Shuttle Loom vs Shuttleless Loom: Weft Insertion, Speed and Selvedge Compared

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In one paragraph

The difference between shuttle and shuttleless looms is how the weft crosses the warp. A shuttle loom carries it in a shuttle, a heavy carrier with a pirn of yarn inside, which is struck from one side to the other and back; the weft is one unbroken thread that turns at each edge and makes a closed selvedge. A shuttleless loom leaves the yarn on a cone beside the machine and sends only a measured length across, gripped by a projectile or a rapier or blown by a jet of air or water, then cuts it, so its edges have to be tucked in, bound with leno threads or fused. Losing the shuttle is what lets shuttleless looms run faster and wider: Picanol's first shuttle loom ran at about 140 picks a minute, against more than 800 for its current rapier and up to 1,350 for its air-jet. They also need no pirn winding and never stop to change a pirn. Shuttle looms survive where the hand process or the closed edge is part of what is being sold: handloom, khadi and selvedge denim.

At a glance

Shuttle and shuttleless looms at a glance

	Shuttle	Projectile	Rapier	Air-jet	Water-jet
What carries the weft	A shuttle with a pirn inside	A small steel gripper	A rod or tape; two rapiers hand over mid-shed	A main nozzle and relay nozzles	A jet of water
Weft supply	Pirn in the shuttle, changed often	Cone beside the machine	Cone beside the machine	Cone beside the machine	Cone beside the machine
Speed, as makers state it	About 140 ppm (Picanol's first loom, 1936)	No ppm published; up to 1,570 m/min of weft	Up to 600, or more than 800, ppm	Up to 1,350 ppm	Over 1,000 rpm
Widths offered today	No current maker's figure	220 to 655 cm	150 to 540 cm	140 to 400 cm	150 to 280 cm
Selvedge	Closed by the weft itself	Tucked in; leno or melted as options	Tucked in, leno or melted	Leno; tucked in as an option	Leno
Weft it takes	Almost any	Any: spun, filament or tape	The widest range; 12 to 16 colours	Spun and filament; up to 8 colours	Synthetic filament only
Energy, in textbook comparisons	Moderate	Lowest of the solid carriers	High	Highest	Lowest
Where it is used	Handloom, khadi, selvedge denim	Very wide and technical cloth	Fashion, furnishing, jacquard	Long runs of staple-fibre cloth	Polyester and nylon filament cloth

How fast is a shuttle loom compared with a shuttleless loom?

Loom	Speed, as the maker states it	Widths offered	Source
Projectile: Itema P7300HP V8	No ppm published; WIR up to 1,570 m/min	220 to 655 cm	Itema brochure
Rapier: Lindauer Dornier P2	Up to 600 ppm	150 to 540 cm	Dornier
Rapier: Picanol Ultimax	More than 800 ppm in mills	190 to 400 cm	Picanol, 2 Oct 2023 (speed); brochure (width)
Air-jet: Picanol OmniPlus-i Connect	Up to 1,350 ppm in mills	190 to 400 cm	Picanol, 2 Oct 2023 (speed); brochure (width)
Air-jet: Tsudakoma ZAX001neo Plus	Maximum working speed 1,350 rpm, on a 190 cm, two-colour, positive-cam machine	150 to 390 cm	Tsudakoma; catalogue
Water-jet: Tsudakoma ZW8200	“Exceeding 1,000 rpm”	150 to 230 cm; 250 and 280 cm as options	Tsudakoma; catalogue

Key figures and their sources

- For a given width, the energy for each pick rises with the square of the loom speed and the picking power with its cube (Istanbul Technical University course notes), so a shuttle loom run 50% faster needs about 3.4 times the picking power.
  Source: Istanbul Technical University course notes (web.itu.edu.tr)
- Its current model comes in widths from 220 to 655 cm, takes “any weft material”, spun, filament or tape, in up to six colours, and states a weft insertion rate of up to 1,570 m/min, “attained at lower machine speeds” (Itema P7300HP; brochure).
  Source: Itema (itemagroup.com)
- Because a solid carrier holds the yarn the whole way, the rapier takes the widest range of weft: Nm 254 to Nm 3 in spun yarn and up to 12 colours on one machine (Picanol Ultimax), 7 denier to 4,500 tex and up to 16 colours on another (Dornier P2).
  Source: Picanol Ultimax (picanol.be)
- A main nozzle blows the measured weft into the shed; because a jet in open air soon slows, relay nozzles about every 50 mm fire in sequence to keep it moving, and a profiled reed with a tunnel in its wires guides the air (ITU jet weaving notes).
  Source: ITU jet weaving notes (web.itu.edu.tr)
- Air drags best on a hairy yarn, so air-jets were built for spun weft and later adapted to filament: Picanol states Ne 100 to Ne 2.4 in spun yarn and 20 to 1,000 denier in filament (OmniPlus-i Connect).
  Source: OmniPlus-i Connect (picanol.be)
- Tsudakoma states a range from 8 dtex polyamide to 5,600 dtex polyester, with airbag and filter fabrics among its uses (Tsudakoma).
  Source: Tsudakoma (tsudakoma.co.jp)
- Rapier and air-jet makers offer mechanical and air tuck-in devices (Picanol), and on the projectile loom every selvedge can be tucked, 18 mm wide or up to 35 mm for special uses (Itema).
  Source: Picanol (picanol.be)

- Many looms hold the weft at the far side with a few catch threads and cut the strip away (Toyota's catalogue lists a "Waste selvage on the right with catch cord"), and a 2025 paper cites selvedge waste of 4 to 8% of the yarn used on shuttleless looms (Indian Journal of Fibre & Textile Research).
  Source: Indian Journal of Fibre & Textile Research (or.niscpr.res.in)

Formulas and diagrams

> The site's loom production calculator does the rest: picks per hour = ppm × 60 × efficiency, and metres = picks ÷ PPI × 0.0254.

> One air-jet makes as much of this cloth as nearly eleven shuttle looms (185.17 ÷ 17.07 = 10.8), and one rapier as nearly five.

> Metres per day = rpm × 60 × 24 × efficiency ÷ (picks per inch × 39.37).



Rapier looms in a weaving shed. Photo source: Pinterest; the photographer is not recorded.

Revision questions

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

What is a shuttle loom machine?

A loom that inserts the weft with a shuttle, a carrier holding a pirn of yarn, struck from one side of the warp to the other and back. Because the same unbroken thread turns at each edge, it weaves a closed selvedge with no waste.

What are shuttleless looms, and what types are there?

Looms that keep the weft on a cone beside the machine and send only a measured length across, cutting it at each edge. The four main types are named after what carries the weft: projectile (a small gripper), rapier (a rod or tape), air-jet and water-jet.

How fast is a shuttle loom compared with a rapier or air-jet loom?

Picanol's first shuttle loom ran at about 140 picks per minute; its current rapier reaches more than 800 in mills and its air-jet up to 1,350. On the same 63-inch cloth at 80 picks per inch, that is 17.07 m a shift for the shuttle loom at 80% efficiency, 82.30 m for a rapier at 600 picks and 185.17 m for an air-jet at 1,350, both at 90%.

What is a leno selvedge?

An edge made on shuttleless looms by two extra threads that twist round each other between the picks and lock the cut weft ends; the fringe outside them is then trimmed. It is the standard selvedge on air-jet and water-jet looms.

How much does a water-jet loom produce per day?

Metres per day = rpm × 60 × 24 × efficiency ÷ (picks per inch × 39.37). A water-jet at 1,000 rpm, the speed Tsudakoma says its current model exceeds, at 90% efficiency on a filament cloth of 100 picks per inch, makes 329.18 m in 24 hours (calculator, set to these figures).

Why is selvedge denim woven on shuttle looms?

Because the closed edge is the point, and a shuttleless loom, which cuts every pick, cannot make it. Levi Strauss & Co. describes selvedge denim as “traditionally woven on narrow-width shuttle looms, producing a clean edge with no fringe”.

Test yourself

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

1. On a shuttle loom of given width, how do the energy per pick and the picking power rise with loom speed?
2. What fires the steel gripper across the shed on a projectile loom?
3. How heavy is a projectile compared with a shuttle?
4. In two-rapier weft transfer, what is the difference between the Dewas and Gabler methods?
5. What floor-space drawback do rigid rapier rods have that flexible tapes avoid?
6. Why does an air-jet loom need relay nozzles, and how far apart are they?
7. How is weft insertion rate (WIR) calculated, and in what unit?
8. How much yarn is lost as selvedge waste on shuttleless looms, according to a 2025 paper?
9. Rank air-jet, rapier, gripper and water-jet looms by energy per kilogram of cloth (IIT Delhi course).
10. How does the KVIC Act define khadi?

Answers

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

1. **Energy per pick rises with the square of the speed; picking power with its cube.**
   See: What is a shuttle loom?
2. **A twisted torsion bar.**
   See: What is a shuttleless loom? › Projectile (gripper) looms
3. **About a tenth of a shuttle.**
   See: What is a shuttleless loom? › Projectile (gripper) looms
4. **Dewas grips the tip of the weft; Gabler carries it as a loop that straightens.**
   See: What is a shuttleless loom? › Rapier looms
5. **They need floor space of at least twice the cloth width beside the loom.**
   See: What is a shuttleless loom? › Rapier looms
6. **Because a jet in open air soon slows; they are about every 50 mm.**
   See: What is a shuttleless loom? › Air-jet looms
7. **Picks per minute × the width the weft crosses, in m/min.**
   See: How fast is a shuttle loom compared with a shuttleless loom?
8. **4 to 8% of the yarn used.**
   See: Selvedge: the closed edge of a shuttle loom, and the edges of a shuttleless one
9. **Air-jet 3.2, rapier 2.5, gripper 1.3, water-jet 0.9 kWh/kg.**
   See: Noise, power and cost
10. **Any cloth woven on handlooms in India from cotton, silk or woollen yarn handspun in India, or a mixture of these.**
    See: Where shuttle looms survive: handloom, khadi, powerlooms and selvedge denim

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