Yarn Numbering System
(Yarn Count)

Definition:

Count is a numerical value, which express the coarseness or fineness (diameter) of the yarn and also indicate the relationship between length and weight (the mass per unit length or the length per unit mass) of that yarn. Therefore, the concept of yarn count has been introduced which specifies a certain ratio of length to weight.

Types of Yarn Count:

One distinguishes between two systems:

1. **Direct Count System:**

The weight of a fixed length of yarn is determined. The weight per unit length is the yarn count!
The common features of all direct count systems are the length of yarn is fixed and the weight of yarn varies according to its fineness.

The following formula is used to calculate the yarn count:

$$N = \frac{W \times l}{L}$$

Where, N = Yarn count or numbering system
W = Weight of the sample at the official regain in the unit of the system
L = Length of the sample
l = Unit of length of the sample

Numbering System	Unit of Length (l)	Unit of Weight(w)
Tex system, Tt	1000 metres	No. of Grams
Denier, D or Td	9000 metres	No. of Grams
DeciTex, dtex	10 000 metres	No. of Grams
Millitex, mtex	1000 metres	No. of Milligrams
Kilotex, ktex	1000 metres	No. of Kilograms
Jute count	14, 400 yards	No. of Pounds (lb)

In brief, definition of the above systems is as follows:

Tex system	: No. of grams per 1000 metres.
Denier	: No. of grams per 9000 metres.
DeciTex	: No. of grams per 10,000 metres.
Millitex	: No. of milligrams per 1000 metres.
Kilotex	: No. of kilograms per 1000 metres.
Jute count	: No. of lb per 14,400 yds.

- The Tex of a yarn indicates the weight in grammes of 1000 metres yarn. So that 40 Tex means 1000 metres of yarn weigh 40 gm.
- The Denier of a yarn indicates the weight in grammes of 9000 metres yarn. So that 150 D means 9000 metres of yarn weigh 150 gm and 100 D means 9000 metres of yarn weigh 100 gm.

From above discussion it is concluded that, higher the yarn number (count) coarser the yarn and lower the number finer the yarn.

2. **Indirect Count System:**

The length of a fixed weight of yarn is measured. The length per unit weight is the yarn count!
The common features of all indirect count systems are the weight of yarn is fixed and the length of yarn varies according to its fineness.

The following formula is used to calculate the yarn count:

$$N = \frac{L \times w}{W \times l}$$

Where, N = Yarn count or numbering system
W = Weight of the sample at the official regain in the unit of the system
L = Length of the sample
w = Unit of weight of the sample.
l = Unit of length of the sample.

Numbering System	Unit of Length (l)	Unit of Weigt (w)
English cotton count, N_e (N_eB)	840 yards (yds)	1 pound (lb)
Metric count, N_m	1000 metres / 1km	1 kg
Woollen count (YSW)	256 yards	1 pound (lb)
Woollen count (Dewsbury)	1 yard	1 ounce (oz)
Worsted count, N_eK	560 yards	1 pound (lb)
Linen count, N_eL	300 yards	1 pound (lb)

In brief, definition of the above systems is as follows:

English count system	: No. of 840yd lengths per pound .
Metric count	: No. of kilometers per kilogram.
Woollen count (YSW)	: No. of 256yd lengths per pound.
Woollen count (Dewsbury)	: No. of yd lengths per oz.
Worsted count, N_eK	: No. of 560yd lengths per pound.
Linen count, N_eL	: No. of 300yd lengths per pound.

- The N_e indicates how many hanks of 840 yards length weigh one English pound. So that 32N_e means 32 hanks of 840 yards i.e. 32×840 yards length weigh one pound.
- The N_m indicates how many hanks of 1000 metres length weigh one kg. So that 50N_m means 50 hanks of 1000 metres i.e. 50×1000 metres length weigh one kg and 100N_m means 100 hanks of 1000 metres i.e. 100×1000 metres length weigh one kg.

From above discussion it is concluded that, higher the yarn number (count) finer the yarn and lower the number coarser the yarn.

Some important conversion factors:

1 yard = 0.9144 metre
1 metre = 1.0936 yard
1 metre = 39.37 inch
1 cm = 0.3937 inch
1 gm = 0.0353 oz
1 oz = 28.350 gm
1 pound = 453.6 gram
1 kg = 2.2046 pound
1 m/kg = 0.4961 yd/lb

1 inch = 2.54 cm
1 m^2 = 1.1960 yd^2
1 yd^2 = 0.8361 m^2
1gm/m^2 = 0.0295 oz/yd^2
1 oz/yd^2 = 33.91 gm/m^2
1 pound = 0.4536 kg
1 yd/lb = 2.0159 m/k

Calculations concerning count:

In practice, three problems may have to be solved in yarn calculations:

- Count to be found, length and weight must be known.
- Weight to be found, count and length must be known.
- Length to be found, count and weight must be known.

Example 1:

On a cone, there are 9800m yarn which weigh 490gm. What is the N_e, N_m, Tex and Denier of the yarn?

Solution:

For N_e :

We know that, $N_e = \frac{L \times w}{W \times l}$

Here, L = 9800m
W = 490gm
w = 1lb = 453.6gm
l = 840yds = 840×0.91m

$\therefore$ $N_e = (9800 \times 453.6) / (840 \times 0.91 \times 490)$

$\therefore$ $N_e = 11.87$

$\therefore$ $N_e \approx 12$

For N_m :

We know that, $N_m = \frac{L \times w}{W \times l}$

Here, L = 9800m
W = 490gm
w = 1kg = 1000gm
l = 1000m

$\therefore$ $N_m = (9800 \times 1000) / (1000 \times 490)$

$\therefore$ $N_m = 20$

For Tex :

We know that, $Tex = \frac{W \times l}{L}$

Here, L = 9800m
W = 490gm
l = 1000m

$\therefore$ $Tex = (490 \times 1000) / 9800$

$\therefore$ $Tex = 50$

For Denier :

$$\text{We know that, Denier} = \frac{W \times l}{L}$$

Here, $L = 9800m$

$W = 490gm$

$l = 9000m$

$\therefore$ Denier = (490×9000) / 9800

$\therefore$ Denier = 450

Example 2:

What length of yarn is contained in 1.2 kg of a yarn of N_e 30?

Solution:

$$\text{We know that, } N_e = \frac{L \times w}{W \times l}$$

$$\therefore \quad L = \frac{Ne \times l \times W}{w}$$

Here, $Ne = 30$

$W = 1.2\ kg = 1200gm$

$w = 1lb = 453.6gm$

$l = 840yds = 840 \times 0.91m$

$\therefore$ L = (30×840×0.91×1200) / 453.6

$\therefore$ L = 60666.67m

Example 3:

How many kg do 700 000 m of a yarn of N_e 30 weigh?

Solution:

$$\text{We know that, } N_e = \frac{L \times w}{W \times l}$$

$$\therefore \quad W = \frac{L \times w}{Ne \times l}$$

Here, $Ne = 30$

$L = 700\,000\ m$

$w = 1lb = 453.6\ gm$

$l = 840yds = 840 \times 0.91m$

$\therefore$ W = (700 000×453.6) / (840×0.91×30)

$\therefore$ W = 13 846.15 gm

$\therefore$ W = 13.85 kg

Formulae for count conversion

Known value		Needed value									
Unit		Direct system					Indirect system				
	Abbr	den	ktex	tex	dtex	mtex	N_m	N_e	N_{eL}	N_{eK}	N_{eW}
Td	den	----	0.00011 × den	0.111 × den	1.111 × den	111 × den	$\frac{9000}{den}$	$\frac{5315}{den}$	$\frac{14882}{den}$	$\frac{7972}{den}$	$\frac{17440}{den}$
Tt	ktex	9000 × ktex	-------	1000 × ktex	10000 × ktex	1000000 × ktex	$\frac{1}{ktex}$	$\frac{0.590}{ktex}$	$\frac{1.654}{ktex}$	$\frac{0.886}{ktex}$	$\frac{1.938}{ktex}$
	tex	9 × tex	0.001 × tex	------	10 × tex	1000 × tex	$\frac{1000}{tex}$	$\frac{590.5}{tex}$	$\frac{1654}{tex}$	$\frac{886}{tex}$	$\frac{1938}{tex}$
	dtex	0.9 × dtex	0.0001 × dtex	0.1 × dtex	------	100 × dtex	$\frac{10000}{dtex}$	$\frac{5900}{dtex}$	$\frac{16540}{dtex}$	$\frac{8860}{dtex}$	$\frac{19380}{dtex}$
	mtex	0.009 × mtex	0.000001 × mtex	0.001 mtex	0.01 × mtex	--------	$\frac{1000000}{mtex}$	$\frac{590000}{mtex}$	$\frac{1654000}{mtex}$	$\frac{886000}{mtex}$	$\frac{1938000}{mtex}$
Metr. No	N_m	$\frac{9000}{N_m}$	$\frac{1}{N_m}$	$\frac{1000}{N_m}$	$\frac{10000}{N_m}$	$\frac{1000000}{N_m}$	-------	0.590 × N_m	1.654 × N_m	0.886 × N_m	1.938 × N_m
Cotton	N_e	$\frac{5315}{N_e}$	$\frac{0.590}{N_e}$	$\frac{590.5}{N_e}$	$\frac{5900}{N_e}$	$\frac{590000}{N_e}$	1.693 × N_e	--------	2.80 × N_e	1.50 × N_e	3.28 × N_e
Linen	N_{eL}	$\frac{14882}{N_{eL}}$	$\frac{1.654}{N_{eL}}$	$\frac{1654}{N_{eL}}$	$\frac{16540}{N_{eL}}$	$\frac{1654000}{N_{eL}}$	0.605 × N_{eL}	0.357 × N_{eL}	--------	0.536 × N_{eL}	1.172 × N_{eL}
Worsted	N_{eK}	$\frac{7972}{N_{eK}}$	$\frac{0.886}{N_{eK}}$	$\frac{886}{N_{eK}}$	$\frac{8860}{N_{eK}}$	$\frac{886000}{N_{eK}}$	1.129 × N_{eK}	0.667 × N_{eK}	1.867 × N_{eK}	--------	2.188 × N_{eK}
Woollen (Yorkshire)	N_{eW}	$\frac{17440}{N_{eW}}$	$\frac{1.938}{N_{eW}}$	$\frac{1938}{N_{eW}}$	$\frac{19380}{N_{eW}}$	$\frac{1938000}{N_{eW}}$	0.516 × N_{ew}	0.305 × N_{ew}	0.853 × N_{ew}	0.457 × N_{ew}	---------

Application:

Multiply or divide the known value by the factor given under needed value to obtain the desired value.

From the above chart the following count conversion formulae those are very important for practical field:

$$Ne = \frac{5315}{D} \qquad D = \frac{5315}{Ne}$$

$$Ne = \frac{590.5}{T} \qquad Tex = \frac{590.5}{Ne}$$

$$Ne = 0.59 \times N_m \qquad N_m = 1.693 \times N_e$$

$$N_m = \frac{9000}{D} \qquad D = \frac{9000}{Nm}$$

$$N_m = \frac{1000}{T} \qquad Tex = \frac{1000}{Nm}$$

$$D = 9 \times Tex \qquad Tex = 0.111 \times D$$

Example 1: Known value: 32 Ne Needed value: Nm, Tex, Denier?

$$Nm = 1.693 \times Ne = 1.693 \times 32 = 54.176 \approx 54$$
$$Tex = 590 / Ne = 590 / 32 = 18.44$$
$$Denier = 5315 / Ne = 5315 / 32 = 166.09$$

Example 2: Known value: 150D Needed value: Ne, Nm, Tex?

$$Ne = 5315 / den = 5315 / 150 = 35.433$$
$$Nm = 9000 / den = 9000 / 150 = 60$$
$$Tex = 0.111 \times den = 0.111 \times 150 = 16.65$$

Count calculation and denotion (Designation) for ply or doubled (folded) yarn:

Ply yarns are produced by twisting two or more singles yarns together. This increases the strength of the yarn. The singles yarns may be of equal or different count and they may be twisted together in one or several stages. Yarns of different count are twisted together in fancy yarns, for instance.

Designation of ply yarns:

In the designation of ply yarns, three different options are commonly used:

The commercial count, which is designed primarily to give information about the composition of the ply yarn, i.e. the number of constituent yarns, their count, twist and direction of twist (S or Z) and the folding twist.

The nominal (resultant) count, which is the count of a singles yarn of the same fineness as the folded or ply yarn. This is used mainly in calculations.

The effective count, which is the nominal count, corrected for the shortening of the yarn during doubling (twist contraction). Twist contraction results in a somewhat shorter and coarser yarn.

The following examples quoted from Tentative Textile Standard No. 62 will illustrate the method.

I. 40/1 Z 16 ring-spun American cotton

   This describes a single yarn of linear density 40 tex (approx. 15s cotton count), having 16 tpi. Z twist, spun on a ring frame from American cotton. Traditional methods of describing the same yarn include the following:
   15s ring-spun American cotton, 16 Z;
   1/15s, 16 Z American cotton, ring-spun; or simply 15s cotton.

II. 15/2 S 18; 7/1 S 27 cotton

This describes a two-fold cotton yarn of resultant linear density 15 tex having 18 tpi. (S-direction) folding twist, made from two single yarns, each of linear density 7 tex and having 27 tpi. (S-direction). Traditional methods of describing the same yarn include the following:

2/80s cotton; 27 S × 18 S: or simply 2/80s cotton.

Note that 15 tex is approximately equivalent to 40s cotton count, and that the resultant count of a 2/80s cotton yarn, which is produced by twisting together two singles each approximately 80s cotton count, is 40s cotton count.

III. 45/3 Z 20; 15/2 S 18; 7/1 S 27 cotton

This describes a cotton-sewing thread of resultant linear density 45 tex made by twisting together, with 20 tpi. Z-twist, three two-fold yarn similar to that described in (II) above.

The first figure in yarn descriptions set out according to Tentative Textile Standard No. 62 always refers to the resultant tex number of the final yarn. In example (III), the groups of figures have the following meanings:

45/3 Z 20 indicates that the linear density of the final yarn is 45 tex, that it consists of 3 plies twisted together with a twist of 20 tpi., Z.

15/2 S 18 indicates that each of the 3 plies comprising the final yarn consists of a two-fold thread having a resultant linear density of 15 tex, and a doubling twist of 18 tpi., S.

7/1 S 27 indicates that each of the single yarns comprising the two-fold plies consists of a cotton yarn having a linear density of 7 tex, and a spinning twist of 27 tpi., S.

- With regard to a plain ply one must differentiate between two possibilities. Such a ply can consist of

  yarns with the same count

  yarns having different counts.

Ply with yarns of the same count:

This is the most commonly used plain ply.

Calculation of count on the indirect system:

$$N_R = \frac{N}{n}$$

Where, N_R = Ply or resultant count (e.g. N_m or N_e)

N = Single yarn count (e.g. N_m or N_e)

n = Number of yarns in the ply

Example 1: A ply consists of 2 single yarns, each having a count of N_m 50.

Solution: Ply count $N_R = \frac{N}{n}$

$= 50 / 2 = 25\ N_m$

Example 2: A ply consists of 2 single yarns, each having a count of N_e 40.

Solution: Ply count $N_R = \frac{N}{n}$

$= 40 / 2 = 20\ N_e$

Denotion or designation based on the indirect system:

N / n

The ply in the example is denoted as follows:
N_m 50 / 2; N_m 30 / 2 / 3; N_m 40 / 2 / 3 / 4; N_e 40 / 2; N_e 40 / 3; N_e 60 / 2 / 3 etc.

Calculation of count on the direct system:

$N_R = N \times n$

Where, N_R = Ply or resultant count (e.g. tex or den)
N = Single yarn count (e.g. tex or den)
n = Number of yarns in the ply

Example 1: A ply consists of 2 single yarns, each having a count of 20 tex.
Solution: Ply count $N_R = N \times n$

$= 20 \times 2 = 40$ tex

Example 2: A ply consists of 3 single yarns, each having a count of 50 den.
Solution: Ply count $N_R = 50 \times 3$

$= 50 \times 3 = 150$ den

Denotion or designation based on the direct system:

N × n

The ply in the example is denoted as follows:

20 tex × 2; 50 den × 3; 330 dtex × 2 × 3 etc.

- Thus the ply denotion always contains the single yarn counts, written in a prescribed manner. A knitted fabric is often produced by feeding-in two (very seldom three) yarns at each feeder without their being twisted previously. It is important to note that in spite of this the same nomenclature is used for denotion as in the case of a ply.

Length calculation of a cone of sewing thread :

Example 1: What length of yarn is contained in 95gm of a yarn of N_e 50/2?

Solution:

We know that, $N_e = \frac{L \times w}{W \times l}$

$\therefore \quad L = \frac{Ne \times l \times W}{w}$

Here, $N_e = 50/2 = 25$

$W = 95gm$

$w = 1lb = 453.6gm$

$l = 840yds = 840 \times 0.91m$

$\therefore \quad L = (25 \times 840 \times 0.91 \times 95) / 453.6$

$\therefore \quad L = 4002.31m$

From the above calculation, the formula can be developed to calculate the length of sewing thread from a cone as follows:

For N_e system: $L = (N_R \times W) \times (840 \times 0.9144) / 453.6$

$\therefore \quad \mathbf{L = (N_R \times W) \times 1.6933}$

Where,

L = Length of the yarn in metre (m)

N_R = Resultant or ply count of yarn in N_e system

W = Weight of the yarn in gramme (gm)

1.6933 = Constant value (Only for N_e system)

For N_m system: $L = (N_R \times W) \times 1000 / 1000$

$\therefore \quad \mathbf{L = N_R \times W}$

Where,

L = Length of the yarn in metre (m)

N_R = Resultant or ply count of yarn

W = Weight of the yarn in gramme (gm)