Weaving Calculations: Loom Production, Reed Count, GSM and Yarn Requirement

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In one paragraph

The main weaving calculations are loom production (metres per hour = loom rpm × 60 × efficiency ÷ (PPI × 39.37)), total warp ends (EPI × cloth width in inches), reed width and reed count (reed width = cloth width × (1 + weft crimp % ÷ 100); dents per inch = total ends ÷ (reed width × ends per dent), and the Stockport count is twice that), fabric weight (GSM = 23.25 × [EPI × (1 + warp crimp) ÷ warp Ne + PPI × (1 + weft crimp) ÷ weft Ne]), yarn requirement (warp kg = ends × fabric length in metres × (1 + warp crimp) × tex ÷ 1,000,000, and the weft the same way from picks per metre and reed width), cover factor (threads per inch ÷ √Ne, where 28 means full cover) and crimp ((straightened yarn length − fabric length) ÷ fabric length × 100). This page works one example fabric through every formula, from the reed to the loom, so each answer can be checked against the others, and links each step to the site’s calculator for it.

At a glance

Weaving formulas at a glance

What you want	Formula	Example fabric
Total warp ends	EPI × cloth width (inches), plus selvedge ends	120 × 63 = 7,560 ends
Reed width	cloth width × (1 + weft crimp)	63 × 1.04 = 65.52 inches
Reed count	dents per inch = total ends ÷ (reed width × ends per dent); Stockport = dents per 2 inches	57.7 dents per inch = 115 Stockport
Fabric weight	GSM = 23.25 × [EPI × (1 + warp crimp) ÷ warp Ne + PPI × (1 + weft crimp) ÷ weft Ne]	122.3 g/m²
Cover factor	K = threads per inch ÷ √Ne; cloth K = K1 + K2 − K1 × K2 ÷ 28	23.05, or 82% of full cover
Crimp	(straightened yarn length − fabric length) ÷ fabric length × 100	106 cm of yarn from 100 cm of cloth = 6%
Warp yarn	kg = ends × fabric length (m) × (1 + warp crimp) × tex ÷ 1,000,000	118.3 kg per 1,000 m of cloth
Weft yarn	kg = PPI × 39.37 × fabric length (m) × reed width (m) × tex ÷ 1,000,000	77.4 kg per 1,000 m of cloth
Loom production	m/h = rpm × 60 × efficiency ÷ (PPI × 39.37)	9.72 m/h at 600 rpm and 85%
Loom efficiency	picks inserted ÷ (rpm × minutes run) × 100	260,000 picks in 8 hours at 600 rpm = 90.3%
Weft insertion rate	m/min = rpm × reed width (m)	600 × 1.664 = 999 m/min
Size add-on	(sized dry weight − unsized dry weight) ÷ unsized dry weight × 100	11% on 118.3 kg of warp = 13.0 kg of size

Revision questions

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

What is the formula for loom production?

Production in metres per hour = loom rpm × 60 × efficiency ÷ (PPI × 39.37). A loom at 600 rpm and 85% efficiency weaving 80 picks per inch makes 9.72 metres an hour, or 77.7 metres in an 8-hour shift.

How do you calculate reed count?

Find the reed width (cloth width × (1 + weft crimp)), then dents per inch = total ends ÷ (reed width × ends per dent). Double it for the Stockport count, which counts dents in 2 inches.

How do you calculate GSM from EPI, PPI and yarn count?

GSM = 23.25 × [EPI × (1 + warp crimp) ÷ warp Ne + PPI × (1 + weft crimp) ÷ weft Ne]. For 120 × 80 in 40s × 40s with 6% and 4% crimp that is 122.3 g/m² in loom state.

How much warp and weft yarn is needed for a fabric?

Warp kg = ends × fabric length (m) × (1 + warp crimp) × tex ÷ 1,000,000; weft kg = PPI × 39.37 × fabric length (m) × reed width (m) × tex ÷ 1,000,000. Then add waste allowances.

What does a cover factor of 28 mean?

That the threads in that direction touch, leaving no gap between them. In Peirce’s system a cotton yarn is about 1 ÷ (28 × √Ne) inches thick, so threads per inch ÷ √Ne reaches 28 when they lie side by side.

What is the difference between crimp and take-up?

Both measure the same extra yarn length. Crimp divides it by the fabric length, take-up by the yarn length.

What is weft insertion rate?

The metres of weft a loom lays per minute: rpm × reed width in metres. It is how looms of different widths are compared.

Test yourself

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

1. A 63-inch cotton cloth has 120 ends per inch. How many warp ends does it need, before selvedge ends?

2. What reed width does a 63-inch cloth with 4% weft crimp need?

3. Why must the warp be spread wider in the reed than the finished cloth?

4. For a 120 × 80, 40s × 40s cotton cloth, what GSM results if crimp is left out of the calculation?

5. What is the warp cover factor of 120 ends per inch in 40s Ne yarn?

6. In direct beam warping, how many warper's beams do 7,560 ends from a 640-position creel need?

7. In sectional warping, how many sections do 7,560 ends at 504 ends per section need?

8. How much size solids does an 11% add-on on 118.3 kg of warp need?

9. A pick counter reads 260,000 picks in an 8-hour shift on a loom running at 600 rpm. What is the loom efficiency?

10. Why is the rpm of a single-width loom equal to its picks per minute?

Answers

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

1. **7,560 ends (120 × 63).**
   See: Weaving formulas at a glance
2. **65.52 inches (63 × 1.04).**
   See: Weaving formulas at a glance
3. **The weft bends over and under the warp and pulls it in by the weft crimp.**
   See: Ends, picks and the reed
4. **116.2 g/m², 5% light.**
   See: Fabric weight (GSM) from the construction
5. **18.97 (120 ÷ √40).**
   See: Cover factor
6. **12 beams of 630 ends.**
   See: Warping and sizing
7. **15 sections.**
   See: Warping and sizing
8. **13.0 kg of size solids.**
   See: Warping and sizing
9. **90.3%.**
   See: Weaving formulas at a glance
10. **It inserts one pick for every turn of its main shaft.**
    See: Loom production and efficiency

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