HIGH-FLEX LV REELING CABLE · RTG / RMG / STS | 3-IN-1 · POWER · CONTROL · FIBRE | 0.6/1 kV | 10 sizes | CSP rubber | 2×12E9

FC-TCS-M-SF2 0.6/1 kV

3-in-1 Power, Control and Fibre-Optic Reeling Cable 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 control cores + overall screen + 24 single-mode fibres G.652.D in two elements, CSP rubber sheath. Complete technical data sheet: construction, dimensions, weights, current ratings, standards and installation guidance for 10 sizes.

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01 Application and Product Overview

FC-TCS-M-SF2 is a high-flex reeling cable for container terminals and heavy port equipment, rated 0.6/1 kV, with the configuration 3 power cores + 3 split PE conductors + 2 control cores + overall screen + 24 single-mode fibres G.652.D in two elements. It has fine-wire class 5 copper conductors, halogen-free EPR/HEPR rubber insulation, a halogen-free inner sheath and an outer sheath of chlorosulfonated polyethylene (CSP) rubber, resistant to weather, ozone and oil; power cores from 25 – 300 mm². Short-lay stranding makes it suitable for continuous winding on and off a cable reel under tensile and torsional load. The construction is derived from the FC-TPU-M D2X11Y platform with a rubber sheath.

Typical applications

- Converter-fed crane drives where control signals in the same cable must be protected against electromagnetic interference
- Remote-controlled and automated cranes that send PLC, video and remote-operation data over single-mode fibre through the reel
- Rubber-tyred gantry (RTG), rail-mounted gantry (RMG) and electrified RTG cranes fed through spring-driven or motor-driven cable reels
- Ship-to-shore (STS) crane auxiliary drives, automated stacking cranes, ship unloaders and bulk-handling machines in terminals
- Outdoor quayside and yard operation with exposure to seawater spray, salt mist, UV radiation and ozone
- Reeling operation at travel speeds up to 60 m/min with repeated tensile and torsional loads

Design

Combined power and control cable with an overall tinned-copper braid screen between the inner and outer sheath. The screen limits interference from frequency-converter-fed drives into the control cores and into nearby signal cables. A 360° screen termination at both ends is recommended. This is a 3-in-1 design in the DIN VDE 0250 reeling-cable tradition: power cores, control cores and optical fibres share one sheath, so one reel, one slip-ring/rotary-joint assembly and one cable route replace three separate cables. The cable contains two optical elements (24 single-mode fibres G.652.D in two elements). Single-mode fibres carry the crane data, video and remote-operation links over the full length of the terminal with very low attenuation, so a single reel cable can connect the crane to the terminal operating system without intermediate repeaters.

10 sizes	0.6/1 kV	+90 °C	CSP rubber
Cross-section 25 – 300 mm²	Rated voltage U_0/U	Maximum conductor temperature	Sheath: CSP rubber

Key features

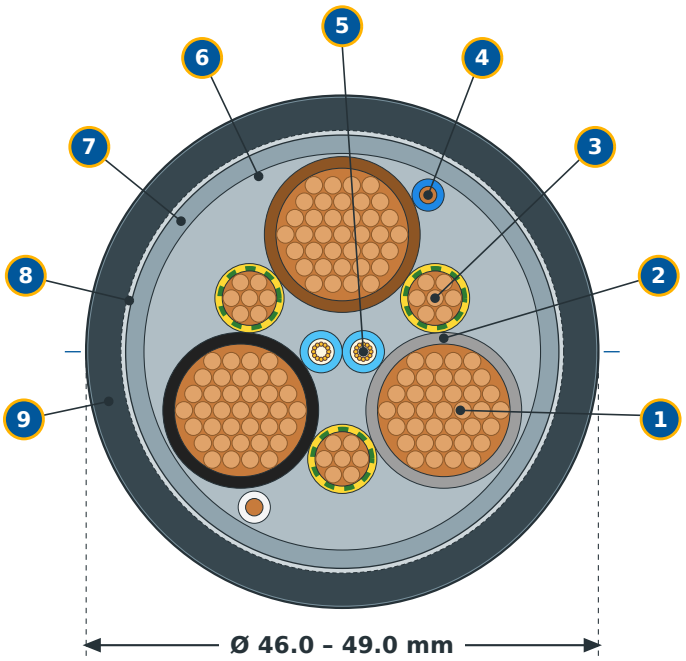
- Fine-wire class 5 copper conductors and a very short core lay length for repeated reeling
- 3-in-1 design: power, control and 24 single-mode fibres G.652.D in two elements in a crush-resistant loose-tube element on the cable axis
- Three split PE conductors in the interstices keep the cross-section round and balanced
- Designed for 20 N/mm² continuous tensile load (on the total copper cross-section of the power cores)
- CSP rubber sheath with proven weather, ozone and oil resistance
- Overall tinned-copper braid screen (≥ 85 % coverage) for EMC
- Flame retardant to IEC 60332-1-2

02 Construction

FEICHUN · CROSS-SECTION A–A · 0.6/1 kV

FC-TCS-M-SF2

Sample size 3×95+3G16+2×1.5+2×12E9 C · Rev 0 · Illustrative, not to scale



No.	Component	Material
1	Conductor	Bare annealed fine-wire copper, class 5 to IEC 60228
2	Insulation	Halogen-free EPR/HEPR rubber
3	Split PE conductor	Class 5 copper, green-yellow insulation, laid in the interstices between the power cores
4	Control cores	Class 5 copper, blue and white insulation
5	Optical element	24 single-mode fibres G.652.D in two elements; gel-filled loose tube, aramid strength members
6	Filler and binder tape	Halogen-free compound, polyester tape
7	Inner sheath	Halogen-free polymer compound
8	Overall screen	Tinned-copper wire braid, coverage ≥ 85 %
9	Outer sheath	Chlorosulfonated polyethylene (CSP) rubber, resistant to weather, ozone and oil

The drawing shows size 3×95+3G16+2×1.5+2×12E9 C. Other sizes have the same construction with scaled dimensions.

Construction details

Conductor	Bare annealed fine-wire copper, class 5 to DIN EN 60228 / IEC 60228 / VDE 0295
Insulation	Halogen-free EPR/HEPR rubber to IEC 60502-1, maximum conductor temperature 90 °C
Core identification	Power cores brown, black, grey to DIN VDE 0298-300
Protective conductor	Three PE conductors (3G), green-yellow, 16 mm² each, laid in the interstices between the power cores
Control cores	Two control cores 2 × 1.5 mm² (blue, white) laid in the free space between the power cores
Optical element	Two elements: 24 single-mode fibres G.652.D in two elements, located at the centre of the cable
Stranding	Power cores, split PE conductors and control or optical elements are stranded together with a very short lay length
Overall screen	Tinned-copper wire braid, coverage ≥ 85 %, between inner and outer sheath
Inner sheath	Halogen-free polymer compound, extruded tightly over the stranded cores
Outer sheath	Chlorosulfonated polyethylene (CSP) rubber, resistant to weather, ozone and oil

Optical fibre data

Fibre type	Single-mode E9/125 µm, ITU-T G.652.D / IEC 60793-2-50 B-652.D, low water peak
Attenuation, cabled	≤ 0.40 dB/km at 1310 nm; ≤ 0.30 dB/km at 1550 nm
Mode-field diameter	9.2 ± 0.4 µm at 1310 nm
Typical link reach	1 Gbit/s and 10 Gbit/s Ethernet up to 10 km (1000BASE-LX, 10GBASE-LR)
Optical element	Gel-filled loose tube with aramid strength members and a crush-resistant TPU element sheath, placed on the cable axis where bending strain is lowest
Fibre colours	IEC 60304 / DIN VDE 0888 colour sequence; tube and element marked for identification
Fibre strain, reeling	≤ 0.25 % at the rated tensile load of the cable
Optical test	Attenuation of every fibre measured by OTDR after cabling; values recorded in the test certificate

Sheath material

The chlorosulfonated polyethylene (CSP) rubber sheath is a proven reeling-cable material for open-air cranes: excellent resistance to weather, ozone and mineral oil, good mechanical robustness and low-temperature flexibility to −30 °C in motion. CSP contains halogen; where halogen-free cables are specified, select the HFFR rubber or PUR version of the same construction.

03 Electrical, Thermal and Mechanical Characteristics

Electrical data

Rated voltage U_0/U	0.6/1 kV AC
Test voltage	2.5 kV AC (power cores); 2 kV AC (control cores)
Maximum operating voltage, DC	0.9/1.8 kV
Current-carrying capacity	To DIN VDE 0298-4 at 30 °C ambient; the table gives rated design values
Conductor resistance	Maximum at 20 °C, class 5 to IEC 60228

Thermal and mechanical data

Maximum conductor temperature	+90 °C
Maximum temperature at short circuit	+250 °C
Ambient temperature, fixed installation	−40 °C to +90 °C
Ambient temperature, in motion	−30 °C to +90 °C
Minimum bending radius	4 × D fixed; 8 × D on a cable reel (DIN VDE 0298-3)
Maximum tensile load	20 N/mm² continuous, on the total copper cross-section of the power cores
Maximum torsional load	±50 °/m
Maximum travelling speed	60 m/min on a cable reel; higher speeds on request
Flame propagation	IEC 60332-1-2 / DIN EN 60332-1-2
Halogen-free	No (CSP rubber sheath)
UV and ozone resistance	Resistant
Mineral oil resistance	Resistant, IEC 60811-404
Optical element, temperature in operation	−40 °C to +70 °C

Sheath material comparison

Property	PUR	PUR low-temp	CSP rubber	CPE rubber	PCP rubber	HFFR rubber
Abrasion resistance	Excellent	Excellent	**Good**	Good	Very good	Good
Cut and tear resistance	Excellent	Excellent	**Good**	Good	Very good	Good
Mineral oil resistance	Very good	Very good	**Very good**	Very good	Very good	Good
Weather, UV and ozone resistance	Very good	Very good	**Excellent**	Very good	Excellent	Very good
Cold flexibility (moving)	−30 °C	−40 °C	**−30 °C**	−30 °C	−25 °C	−25 °C
Halogen-free (IEC 60754-1/-2)	Yes	Yes	**No**	No	No	Yes

The column of the sheath used in this cable is highlighted. Ratings are qualitative; ask FeiChun for test data on a specific requirement.

04 Dimensions, Weights and Rated Data – 0.6/1 kV (10 sizes)

Type designation cores × mm²	FeiChun article no.	Conductor Ø max mm	Outer Ø min mm	Outer Ø max mm	Min. bend radius mm	Weight approx. kg/km	Max. pull force N	R_{20} max Ω/km	Rated current A	I_k (1 s) kA
3×25+3G6+2×1+2×12E9 C	FC-LV108-001	6.2	26.0	27.5	220	1,400	1,500	0.780	131	3.58
3×35+3G6+2×1.5+2×12E9 C	FC-LV108-002	7.8	30.5	32.5	260	1,880	2,100	0.554	162	5.00
3×50+3G10+2×1.5+2×12E9 C	FC-LV108-003	9.6	35.0	37.5	300	2,610	3,000	0.386	202	7.15
3×70+3G16+2×1.5+2×12E9 C	FC-LV108-004	11.1	40.5	43.0	344	3,630	4,200	0.272	250	10.01
3×95+3G16+2×1.5+2×12E9 C	FC-LV108-005	12.6	46.0	49.0	392	4,280	5,700	0.206	302	13.59
3×120+3G25+2×1.5+2×12E9 C	FC-LV108-006	14.8	49.0	52.0	416	5,430	7,200	0.161	350	17.16
3×150+3G25+2×1.5+2×12E9 C	FC-LV108-007	16.0	55.0	58.5	468	6,510	9,000	0.129	402	21.45
3×185+3G35+2×1.5+2×12E9 C	FC-LV108-008	17.7	58.5	62.5	500	8,130	11,100	0.106	459	26.45
3×240+3G50+2×1.5+2×12E9 C	FC-LV108-009	20.2	66.5	70.5	564	10,560	14,400	0.0801	540	34.32
3×300+3G50+2×1.5+2×12E9 C	FC-LV108-010	22.4	72.0	76.5	612	12,590	18,000	0.0641	621	42.90

Current-carrying capacity: rated design values to DIN VDE 0298-4 for flexible cables, free air, 30 °C ambient; for other ambient temperatures, grouping or layered winding on a reel, apply the factors below. Pull force = 20 N/mm² × total copper cross-section of the power cores. Diameters, dimensions and weights are nominal design values and vary within manufacturing tolerances; confirm critical dimensions before dimensioning reels, guides or festoon systems. Other sizes and configurations are produced to order.

Ambient temperature factors (conductor 90 °C)

°C	20	25	30	35	40	45	50
Factor	1.08	1.04	1.00	0.96	0.91	0.87	0.82

Short-circuit current rating

I_k = 0.143 kA/mm² × cross-section of the power core (conductor 90 °C → 250 °C). For another short-circuit duration t: $I_{k,t} = I_{k,1s} / \sqrt{t}$ (0.1 s ≤ t ≤ 5 s).

Derating on a cable reel (DIN VDE 0298-4)

1 layer: 0.80 · 2 layers: 0.61 · 3 layers: 0.49 · 4 layers: 0.41. Permissible current = table current × layer factor × temperature factor.

05 Reeling Performance and Reel Design Data

The values below support the dimensioning of the cable reel: minimum reel core diameter, copper weight for earthing and loop-resistance calculations, cable weight, and the rated current for the number of layers wound on the reel.

Type designation cores × mm²	Outer Ø max mm	Min. bend radius on reel, mm	Min. reel core Ø mm	Copper weight kg/km	Cable weight kg/100 m	Current, 1 layer A	2 layers A	3 layers A	4 layers A
3×25+3G6+2×1+2×12E9 C	27.5	220	440	970	140.0	105	80	64	54
3×35+3G6+2×1.5+2×12E9 C	32.5	260	520	1,250	188.0	130	99	79	66
3×50+3G10+2×1.5+2×12E9 C	37.5	300	600	1,780	261.0	162	123	99	83
3×70+3G16+2×1.5+2×12E9 C	43.0	344	688	2,480	363.0	200	152	122	102
3×95+3G16+2×1.5+2×12E9 C	49.0	392	784	3,170	428.0	242	184	148	124
3×120+3G25+2×1.5+2×12E9 C	52.0	416	832	4,090	543.0	280	214	172	144
3×150+3G25+2×1.5+2×12E9 C	58.5	468	936	4,910	651.0	322	245	197	165
3×185+3G35+2×1.5+2×12E9 C	62.5	500	1,000	6,130	813.0	367	280	225	188
3×240+3G50+2×1.5+2×12E9 C	70.5	564	1,128	8,020	1,056.0	432	329	265	221
3×300+3G50+2×1.5+2×12E9 C	76.5	612	1,224	9,650	1,259.0	497	379	304	255

Reel design guidance

- Minimum reel core diameter = 2 × minimum bending radius = 16 × D (outer diameter D).
- Spring reels suit short travel and low tensile load; motor-driven reels with torque control keep the cable under constant, low tension.
- Fit a guide or level-wind that keeps the cable parallel to the reel axis to prevent crossing turns.
- Rated current falls with the number of layers on the reel because heat is not dissipated; see the layer factors below.

06 Selection Guide and Sizing Aid

FC-TCS-M-SF2 covers 10 sizes. The smallest, 3×25+3G6+2×1+2×12E9 C, has an outer diameter of up to 27.5 mm and weighs about 1,400 kg/km; the largest, 3×300+3G50+2×1.5+2×12E9 C, has an outer diameter of up to 76.5 mm and weighs about 12,590 kg/km, 9.0 times as much. Across the range the rated current in free air rises from 131 A to 621 A at 30 °C, and the minimum bending radius from 220 mm to 612 mm.

Example 1. A drive draws 128 A continuously, the cable is wound in 2 layers on the reel and the ambient temperature is 40 °C. Required table current = 128 / (0.61 × 0.91) = 231 A. The smallest suitable size is 3×70+3G16+2×1.5+2×12E9 C with 250 A.

Example 2. A drive draws 284 A continuously, the cable is wound in 1 layer on the reel and the ambient temperature is 35 °C. Required table current = 284 / (0.80 × 0.96) = 370 A. The smallest suitable size is 3×150+3G25+2×1.5+2×12E9 C with 402 A.

Type designation cores × mm²	Apparent power at 400 V kVA (1 layer)	Apparent power at 690 V kVA (1 layer)	Winding capacity m
3×25+3G6+2×1+2×12E9 C	72.6	125.2	5,490
3×35+3G6+2×1.5+2×12E9 C	89.8	154.9	3,805
3×50+3G10+2×1.5+2×12E9 C	112.0	193.1	2,825
3×70+3G16+2×1.5+2×12E9 C	138.6	239.0	2,175
3×95+3G16+2×1.5+2×12E9 C	167.4	288.7	1,555
3×120+3G25+2×1.5+2×12E9 C	194.0	334.6	1,430
3×150+3G25+2×1.5+2×12E9 C	222.8	384.3	1,060
3×185+3G35+2×1.5+2×12E9 C	254.4	438.8	950
3×240+3G50+2×1.5+2×12E9 C	299.3	516.3	630
3×300+3G50+2×1.5+2×12E9 C	344.2	593.7	540

Apparent power S = √3 × U × I × 0.80 (one layer on the reel, 30 °C). Winding capacity is an indicative value for a reel with 2,500 mm flange diameter, 1,000 mm traverse width, core diameter equal to the minimum reel core diameter and 90 % fill; it is not a substitute for the reel manufacturer’s calculation.

07 Standards and Testing

Standard	Scope
DIN EN 60228 / IEC 60228 / VDE 0295	Conductors, class 5
IEC 60502-1	Insulation compound, power cables up to 1 kV
DIN VDE 0298-3	Application of cables – bending radii and tensile loads
DIN VDE 0298-4	Application of cables – current-carrying capacity
DIN EN 60332-1-2 / IEC 60332-1-2	Flame propagation, single cable
DIN VDE 0298-300	Core identification
DIN VDE 0250-814	Design reference for flexible reeling and trailing cables (NSHTÖU type)
ITU-T G.652.D / IEC 60793-2-50	Single-mode optical fibres
IEC 60794-1-21	Optical cables – mechanical test methods
IEC 60811-404	Mineral oil immersion test

Routine and type tests

- AC voltage test on every reel length (routine test): 2.5 kV AC (power cores); 2 kV AC (control cores)
- Conductor resistance and checks of dimensions, insulation thickness and sheath thickness
- Continuity of conductors and protective earth and control cores
- Bending, tensile and reeling torsion tests (type test)
- Flame propagation (IEC 60332-1-2)
- Optical attenuation of every fibre by OTDR after cabling (routine test); reeling and torsion tests with optical monitoring (type test)

Test documentation: every delivery is accompanied by a test certificate from FeiChun's own laboratory. Third-party witnessed tests can be arranged at the buyer's cost.

08 Installation, Marking and Delivery

Installation guidance

- Use a spring-driven or motor-driven cable reel with a core diameter of at least twice the minimum bending radius (16 × D).
- Unwind from the shipping reel tangentially; never pull the cable over the flange of the drum, and avoid loops and kinks.
- Keep torsion within the permitted limit (±50 °/m) and tensile load within the value in the table.
- Guide the cable so that it is not run over by vehicles or crushed; inspect the sheath regularly.
- Connect all parts of the split PE conductor at both ends of the cable.
- Suitable for wet conditions; consult FeiChun for continuous immersion.

Sheath marking

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FEICHUN FC-TCS-M-SF2 [cross-section] 0.6/1 kV [year] [serial no.] [metre mark]
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Packing and delivery

Reel	Steel or fumigated wooden reels; cable ends sealed with heat-shrink caps
Delivery length	As ordered, in one continuous length without joints
Lead time	2–3 weeks after technical approval
Warranty	1 year, covering failures not caused by human factors
Reel label	Type, cross-section, length, gross/net weight, batch no., reel no.

Ordering information

Field	Example	Meaning
Series code	FC-TCS-M-SF2	FeiChun series and sheath system
Core configuration	3×95+3G16+2×1.5+2×12E9 C	Number × cross-section (mm²) of the power cores, split PE conductors (G) and control or optical elements
Rated voltage	0.6/1 kV	U_0/U, AC
Length and packing	500 m, steel reel	Delivery length in one piece; reel type on request

Order example: FC-TCS-M-SF2 3×95+3G16+2×1.5+2×12E9 C 0.6/1 kV – 500 m on one steel reel. When requesting a quotation, state the cable type, configuration, cross-section, voltage, length per piece, required standards and installation conditions.

09 Certification and Quality

All cable is subject to FeiChun's quality control, with routine testing over 100 % of the delivered length. Certificates, type tests and third-party tests (for example partial discharge or compatibility with cable accessories) are provided per project requirement; copies of the records are available on request.

The CE, EAC and UKCA certificates listed in datasheet FC-TDS-TMP-2026-9238-EN apply to the FC-TPU-M D2X11Y product group. Confirm with FeiChun that the certificate scope covers this construction before quoting it in a tender.

10 Related Datasheets

Variants of this cable that differ in one attribute – sheath, configuration, optical fibres or voltage. All datasheets are in PDF format.

- FC-TPU-M D2X11Y-SF2 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 control cores + overall screen + 24 single-mode fibres G.652.D in two elements, PUR
- FC-TCS-M-KF2 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 control cores + 24 single-mode fibres G.652.D in two elements, CSP rubber
- FC-TCS-M-S 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 control cores + overall screen, CSP rubber
- FC-TPU-MA D2X11Y-SF2 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 control cores + overall screen + 24 single-mode fibres G.652.D in two elements, PUR low-temp
- FC-TCS-M-F2 0.6/1 kV – 3 power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, CSP rubber
- FC-TCS-M-SF6 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 control cores + overall screen + 6 single-mode fibres G.652.D, CSP rubber
- FC-TRB-M-SF2 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 control cores + overall screen + 24 single-mode fibres G.652.D in two elements, CPE rubber
- FC-TCS-M-PF2 0.6/1 kV – 3 power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 24 single-mode fibres G.652.D in two elements, CSP rubber

Overview of all datasheets: Low-Voltage Port Reeling Cables 0.6/1 kV

Frequently asked questions

What is FC-TCS-M-SF2 used for?
Typical applications include converter-fed crane drives where control signals in the same cable must be protected against electromagnetic interference.

What are the outer diameter and minimum bending radius of 3×95+3G16+2×1.5+2×12E9 C?
The outer diameter is 46.0 to 49.0 mm and the minimum bending radius in moving or reeling operation is 392 mm (8 × D).

What minimum reel core diameter is needed for 3×95+3G16+2×1.5+2×12E9 C?
At least 784 mm, which is twice the minimum bending radius of 392 mm. A larger core diameter extends cable life.

What current rating applies to 3×95+3G16+2×1.5+2×12E9 C on a cable reel?
The rated current in free air at 30 °C ambient is 302 A. Multiply it by 0.80 for one layer on the reel, 0.61 for two layers, 0.49 for three layers and 0.41 for four layers (DIN VDE 0298-4), and by the ambient temperature factor.

Which optical fibres does FC-TCS-M-SF2 contain?
24 single-mode fibres G.652.D in two elements. 1 Gbit/s and 10 Gbit/s Ethernet up to 10 km (1000BASE-LX, 10GBASE-LR).

Why choose a 3-in-1 reeling cable?
One cable carries power, control signals and data, so the crane needs one reel channel, one slip-ring assembly with a fibre-optic rotary joint and one cable route. This saves reel space and weight and reduces the number of terminations to maintain.

How are the fibres connected on the reel?
Through a fibre-optic rotary joint (FORJ) on the reel axis, normally combined with the power slip-ring assembly. Match the number of FORJ channels to the number of fibres in use and keep spare fibres for later expansion.

Is this cable halogen-free?
No. The CSP rubber sheath contains halogen. If halogen-free cables are required, select the HFFR rubber or PUR version of the same construction.

Which cross-sections are available?
FC-TCS-M-SF2: 25, 35, 50, 70, 95, 120, 150, 185, 240, 300 mm². Other sizes and special designs can be produced to order.

11 Trademark Notice and Intellectual Property

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