Band Standardization at UNSW

A student's report written in May 1974 and edited in 1976 HW.

" The idea behind this exercise was to determine the actual length between engraved marks found on wallbrackets behind the workshop of the School of Mechanical Engineering and then to standardize a fieldband in terms o the length found beforehand."

Equipment A conventional steelband, 3 x 0.5 mm (cross section), 0.1197 N/m (unit weight), with brass sleeves at 0,25,50,75,and 100 m and 100,200,300 and 310 ft. At either end are brass sleeves and eyes and the leading sleeve is marked 15 70 meaning 15 lb tension and 70°F which should now be entered as 66.723 N and 21.11°C. This University Standard Band had been registered at the National Standards Laboratory at Chippendale in March 1969 under the Ref. no. APT 3246 and its values were determined there as follows: -

Band on a flat horizontal frictionless surface.	0/25 m	24.999 5 m	at 66.723 N and 20°C	± 1 : 100 000
	0/50 m	49.9997 m	" "	
	0/75 m	74.999 7 m	" "	
	0/100m	99.999 6 m	" "	

The thermal coefficient is 1.1 x 10^{-5} /°C

The band has auxiliary graduations at 15,40,65,and 90 m which were not examined by the NSC.(too costly)

Care, maintanance and accessories

Care -obviusly UTMOST. No s t u d e n t is allowed to handle this band. In an unwound condition, it must NOT be dragged along the ground. After use, it must be wiped clean and a thin film of anti corrosion oilfilm (RP 7) is to be applied.

Accessories - thermometers, brush for cleaning scale blocks, magnifying glasses, cord pulley cylinders, bridge for holding 310 ft. end of ~~tape~~ band slide for reading 0 ft. end of band.

Weights : 2 10 lb and ~~5~~ 4 5 lb to make 15 lb = 66.723 N weights.

" The pulleys were fitted, the standard band unwound and checked agains twisting, layed on the base and brought under tension at both ends at a given signal. On anither signal, readers wouls read the band against the graduations on the base plates. The band was then shifted slightly along the base and, upon another signal, read again. This procedure was repeated 9 times to give 10 samples. At each reading, the temperature was recorded at 2 m above ground level at 0, 50 and 100 m approximately

After that, the standard band was removed and the first fieldband placed on the base. Since these field bands have no excess length , i.e the loops at both ends are supposed to be 100 m apart at stdd. temperat ure, the weight (66.723 N) cou d only be applied from one end. The ZERO end of the band was hooked on a brass pin which automatically zeroes the end of the band. Therefore, no shifting of the band could take place. In order to have some resemblance of independent observatio the fieldband was lifted and replaced before making a second (and more) readings. The tension applied (15 lb = 66.723 N) was recorded as Stand ard Tension.

Note : It would ,of course, be desirable to apply, say 50 N, particular ly so because new bands have standards stamped like this - 50 N, 20 $_{o}$C. However, our School has not yet obtained $0/ 9.806 65 = 5.099 kg mass weights; consequently, corrections for tension should be prepared. In other words : The standardization takes place with 66.723 N; its re sult is pronounced in terms of the manufacturer's stamp marks, i.e. 50 N. This has not been done before. THE TEMPERATURE AT WHICH THE BAND WOULD BE AT STANDARD LENGTH UNDER STANDARD TENSION WHILE FULLY SUPPORTED, IS CALLED THE STANDARD TEMPERATURE.

The measurement of the temperature of any steelband is d difficult task. (consult A.H. Campbell's publications in our School library and in the " Australalian Surveyor" and the Newcastle Survey Congress Paper in 1972 ?) Band width, material and surface quality affect the temperature

A change in temperature dt causes a change in length dl -

$$dl = alpha \cdot dt \cdot length\ L \qquad (dt = T_{field} - T_{stand})$$

so that dl/L = alpha . dt.

Suppose we want a relative accuracy of standardizing of 1 : 50 000, the temperature would have to be determined with an accuracy range of

$$dt = 1/50\ 000 \cdot 1.1 \cdot 10^{-5} = = 1.8\ ^{\circ}C.$$

At 100 m for L , and wanting ± 1 mm = 1:100 000, dt would be 0.91 °C which is difficult to achieve.

Sequence: Stdd. APT 3246 (Table 1), then Fieldband No. 'f',(Table 3)
and Stdd. APT 3246 again (Table 2), also test springbalance
and get the surprise of your life at no entertainment cost.

Note The Table 1 may be found on the School Standard Form of reporting Standardization.

Table 2 Standardization APT 3246 'After' Grand Means (B+A)½

After	24.999 5	49.999 7	74.999 7	99.999 6	0/25	25.000 2 m
Temp.Cor.	- .000 3	- .000 6	- .000 9	- .001 2	0/50	50.000 8 m
Base Cor.	+ .000 8	+ .001 2	+ .003 6	+ .003 1	0/75	75.003 3 m
Sum	25.000 0	50.000 3	75.002 4	100.001 5	0/100	100.002 2 m
Table 1	25.000 5	50,001 4	75.003 5	100.002 8		
Diff. (mm)	.5	1.1	1.1	1.3		

These differences are not random but indicate a slow change in temperature in spite of the measurement of it and its consequent incorporation.

This does highlight the difficulties encountered in using adequate procedures.

It seems to be an acceptable compromise to mean the 'before' and 'after' results(Tables 1 & 2.

Table 3 Standardization of Fieldband No (f). The 100 m mark was at the ZERO end of the base which is at its northern most end.

	100	50	0	Temp.	Tension = 66.723 N
1.M't.	L .002.5	L .002 03	0	Av. 19.3	Base length on that day:
2.M'T.	L .003 0	L .002 2	0	corr - 4.6	100.002 2 m
Mean	L .002 7	L .002 1	0	BD.Std.T 14.7 °C	Base correction to Bd(f)

dt for fieldband = -0.0051/100 . 1.1 .10⁻⁵ = -4.6

L = + 0.002 7 m

Fband therefore 100.004 9m

Check against 50 m : Base 50.0014 +diff L(+0.0006)-Temp.corr(-0.0025 = 49.999 5 m which is* the NSC. value for the Standard Band.

* -0.000 2

SCHOOL OF SURVEYING

CALIBRATION OF UNSW STANDARD BASE
OBSERVATION SHEET

Stand. ~~Tape~~ * APT 3246
" Band
Date: 4.5.74
Supervisor: Dr. Brunner
Subject: 29.103 P/T
Group(s): D. Warry

FIELD TEMPERATURE		
100 m	17.9	
75 m	18.1	
50 m	18.2	
25 m	-	
0 m	19.2	
Mean Temp:	18.3°C	

(18.9)

Note: ~~3~~ 4 field-thermometers compared and reduced to one of them which appeared giving about mean rdgs.

Grand Mean Temp. 18.6

Before standardizing (f) SCALE READINGS ** Second SET (after)* in() below

No.	100 m Red.	100 m Obs.	75 m Red.	75 m Obs.	50 m Red.	50 m Obs.	25 m Red.	25 m Obs.	0 m Red.	0 m Obs.
		R 1.1		R 1.2		L 1.8		L 2.8	0.0	L 4.3
		L 7.1		L 7.0		L 9.9		L 10.9		L 12.2
		R 15.7		R 15.8		R 12.9		R 11.8		R 10.3
		L 18.9		L 18.7		L 21.5		L 22.4		L 23.7
		R 27.0		R 27.0		R 24.1		R 23.1		R 21.7
		R 5.6		R 5.8		R 2.8		R 1.9		R 0.2
		L 8.5		L 8.3		L 10.9		L 12.0		L 13.7
		R 15.8		R 15.9		R 13.1		R 12.2		R 11.0
		L 28.2		L 28.2		L 30.9		L 31.9		L 33.2
		R 32.3		R 32.6		R 29.8		R 29.4		R 28.1
Σ									0.0	
Mean	R 5.06	R 3.48 mm	R 5.19	R 3.61 mm	R 2.35	R 0.77 mm	R 1.42	L 0.16 mm	0.0	L 1.58 mm
'After'	R 3.10	L 2.05	R 3.63	L 1.52	R 1.17	L 3.98	R 0.85	L 4.30	0.0	L 5.15

C_T per 25 m per °C = 0.00028(t_F - 20) = m

** Consider Mean Reduced Scale Readings as +ive Right, -ive Left

Length of Standard Tape at Field Temperature		+ Mean Reduced ** Scale Reading		Distance Between Zero Graduations on Scale			
before	(after)	before	(after)	before	(after)	MEAN	
l_{0-25} = 24.9995 + C_T -0.000 4 =	(-0.000 3)+	0.001 4	(+0.000 3)	25.000 5	(25.000 0)	25.000 2 m	0-25 m
l_{0-50} = 49.9997 + $2C_T$ -0.000 9 =	(-0.000 6)+	0.002 4	(+0.001 2)	50.001 4	(50.000 3)	50.000 7 m	0-50 m
l_{0-75} = 74.9997 + $3C_T$ -0.001 4 =	(-0.000 9)+	0.005 2	(+0.003 3)	75.003 5	(75.002 4)	75.003 0 m	0-75 m
l_{0-100} = 99.9996 + $4C_T$ -0.001 9 =	(-0.001 2)+	0.005 1	(+0.003 7)	100.002 8	(100.001 5)	100.0022 m	0-100 m

Any *apparent discrepancy due to rounding off when typing