WALSTOON®

WS-FSTN-2PNCT-PSB

Festoon System Flexible Cable

Kevlar® Para-Aramid Fibre Braided Tensile Reinforcement
AC 600V | JIS C 3327 | –40°C to +90°C
Port Gantry Cranes • Ship Unloaders • Cable Chain Systems

TECHNICAL PRODUCT MANUAL

Anhui Feichun Special Cable Co., Ltd.
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Table of Contents

1. Product Overview
2. Technical Specifications
3. Kevlar® Aramid Fibre Tensile Reinforcement
4. Braiding Architecture
5. Cable Construction — Layer-by-Layer
6. Dimensional & Electrical Data
7. Application Guide: Port Cranes & Ship Unloaders
8. Environmental Performance
9. Festoon System Design Considerations
10. Comparison: Kevlar® vs. Steel Wire Armoured
11. Feichun Equivalent — Cost & Lead Time Advantage
12. Technical FAQ
13. Contact Information

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1. Product Overview

The WALSTOON® WS-FSTN-2PNCT-PSB is a high-performance festoon system flexible cable engineered specifically for port gantry cranes, ship-to-shore (STS) container cranes, grab-type ship unloaders, and cable chain (energy chain) systems. The cable features a **Kevlar® para-aramid fibre braided tensile reinforcement layer** — the same ballistic-grade material used in military body armour — delivering extraordinary tensile strength at a fraction of the weight of conventional steel wire armouring.

Festoon cables on port cranes endure extreme mechanical demands: continuous acceleration and deceleration across 100–300 metre spans, dynamic shock loads during emergency stops, sustained wind-induced vibration, and permanent exposure to coastal saltwater spray, UV radiation, and industrial contaminants. Conventional steel-armoured cables corrode rapidly in these environments and fatigue under repeated bending cycles. The WS-FSTN-2PNCT-PSB eliminates these failure modes with Kevlar reinforcement that is corrosion-immune, fatigue-resistant, and five times stronger than steel per unit weight.

SAFETY-CRITICAL COMPONENT: Festoon cables on port cranes are safety-critical. Cable failure during crane operation can result in loss of crane control, uncontrolled load release, and risk to human life. Install, support, and maintain this cable in strict accordance with crane manufacturer specifications and local port authority safety regulations.

2. Technical Specifications

Parameter	Specification
Product Designation	WS-FSTN-2PNCT-PSB
Standard	JIS C 3327
Rated Voltage	AC 600V
Test Voltage	AC 3,000V / 1 minute
Rated Temperature	90°C (max. continuous)
Ambient Temp. Range	–40°C to +90°C

Parameter	Specification
Min. Bending Radius	6 × OD
Tensile Reinforcement	Kevlar® para-aramid fibre braided layer
Flame Retardancy	JIS C 3005
Oil Resistance	JIS C 3005
Abrasion Resistance	JIS C 3327 Table 6.12
Weather Resistance	Ozone, UV, moisture resistant
Application	Festoon systems, cable chain systems

3. Kevlar® Aramid Fibre Tensile Reinforcement

Kevlar® (poly-paraphenylene terephthalamide) is a para-aramid synthetic fibre developed by DuPont that delivers a unique combination of extraordinary tensile strength (3,000 MPa — five times steel per unit weight), near-zero permanent elongation, complete corrosion immunity, and exceptional fatigue resistance. Its density of just 1.44 g/cm³ (vs. 7.8 g/cm³ for steel) means the reinforcement layer adds negligible weight — a critical advantage for festoon systems where cable self-weight affects trolley motor sizing and structural loading.

Unlike steel wire armouring that corrodes within months in coastal port environments, Kevlar is chemically inert to saltwater, most acids and alkalis, fuels, and hydraulic fluids. Its energy absorption capability (~60 J/g vs. ~1 J/g for steel) means the braided reinforcement acts as an integrated shock absorber during crane emergency stops, distributing dynamic loads across the full cable span rather than concentrating stress at termination points.

Property	Kevlar® 49	Steel Wire
Tensile Strength	3,000 MPa	600 MPa
Density	1.44 g/cm³	7.8 g/cm³
Strength-to-Weight	5× steel	1× (baseline)
Energy Absorption	~60 J/g	~1 J/g
Corrosion	Immune	Corrodes in salt spray
Elastic Modulus	112 GPa	200 GPa
Fatigue Life	>10M cycles	1–3M cycles

4. Braiding Architecture

The tensile reinforcement uses a precision-engineered biaxial or triaxial braiding pattern at controlled braid angles (45°–55°), interlocking hundreds of individual Kevlar yarns into a tubular structure that provides omnidirectional tensile strength. This geometry delivers tensile strength in all directions (axial, radial, circumferential), controlled elastic elongation via the 'scissors effect' for shock absorption, and uniform load redistribution if any single yarn is locally damaged.

Feichun Braiding Capability: 16-carrier and 24-carrier high-speed braiding machines for para-aramid fibre. Braid angle, yarn tension, picks-per-cm, and coverage ratio are precisely controlled. Each batch undergoes pull-test verification. Cable diameters from 15 mm to 80 mm supported.

5. Cable Construction — Layer-by-Layer

Layer	Material	Function
Conductor	Annealed copper, Class 5 flexible	Power/signal transmission; max flex life
Insulation	Cross-linked elastomer, 90°C rated	Primary electrical insulation; oil resistant
Core Assembly	Paired cores (P) with fillers	Balanced signal transmission
Shield Braid	Tinned copper, 0.3 mm	EMI shielding for crane control signals
Kevlar® Layer	Para-aramid fibre, precision braided	Primary tensile reinforcement; shock absorption
Outer Sheath	Chloroprene rubber (CR)	Oil/ozone/UV/abrasion/flame protection

6. Dimensional & Electrical Data

Pairs	mm²	Cond. Ø	Insul.	Shield	Sheath	OD (mm)	kg/km	R (Ω/km)	IR (MΩ·km)
2P	1.25	1.5	0.8	0.3	2.3	20.0	380	16.00	500
2P	2	1.8	0.8	0.3	2.4	22.0	450	10.20	500
2P	3.5	2.5	0.8	0.3	2.6	25.0	615	5.54	400
3P	1.25	1.5	0.8	0.3	2.4	22.0	465	16.00	500
3P	2	1.8	0.8	0.3	2.5	23.0	555	10.20	500
3P	3.5	2.5	0.8	0.3	2.7	27.0	765	5.54	400
4P	1.25	1.5	0.8	0.3	2.5	24.0	575	16.00	500
4P	2	1.8	0.8	0.3	2.6	26.0	685	10.20	500
4P	3.5	2.5	0.8	0.3	2.8	29.0	950	5.54	400
5P	1.25	1.5	0.8	0.3	2.7	26.0	705	16.00	500
5P	2	1.8	0.8	0.3	2.8	28.0	840	10.20	500
5P	3.5	2.5	0.8	0.3	3.0	32.0	1,170	5.54	400
6P	1.25	1.5	0.8	0.3	2.8	29.0	835	16.00	500
6P	2	1.8	0.8	0.3	2.9	31.0	1,000	10.20	500
6P	3.5	2.5	0.8	0.3	3.2	36.0	1,420	5.54	400
7P	1.25	1.5	0.8	0.3	3.0	31.0	985	16.00	500
7P	2	1.8	0.8	0.3	3.1	34.0	1,180	10.20	500
7P	3.5	2.5	0.8	0.3	3.4	39.0	1,660	5.54	400
8P	1.25	1.5	0.8	0.3	3.1	34.0	1,140	16.00	500
8P	2	1.8	0.8	0.3	3.3	36.0	1,370	10.20	500
8P	3.5	2.5	0.8	0.3	3.6	42.0	1,920	5.54	400
9P	1.25	1.5	0.8	0.3	3.3	37.0	1,310	16.00	500
9P	2	1.8	0.8	0.3	3.4	39.0	1,560	10.20	500
9P	3.5	2.5	0.8	0.3	3.8	45.0	2,200	5.54	400
10P	1.25	1.5	0.8	0.3	3.3	37.0	1,400	16.00	500
10P	2	1.8	0.8	0.3	3.5	40.0	1,370	10.20	500
10P	3.5	2.5	0.8	0.3	3.8	46.0	2,380	5.54	400
12P	1.25	1.5	0.8	0.3	3.4	38.0	1,570	16.00	500
12P	2	1.8	0.8	0.3	3.5	41.0	1,870	10.20	500
12P	3.5	2.5	0.8	0.3	3.9	48.0	2,680	5.54	400

Notes: P = pair (2 conductors per pair). R = max DC resistance at 20°C. IR = min insulation resistance at 20°C. All values nominal per JIS C 3327 tolerances.

7. Application Guide

Ship-to-Shore (STS) Container Cranes

The primary application: festoon spans of 80–250 metres along crane booms, trolley speeds up to 240 m/min, continuous acceleration/deceleration cycles, salt spray, UV, and temperature extremes from –40°C to +90°C. The

Kevlar reinforcement maintains dimensional stability across millions of trolley travel cycles over 10–15 years.

Grab-Type Ship Unloaders

Bulk cargo handling (coal, iron ore, grain) generates severe shock loads during grab bucket operation, plus abrasive dust and 24/7 continuous operation. The oil-resistant, abrasion-resistant sheath protects against particulate environments while the Kevlar layer absorbs repetitive shock loading without fatigue failure.

Rail-Mounted Gantry Cranes (RMG/RTG)

Container yard gantry cranes with festoon or cable reel power supply. The cable's JIS C 3005 flame retardancy is critical for operations near container stacks and terminal infrastructure.

Cable Chain (Energy Chain) Systems

Enclosed track systems for guided cable travel. The 6×OD minimum bending radius is compatible with standard energy chain bend radii. Kevlar reinforcement prevents elongation at reversal points.

8. Environmental Performance

Threat	Protection Mechanism	Standard
Mineral oils & hydraulic fluids	CR rubber sheath formulation	JIS C 3005
Ozone degradation	Ozone stabilizers in CR compound	Weather rated
UV radiation	UV absorbers in sheath polymer	Outdoor certified
Saltwater spray	CR sheath + Kevlar (no metal to corrode)	Coastal rated
Abrasive dust (coal, ore)	Abrasion-resistant CR compound	JIS C 3327 T6.12
Flame/fire	Self-extinguishing CR + Kevlar (LOI 29%)	JIS C 3005
Extreme cold (–40°C)	CR rubber maintains flexibility	Full rated
Extreme heat (+90°C)	Cross-linked elastomer insulation	Full rated

9. Festoon System Design Considerations

Hanger Spacing: Kevlar-reinforced cable weighs 20–35% less than steel-armoured equivalents, allowing wider hanger spacing or reduced sag at identical spacing. **Trolley Speed:** Rated for 180–240 m/min with 0.5 m/s² acceleration. Kevlar braid absorbs dynamic forces elastically, preventing the 'whip' effect. **Multi-Cable Arrangements:** Tinned copper shield braid prevents EMI crosstalk between adjacent power and signal cables. **Emergency Stop:** Kevlar's energy absorption (~60 J/g) distributes shock loads across the full span, dramatically reducing peak loads on terminations.

10. Comparison: Kevlar® vs. Steel Wire Armoured

Feature	WS-FSTN-2PNCT-PSB (Kevlar®)	Steel Wire Armoured	Textile Filler
Strength-to-Weight	Excellent (5× steel/kg)	Good (heavy)	Poor
Cable Weight	20–35% lighter	Heaviest	Lightest
Corrosion	Immune	Corrodes in salt	N/A
Elongation	Near zero	Low	High (stretches)

Feature	WS-FSTN-2PNCT-PSB (Kevlar®)	Steel Wire Armoured	Textile Filler
Shock Absorption	60 J/g	~1 J/g (brittle)	None
Flex Life	>10M cycles	1–3M cycles	2–5M cycles
Bending Radius	6 × OD	8–10 × OD	6 × OD
Temp. Range	–40 to +90°C	–30 to +80°C	–20 to +70°C
Service Life	10–15 years	5–8 years	3–5 years
Total Cost of Ownership	Best	Moderate	Poor

11. Feichun Equivalent — Cost & Lead Time Advantage

Feichun Lead Time: 4–6 weeks (Japanese OEM: 12–18 weeks). **Pricing Example:** 8P×2 mm² cable — Japanese OEM ~$80/m; Feichun ~$41/m. Per 200-metre crane run: savings of ~$7,800.

> **Case Study — Southeast Asian Container Terminal:** 6 STS cranes, 7,200 metres of 8P×2 mm² cable. Japanese OEM: $580,000 / 16 weeks. Feichun: $295,000 / 5 weeks. Independent testing confirmed: Kevlar braid breaking strength 8.5 kN (spec: 7.0 kN min), flex life 12.4M cycles, zero degradation after 500-hour salt spray. Total savings: $285,000 with 11 weeks faster delivery.

Custom configurations available: hybrid power + control, fibre optic composite, extended pair counts (up to 24P), increased conductor sizes (up to 10 mm²), and fire-resistant (IEC 60331) variants.

12. Technical FAQ

Q: Does the Kevlar layer affect flexibility?

No — the braided structure is inherently flexible (yarns slide during bending). Min bending radius 6×OD is tighter than steel-armoured cables (8–10×OD).

Q: How does Kevlar perform in fire?

Kevlar is inherently flame-resistant (LOI 29%), does not melt, self-extinguishes. This complements the JIS C 3005 flame-retardant outer sheath.

Q: Can localised Kevlar damage be repaired?

Yes — field-applied Kevlar repair sleeves for damage <25% of braid circumference. Beyond 25%, replace the cable section.

Q: Expected flex life?

>10 million cycles at 6×OD. In typical STS crane service (~200 trolley cycles/shift, 300 days/year) = 15+ years.

Q: Suitable for cable reel systems?

This model is optimised for festoon/cable chain. For cable reels, contact Feichun for the WS-REEL-2PNCT-PSB variant.

Q: Does Kevlar provide EMI shielding?

No — Kevlar is an electrical insulator. EMI shielding is provided by the dedicated tinned copper braid beneath the Kevlar layer.

13. Contact Information

Technical Specifications & Application Engineering	Tech@feichuncables.com
Port Equipment Cable Procurement & Bulk Orders	Tech@feichuncables.com
WhatsApp & WeChat	+86 138 5512 3218

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