

Report on the Calibration of 7 Core Transport Technologies Temperature Data Loggers

Report No. Humidity/2024/615, 12 April 2024

ISSUED BY:

Measurement Standards Laboratory of New Zealand.

Established under the Measurement Standards Act 1992 and the Measurement Standards Regulations 2019 to provide uniform measurement of physical quantities throughout New Zealand.

All results quoted in this report are directly traceable to the national measurement standards held by the Measurement Standards Laboratory of New Zealand (MSL). MSL is New Zealand's national metrology institute and operates within Callaghan Innovation.



Accreditation Number 1

All measurements reported herein, unless otherwise noted, have been performed in accordance with the laboratory's scope of accreditation. *For details see www.ianz.govt.nz*

Report on the Calibration of 7 Core Transport Technologies Temperature Data Loggers

Description

Temperature data loggers manufactured by Core Transport Technologies, New Zealand.

Identification

The data loggers are identified with their associated MAC address.

Logger 1. 2C:DC:78:04:95:77
Logger 2. 2C:DC:78:04:97:1F
Logger 3. 2C:DC:78:04:97:2D
Logger 4. C6:7D:81:A4:1A:8E
Logger 5. DC:E1:E4:3E:DE:52
Logger 6. E8:BE:D9:15:15:1C
Logger 7. FB:C4:03:BB:3B:50

Client

Core Transport Technologies NZ Limited, 105 Trafalgar Street, 2nd Floor, Nelson, New Zealand.

Date of Calibration

1 to 14 February 2024.

Method

The method followed procedure MSLT.H.002.006.

The loggers were fitted to a minichamber through which conditioned air of known humidity and temperature was passed at a nominal flow-rate of 35 L/min.

The temperature reading T (units °C) of each logger was compared with reference thermometers held by this laboratory over the same temperature range.

Conditions of Calibration

All loggers were fully immersed in the conditioned air at the time of calibration. The ambient air temperature in the laboratory was maintained at (20 ± 1) °C.

Results

The temperature $t = T + \Delta t$ with units °C, where the corrections are given by equations (1) to (7) for loggers 1 to 7, respectively.

$$\Delta t = -3.5 \times 10^{-2} - 1.79 \times 10^{-3} T \quad (1)$$

$$\Delta t = 1.4 \times 10^{-2} - 4.83 \times 10^{-3} T \quad (2)$$

$$\Delta t = 1.16 \times 10^{-1} - 9.24 \times 10^{-3} T \quad (3)$$

$$\Delta t = -0.54 \quad (4)$$

$$\Delta t = -4.77 \times 10^{-1} - 1.69 \times 10^{-3} T \quad (5)$$

$$\Delta t = -6.35 \times 10^{-1} + 5.25 \times 10^{-3} T \quad (6)$$

$$\Delta t = -0.56 \quad (7)$$

For equations (1) – (5) and (7), the expanded uncertainty in the corrections is 0.11 °C. For equation (6), the expanded uncertainty in the corrections is 0.14 °C.

Corrections for loggers 1, 2, 3, 5 and 6 calculated using equations (1), (2), (3), (5) and (6) are presented respectively in part (a) of Tables 1, 2, 3, 4 and 5, for the range $T \geq 0$ °C, and in part (b) of the tables, for the range $T \leq 0$ °C. Values of the temperature calculated using Δt are valid when -10 °C $\leq t \leq 40$ °C.

Table 1: Temperature corrections Δt for Logger 1 calculated using equation (1).

Temperature reading $T / ^\circ\text{C}$										
(a) $T \geq 0 / ^\circ\text{C}$	0	1	2	3	4	5	6	7	8	9
0	-0.04	-0.04	-0.04	-0.04	-0.04	-0.04	-0.05	-0.05	-0.05	-0.05
10	-0.05	-0.05	-0.06	-0.06	-0.06	-0.06	-0.06	-0.07	-0.07	-0.07
20	-0.07	-0.07	-0.07	-0.08	-0.08	-0.08	-0.08	-0.08	-0.09	-0.09
30	-0.09	-0.09	-0.09	-0.09	-0.10	-0.10	-0.10	-0.10	-0.10	-0.10
40	-0.11									
(b) $T \leq 0$ °C	0	-1	-2	-3	-4	-5	-6	-7	-8	-9
0	-0.04	-0.03	-0.03	-0.03	-0.03	-0.03	-0.02	-0.02	-0.02	-0.02
-10	-0.02									

Table 2: Temperature corrections Δt for Logger 2 calculated using equation (2).

Temperature reading $T / ^\circ\text{C}$	0	1	2	3	4	5	6	7	8	9
(a) $T \geq 0 / ^\circ\text{C}$										
0	0.01	0.01	0.00	0.00	-0.01	-0.01	-0.01	-0.02	-0.02	-0.03
10	-0.03	-0.04	-0.04	-0.05	-0.05	-0.06	-0.06	-0.07	-0.07	-0.08
20	-0.08	-0.09	-0.09	-0.10	-0.10	-0.11	-0.11	-0.12	-0.12	-0.13
30	-0.13	-0.14	-0.14	-0.15	-0.15	-0.16	-0.16	-0.16	-0.17	-0.17
40	-0.18									
(b) $T \leq 0 ^\circ\text{C}$										
0	0.01	0.02	0.02	0.03	0.03	0.04	0.04	0.05	0.05	0.06
-10	0.06									

Table 3: Temperature corrections Δt for Logger 3 calculated using equation (3).

Temperature reading $T / ^\circ\text{C}$	0	1	2	3	4	5	6	7	8	9
(a) $T \geq 0 / ^\circ\text{C}$										
0	0.12	0.11	0.10	0.09	0.08	0.07	0.06	0.05	0.04	0.03
10	0.02	0.01	0.01	0.00	-0.01	-0.02	-0.03	-0.04	-0.05	-0.06
20	-0.07	-0.08	-0.09	-0.10	-0.11	-0.12	-0.12	-0.13	-0.14	-0.15
30	-0.16	-0.17	-0.18	-0.19	-0.20	-0.21	-0.22	-0.23	-0.24	-0.24
40	-0.25									
(b) $T \leq 0 ^\circ\text{C}$										
0	0.12	0.13	0.13	0.14	0.15	0.16	0.17	0.18	0.19	0.20
-10	0.21	0.22								

Table 4: Temperature corrections Δt for Logger 5 calculated using equation (5).

Temperature reading $T / ^\circ\text{C}$	0	1	2	3	4	5	6	7	8	9
(a) $T \geq 0 / ^\circ\text{C}$										
0	-0.48	-0.48	-0.48	-0.48	-0.48	-0.49	-0.49	-0.49	-0.49	-0.49
10	-0.49	-0.50	-0.50	-0.50	-0.50	-0.50	-0.50	-0.51	-0.51	-0.51
20	-0.51	-0.51	-0.51	-0.52	-0.52	-0.52	-0.52	-0.52	-0.52	-0.53
30	-0.53	-0.53	-0.53	-0.53	-0.53	-0.54	-0.54	-0.54	-0.54	-0.54
40	-0.54									
(b) $T \leq 0 ^\circ\text{C}$										
0	-0.48	-0.48	-0.47	-0.47	-0.47	-0.47	-0.47	-0.47	-0.46	-0.46
-10	-0.46									

Table 5: Temperature corrections Δt for Logger 6 calculated using equation (6).

Temperature reading $T / ^\circ\text{C}$										
(a) $T \geq 0 / ^\circ\text{C}$	0	1	2	3	4	5	6	7	8	9
0	-0.64	-0.63	-0.62	-0.62	-0.61	-0.61	-0.60	-0.60	-0.59	-0.59
10	-0.58	-0.58	-0.57	-0.57	-0.56	-0.56	-0.55	-0.55	-0.54	-0.54
20	-0.53	-0.52	-0.52	-0.51	-0.51	-0.50	-0.50	-0.49	-0.49	-0.48
30	-0.48	-0.47	-0.47	-0.46	-0.46	-0.45	-0.45	-0.44	-0.44	-0.43
40	-0.43									
(b) $T \leq 0 ^\circ\text{C}$	0	-1	-2	-3	-4	-5	-6	-7	-8	-9
0	-0.64	-0.64	-0.65	-0.65	-0.66	-0.66	-0.67	-0.67	-0.68	-0.68
-10	-0.69									

Uncertainty

Expanded uncertainties quoted are for a 95% level of confidence, calculated using a coverage factor of 2.0 (see the ISO Guide to the Expression of Uncertainty in Measurement, 2008, available at www.bipm.org/utis/common/documents/jcgm/JCGM_100_2008_E.pdf, for an explanation of terms).

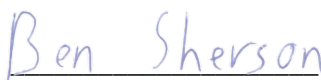
The expanded uncertainties were calculated by combining components of uncertainty accounting for possible errors in the temperature standard, and for possible errors associated with the instrument's response, resolution, short-term stability and hysteresis.

Note

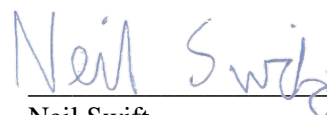
Tables 1 to 5 are constructed such that for any reading, the correction is found at the intersection of the row and column whose first entries add to the reading in question. Thus, in Table 1, when $T = 12 ^\circ\text{C}$, $\Delta t = -0.06 ^\circ\text{C}$.



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Humidity Standards



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