HIGH-FLEX MV REELING CABLE · PORT CRANES | FIBRE-OPTIC HYBRID | 12/20 kV | 10 sizes | PCP rubber | 2×12E9

# FC-PMR (N)TSCGEWÖU-F2 12/20 kV

MV Power and Fibre-Optic Hybrid Reeling Cable 12/20 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PCP (polychloroprene) rubber sheath 5GM5. 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-PMR (N)TSCGEWÖU-F2 is a high-flex medium-voltage reeling cable rated 12/20 kV for ship-to-shore cranes, rail-mounted gantry cranes and electrified port equipment, with the configuration 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements. Each power core has a class 5 copper conductor, semi-conductive layers, EPR insulation 5.5 mm thick and its own tinned-copper braid screen; inner and outer sheaths are polychloroprene (PCP/CR) rubber compound 5GM5 to DIN VDE 0207-21, flame-retardant, resistant to oil, weather and ozone. Power cores from 25 – 300 mm².

### Typical applications

- Medium-voltage supply of ship-to-shore (STS) cranes and rail-mounted gantry cranes through motor-driven cable reels
- Remote-controlled and automated cranes that send PLC, video and remote-operation data over single-mode fibre through the reel
- Shore connections and mobile equipment powered from the terminal MV network
- Stackers, reclaimers, ship loaders and open-cast mining machines travelling on rails with a cable reel
- Outdoor operation with seawater spray, salt mist, UV radiation and ozone
- MV supply of ship-to-shore cranes, shore connections and electrified yard equipment through a cable reel

### Design

Three individually screened power cores and three split PE conductors in the interstices. Each core has an inner and outer semi-conductive layer and its own tinned-copper braid screen, so the electric field stays inside the core insulation and the cores can be terminated with standard MV accessories. 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 | 12/20 kV | +90 °C | PCP rubber |
|---|---|---|---|
| Cross-section 25 – 300 mm² | Rated voltage $U_0/U$ | Maximum conductor temperature | Sheath: PCP rubber |

### Key features

- Fine-wire class 5 copper conductors and a very short core lay length for repeated reeling
- 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)

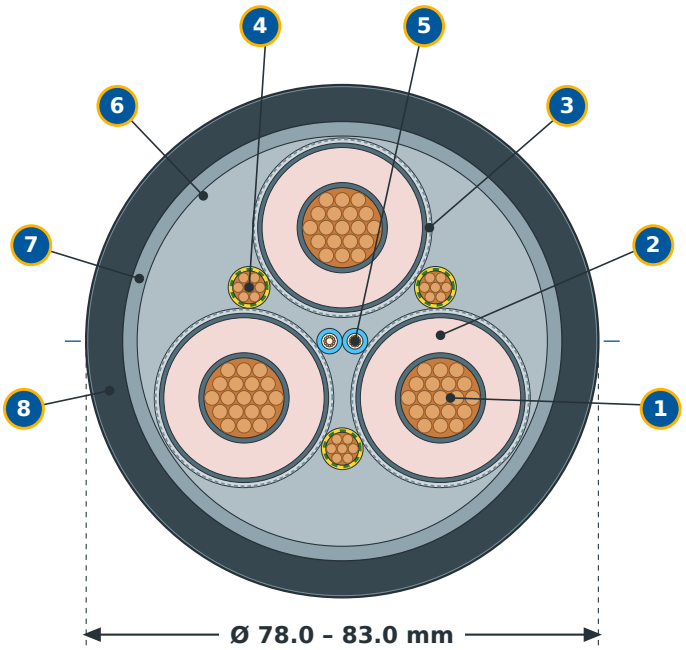
- PCP rubber sheath with proven weather, ozone and oil resistance
- PCP rubber sheath 5GM5 in the DIN VDE 0250 (N)SHTÖU / (N)TSCGEWÖU tradition
- Flame retardant to IEC 60332-1-2

## 02 Construction

**FEICHUN · CROSS-SECTION A-A · 12/20 kV**

**FC-PMR (N)TSCGEWÖU-F2**

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




| No. | Component | Material |
|---|---|---|
| 1 | Conductor | Bare annealed fine-wire copper, class 5 to IEC 60228 (tinned on request) |
| 2 | Semi-conductive layers and insulation | Inner and outer semi-conductive compound with EPR insulation, extruded in one pass |
| 3 | Core screen | Tinned-copper wire braid, coverage ≥ 80 % |
| 4 | Split PE conductor | Class 5 copper, green-yellow insulation, laid in the interstices between the power cores |
| 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 | Outer sheath | Polychloroprene (PCP/CR) rubber compound 5GM5 to DIN VDE 0207-21, flame-retardant, resistant to oil, weather and ozone |

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

### Construction details

| | |
|---|---|
| **Conductor** | Bare annealed fine-wire copper; tinned on request, class 5 to DIN EN 60228 / IEC 60228 / VDE 0295 |
| **Insulation** | Halogen-free EPR/HEPR rubber to IEC 60502-2, maximum conductor temperature 90 °C |
| **Core screen** | Semi-conductive layers extruded together with the EPR insulation; tinned-copper wire braid screen, coverage ≥ 80 % |
| **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 |
| **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 |
| **Inner sheath** | Halogen-free polymer compound, extruded tightly over the stranded cores |
| **Outer sheath** | Polychloroprene (PCP/CR) rubber compound 5GM5 to DIN VDE 0207-21, flame-retardant, resistant to oil, weather and ozone |

### 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 polychloroprene (PCP/CR) rubber outer sheath, compound type 5GM5 to DIN VDE 0207-21, is the classic sheath of DIN VDE 0250 reeling and trailing cables of the (N)SHTÖU and (N)TSCGEWÖU type. It is heavy-duty, flame-retardant and highly resistant to weather, ozone, UV radiation and mineral oil, and keeps its elasticity on the reel down to −25 °C in motion. Polychloroprene 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 $U_0/U$** | 12/20 kV AC |
| **Test voltage** | 30 kV AC, 5 min |
| **Maximum operating voltage, DC** | 18/36 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** | −25 °C to +90 °C |
| **Minimum bending radius** | 6 × D fixed; 12.5 × D on a cable reel |
| **Maximum tensile load** | 20 N/mm² continuous, on the total copper cross-section of the power cores |
| **Maximum torsional load** | To be agreed with FeiChun for the specific reel design |
| **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 (PCP 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 – 12/20 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+2×12E9** | FC-MV326-001 | 6.2 | 64.5 | 68.5 | 856 | 4,920 | 1,500 | 0.780 | 121 | 3.58 |
| **3×35+3G6+2×12E9** | FC-MV326-002 | 7.8 | 67.0 | 71.5 | 894 | 5,470 | 2,100 | 0.554 | 149 | 5.00 |
| **3×50+3G10+2×12E9** | FC-MV326-003 | 9.6 | 70.5 | 75.0 | 938 | 6,340 | 3,000 | 0.386 | 186 | 7.15 |
| **3×70+3G16+2×12E9** | FC-MV326-004 | 11.1 | 74.0 | 78.5 | 982 | 7,450 | 4,200 | 0.272 | 230 | 10.01 |
| **3×95+3G16+2×12E9** | FC-MV326-005 | 12.6 | 78.0 | 83.0 | 1,038 | 8,580 | 5,700 | 0.206 | 278 | 13.59 |
| **3×120+3G25+2×12E9** | FC-MV326-006 | 14.8 | 81.5 | 86.5 | 1,082 | 9,910 | 7,200 | 0.161 | 322 | 17.16 |
| **3×150+3G25+2×12E9** | FC-MV326-007 | 16.0 | 85.5 | 90.5 | 1,132 | 11,190 | 9,000 | 0.129 | 370 | 21.45 |
| **3×185+3G35+2×12E9** | FC-MV326-008 | 17.7 | 89.0 | 94.5 | 1,182 | 12,820 | 11,100 | 0.106 | 422 | 26.45 |
| **3×240+3G50+2×12E9** | FC-MV326-009 | 20.2 | 94.5 | 100.5 | 1,256 | 15,400 | 14,400 | 0.0801 | 497 | 34.32 |
| **3×300+3G50+2×12E9** | FC-MV326-010 | 22.4 | 100.0 | 106.0 | 1,324 | 17,720 | 18,000 | 0.0641 | 571 | 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+2×12E9 | 68.5 | 856 | 1,712 | 1,330 | 492.0 | 97 | 74 | 59 | 50 |
| 3×35+3G6+2×12E9 | 71.5 | 894 | 1,788 | 1,620 | 547.0 | 119 | 91 | 73 | 61 |
| 3×50+3G10+2×12E9 | 75.0 | 938 | 1,876 | 2,160 | 634.0 | 149 | 113 | 91 | 76 |
| 3×70+3G16+2×12E9 | 78.5 | 982 | 1,964 | 2,890 | 745.0 | 184 | 140 | 113 | 94 |
| 3×95+3G16+2×12E9 | 83.0 | 1,038 | 2,076 | 3,600 | 858.0 | 222 | 170 | 136 | 114 |
| 3×120+3G25+2×12E9 | 86.5 | 1,082 | 2,164 | 4,550 | 991.0 | 258 | 196 | 158 | 132 |
| 3×150+3G25+2×12E9 | 90.5 | 1,132 | 2,264 | 5,390 | 1,119.0 | 296 | 226 | 181 | 152 |
| 3×185+3G35+2×12E9 | 94.5 | 1,182 | 2,364 | 6,630 | 1,282.0 | 338 | 257 | 207 | 173 |
| 3×240+3G50+2×12E9 | 100.5 | 1,256 | 2,512 | 8,550 | 1,540.0 | 398 | 303 | 244 | 204 |
| 3×300+3G50+2×12E9 | 106.0 | 1,324 | 2,648 | 10,210 | 1,772.0 | 457 | 348 | 280 | 234 |

### Reel design guidance

- Minimum reel core diameter = 2 × minimum bending radius = 25 × 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-PMR (N)TSCGEWÖU-F2 covers 10 sizes. The smallest, 3×25+3G6+2×12E9, has an outer diameter of up to 68.5 mm and weighs about 4,920 kg/km; the largest, 3×300+3G50+2×12E9, has an outer diameter of up to 106.0 mm and weighs about 17,720 kg/km, 3.6 times as much. Across the range the rated current in free air rises from 121 A to 571 A at 30 °C, and the minimum bending radius from 856 mm to 1,324 mm.

**Example 1.** A drive draws 117 A continuously, the cable is wound in 2 layers on the reel and the ambient temperature is 40 °C. Required table current = 117 / (0.61 × 0.91) = 211 A. The smallest suitable size is 3×70+3G16+2×12E9 with 230 A.

**Example 2.** A drive draws 261 A continuously, the cable is wound in 1 layer on the reel and the ambient temperature is 35 °C. Required table current = 261 / (0.80 × 0.96) = 340 A. The smallest suitable size is 3×150+3G25+2×12E9 with 370 A.

| Type designation cores × mm² | Apparent power at 20 kV MVA (1 layer) | Winding capacity m |
|---|---|---|
| 3×25+3G6+2×12E9 | 3.35 | 405 |
| 3×35+3G6+2×12E9 | 4.13 | 305 |
| 3×50+3G10+2×12E9 | 5.15 | 320 |
| 3×70+3G16+2×12E9 | 6.37 | 225 |
| 3×95+3G16+2×12E9 | 7.70 | 150 |
| 3×120+3G25+2×12E9 | 8.92 | 70 |
| 3×150+3G25+2×12E9 | 10.25 | 75 |
| 3×185+3G35+2×12E9 | 11.69 | – |
| 3×240+3G50+2×12E9 | 13.77 | – |
| 3×300+3G50+2×12E9 | 15.82 | – |

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 60502-2** | Power cables with extruded insulation, 6 kV to 30 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 0250-813** | Reference construction of MV reeling cables |
| **ITU-T G.652.D / IEC 60793-2-50** | Single-mode optical fibres |
| **IEC 60794-1-21** | Optical cables – mechanical test methods |
| **DIN VDE 0207-21** | Sheath compound 5GM5 (polychloroprene) |
| **IEC 60811-404** | Mineral oil immersion test |

### Routine and type tests

- AC voltage test on every reel length (routine test): 30 kV AC, 5 min
- Partial-discharge test of the MV power cores to IEC 60502-2
- Conductor resistance and checks of dimensions, insulation thickness and sheath thickness
- Continuity of conductors and protective earth
- 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 (25 × 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 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.
- Use terminations and joints that are approved for individually screened cores; do not cut back the semi-conductive layers unless instructed by the accessory manufacturer.

### Sheath marking

```
FEICHUN FC-PMR (N)TSCGEWÖU-F2 [cross-section] 12/20 kV [year] [serial no.] [metre mark]
```

### 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-PMR (N)TSCGEWÖU-F2 | FeiChun series and sheath system |
| **Core configuration** | 3×95+3G16+2×12E9 | Number × cross-section (mm²) of the screened power cores, split PE conductors (G) and pilot or optical elements |
| **Rated voltage** | 12/20 kV | $U_0$/U, AC |
| **Length and packing** | 500 m, steel reel | Delivery length in one piece; reel type on request |

**Order example: FC-PMR (N)TSCGEWÖU-F2 3×95+3G16+2×12E9 12/20 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.

## 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-MRT-P-F2 12/20 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PUR
- FC-PMR (N)TSCGEWÖU-PF2 12/20 kV – 3 screened power cores + 3 split PE conductors + 2 pilot cores 2×2.5 mm² + 24 single-mode fibres G.652.D in two elements, PCP rubber
- FC-PMR (N)TSCGEWÖU 12/20 kV – 3 screened power cores + 3 split PE conductors, PCP rubber
- FC-PMR (N)TSCGEWÖU-F2 1.8/3 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PCP rubber
- FC-MRT-PA-F2 12/20 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PUR low-temp
- FC-PMR (N)TSCGEWÖU-F6 12/20 kV – 3 screened power cores + 3 split PE conductors + 6 single-mode fibres G.652.D, PCP rubber
- FC-PMR (N)TSCGEWÖU-F2 3.6/6 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, PCP rubber
- FC-MRT-C-F2 12/20 kV – 3 screened power cores + 3 split PE conductors + 24 single-mode fibres G.652.D in two elements, CSP rubber

Overview of all datasheets: Medium-Voltage Port Reeling Cables 1.8/3 – 20/35 kV

### Frequently asked questions

**What is FC-PMR (N)TSCGEWÖU-F2 used for?**
Typical applications include medium-voltage supply of ship-to-shore (STS) cranes and rail-mounted gantry cranes through motor-driven cable reels.

**What are the outer diameter and minimum bending radius of 3×95+3G16+2×12E9?**
The outer diameter is 78.0 to 83.0 mm and the minimum bending radius in moving or reeling operation is 1,038 mm (12.5 × D).

**What minimum reel core diameter is needed for 3×95+3G16+2×12E9?**
At least 2,076 mm, which is twice the minimum bending radius of 1,038 mm. A larger core diameter extends cable life.

**What current rating applies to 3×95+3G16+2×12E9 on a cable reel?**
The rated current in free air at 30 °C ambient is 278 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-PMR (N)TSCGEWÖU-F2 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).

**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 PCP 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-PMR (N)TSCGEWÖU-F2: 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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