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Textiles — Twist factor related to the Tex System

0 Introduction

Twist factor is a measure of the spiralling orientation of the fibres in a spun yarn or of the filaments in a filament yarn. It links together the two other characteristics of a yarn, namely the linear density and the twist. Apart from the linear density and twist, yarns or rovings composed of the same fibres and having the same twist factor have the same positioning of the fibres and consequently a certain similarity of structure.

The numerical value of the twist factor is dependent on the yarn linear density system, the chosen unit for expressing linear density in that system and the chosen length across which the twist is measured. The Tex System, with its four recommended units, has been adopted internationally (see ISO 1144). For length, the SI units given in ISO 1000 should be used. Consequently twist factor, which is frequently used in the textile industry, should be adapted to these units.

The equation for calculating α_t in clause 4 of this Technical Report is the preferred system and it is hoped that the second equation, for calculating α_m, will only be used where necessary as an interim measure until the α_t equation can be fully implemented. It is felt that full implementation of the α_t system internationally would be of considerable benefit to the industry.

Since the meeting of ISO/TC 38/SC 4, *Implementation of the Tex System*, in Timperley in 1967, the sub-committee have tried to find an acceptable formula for this parameter.

During the technical discussions it was found that fibre density was important when comparing the positioning of fibres in blended yarns. However, for routine purposes, the introduction of fibre density would make the practical use of twist factor somewhat complicated. It was accepted, however, that for scientific use and for the purposes of comparing yarns composed of different natural and synthetic fibres, the inclusion of fibre density was of interest. At that time no agreement could be reached on a formula for including fibre density.

Several enquiries were made amongst member bodies but these did not indicate a preference for any of the proposed formulae. From amongst the many proposals, two possible solutions remained. The first was based on the basic unit tex and resulted in a twist factor whose numerical value was approximately ten times that of a twist factor based on the traditional English cotton count system (N_{ec}). The numerical value obtained using the second formula was equal to that obtained using the metric count system (N_m). It was felt that this relationship between the numerical values would be advantageous during the transition period until the Tex System had been fully implemented.

At the eighth meeting of ISO/TC 38 in 1980, it was decided that a Technical Report, Type 2, should be prepared which summarized the current situation.

1 Scope and field of application

This Technical Report gives equations for the calculation of twist factors in SI units and conversion tables with which twist factors expressed in other unit systems can be transformed into SI units. It is applicable to single twisted yarns, folded yarns and cabled yarns.

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2 References

ISO 1000, *SI units and recommendations for the use of their multiples and of certain other units.*

ISO 1144, *Textiles — Universal system for designating linear density (Tex System).*

3 Definition

twist factor : A measure of the spiralling orientation of the fibres in a spun yarn or of the filaments in a filament yarn. It is related to the angle which fibres on the surface of the yarn make with the axis of the yarn. Provided they are of the same material, the fibres or filaments in yarns with similar twist factors will be similarly orientated with respect to the yarn axis.

4 Twist factor in the Tex System

The twist factor in the Tex System expresses the spiralling orientation in terms of the twist in the yarn, in turns per metre, and the linear density of the yarn, in a unit of the Tex System.

For calculating the twist factor, one of the following two different equations should be used :

$$\alpha_t = \frac{T}{100}\sqrt{\varrho_l}$$

$$\alpha_m = \frac{T}{100}\sqrt{\varrho'_l}$$

where

α_t (alpha tex) is the twist factor (torsion angle), expressed in the Tex System;

α_m (alpha metric) is the twist factor (torsion angle), expressed in the metric system;

T is the twist, expressed in turns per metre;

ϱ_l is the linear density, in tex;

ϱ'_l is the linear density, in decitex.

NOTES

1 It is essential that any expression of the value of the twist factor be accompanied by a statement of the equation chosen.

2 The equation for calculating α_t is the preferred system. The equation for calculating α_m should only be used where necessary as an interim measure until the α_t equation can be fully implemented.

5 Relationship between α_t and α_m

$$\alpha_t = \frac{\alpha_m}{\sqrt{10}} = 0{,}316\,23\ \alpha_m$$

$$\alpha_m = \alpha_t \times \sqrt{10} = 3{,}162\,3\ \alpha_t$$

6 Conversion factors

Yarn count systems

Tex System	English cotton system	Metric system	Tex System
tex	N_{ec}	N_m	dtex
α_t	9.567 3 α_{el}	0,316 3 α_m	0,316 3 α_m
0,104 52 α_t	α_{el}	0,033 05 α_m	0,033 05 α_m
3,162 3 α_t	30.255 α_{el}	α_m	α_m

7 Conversion table for turns per inch into turns per metre

Turns		Turns		Turns		Turns	
per inch	per metre	per inch	per metre	per inch	per metre	per inch	per metre
1	39,37	1,85	72,83	3,2	126,0	5,6	220,5
1,016	40	1,880	74	3,3	129,9	5,715	225
1,04	40,94	1,9	74,80	3,302	130	5,8	228,3
1,041	41	1,930	76	3,4	133,9	5,842	230
1,067	42	1,95	76,77	3,429	135	5,969	235
1,08	42,52	1,981	78	3,5	137,8	6	236,2
1,082	43	2	78,74	3,556	140	6,096	240
1,118	44	2,032	80	3,6	141,7	6,2	244,1
1,12	44,09	2,05	80,71	3,683	145	6,223	245
1,143	45	2,083	82	3,7	145,7	6,350	250
1,16	45,67	2,1	82,68	3,8	149,6	6,4	252,0
1,168	46	2,134	84	3,810	150	6,6	259,8
1,194	47	2,15	84,65	3,9	153,5	6,604	260
1,2	47,24	2,184	86	3,937	155	6,8	267,7
1,219	48	2,2	86,61	4	157,5	6,858	270
1,245	49	2,235	88	4,064	160	7	275,6
1,25	49,21	2,25	88,58	4,1	161,4	7,112	280
1,270	50	2,286	90	4,191	165	7,2	283,5
1,3	51,18	2,3	90,55	4,2	165,4	7,366	290
1,321	52	2,337	92	4,3	169,3	7,4	291,3
1,35	53,15	2,35	92,52	4,318	170	7,6	299,2
1,372	54	2,388	94	4,4	173,2	7,620	300
1,4	55,12	2,4	94,50	4,445	175	7,8	307,1
1,422	56	2,438	96	4,5	177,2	7,874	310
1,45	57,09	2,45	96,46	4,572	180	8	315,0
1,473	58	2,489	98	4,6	181,1	8,128	320
1,5	59,06	2,5	98,43	4,699	185	8,2	322,8
1,524	60	2,540	100	4,7	185,0	8,382	330
1,55	61,02	2,6	102,4	4,8	189,0	8,4	330,7
1,575	62	2,642	104	4,826	190	8,6	338,6
1,6	62,99	2,7	106,3	4,9	192,9	8,636	340
1,626	64	2,743	108	4,953	195	8,8	346,5
1,65	64,96	2,8	110,2	5	196,9	8,890	350
1,676	66	2,845	112	5,080	200	9	354,3
1,7	66,93	2,9	114,2	5,2	204,7	9,144	360
1,727	68	2,946	116	5,207	205	9,2	362,2
1,75	68,90	3	118,1	5,334	210	9,398	370
1,778	70	3,048	120	5,4	212,6	9,4	370,1
1,8	70,87	3,1	122,0	5,461	215	9,6	378,0
1,829	72	3,175	125	5,588	220	9,652	380
						9,8	385,8
						9,905	390
						10	393,7

8 Conversion table for twist factors

α_t	α_{el}	α_m
4,975	0.52	—
5	0.522 6	15,81
5,060	—	16
5,166	0.54	—
5,2	0.543 5	16,44
5,218	—	16,5
5,358	0.56	—
5,376	—	17
5,4	0.564 4	17,08
5,534	—	17,5
5,549	0.58	—
5,6	0.585 3	17,71
5,692	—	18
5,740	0.6	—
5,8	0.606 2	18,34
5,850	—	18,5
5,932	0.62	—
6	0.627 1	18,97
6,008	—	19
6,123	0.64	—
6,166	—	19,5
6,2	0.648 0	19,61
6,314	0.66	—
6,325	—	20
6,4	0.668 9	20,24
6,483	—	20,5
6,506	0.68	—
6,6	0.689 8	20,87
6,641	—	21
6,697	0.7	—
6,8	0.710 7	21,5
6,888	0.72	—
6,957	—	22
7	0.731 6	22,14
7,080	0.74	—
7,115	—	22,5
7,2	0.752 5	22,77
7,271	0.76	—
7,273	—	23
7,4	0.773 4	23,40
7,431	—	23,5
7,462	0.78	—
7,590	—	24
7,6	0.794 4	24,03
7,654	0.8	—
7,748	—	24,5
7,8	0.815 3	24,67
7,845	0.82	—
7,906	—	25
8	0.836 2	25,30
8,037	0.84	—
8,2	0.857 1	25,93
8,222	—	26
8,228	0.86	—
8,4	0.878 0	26,56
8,419	0.88	—
8,538	—	27
8,6	0.898 9	27,20
8,611	0.9	—

α_t	α_{el}	α_m
8,8	0.919 8	27,83
8,802	0.92	—
8,854	—	28
8,993	0.94	—
9	0.940 7	28,46
9,171	—	29
9,185	0.96	—
9,2	0.961 6	29,09
9,376	0.98	—
9,4	0.982 5	29,73
9,487	—	30
9,567	1	—
9,6	1.003	30,36
9,8	1.024	30,99
9,803	—	31
9,950	1.04	—
10	1.045	31,62
10,12	—	32
10,33	1.08	—
10,4	1.087	32,89
10,44	—	33
10,72	1.12	—
10,75	—	34
10,8	1.129	34,15
11,07	—	35
11,10	1.16	—
11,2	1.170	35,42
11,38	—	36
11,48	1.2	—
11,6	1.212	36,68
11,70	—	37
11,96	1.25	—
12	1.254	37,95
12,02	—	38
12,33	—	39
12,44	1.3	—
12,5	1.307	39,53
12,65	—	40
12,92	1.35	—
12,97	—	41
13	1.359	41,11
13,28	—	42
13,39	1.4	—
13,5	1.411	42,69
13,60	—	43
13,87	1.45	—
13,91	—	44
14	1.463	44,27
14,23	—	45
14,35	1.5	—
14,5	1.516	45,85
14,55	—	46
14,83	1.55	—
14,86	—	47
15	1.568	47,43
15,18	—	48
15,31	1.6	—
15,5	1.620	49

α_t	α_{el}	α_m
15,79	1.65	—
15,81	—	50
16	1.672	50,60
16,26	1.7	—
16,44	—	52
16,5	1.725	52,18
16,74	1.75	—
17	1.777	53,76
17,08	—	54
17,22	1.8	—
17,5	1.829	55,34
17,70	1.85	56
18	1.881	56,92
18,18	1.9	—
18,34	—	58
18,5	1.934	58,50
18,66	1.95	—
18,97	—	60
19	1.986	60,08
19,13	2	—
19,5	2.038	61,65
19,61	2.05	62
20	2.090	63,25
20,09	2.1	—
20,24	—	64
20,5	2.143	64,83
20,57	2.15	—
20,87	—	66
21	2.195	66,41
21,05	2.2	—
21,5	2.247	68
21,53	2.25	—
22	2.3	69,57
22,14	—	70
22,48	2.35	—
22,5	2.352	71,15
22,77	—	72
22,96	2.4	—
23	2.404	72,73
23,40	—	74
23,44	2.45	—
23,5	2.456	74,31
23,92	2.5	—
24	2.508	75,89
24,03	—	76
24,5	2.561	77,48
24,67	—	78
24,87	2.6	—
25	2.613	79,06
25,30	—	80
25,83	2.7	—
25,93	—	82
26	2.718	82,22
26,56	—	84
26,79	2.8	—
27	2.822	85,38
27,20	—	86

α_t	α_{el}	α_m
27,75	2.9	—
27,83	—	88
28	2.927	88,54
28,46	—	90
28,70	3	—
29	3.031	91,71
29,09	—	92
29,66	3.1	—
29,73	—	94
30	3.136	94,87
30,36	—	96
30,62	3.2	—
31	3.240	98
31,57	3.3	—
31,62	—	100
32	3.345	101,2
32,53	3.4	—
32,89	—	104
33	3.449	104,4
33,49	3.5	—
34	3.554	107,5
34,15	—	108
34,44	3.6	—
35	3.658	110,7
36,41	3.7	112
36	3.763	113,8
35,36	3.8	—
36,68	—	116
37	3.867	117,0
37,31	3.9	—
37,94	—	120
38	3.972	120,2
38,27	4	—
39	4.076	123,3
39,23	4.1	—
39,53	—	125
40	4.181	126,5
40,18	4.2	—
41	4.285	129,7
41,12	4.3	130
42	4.390	132,8
42,10	4.4	—
42,69	—	135
43	4.494	136,0
43,05	4.5	—
44	4.6	139,1
44,27	—	140
44,97	4.7	—
45	4.703	142,3
45,85	—	145
45,92	4.8	—
46	4.808	145,5
46,88	4.9	—
47	4.912	148,6
47,43	—	150
47,84	5	—
48	5.017	151,8
49	5.121	155
49,75	5.2	—
50,0	5.226	158,1
50,60	—	160