

# Yarn Spinning Formulas: Count, Draft, Twist and Production

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## In one paragraph

The core yarn spinning formulas are count conversion ( $\text{tex} = 590.5 \div \text{Ne} = 1000 \div \text{Nm} = \text{denier} \div 9$ ), draft (draft = feed linear density  $\div$  delivered linear density, or delivery roller surface speed  $\div$  feed roller surface speed), twist ( $\text{TPI} = \text{twist multiplier} \times \sqrt{\text{Ne}}$ , and  $\text{TPI} = \text{spindle rpm} \div \text{front roller delivery in inches per minute}$ ) and production ( $\text{kg per hour} = \text{delivery speed in m/min} \times \text{sliver or yarn linear density in g/m} \times 60 \times \text{efficiency} \div 1000$ ). On a ring frame, output per spindle in an 8-hour shift is  $0.0072 \times \text{spindle rpm} \times \text{efficiency} \div (\text{TPI} \times \text{Ne})$  kg. This page gives every formula in one table, then works each one through with real numbers for the card, drawframe, ring frame and winder, explains where the constants come from, and links each formula to the site's calculator for it.

## At a glance

### Spinning formulas at a glance

| What you want                               | Formula                                                                                                                  | Where it is explained |
|---------------------------------------------|--------------------------------------------------------------------------------------------------------------------------|-----------------------|
| Convert a yarn count                        | $\text{tex} = 590.5 \div \text{Ne} = 1000 \div \text{Nm} = \text{denier} \div 9 = \text{dtex} \div 10$                   | Yarn count            |
| Grams per metre of a sliver, roving or yarn | $\text{g/m} = 0.5905 \div \text{Ne} = \text{tex} \div 1000$ (1 ktex = 1 g/m)                                             | Yarn count            |
| Draft from linear density                   | draft = feed linear density $\div$ delivered linear density (same units)                                                 | Draft                 |
| Draft from roller speeds                    | draft = delivery roller surface speed $\div$ feed roller surface speed                                                   | Draft                 |
| Draft over several zones                    | total draft = break draft $\times$ main draft                                                                            | Draft                 |
| Hank after doubling and drafting            | hank delivered = hank fed $\times$ draft $\div$ doublings                                                                | Draft                 |
| Actual and mechanical draft                 | actual draft = mechanical draft $\times 100 \div (100 - \text{waste \%})$                                                | Draft                 |
| Twist from the twist multiplier             | $\text{TPI} = \text{TM} \times \sqrt{\text{Ne}}$ ; $\text{TPM} = \text{TPI} \times 39.37$                                | Twist                 |
| Twist from the machine                      | $\text{TPI} = \text{spindle rpm} \div \text{front roller delivery (inches per minute)}$                                  | Twist                 |
| Front roller delivery                       | inches per minute = $\pi \times \text{front roller diameter (inches)} \times \text{front roller rpm}$                    | Twist                 |
| Production of a card, drawframe or winder   | $\text{kg/h} = \text{delivery speed (m/min)} \times \text{ktex} \times 60 \times \text{efficiency} \div 1000$            | Production            |
| The same in English count                   | $\text{kg per 8 h} = 0.2835 \times \text{delivery speed (m/min)} \times \text{efficiency} \div \text{Ne}$ , per delivery | Production            |
| Ring frame output per spindle               | $\text{kg per 8 h} = 0.0072 \times \text{spindle rpm} \times \text{efficiency} \div (\text{TPI} \times \text{Ne})$       | Ring frame            |
| Hanks per spindle                           | $\text{hanks per 8 h} = \text{spindle rpm} \times \text{efficiency} \div (63 \times \text{TPI})$                         | Ring frame            |
| Ring traveller speed                        | $\text{m/s} = \pi \times \text{ring diameter (mm)} \times \text{spindle rpm} \div 60,000$                                | Ring frame            |

## Revision questions

*The questions readers ask most, with the article's own answer.*

### What is the formula for draft in spinning?

Draft = feed linear density ÷ delivered linear density, which equals delivery roller surface speed ÷ feed roller surface speed. In hanks it is hank delivered ÷ hank fed, multiplied by the number of doublings when several ends are fed together.

### What is 0.2835 (or 0.2836) in spinning production formulas?

It converts metres per minute into kilograms per 8-hour shift for a strand counted in Ne:  $480 \text{ minutes} \times 1.0936 \text{ yards per metre} \div 840 \text{ yards per hank} \div 2.2046 \text{ pounds per kilogram} = 0.2835$ . Production in kg per 8 hours =  $0.2835 \times \text{delivery speed} \times \text{efficiency} \div \text{Ne}$ .

### How do you calculate TPI from the twist multiplier?

Multiply the twist multiplier by the square root of the English count:  $\text{TPI} = \text{TM} \times \sqrt{\text{Ne}}$ . A 30s yarn at TM 4.0 needs  $4.0 \times 5.477 = 21.9$  turns per inch, or 862.6 turns per metre.

### How do you calculate ring frame production?

Output per spindle in an 8-hour shift is  $0.0072 \times \text{spindle rpm} \times \text{efficiency} \div (\text{TPI} \times \text{Ne}) \text{ kg}$ . Multiply by the number of spindles for the frame.

### How do you convert Ne to tex?

Divide 590.5 by the Ne count:  $\text{tex} = 590.5 \div \text{Ne}$ . A 30s yarn is 19.68 tex and a 40s yarn is 14.76 tex.

### What is the difference between actual draft and mechanical draft?

Mechanical draft is set by the roller speeds. Actual draft is measured from the strand going in and coming out.

## Test yourself

*Ten questions on this topic. Answer them without looking, then check on the last page.*

1. In the English cotton count system, what does Ne measure?
2. What is tex, and which international standard sets out the tex system?
3. Roughly what linear density in tex does a cotton micronaire reading of 4.0 correspond to?
4. In a three-roller drafting zone, how is total draft related to break draft and main draft?
5. Why is the actual draft of a card higher than its mechanical draft?
6. A drawframe is fed 8 ends of 5 ktex sliver and delivers 5 ktex sliver. What is the draft?
7. Why is twist set through a twist multiplier rather than directly in turns per inch?
8. What twist does a 30s Ne yarn need at a twist multiplier of 4.0, in TPI and TPM?
9. What is the production of a card at 150 m/min delivering 5 ktex sliver at 90% efficiency?
10. Where does the constant 63 in the ring frame hanks-per-spindle formula come from?

## Answers

*Each answer is stated in the article; the section to read again is named after it.*

1. **The number of 840-yard hanks in one pound.**  
See: Yarn count and linear density
2. **Grams per 1000 metres; ISO 1144.**  
See: Yarn count and linear density
3. **About 0.157 tex (157 millitex).**  
See: Yarn count and linear density
4. **Total draft = break draft × main draft.**  
See: Draft
5. **The machine removes waste, so less mass leaves than entered and the delivered strand is finer than the gearing predicts.**  
See: Draft
6. **8, equal to the doublings, so the hank is unchanged.**  
See: Draft
7. **A finer yarn has fewer fibres in its cross-section and needs more turns per inch to reach the same twist angle.**  
See: Twist
8. **21.91 TPI, which is 862.6 TPM.**  
See: Twist
9. **40.5 kg/h, or 324 kg per 8 hours.**  
See: Production: card, drawframe and winder
10.  **$36 \times 840 \div 480$  minutes = 63.**  
See: Ring frame production

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