0.005
45		5	2.33		9	2.25	0.006
46		5	2.33		10	2.33	0.000
47		5	2.33		11	2.31	0.000
48		5	2.33		15	2.40	0.005
49		5	2.33		17	2.34	0.000
50		5	2.33		19	2.27	0.004

51		7	2.31		8	2.26	0.003
52		7	2.31		9	2.25	0.004
53		7	2.31		10	2.33	0.000
54		7	2.31		11	2.31	0.000
55		7	2.31		15	2.40	0.008
56		7	2.31		17	2.34	0.001
57		7	2.31		19	2.27	0.002
58		8	2.26		9	2.25	0.000
59		8	2.26		10	2.33	0.005
60		8	2.26		11	2.31	0.003
61		8	2.26		15	2.40	0.020
62		8	2.26		17	2.34	0.006
63		8	2.26		19	2.27	0.000
64		9	2.25		10	2.33	0.006
65		9	2.25		11	2.31	0.004
66		9	2.25		15	2.40	0.023
67		9	2.25		17	2.34	0.008
68		9	2.25		19	2.27	0.000
69		10	2.33		11	2.31	0.000
70		10	2.33		15	2.40	0.005
71		10	2.33		17	2.34	0.000
72		10	2.33		19	2.27	0.004
73		11	2.31		15	2.40	0.008
74		11	2.31		17	2.34	0.001
75		11	2.31		19	2.27	0.002
76		15	2.40		17	2.34	0.004
77		15	2.40		19	2.27	0.017
78		17	2.34		19	2.27	0.005

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	2.3123	*Standard Deviation*	0.039444
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±0.0789

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD NZTA T28: 2024 OMC - Clamped, MC taken after compaction

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	4.40		2	4.60	0.040
2		1	4.40		3	6.20	3.240
3		1	4.40		4	5.90	2.250
4		1	4.40		5	4.30	0.010
5		1	4.40		7	5.40	1.000
6		1	4.40		8	5.70	1.690
7		1	4.40		9	4.50	0.010
8		1	4.40		10	5.30	0.810
9		1	4.40		11	4.90	0.250
10		1	4.40		15	5.00	0.360
11		1	4.40		17	5.00	0.360
12		1	4.40		19	6.20	3.240
13		2	4.60		3	6.20	2.560
14		2	4.60		4	5.90	1.690
15		2	4.60		5	4.30	0.090
16		2	4.60		7	5.40	0.640
17		2	4.60		8	5.70	1.210
18		2	4.60		9	4.50	0.010
19		2	4.60		10	5.30	0.490
20		2	4.60		11	4.90	0.090
21		2	4.60		15	5.00	0.160
22		2	4.60		17	5.00	0.160
23		2	4.60		19	6.20	2.560
24		3	6.20		4	5.90	0.090
25		3	6.20		5	4.30	3.610
26		3	6.20		7	5.40	0.640
27		3	6.20		8	5.70	0.250
28		3	6.20		9	4.50	2.890
29		3	6.20		10	5.30	0.810
30		3	6.20		11	4.90	1.690
31		3	6.20		15	5.00	1.440
32		3	6.20		17	5.00	1.440
33		3	6.20		19	6.20	0.000
34		4	5.90		5	4.30	2.560
35		4	5.90		7	5.40	0.250
36		4	5.90		8	5.70	0.040
37		4	5.90		9	4.50	1.960
38		4	5.90		10	5.30	0.360
39		4	5.90		11	4.90	1.000
40		4	5.90		15	5.00	0.810
41		4	5.90		17	5.00	0.810
42		4	5.90		19	6.20	0.090
43		5	4.30		7	5.40	1.210
44		5	4.30		8	5.70	1.960
45		5	4.30		9	4.50	0.040
46		5	4.30		10	5.30	1.000
47		5	4.30		11	4.90	0.360
48		5	4.30		15	5.00	0.490
49		5	4.30		17	5.00	0.490
50		5	4.30		19	6.20	3.610

51		7	5.40		8	5.70	0.090
52		7	5.40		9	4.50	0.810
53		7	5.40		10	5.30	0.010
54		7	5.40		11	4.90	0.250
55		7	5.40		15	5.00	0.160
56		7	5.40		17	5.00	0.160
57		7	5.40		19	6.20	0.640
58		8	5.70		9	4.50	1.440
59		8	5.70		10	5.30	0.160
60		8	5.70		11	4.90	0.640
61		8	5.70		15	5.00	0.490
62		8	5.70		17	5.00	0.490
63		8	5.70		19	6.20	0.250
64		9	4.50		10	5.30	0.640
65		9	4.50		11	4.90	0.160
66		9	4.50		15	5.00	0.250
67		9	4.50		17	5.00	0.250
68		9	4.50		19	6.20	2.890
69		10	5.30		11	4.90	0.160
70		10	5.30		15	5.00	0.090
71		10	5.30		17	5.00	0.090
72		10	5.30		19	6.20	0.810
73		11	4.90		15	5.00	0.010
74		11	4.90		17	5.00	0.010
75		11	4.90		19	6.20	1.690
76		15	5.00		17	5.00	0.000
77		15	5.00		19	6.20	1.440
78		17	5.00		19	6.20	1.440

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	5.1846	*Standard Deviation*	0.666158
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±1.3323

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD NZTA T28: 2024 MDD - Clamped, MC taken before compaction

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	4.80		2	4.80	0.000
2		1	4.80		3	6.40	2.560
3		1	4.80		4	6.70	3.610
4		1	4.80		5	4.40	0.160
5		1	4.80		7	4.90	0.010
6		1	4.80		8	6.00	1.440
7		1	4.80		9	4.90	0.010
8		1	4.80		10	5.90	1.210
9		1	4.80		11	5.30	0.250
10		1	4.80		15	5.20	0.160
11		1	4.80		17	5.70	0.810
12		1	4.80		19	6.40	2.560
13		2	4.80		3	6.40	2.560
14		2	4.80		4	6.70	3.610
15		2	4.80		5	4.40	0.160
16		2	4.80		7	4.90	0.010
17		2	4.80		8	6.00	1.440
18		2	4.80		9	4.90	0.010
19		2	4.80		10	5.90	1.210
20		2	4.80		11	5.30	0.250
21		2	4.80		15	5.20	0.160
22		2	4.80		17	5.70	0.810
23		2	4.80		19	6.40	2.560
24		3	6.40		4	6.70	0.090
25		3	6.40		5	4.40	4.000
26		3	6.40		7	4.90	2.250
27		3	6.40		8	6.00	0.160
28		3	6.40		9	4.90	2.250
29		3	6.40		10	5.90	0.250
30		3	6.40		11	5.30	1.210
31		3	6.40		15	5.20	1.440
32		3	6.40		17	5.70	0.490
33		3	6.40		19	6.40	0.000
34		4	6.70		5	4.40	5.290
35		4	6.70		7	4.90	3.240
36		4	6.70		8	6.00	0.490
37		4	6.70		9	4.90	3.240
38		4	6.70		10	5.90	0.640
39		4	6.70		11	5.30	1.960
40		4	6.70		15	5.20	2.250
41		4	6.70		17	5.70	1.000
42		4	6.70		19	6.40	0.090
43		5	4.40		7	4.90	0.250
44		5	4.40		8	6.00	2.560
45		5	4.40		9	4.90	0.250
46		5	4.40		10	5.90	2.250
47		5	4.40		11	5.30	0.810
48		5	4.40		15	5.20	0.640
49		5	4.40		17	5.70	1.690
50		5	4.40		19	6.40	4.000

51		7	4.90		8	6.00	1.210
52		7	4.90		9	4.90	0.000
53		7	4.90		10	5.90	1.000
54		7	4.90		11	5.30	0.160
55		7	4.90		15	5.20	0.090
56		7	4.90		17	5.70	0.640
57		7	4.90		19	6.40	2.250
58		8	6.00		9	4.90	1.210
59		8	6.00		10	5.90	0.010
60		8	6.00		11	5.30	0.490
61		8	6.00		15	5.20	0.640
62		8	6.00		17	5.70	0.090
63		8	6.00		19	6.40	0.160
64		9	4.90		10	5.90	1.000
65		9	4.90		11	5.30	0.160
66		9	4.90		15	5.20	0.090
67		9	4.90		17	5.70	0.640
68		9	4.90		19	6.40	2.250
69		10	5.90		11	5.30	0.360
70		10	5.90		15	5.20	0.490
71		10	5.90		17	5.70	0.040
72		10	5.90		19	6.40	0.250
73		11	5.30		15	5.20	0.010
74		11	5.30		17	5.70	0.160
75		11	5.30		19	6.40	1.210
76		15	5.20		17	5.70	0.250
77		15	5.20		19	6.40	1.440
78		17	5.70		19	6.40	0.490

Version 3: June 2022

Notes

Each sample is to be tested twice and should include all normal variations of testing within the laboratory, i.e different technician, equipment, time etc.
If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
The level of uncertainty of the test will be shown in the grey area of bottom right of the worksheet
Only the yellow cells are able to be modified.
Transfer the results to the spreadsheet of "UoM".

Average	5.4923	*Standard Deviation*	0.743544
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±1.4871

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD **NZTA T28: 2024 OMC - Un-clamped, MC taken after compaction**

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	5.00		2	4.70	0.090
2		1	5.00		3	5.47	0.221
3		1	5.00		4	5.90	0.810
4		1	5.00		5	4.40	0.360
5		1	5.00		7	4.70	0.090
6		1	5.00		8	5.30	0.090
7		1	5.00		9	4.50	0.250
8		1	5.00		10	5.20	0.040
9		1	5.00		11	4.40	0.360
10		1	5.00		15	5.20	0.040
11		1	5.00		17	4.90	0.010
12		1	5.00		19	5.60	0.360
13		2	4.70		3	5.47	0.593
14		2	4.70		4	5.90	1.440
15		2	4.70		5	4.40	0.090
16		2	4.70		7	4.70	0.000
17		2	4.70		8	5.30	0.360
18		2	4.70		9	4.50	0.040
19		2	4.70		10	5.20	0.250
20		2	4.70		11	4.40	0.090
21		2	4.70		15	5.20	0.250
22		2	4.70		17	4.90	0.040
23		2	4.70		19	5.60	0.810
24		3	5.47		4	5.90	0.185
25		3	5.47		5	4.40	1.145
26		3	5.47		7	4.70	0.593
27		3	5.47		8	5.30	0.029
28		3	5.47		9	4.50	0.941
29		3	5.47		10	5.20	0.073
30		3	5.47		11	4.40	1.145
31		3	5.47		15	5.20	0.073
32		3	5.47		17	4.90	0.325
33		3	5.47		19	5.60	0.017
34		4	5.90		5	4.40	2.250
35		4	5.90		7	4.70	1.440
36		4	5.90		8	5.30	0.360
37		4	5.90		9	4.50	1.960
38		4	5.90		10	5.20	0.490
39		4	5.90		11	4.40	2.250
40		4	5.90		15	5.20	0.490
41		4	5.90		17	4.90	1.000
42		4	5.90		19	5.60	0.090
43		5	4.40		7	4.70	0.090
44		5	4.40		8	5.30	0.810
45		5	4.40		9	4.50	0.010
46		5	4.40		10	5.20	0.640
47		5	4.40		11	4.40	0.000
48		5	4.40		15	5.20	0.640
49		5	4.40		17	4.90	0.250
50		5	4.40		19	5.60	1.440

51		7	4.70		8	5.30	0.360
52		7	4.70		9	4.50	0.040
53		7	4.70		10	5.20	0.250
54		7	4.70		11	4.40	0.090
55		7	4.70		15	5.20	0.250
56		7	4.70		17	4.90	0.040
57		7	4.70		19	5.60	0.810
58		8	5.30		9	4.50	0.640
59		8	5.30		10	5.20	0.010
60		8	5.30		11	4.40	0.810
61		8	5.30		15	5.20	0.010
62		8	5.30		17	4.90	0.160
63		8	5.30		19	5.60	0.090
64		9	4.50		10	5.20	0.490
65		9	4.50		11	4.40	0.010
66		9	4.50		15	5.20	0.490
67		9	4.50		17	4.90	0.160
68		9	4.50		19	5.60	1.210
69		10	5.20		11	4.40	0.640
70		10	5.20		15	5.20	0.000
71		10	5.20		17	4.90	0.090
72		10	5.20		19	5.60	0.160
73		11	4.40		15	5.20	0.640
74		11	4.40		17	4.90	0.250
75		11	4.40		19	5.60	1.440
76		15	5.20		17	4.90	0.090
77		15	5.20		19	5.60	0.160
78		17	4.90		19	5.60	0.490

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Notes

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If you do more than a pair of tests on the same sample, treat each additional two as a pair.
Aim for at least 10 degree of freedom (DoF). DoF = (No. of samples.)
Substitute new data for oldest after 20 DoF (20 samples) exceeded by press the New Data button.
Type in the results to the table, one pair a row
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Average	5.0208	*Standard Deviation*	0.478762
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±0.9575

EVALUATION OF UNCERTAINTY BY STATISTICAL ANALYSIS

TEST METHOD NZTA T28: 2024 OMC - Un-clamped, MC taken after compaction

When the table is full, click the button to substitute new data for oldest

Sample Number	Date	Lab	Test R_1	Date	Lab	Test R_2	Difference $(R_2-R_1)^2$
1		1	5.50		2	4.70	0.640
2		1	5.50		3	6.40	0.810
3		1	5.50		4	6.70	1.440
4		1	5.50		5	4.40	1.210
5		1	5.50		7	4.90	0.360
6		1	5.50		8	5.80	0.090
7		1	5.50		9	4.70	0.640
8		1	5.50		10	5.40	0.010
9		1	5.50		11	4.40	1.210
10		1	5.50		15	5.20	0.090
11		1	5.50		17	5.70	0.040
12		1	5.50		19	6.00	0.250
13		2	4.70		3	6.40	2.890
14		2	4.70		4	6.70	4.000
15		2	4.70		5	4.40	0.090
16		2	4.70		7	4.90	0.040
17		2	4.70		8	5.80	1.210
18		2	4.70		9	4.70	0.000
19		2	4.70		10	5.40	0.490
20		2	4.70		11	4.40	0.090
21		2	4.70		15	5.20	0.250
22		2	4.70		17	5.70	1.000
23		2	4.70		19	6.00	1.690
24		3	6.40		4	6.70	0.090
25		3	6.40		5	4.40	4.000
26		3	6.40		7	4.90	2.250
27		3	6.40		8	5.80	0.360
28		3	6.40		9	4.70	2.890
29		3	6.40		10	5.40	1.000
30		3	6.40		11	4.40	4.000
31		3	6.40		15	5.20	1.440
32		3	6.40		17	5.70	0.490
33		3	6.40		19	6.00	0.160
34		4	6.70		5	4.40	5.290
35		4	6.70		7	4.90	3.240
36		4	6.70		8	5.80	0.810
37		4	6.70		9	4.70	4.000
38		4	6.70		10	5.40	1.690
39		4	6.70		11	4.40	5.290
40		4	6.70		15	5.20	2.250
41		4	6.70		17	5.70	1.000
42		4	6.70		19	6.00	0.490
43		5	4.40		7	4.90	0.250
44		5	4.40		8	5.80	1.960
45		5	4.40		9	4.70	0.090
46		5	4.40		10	5.40	1.000
47		5	4.40		11	4.40	0.000
48		5	4.40		15	5.20	0.640
49		5	4.40		17	5.70	1.690
50		5	4.40		19	6.00	2.560

51		7	4.90		8	5.80	0.810
52		7	4.90		9	4.70	0.040
53		7	4.90		10	5.40	0.250
54		7	4.90		11	4.40	0.250
55		7	4.90		15	5.20	0.090
56		7	4.90		17	5.70	0.640
57		7	4.90		19	6.00	1.210
58		8	5.80		9	4.70	1.210
59		8	5.80		10	5.40	0.160
60		8	5.80		11	4.40	1.960
61		8	5.80		15	5.20	0.360
62		8	5.80		17	5.70	0.010
63		8	5.80		19	6.00	0.040
64		9	4.70		10	5.40	0.490
65		9	4.70		11	4.40	0.090
66		9	4.70		15	5.20	0.250
67		9	4.70		17	5.70	1.000
68		9	4.70		19	6.00	1.690
69		10	5.40		11	4.40	1.000
70		10	5.40		15	5.20	0.040
71		10	5.40		17	5.70	0.090
72		10	5.40		19	6.00	0.360
73		11	4.40		15	5.20	0.640
74		11	4.40		17	5.70	1.690
75		11	4.40		19	6.00	2.560
76		15	5.20		17	5.70	0.250
77		15	5.20		19	6.00	0.640
78		17	5.70		19	6.00	0.090

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Notes

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Average	5.3692	*Standard Deviation*	0.744591
Degrees of freedom	77		

UNCERTAINTY OF MEASUREMENT = ±1.4892