TRATOS

CABLES FOR A MOVING WORLD

# TRATOSFLEX®

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2019

## Tratos-JBA® compound

**TRATOSFLEX-ESDB®, TRATOSMART-DB® and other TRATOSFLEX® cables are made with award winning Tratos-JBA® compound.**
**Tratos UK Ltd, has won a Queen's Award for Enterprise - Innovation for its technologically advanced Tratos-JBA® compound.**

*June* **2020**
TCn07-Rev44

# INDEX



## CONTROL CABLES

**According to standards VDE 0250** (as applicable)



## LOW VOLTAGE POWER CABLES

**According to standards VDE 0250** (as applicable)



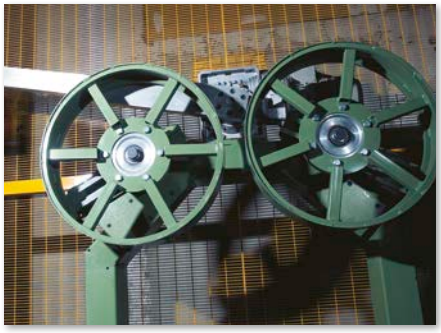
## MEDIUM VOLTAGE POWER CABLES

**According to standards VDE 0250 p. 813** (as applicable)



## FIBRE CABLES

Mechanical torsion test



Reversed bending test

Chemical laboratory

## CUSTOMIZED UPON REQUEST

1) **Reduced halogens and flame retardant (e.g. for tunnels, buildings...) TratosGreen type**
2) **Improved resistance to chemical attack**
3) **Improved resistance to low temperatures (down to -50°C only for black outer sheath)**
4) **Composed cables (e.g. power and control cores screened or without screen)**

# STANDARDS AND QUALITY SYSTEM

## QUALITY SYSTEM

Tratos aim to work closely with customers to find better, more environmentally friendly solutions to their challenges.
We are committed to our vision and strategy to serve all our internal and external customers by providing high quality services and products. Tratos is an established industry leader in the design, manufacture and supply of cables and products and to maintain this leading position we are committed at every level to providing our customers with quality services and products at a competitive price. As a commercial enterprise we are aware of the importance of satisfying our customers and of the financial impact of which nonconformities may have on our profitability. For these reasons we are committed to complying with all customer requirements and specifications both legal and statutory requirements. Our Quality Management System has been audited and approved by two independent, Internationally recognized and accepted authorities: BSI and AENOR-IQNET (E), in accordance to BS EN ISO 9001:2015 covering the production, purchasing of raw materials design and final test including various document types. The Tratos Quality Management system is under frequent regular surveillance by inspectors working for the Certification Autorities.

## ENVIRONMENTAL SYSTEM

Our Environmental Management System has been audited and approved by two independent, Internationally recognized and accepted authorities:
BSI and AENOR-IQNET (E), in accordance to BS EN ISO 14001:2015 covering the production, purchasing of raw materials design and final test including various document types. The Tratos Quality Management system is under frequent regular surveillance by inspectors working for the Certification Autorities.

## ENERGY MANAGEMENT SYSTEMS

By complying with the BS EN ISO 50001:2018 Tratos follows a systematic approach in achieving continual improvement of energy performance and the Energy Management Systems (EnMS).
The BS EN ISO 50001:2018 is a standard issued by the International Standard Organization (ISO) which outlines the requirements for establishing, implementing, maintaining and improving an energy management system (EnMS).

## CIRCULAR ECONOMY

The EU Eco-Management and Audit Scheme (EMAS) is a premium management instrument developed by the European Commission for companies and other organisations to evaluate, report, and improve their environmental performance. EMAS is open to every type of organisation eager to improve its environmental performance. It spans all economic and service sectors and is applicable worldwide.

## AWARDS

Tratos cables are made with award winning Tratos-JBA® compound.
Tratos UK Ltd has won a **Queen's Award for Enterprise - Innovation** for its technologically advanced Tratos-JBA® compound.

# STANDARDS AND QUALITY SYSTEM

## HEALTY & SAFETY SYSTEM

Oince its decision to create a board post dedicated to furthering best practice for Health and Safety, international cable manufacturer Tratos is celebrating receipt of ISO 45001.
ISO 45001 sets out the minimum requirements for occupational health and safety management best practice and helps companies achieve the maximum return for employees, operations and customers.

## REACH, WEEE & ROHS

Tratos is fully compliant with the **REACH**. This is a European Union regulation concerning the **Registration, Evaluation, Authorisation and restriction of Chemicals**. It came into force on 1st June 2007 and replaced a number of European Directives and Regulations with a single system. REACH applies to substances manufactured or imported into the EU in quantities of 1 tonne or more per year. Generally, it applies to all individual chemical substances on their own, in preparations or in articles . To summarise, REACH makes the cable industry directly responsible for assessing and managing the risks posed by chemicals and providing safety information to their users.

Tratos fully subscribes to The **Waste Electrical and Electronic Equipment Directive (WEEE Directive)**, introduced into UK law in January 2007 by the Waste Electronic and Electrical Equipment Regulations 2006. The WEEE Directive aims to reduce the amount of electrical and electronic equipment being produced and to encourage everyone to reuse, recycle and recover it. The WEEE Directive also aims to improve the environmental performance of businesses that manufacture, supply, use, recycle and recover electrical and electronic equipment. TRATOS has enlisted the services of the UK's leading producer compliance scheme, Valpak, whom manage our recycling obligations and also ensure our compliance to the WEEE Regulations and the Waste Batteries and Accumulators Regulations.

Tratos is fully compliant with the **Restriction of Hazardous Substances (RoHS) Regulations**. These Regulations implement EU Directive 2011/65/EU which bans the placing on the EU market of new electrical and electronic equipment containing more than agreed levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBB) and polybrominated diphenyl ether (PBDE) flame retardants. Tratos fully understands the requirements of the RoHS Directive and ensures that our products, and their components, comply.

## CORPORATE SOCIAL RESPONSABILITY

Tratos adoptes a Code of Ethics which adheres to the United Nations Global Compact on human rights, labour standards, protection of the environment and anti corruption measures.
Under this self regulatory code, Tratos will carry out initiatives in the environmental and social fields with special reference to environmental policies and social policies regarding child labour, compulsory labour, health and security, freedom of association and the right to collective bargaining, discrimination, disciplinary procedures, working hours and wages.

## APPROVALS

Reeling cables made by Tratos have been tested and certified by the following Approval Organisations:

Verband Der Elektrotechnik

Instituto Marchio di Qualità

Lloyd's Register Group

Underwriters Laboratories Inc.®

EAC - Eurasian Conformity

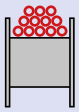
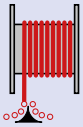
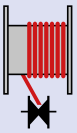
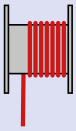
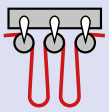
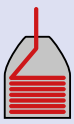
Registro Italiano Navale

## 1. Selection of cable type in relation to use

The cable designs shall adopt construction characteristics required to give the cable the best performance in relation to its application.
Other important factors which are also considered for all the types are:

- Operating temperature
- Tensile stress (static and dynamic)
- Bending radius
- Operating speed
- Acceleration

### Table 1 Selection of cables

| DESIGN | Reels | | | | | | | | Festoons | Vertical Basket | Operating Temperature | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Cable Laid on Ground | | | | | | | | | | Ambient condition | | On cable surface | |
| |  end feed | | |  centre feed |  random |  multispire |  tender system |  vertical |  |  | Min. Value °C | Max Value °C | Min. Value °C | Max Value °C |
| Operating max speed (mt/min) | 60 | 200 | 300 | 200 | 60 | 200 | 60 | 300 | 240 | 160 | | | | |
| **CONTROL CABLES** | | | | | | | | | | | | | | |
| **TRATOSMART** - (N) SHTÖU - JZ | S | MA | x | x | x | MA | S | x | S | x | -25 | +80 | -25 | +60 |
| **TRATOSMART** - (N) SHTÖU - JZK | S | MA | x | x | x | MA | S | x | S | x | -40 | +60 | -40 | +60 |
| **TRATOSFESTOON** | x | x | x | x | x | x | x | x | MA | x | -25 | +80 | -25 | +60 |
| **TRATOSLIGHT - VRDB** | x | x | x | x | x | S | S | MA | x | x | -25 | +80 | -25 | +60 |
| **TRATOSCOILFLEX** | x | x | x | x | x | x | x | x | x | MA | -20 | +80 | -20 | +60 |
| **POWER L.V. CABLES** | | | | | | | | | | | | | | |
| **TRATOSMART DB** - (N) SHTÖU - J | S | S | S | MA | x | MA | x | x | S | x | -25 | +80 | -25 | +60 |
| **TRATOSMART** - (N) SHTÖU - J | S | MA | x | x | x | MA | S | x | S | x | -25 | +80 | -25 | +60 |
| **TRATOSMART** - (N) SHTÖU - JK | S | MA | x | x | x | MA | S | x | S | x | -40 | +60 | -40 | +60 |
| **TRATOSFESTOON** | x | x | x | x | x | x | x | x | MA | x | -25 | +80 | -25 | +60 |
| **POWER M.V. CABLES** | | | | | | | | | | | | | | |
| **TRATOSFLEX - ES3** | MA | MA | x | S | x | x | MA | x | x | x | -30 | +80 | -30 | +60 |
| **TRATOSFLEX - ESDB** | S | S | MA | MA | MA | MA | S | x | x | x | -20 | +60 | -20 | +60 |
| **TRATOSFLEX - FO ES3** | MA | MA | x | S | x | x | MA | x | x | x | -30 | +80 | -30 | +60 |
| **TRATOSFLEX - FO ESDB** | S | S | MA | MA | MA | MA | S | x | x | x | -20 | +60 | -20 | +60 |
| **TRATOSFLAT** | MA | MA | x | x | x | x | x | x | x | x | -30 | +80 | -30 | +60 |
| **FIBRE CABLES** | | | | | | | | | | | | | | |
| **TRATOSFIBRE - DB** | MA | MA | MA | x | x | x | x | x | MA | x | -25 | +80 | -25 | +60 |

**MA** = Main application  **S** = Suitable  x = Not suitable

## 2. Recommended Minimum Bending Radius

The recommended minimum values for different uses are given in Table 2.

### Table 2

| TYPES OF CABLES | CABLE DIAMETER MAX (mm) | APPLICATIONS | | | | |
|---|---|---|---|---|---|---|
| | | Festoons | Reels | Basket | Cable Carrier Chains | Fixed Installation |
| L. V. up to 1 kV | ≤ 25 | 5 x O.D. (1) | 6 x O.D. (1) | | 10 x O.D. | 4 x O.D. |
| | ≤ 40 | 6 x O.D. (1) | 7 x O.D. | 15 x O.D. | 12 x O.D. | 4 x O.D. |
| | > 40,1 | 7 x O.D. | 8 x O.D. | 15 x O.D. | 12 x O.D. | 4 x O.D. |
| M. V. over 1 kV | all | | 12 x O.D. | | 10 x O.D. | 6 x O.D. |

(1) For EMC shielded cables (Tratosflex OCS Type) minimum bending radius 7 x O.D.

Where the OD is the overall diameter of the cable in mm.
For low speed operations smaller bending radius values may be allowed - please contact our Technical Department for advice.

## 3. Current carrying capacities for continuous operation (at 30°C): 3 core cables + earth conductor

According to DIN VDE 0298-4

### Table 3 Low Voltage cables up to 0,6/1 kV and Medium Voltage cables up to 10 kV

| Cross section | One cable | Festoon | Multilayer reels | | | | | Mono-spiral reels | |
|---|---|---|---|---|---|---|---|---|---|
| | Laid on ground | Suspended freely in air | Reeled in 1 layer | Reeled in 2 layers | Reeled in 3 layers | Reeled in 4 layers | Reeled in 5 layers | Round cables | Flat cables |
| mm² | A | A | A | A | A | A | A | A | A |
| | (Factor 1)* | (1.05)* | (0.80)* | (0.61)* | (0.49)* | (0.42)* | (0.34)* | (0.80)* | (0.49)* |
| 1 | 18 | 19 | 14 | 11 | 9 | 8 | 6 | 14 | 9 |
| 1,5 | 23 | 24 | 18 | 14 | 11 | 10 | 8 | 18 | 11 |
| 2,5 | 30 | 32 | 24 | 18 | 15 | 13 | 10 | 24 | 15 |
| 4 | 41 | 43 | 33 | 25 | 20 | 17 | 14 | 33 | 20 |
| 6 | 53 | 56 | 42 | 32 | 26 | 22 | 18 | 42 | 26 |
| 10 | 74 | 78 | 59 | 45 | 36 | 31 | 25 | 59 | 36 |
| 16 | 99 | 104 | 79 | 60 | 49 | 42 | 34 | 79 | 49 |
| 25 | 131 | 138 | 105 | 80 | 64 | 55 | 45 | 105 | 65 |
| 35 | 162 | 170 | 130 | 99 | 79 | 68 | 55 | 130 | 80 |
| 50 | 202 | 212 | 162 | 123 | 99 | 85 | 69 | 162 | 99 |
| 70 | 250 | 263 | 200 | 153 | 123 | 105 | 85 | 200 | 123 |
| 95 | 301 | 316 | 241 | 184 | 147 | 126 | 102 | 241 | 148 |
| 120 | 352 | 370 | 282 | 215 | 172 | 148 | 120 | 282 | 172 |
| 150 | 404 | 424 | 323 | 246 | 198 | 170 | 137 | 323 | 197 |
| 185 | 461 | 484 | 369 | 281 | 226 | 194 | 157 | 369 | 226 |
| 240 | 540 | 567 | 432 | 329 | 265 | 227 | 184 | 432 | 265 |
| 300 | 620 | 651 | 496 | 378 | 304 | 260 | 211 | 496 | 304 |

* De-rating factor

### Table 3 Medium Voltage cables above 10 kV

| Cross section | One cable | Festoon | Multilayer reels | | | | | Mono-spiral reels | |
|---|---|---|---|---|---|---|---|---|---|
| | Laid on ground | Suspended freely in air | Reeled in 1 layer | Reeled in 2 layers | Reeled in 3 layers | Reeled in 4 layers | Reeled in 5 layers | Round cables | Flat cables |
| mm² | A | A | A | A | A | A | A | A | A |
| | (Factor 1)* | (1.05)* | (0.80)* | (0.61)* | (0.49)* | (0.42)* | (0.34)* | (0.80)* | (0.49)* |
| 16 | 105 | | 84 | 64 | 51 | 44 | 36 | 84 | 51 |
| 25 | 139 | | 111 | 85 | 68 | 58 | 47 | 111 | 68 |
| 35 | 172 | | 138 | 105 | 84 | 72 | 58 | 138 | 84 |
| 50 | 215 | | 172 | 131 | 105 | 90 | 73 | 172 | 105 |
| 70 | 265 | | 212 | 162 | 130 | 111 | 90 | 212 | 130 |
| 95 | 319 | | 255 | 195 | 156 | 134 | 108 | 255 | 156 |
| 120 | 371 | | 297 | 226 | 182 | 156 | 126 | 297 | 182 |
| 150 | 428 | | 342 | 261 | 210 | 180 | 146 | 342 | 210 |
| 185 | 488 | | 390 | 293 | 239 | 205 | 166 | 390 | 239 |

* De-rating factor

### Table 3a De-rating factor for ambient temperatures other than 30°C

| Cables | Ambient Temperature °C | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 10 | 15 | 20 | 25 | 30 | 35 | 40 | 45 | 50 | 55 | 60 | 65 | 70 |
| **POWER L.V. CABLES** | | | | | | | | | | | | | |
| **TRATOSMART** (N) SHTÖU | 1,15 | 1,12 | 1,08 | 1,04 | 1,00 | 0,96 | 0,91 | 0,87 | 0,82 | 0,76 | 0,71 | 0,65 | 0,58 |
| **TRATOSLIGHT - VR** | 1,15 | 1,12 | 1,08 | 1,04 | 1,00 | 0,96 | 0,91 | 0,87 | 0,82 | 0,76 | 0,71 | 0,65 | 0,58 |
| **TRATOSCOILFLEX** | 1,15 | 1,12 | 1,08 | 1,04 | 1,00 | 0,96 | 0,91 | 0,87 | 0,82 | 0,76 | 0,71 | 0,65 | 0,58 |
| **TRATOSFESTOON** | 1,15 | 1,12 | 1,08 | 1,04 | 1,00 | 0,96 | 0,91 | 0,87 | 0,82 | 0,76 | 0,71 | 0,65 | 0,58 |
| **POWER M.V. CABLES** | | | | | | | | | | | | | |
| **TRATOSFLEX - ES3 / ESDB** | 1,15 | 1,12 | 1,08 | 1,04 | 1,00 | 0,96 | 0,91 | 0,87 | 0,82 | 0,76 | 0,71 | 0,65 | 0,58 |
| **TRATOSFLEX - FO ES3 / ESDB** | 1,15 | 1,12 | 1,08 | 1,04 | 1,00 | 0,96 | 0,91 | 0,87 | 0,82 | 0,76 | 0,71 | 0,65 | 0,58 |
| **TRATOSFLAT** | 1,15 | 1,12 | 1,08 | 1,04 | 1,00 | 0,96 | 0,91 | 0,87 | 0,82 | 0,76 | 0,71 | 0,65 | 0,58 |

### Table 3b De-rating factor for multicores cables with conductor cross section up to 10 mm²

| Number of conductor loaded | 5 | 7 | 12 | 18 | 24 | 30 | 36 | 42 | 54 | 61 |
|---|---|---|---|---|---|---|---|---|---|---|
| **De-rating Factor** | 0,75 | 0,65 | 0,53 | 0,44 | 0,40 | 0,40 | 0,36 | 0,35 | 0,32 | 0,30 |

## 4. Current carrying capacities for intermittent operation

In the case of intermittent operation, for example, a period of 10 minutes at full load, followed by a 30 minute period of no load. These 10 minutes taken as a percentage of the total duration, DT = 40 minutes, gives a percentage load factor of 25%.

***Load factor FC %*** = *(10mi/ DT) x 100*

In this case the current carrying capacity as calculated using table 1, can be increased using factors given in table 4.

### Table 4

| Cable cross section (mm²) | 1,5 | 2,5 | 4 | 6 | 10 | 16 | 25 | 35 | 50 | 70 | 95 | 120 | 150 | 185 | 240 | 300 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Load Factor (FC %)** | **Correction factors** | | | | | | | | | | | | | | | |
| 60% | 1,00 | 1,00 | 1,00 | 1,00 | 1,03 | 1,07 | 1,10 | 1,13 | 1,16 | 1,18 | 1,20 | 1,21 | 1,22 | 1,23 | 1,24 | 1,25 |
| 40% | 1,00 | 1,00 | 1,03 | 1,04 | 1,09 | 1,16 | 1,23 | 1,28 | 1,34 | 1,38 | 1,42 | 1,44 | 1,46 | 1,48 | 1,49 | 1,50 |
| 25% | 1,00 | 1,02 | 1,05 | 1,13 | 1,21 | 1,34 | 1,45 | 1,53 | 1,62 | 1,69 | 1,74 | 1,78 | 1,81 | 1,82 | 1,85 | 1,87 |
| 20% | 1,00 | 1,04 | 1,11 | 1,18 | 1,31 | 1,45 | 1,59 | 1,69 | 1,79 | 1,87 | 1,93 | 1,97 | 2,01 | 2,04 | 2,10 | 2,15 |
| 15% | 1,00 | 1,08 | 1,19 | 1,27 | 1,44 | 1,62 | 1,79 | 1,90 | 2,03 | 2,13 | 2,21 | 2,26 | 2,30 | 2,32 | 2,36 | 2,39 |

## 5. Three phase voltage drop

### Table 5 Factor calculation of voltage drop

| Nominal cable | Operating electrical resistance (R) at 90°C | Reactance (x) at 50 Hz for three core + earth cables at operating voltage of: | | | | | | Voltage drop |
|---|---|---|---|---|---|---|---|---|
| Cross section | | up to 1kV | 3 kV | 6 kV | 10 kV | 15 kV | 20 kV | factor K |
| | A.C. 50 Hz | (Ohm / km) | (Ohm / km) | (Ohm / km) | (Ohm / km) | (Ohm / km) | (Ohm / km) | (cos ϕ = 0,8) |
| mm² | (Ohm / km) | (indicative value) kA | | | | | | m V/A m |
| 1,5 | 17,540 | 0,109 | | | | | | 23,5 |
| 2,5 | 10,509 | 0,103 | | | | | | 14,2 |
| 4 | 6,515 | 0,095 | | | | | | 8,8 |
| 6 | 4,340 | 0,090 | | | | | | 5,93 |
| 10 | 2,496 | 0,087 | 0,097 | | | | | 3,45 |
| 16 | 1,588 | 0,086 | 0,095 | 0,105 | 0,118 | | | 2,24 |
| 25 | 1,018 | 0,081 | 0,090 | 0,102 | 0,110 | 0,124 | | 1,46 |
| 35 | 0,723 | 0,078 | 0,087 | 0,097 | 0,108 | 0,121 | 0,131 | 1,06 |
| 50 | 0,503 | 0,077 | 0,083 | 0,094 | 0,103 | 0,114 | 0,123 | 0,77 |
| 70 | 0,355 | 0,076 | 0,080 | 0,090 | 0,095 | 0,108 | 0,113 | 0,57 |
| 95 | 0,269 | 0,075 | 0,079 | 0,088 | 0,093 | 0,104 | | 0,45 |
| 120 | 0,210 | 0,074 | 0,077 | 0,085 | 0,091 | | | 0,36 |
| 150 | 0,169 | 0,074 | 0,076 | 0,083 | 0,089 | | | 0,3 |
| 185 | 0,138 | 0,073 | 0,074 | 0,081 | | | | 0,26 |
| 240 | 0,105 | 0,072 | 0,074 | | | | | 0,22 |

The value is calculated by multiplying the factors K (mV/Am) given in the table by effective current capacity I (A) of the cable then by the length of the connection L (in km):
Voltage drop (v) = I (A) x L (km) x K (mV/Am)

The factors have been calculated using the formula:

$$K\ (mV/Am) = 1.73 \times (R\cos\phi + X\sin\phi)$$

Where:
R = resistance of the conductor (Ohm/km) at operating temperature of 90°C and frequency of 50 Hz
X = Cable reactance (Ohm/km) at 50 Hz

# 6. Short circuit current

Short circuit current (thermal limit of short circuit) in heavy duty mobile application, must be calculated using the following reference values (VDE 0250 c.8/75)

Initial = 90°C (cable under full load)
Final short circuit temperature = 250°C

The short circuit currents (thermal limit) given in the table below have been calculated using these values and are valid for a base time of 1 sec.

## Table 6

| Nominal cable cross section | One second thermal limit for all voltages | Dynamic limit for three core cables | | | | | |
|---|---|---|---|---|---|---|---|
| | | up to 1kV | 3 kV | 6 kV | 10 kV | 15 kV | 20 kV |
| mm² | kA | indicative value (1) kA | | | | | |
| 1,5 | 0,210 | | | | | | |
| 2,5 | 0,35 | | | | | | |
| 4 | 0,57 | | | | | | |
| 6 | 0,85 | | | | | | |
| 10 | 1,43 | | | | | | |
| 16 | 2,28 | 30 | 40 | 45 | 50 | 55 | |
| 25 | 3,57 | 35 | 43 | 50 | 55 | 60 | |
| 35 | 5,00 | 40 | 48 | 53 | 60 | 65 | 75 |
| 50 | 7,15 | 45 | 50 | 58 | 63 | 70 | 80 |
| 70 | 10,00 | 50 | 55 | 63 | 68 | 75 | 83 |
| 95 | 13,58 | 55 | 60 | 70 | 75 | 75 | |
| 120 | 17,16 | 60 | 65 | 72 | 78 | 80 | |
| 150 | 21,45 | 65 | 68 | 75 | 80 | | |
| 185 | 26,45 | 70 | 72 | 80 | 84 | | |
| 240 | 34,32 | 80 | | | | | |

**For a different initial and final temperature (for example 90°C initial and 250°C final temperature admissible for our cable HEPR insulated). The thermal limits are calculated with:**

$$Icc(a) = \frac{\text{Kcc x conductor cross section } (mm^2)}{\sqrt{t \text{ (sec)}}}$$

## Where the coefficient Kcc assumes the following values:

| Final short circuit temperature °C | Initial short circuit temperature of the conductor | | | | | | |
|---|---|---|---|---|---|---|---|
| | 30 °C | 40 °C | 50 °C | 60 °C | 70 °C | 80 °C | 90 °C |
| 160 | 143 | 136 | 129 | 122 | 115 | 107 | 100 |
| 200 | 159 | 153 | 147 | 141 | 135 | 128 | 122 |
| **250** | 176 | 170 | 165 | 159 | 154 | 148 | 143 |

(1) Indicative value because in flexible cables only a very special construction (e.g. pitch conductors, cores assembly...) reduces the electrodynamic forces from separating the grouped cores.

## 7. Fibre optical technical information*

| OPTICAL parameters | | |
|---|---|---|
| | **Grade index fibre 62,5/125** | **Monomode fibre E9/125** |
| **Max attenuation at wavelength 850 nm** | 3,2 dB/km | - |
| **Max attenuation at wavelength 1300 nm** | 0,9 dB/km | 0,4 dB/km |
| **Max attenuation at wavelength 1550 nm** | - | 0,3 dB/km |
| **Bandwidth at 850 nm** | ≥ 400 MHz | - |
| **Bandwidth at 1300 nm** | ≥ 600 MHz | - |
| **Numerical aperture** | 0,275 ± 0,015 | 0,140 ± 0,02 |
| **Attenuation on completed cable (max) at wavelength 1300 nm** | 5,00 dB/km | 2,00 dB/km |

## 8. Tratos-JBA® compound

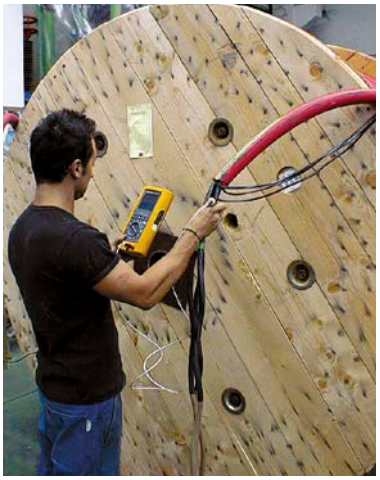
TRATOSFLEX-ESDB®, TRATOSMART-DB® and other TRATOSFLEX® cables are made with award winning Tratos-JBA® compound. Tratos UK Ltd, has won a Queen's Award for Enterprise - Innovation for its technologically advanced Tratos-JBA® compound.
Tratos' new compound increases the safety of cable, its resistance to the most invasive and corrosive elements in the environment and its performance. It also offers significant reduction of fire propagation while continuing to function. All of these are significant gains and are the compelling reasons behind Tratos' investment in the technology.

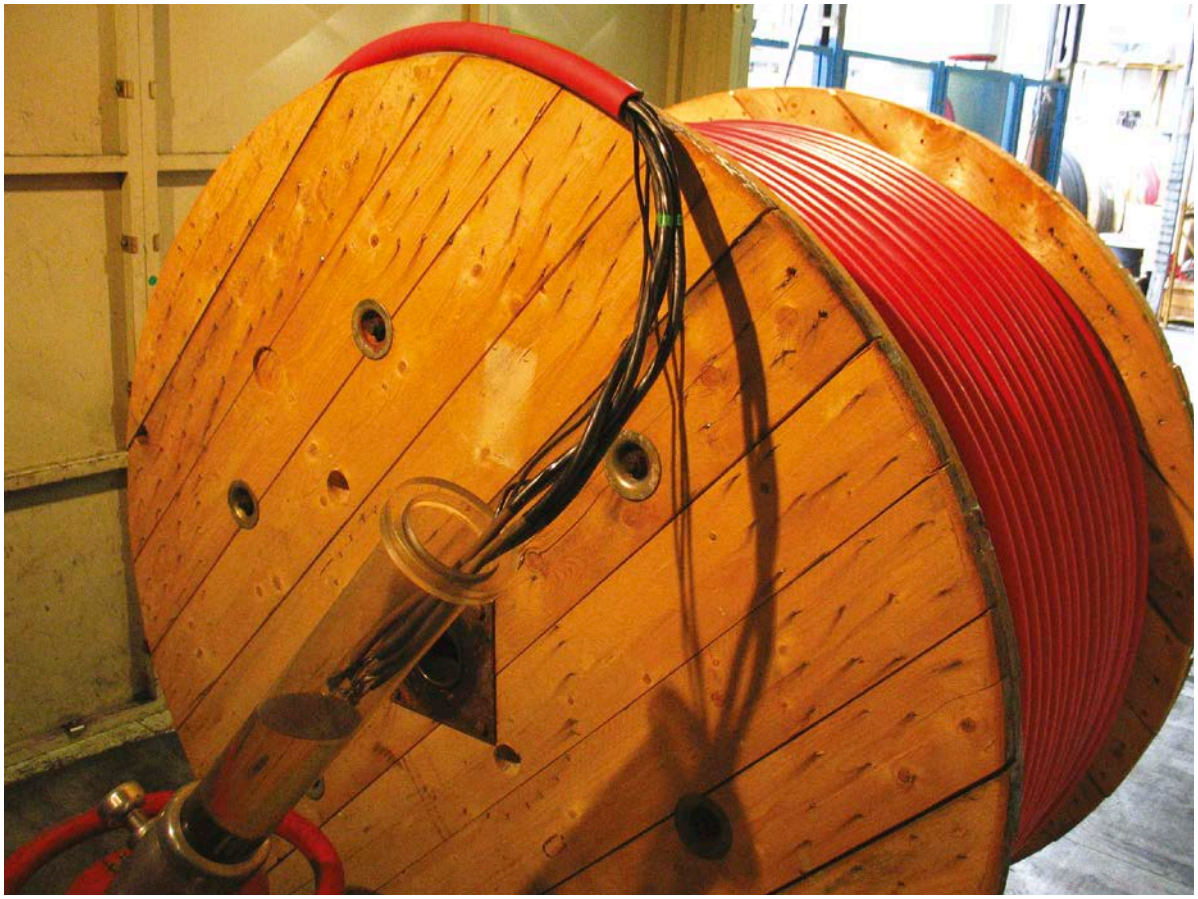
THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2019

## 9. General recommendations

Fundamental to avoid:

- Misalignement in order to avoid cable twisting the cable
- Sudden changes of bending radius or direction
- Overtension of the cable
- Change of direction within a distance of less than 20 times cable O.D.
- Use of sheaves not having a flat profile



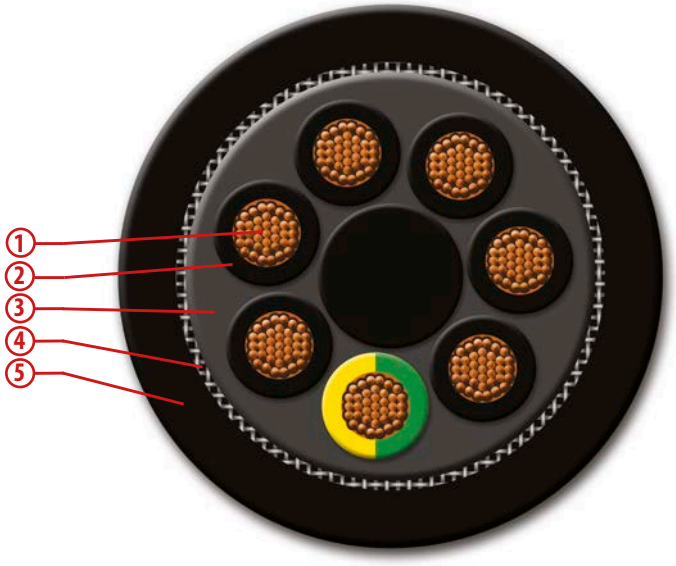


CONTROL CABLES according to standards VDE 0250 p.814 (as applicable)

# TRATOSMART® - (N)SHTÖU-JZ
# TRATOSMART® - (N)SHTÖU-JZK(1)
# TRATOSGREEN® - (N)SHTÖU-JZ(1) - Reduced halogens(2)(3)

Reduced dimension cable laid on ground for reeling **end feed application**.

## FEATURES AND PERFORMANCES

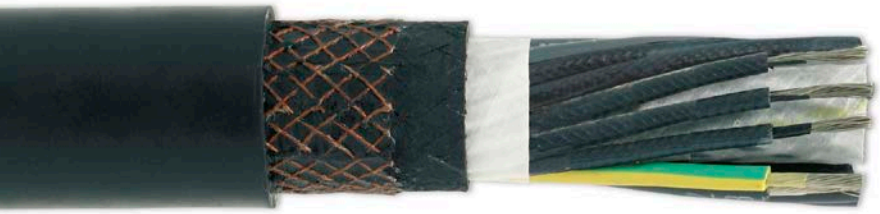



### CONSTRUCTION

1) Tinned flexible conductor Cl. 5 VDE 0295
2) Insulation special compound Tratosmart-I®, equivalent to or better than EPR 3GI3 quality
3) Inner sheath special compound Tratosmart-IS®, better than GM1b quality
4) Anti-twist protection
5) Outer sheath black colour special compound Tratosmart-OS®, better than 5GM3 (or 5GM5 if required) quality

### TECHNICAL SPECIFICATIONS

- Rated Voltage 0,6/1 kV
- Max Voltage AC 0,7/1,2 kV
- AC Voltage Test 2,5 kV



| Working Ambient Temperature: | TRATOSMART | Type K |
|---|---|---|
| **Fixed installation** | -40 °C to +80 °C | -60 °C to +60 °C |
| **In operation** | -25 °C to +80 °C | -40 °C to +80 °C |

| Travel Condition: | | |
|---|---|---|
| **Main application** | Monospiral Reel | - |
| **Suitable** | - | Festoon |
| **Operating max speed** (mt/min) | 240 | 240 |

(1) Produced on request
(2) Toxicity index on finished cable <5
(3) Upon request special construction with copper braid screen according to **atex recommendations**

## **TRATOSMART-**(N)SHTÖU-JZ - **TRATOSMART-**(N)SHTÖU-JZK - **TRATOSGREEN-**(N)SHTÖU-JZ

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Temperature of the Conductor During Operation °C | Maximum Temperature of the Conductor During Short Circuit °C | Max. Tensile Load During Installation and Operation N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|---|
| FSA701 | 7x1,5 | 1,6 | 13,7 | 90 | 250 | 157 | 16,0 | 18,0 | 0,440 |
| FSA121 | 12x1,5 | 1,6 | 13,7 | 90 | 250 | 270 | 21,0 | 23,0 | 0,650 |
| FSA181 | 18x1,5 | 1,6 | 13,7 | 90 | 250 | 405 | 21,5 | 23,5 | 0,780 |
| FSA241 | 24x1,5 | 1,6 | 13,7 | 90 | 250 | 540 | 26,0 | 28,0 | 0,990 |
| FSA301 | 30x1,5 | 1,6 | 13,7 | 90 | 250 | 675 | 27,5 | 30,5 | 1,250 |
| FSA361 | 36x1,5 | 1,6 | 13,7 | 90 | 250 | 810 | 28,5 | 31,5 | 1,350 |
| FSA702 | 7x2,5 | 2,1 | 8,21 | 90 | 250 | 262 | 17,8 | 19,8 | 0,540 |
| FSA122 | 12x2,5 | 2,1 | 8,21 | 90 | 250 | 450 | 23,3 | 26,3 | 0,950 |
| FSA182 | 18x2,5 | 2,1 | 8,21 | 90 | 250 | 675 | 24,5 | 26,5 | 1,100 |
| FSA242 | 24x2,5 | 2,1 | 8,21 | 90 | 250 | 900 | 28,5 | 31,5 | 1,450 |
| FSA302 | 30x2,5 | 2,1 | 8,21 | 90 | 250 | 1125 | 31,0 | 34,0 | 1,850 |
| FSA362 | 36x2,5 | 2,1 | 8,21 | 90 | 250 | 1350 | 32,0 | 35,0 | 1,950 |

## Special signal - **TRATOSMART-**(N)SHTÖU-JZ - **TRATOSMART-**(N)SHTÖU-JZK

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Conductor DC Resistance at 20 °C Max Ω/Km | Maximum Temperature of the Conductor During Operation °C | Maximum Temperature of the Conductor During Short Circuit °C | Max. Tensile Load During Installation and Operation N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|---|
| FSA600C | 3x(2x1)C* | 1,3 | 20,0 | 90 | 250 | 90 | 22,5 | 24,5 | 0,650 |
| FSA601C | 3x(2x1,5)C* | 1,6 | 13,7 | 90 | 250 | 135 | 23,5 | 25,5 | 0,800 |
| FSA120C | 6x(2x1)C* | 1,3 | 20,0 | 90 | 250 | 180 | 28,0 | 29,5 | 1,150 |
| FSA121C | 6x(2x1,5)C* | 1,6 | 13,7 | 90 | 250 | 270 | 28,5 | 31,5 | 1,300 |
| FSA192501C | 19x2,5+5x1,5(C)* | 2,1/1,6 | 8,21/13,7 | 90 | 250 | 938 | 33,0 | 36,0 | 1,600 |

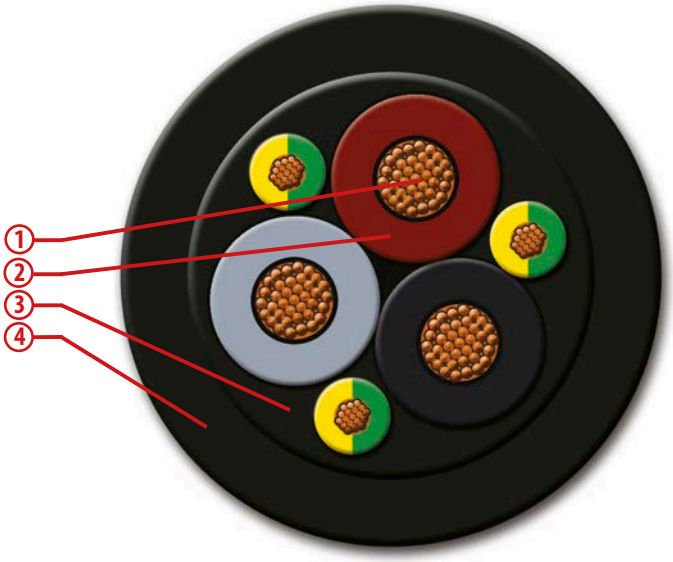
* Copper braid screened paires

LOW VOLTAGE POWER AND CONTROL CABLES

# TRATOSFESTOON®

Reduced dimension cable for **festoon application**.

## FEATURES AND PERFORMANCES

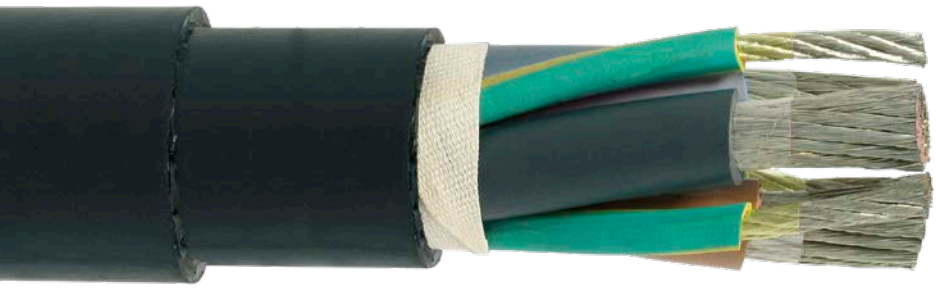



### CONSTRUCTION

1) Tinned flexible conductor Cl. 5 VDE 0295
2) Insulation special compound Tratosfestoon-I®, equivalent to or better than EPR 3GI3
3) Inner sheath special compound Tratosfestoon-IS®
4) Outer sheath special compound Tratosfestoon-OS®, black colour, at least 5GM3 quality

### TECHNICAL SPECIFICATIONS

- Rated Voltage 0,6/1 kV
- Max Voltage AC 0,7/1,2 kV
- AC Voltage Test 2,5 kV CONTROL CABLES
  3,5 kV POWER CABLES



| Working Ambient Temperature: | TRATOSFESTOON | Type K |
|---|---|---|
| **Fixed installation** | -40 °C to +80 °C | -60 °C to +60 °C |
| **In operation** | -25 °C to +80 °C | -40 °C to +80 °C |

| Travel Condition: | |
|---|---|
| **Main application** | FESTOON |
| **Suitable** m/min Max | - |
| **Operating max speed** (mt/min) | 240 |

## **TRATOSFESTOON -** Power cables - 0,6/1 kV

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Temperature of the Conductor During Operation °C | Maximum Temperature of the Conductor During Short Circuit °C | Max. Tensile Load During Installation and Operation N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|---|
| FOA125 | 1x25 | 6,5 | 0,795 | 90 | 250 | 375 | 12,0 | 13,25 | 0,340 |
| FOA135 | 1x35 | 7,9 | 0,565 | 90 | 250 | 525 | 13,3 | 14,60 | 0,450 |
| FOA150 | 1x50 | 9,5 | 0,393 | 90 | 250 | 750 | 15,5 | 16,80 | 0,640 |
| FOA170 | 1x70 | 11,4 | 0,277 | 90 | 250 | 1050 | 17,4 | 19,80 | 0,820 |
| FOA195 | 1x95 | 13,0 | 0,210 | 90 | 250 | 1425 | 19,2 | 21,20 | 1,100 |
| FOA10A | 1x120 | 14,8 | 0,164 | 90 | 250 | 1750 | 20,4 | 22,40 | 1,360 |
| FOA404 | 4x4 | 2,5 | 5,09 | 90 | 250 | 240 | 15,0 | 16,4 | 0,360 |
| FOA406 | 4x6 | 3,1 | 3,39 | 90 | 250 | 360 | 16,8 | 18,2 | 0,470 |
| FOA410 | 4x10 | 4,3 | 1,95 | 90 | 250 | 600 | 20,3 | 22,3 | 0,700 |
| FOA416 | 4x16 | 5,4 | 1,24 | 90 | 250 | 960 | 23,0 | 25,0 | 1,100 |
| FOA425 | 4x25 | 6,5 | 0,795 | 90 | 250 | 1500 | 27,5 | 29,5 | 1,650 |
| FOA335 | 3x35+3x16/3 | 7,9/3,1 | 0,565/1,24* | 90 | 250 | 1575 | 29,5 | 31,5 | 1,850 |
| FOA350 | 3x50+3x25/3 | 9,5/4,2 | 0,393/0,795* | 90 | 250 | 2250 | 33,9 | 35,9 | 2,600 |
| FOA370 | 3x70+3x35/3 | 11,4/4,8 | 0,277/0,565* | 90 | 250 | 3150 | 39,5 | 41,5 | 3,600 |

* Value of three conductors in parallel connection

## **TRATOSFESTOON -** Control cables - 0,6/1 kV

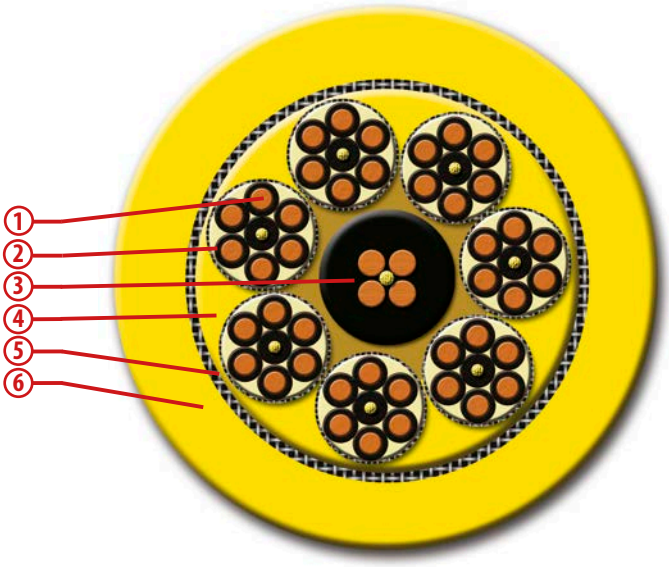
| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Conductor DC Resistance at 20 °C Max Ω/Km | Maximum Temperature of the Conductor During Operation °C | Maximum Temperature of the Conductor During Short Circuit °C | Max. Tensile Load During Installation and Operation N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|---|
| FOA122 | 12x2,5 | 2,1 | 8,21 | 90 | 250 | 450 | 23,8 | 25,8 | 0,840 |
| FOA182 | 18x2,5 | 2,1 | 8,21 | 90 | 250 | 650 | 24,5 | 26,5 | 0,980 |
| FOA242 | 24x2,5 | 2,1 | 8,21 | 90 | 250 | 900 | 27,8 | 30,8 | 1,250 |

LOW VOLTAGE CONTROL CABLES

# TRATOSLIGHT-VRDB® - Vertical Reels
# TRATOSLIGHT-VRDB-FO® - Vertical Reels + Fibre optic

**Cable for vertical application.**

## FEATURES AND PERFORMANCES




### CONSTRUCTION

1) Very fine plain copper conductor cl. 6 VDE 0295
2) Tratoslight-IR® special technopolymer
3) Reinforced central support
4) Inner sheath special elastomeric compound Tratoslight-IS®
5) Antitorsional braid embedded between inner and outer sheath
6) Outer sheath special elastomeric compound Tratoslight-OS®, yellow colour resistant to tearing and abrasion

### TECHNICAL SPECIFICATIONS

- Rated Voltage 0,6/1 kV
- Max Voltage AC 0,7/1,2 kV
- AC Voltage Test 2,5 kV

| Working Ambient Temperature: | TRATOSLIGHT-VRDB | Type K |
|---|---|---|
| **Fixed installation** | -40 °C to +80 °C | -60 °C to +60 °C |
| **In operation** | -20 °C to +80 °C | -40 °C to +80 °C |

| Travel Condition: | | | |
|---|---|---|---|
| **Main application** | - | - | Vertical Reels |
| **Suitable** m/min Max | Spreader Reels | Tender System | - |
| **Operating max speed** (mt/min) | **300** | **180** | **300** |

## **TRATOSLIGHT-VRDB -** Vertical Reels

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Temperature of the Conductor During Operation °C | Maximum Temperature of the Conductor During Short Circuit °C | Max. Tensile Load During Installation and Operation N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|---|
| FLDVA482 | 48x1 | 1,3 | 19,5 | 90 | 250 | 2000 | 35,0 | 38,0 | 1,600 |
| FLDVA182 | 18x2,5* | 2,15 | 7,98 | 90 | 250 | 3000 | 22,0 | 26,0 | 1,100 |
| FLDVA242 | 24x2,5* | 2,15 | 7,98 | 90 | 250 | 3600 | 26,4 | 29,4 | 1,400 |
| FLDVA302 | 30x2,5* | 2,15 | 7,98 | 90 | 250 | 4700 | 30,2 | 33,2 | 1,500 |
| FLDVA362S | 37x2,5* | 2,15 | 7,98 | 90 | 250 | 4700 | 30,2 | 33,0 | 1,850 |
| FLDVA422 | 42x2,5(7x6x2,5)** | 2,15 | 7,98 | 90 | 250 | 6600 | 37,8 | 41,8 | 2,280 |
| FLDVA442 | 44x2,5* | 2,15 | 7,98 | 90 | 250 | 5500 | 32,5 | 35,5 | 1,950 |
| FLDVA542 | 56x2,5* | 2,15 | 7,98 | 90 | 250 | 6600 | 39,0 | 43,0 | 2,500 |
| FLDVA363 | 37x3,3* | 2,65 | 6,00 | 90 | 250 | 4700 | 37,0 | 40,0 | 2,200 |
| FLDVA423 | 42x3,3* | 2,65 | 6,00 | 90 | 250 | 6600 | 41,0 | 44,0 | 2,450 |

* Cores assembled in different concentric layers
** Cores assembled in groups (each group 6 cores assembled). Produced upon request

## **TRATOSLIGHT-VRDB-FO -** Vertical Reels + Fibre optic

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Temperature of the Conductor During Operation °C | Maximum Temperature of the Conductor During Short Circuit °C | Max. Tensile Load During Installation and Operation N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|---|
| FLDVA242F | 24x2,5/4x(6x2,5)+FO** | 2,15 | 7,98 | 90 | 250 | 4700 | 31,8 | 34,8 | 1,600 |
| FLDVA302F | 30x2,5/5x(6x2,5)+FO** | 2,15 | 7,98 | 90 | 250 | 4700 | 34,7 | 38,5 | 2,080 |
| FLDVA362F | 36x2,5/6x(6x2,5)+FO** | 2,15 | 7,98 | 90 | 250 | 6600 | 37,8 | 41,8 | 2,280 |
| FLDVA548F | 48x2,5/8x(6x2,5)+FO** | 2,15 | 7,98 | 90 | 250 | 6600 | 43,8 | 47,8 | 2,800 |

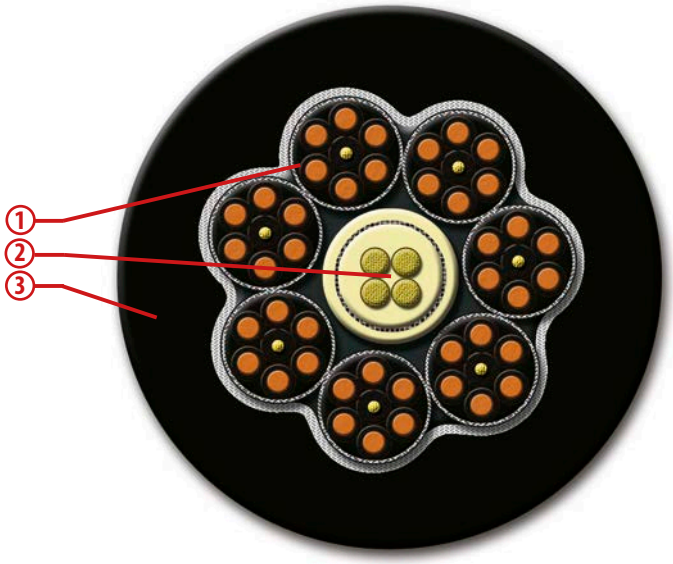
* Cores assembled in different concentric layers
** Upon request available special construction with 6 up to 24 integrated optical fires. Standard fibres type 62,5/125 (also available 50/125 and monomode E9/125)

CONTROL CABLES FOR GRAVITY-FED COLLECTOR IN BASKET suitable for spreader connection

# TRATOSCOILFLEX® - 300/500 V - Lead free
# TRATOSCOILFLEX-K®- 300/500 V - Lead free
# TRATOSCOILFLEX-FO® - 300/500 V - Lead free + Fibre optic

Heavy duty cable for **basket operation**.

## FEATURES AND PERFORMANCES

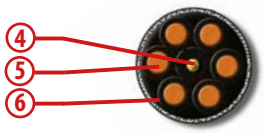


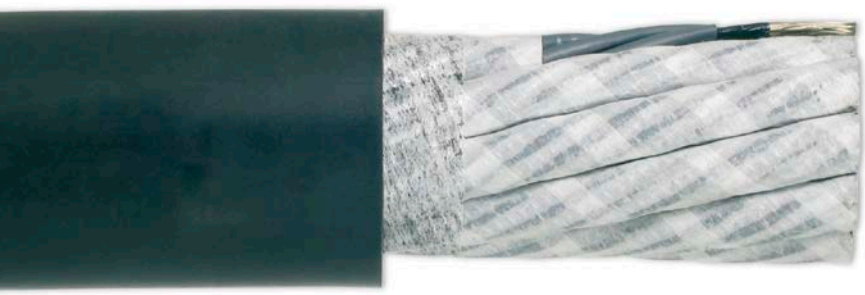

### CONSTRUCTION

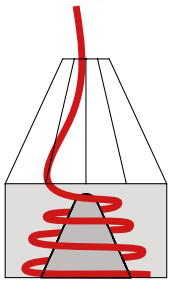
1) 6 core group
2) Kevlar support
3) Outer sheath black colour special polychloroprene compound Tratoscoilflex-OS®, better than 5GM3 quality
4) Kevlar support
5) Extra flexible conductor
6) Special EPR (90°C) insulation

### TECHNICAL SPECIFICATIONS

- Rated Voltage 300/500 V
- Max Voltage AC 550 V
- AC Voltage Test 2 kV





| Working Ambient Temperature: | TRATOSCOILFLEX | Type K |
|---|---|---|
| **Fixed installation** | -40 °C to +80 °C | -60 °C to +60 °C |
| **In operation** | -25 °C to +80 °C | -40 °C to +80 °C |

| Travel Condition: | |
|---|---|
| **Main application** | Vertical Basket |
| **Operating max speed** (mt/min) | 160 |

**Conductors/groups/total assembly lefthand:** during the installation please consider that cable turns to left direction
**Clockwise coiling recommended** starting from the bottom of the basket

## TRATOSCOILFLEX / TRATOSCOILFLEX-K - Lead free

| Part Number | Nominal Cores and Nominal Cross Section mm²/AWG | Maximum Single Wire Diameter mm | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Tensile Load N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m | Approx Minimum Bending Radius mm |
|---|---|---|---|---|---|---|---|---|---|
| FCA362 | 36x2,5/14AWG | 0,16 | 2,00 | 8,21 | 4000 | 38,6 | 41,6 | 2,600 | 650 |
| FCA422 | 42x2,5/14AWG | 0,16 | 2,00 | 8,21 | 4000 | 40,8 | 43,8 | 3,100 | 700 |
| FCA482 | 48x2,5/14AWG | 0,16 | 2,00 | 8,21 | 4000 | 45,8 | 48,8 | 3,700 | 750 |
| FCA542 | 54x2,5/14AWG | 0,16 | 2,00 | 8,21 | 4000 | 48,0 | 52,0 | 4,100 | 800 |
| FCA363 | 36x3,3/12AWG | 0,16 | 2,60 | 6,11 | 4000 | 44,5 | 47,5 | 3,250 | 700 |
| FCA423 | 42x3,3/12AWG | 0,16 | 2,60 | 6,11 | 4000 | 47,6 | 50,6 | 3,800 | 750 |
| FCA483 | 48x3,3/12AWG | 0,16 | 2,60 | 6,11 | 4000 | 52,0 | 55,0 | 4,500 | 800 |
| FCA543 | 54x3,3/12AWG | 0,16 | 2,60 | 6,11 | 4000 | 57,0 | 60,0 | 5,000 | 900 |

## TRATOSCOILFLEX-FO - Lead free + Fibre optic*

| Part Number | Nominal Cores and Nominal Cross Section mm²/AWG | Maximum Single Wire Diameter mm | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Tensile Load N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m | Approx Minimum Bending Radius mm |
|---|---|---|---|---|---|---|---|---|---|
| FCA362F | 36x2,5/14AWG+FO* | 0,16 | 2,00 | 8,21 | 4000 | 40,8 | 43,8 | 3,100 | 700 |
| FCA422F | 42x2,5/14AWG+FO* | 0,16 | 2,00 | 8,21 | 4000 | 45,8 | 48,8 | 3,700 | 750 |
| FCA482F | 48x2,5/14AWG+FO* | 0,16 | 2,00 | 8,21 | 4000 | 47,0 | 51,0 | 4,100 | 800 |
| FCA363F | 36x3,3/12AWG+FO* | 0,16 | 2,60 | 6,11 | 4000 | 46,6 | 49,6 | 3,800 | 750 |
| FCA423F | 42x3,3/12AWG+FO* | 0,16 | 2,60 | 6,11 | 4000 | 52,0 | 55,0 | 4,500 | 800 |
| FCA483F | 48x3,3/12AWG+FO* | 0,16 | 2,60 | 6,11 | 4000 | 57,0 | 60,0 | 5,000 | 900 |

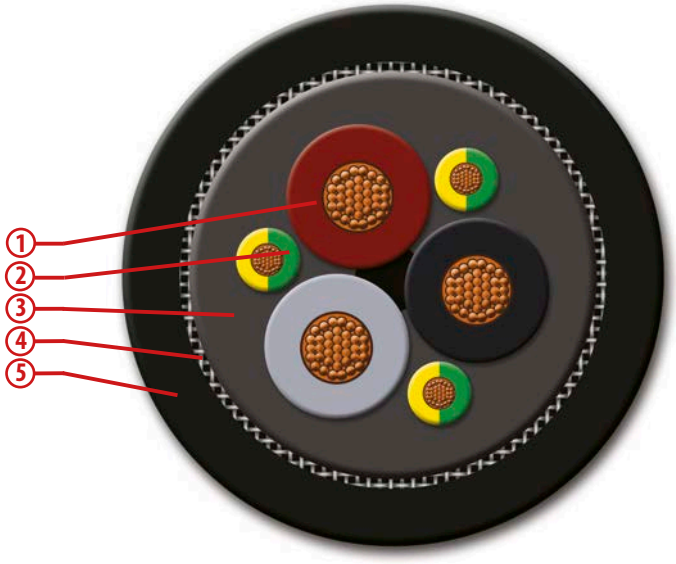
* Upon request available special construction with 6 up to 24 integrated optical fires. Standard fibres type 62,5/125 (also available 50/125 and monomode E9/125)

LOW VOLTAGE POWER CABLES - (N)SHTÖU-J VDE 0250 p.814

# TRATOSMART-DB® - (N)SHTÖU-J - High speed, high pull & torsion resistance
# TRATOSGREEN-DB® - (N)SHTÖU-J[1] - Reduced halogens and reduced toxicity[2][3]

High speed, high pull & torsion resistance. Main application **Electrified rubber tyred gantry cranes (E-RTG)** and **reel centre feed .**

## FEATURES AND PERFORMANCES

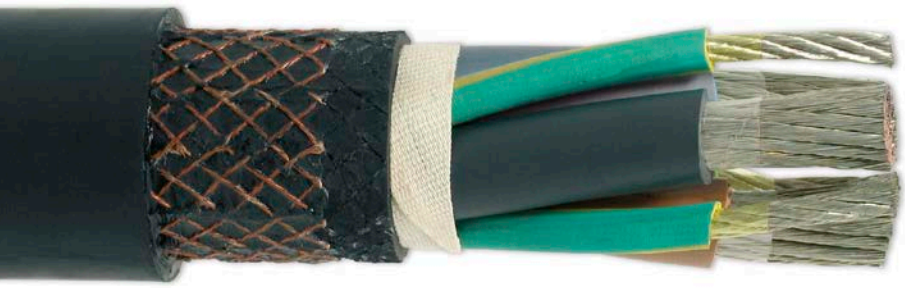



### CONSTRUCTION

1) Tinned flexible conductor Cl. 5 VDE 0295
2) Insulation special compound Tratos-JBA®, equivalent to or better than EPR 3GI3 quality
3) Inner sheath
4) Antitorsional protection better than 5GM3 quality
5) Outer sheath black colour special compound Tratos-JBA-OS®, better than 5GM3 (or 5GM5 if required) quality

### TECHNICAL SPECIFICATIONS

- Rated Voltage 0,6/1 kV
- Max Voltage AC 0,7/1,2 kV
- AC Voltage Test 3,5 kV



| Working Ambient Temperature: | TRATOSMART-DB | Type K |
|---|---|---|
| **Fixed installation** | -40 °C to +80 °C | -60 °C to +60 °C |
| **In operation** | -20 °C to +80 °C | -40 °C to +80 °C |

| Travel Condition: | | | |
|---|---|---|---|
| **Main application** | - | Monospiral Reel Centre Feed | - |
| **Suitable** m/min Max | Monospiral Reel End feed | - | Festoon |
| **Operating max speed** (mt/min) | **300** | 200 | 240 |

(1) Produced on request
(2) Toxicity index on finished cable <5
(3) Upon request special construction with copper braid screen according to **atex recommendations**

## **TRATOSMART-DB-**(N)SHTÖU-J/JK - **TRATOSGREEN-DB-**(N)SHTÖU-JZ - High speed, high pull & torsion resistance

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Temperature of the Conductor During Operation °C | Maximum Temperature of the Conductor During Short Circuit °C | Maximum Permanent Tensile Load N | Maximum Dynamical Tensile Load During Acceleration Processt N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|---|---|
| FDSA416 | 4x16 | 5,4 | 1,24 | 90 | 250 | 2000 | **2500** | 25,0 | 28,0 | 1,180 |
| FDSA425 | 4x25 | 6,5 | 0,795 | 90 | 250 | 3000 | **3600** | 28,5 | 31,5 | 1,710 |
| FDSA435 | 4x35 | 7,9 | 0,565 | 90 | 250 | 3500 | **4000** | 33,0 | 36,0 | 2,420 |
| FDSA450 | 4x50 | 9,5 | 0,393 | 90 | 250 | 4000 | **5000** | 37,5 | 40,5 | 2,800 |
| FDSA370 | 3x70+3x35/3 | 11,4/4,8 | 0,277/0,565* | 90 | 250 | 5600 | **6800** | 40,2 | 43,2 | 3,700 |
| FDSA395 | 3x95+3x50/3 | 13,0/5,4 | 0,210/0,393* | 90 | 250 | 6700 | **8500** | 44,5 | 47,5 | 4,680 |
| FDSA30A | 3x120+3x70/3 | 14,7/6,5 | 0,164/0,277* | 90 | 250 | 8500 | **11000** | 49,5 | 53,5 | 5,900 |
| FDSA30B | 3x150+3x70/3 | 16,5/6,5 | 0,132/0,277* | 90 | 250 | 11000 | **14000** | 53,8 | 57,8 | 6,950 |
| FDSA30C | 3x185+3x95/3 | 18,3/7,8 | 0,108/0,210* | 90 | 250 | 14000 | **17000** | 60,2 | 64,2 | 8,400 |
| FDSA30D | 3x240+3x120/3 | 20,7/9,3 | 0,0817/0,164* | 90 | 250 | 16000 | **21800** | 67,5 | 71,5 | 11,560 |

* Value of three conductors in parallel connection

Single, two and three cores cable produced upon request

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2019

### Tratos-JBA® compound

TRATOSMART-DB® and TRATOSGREEN-DB® are made with award winning Tratos-JBA® compound.

Tratos UK Ltd, has won a Queen's Award for Enterprise - Innovation for its technologically advanced Tratos-JBA® compound.

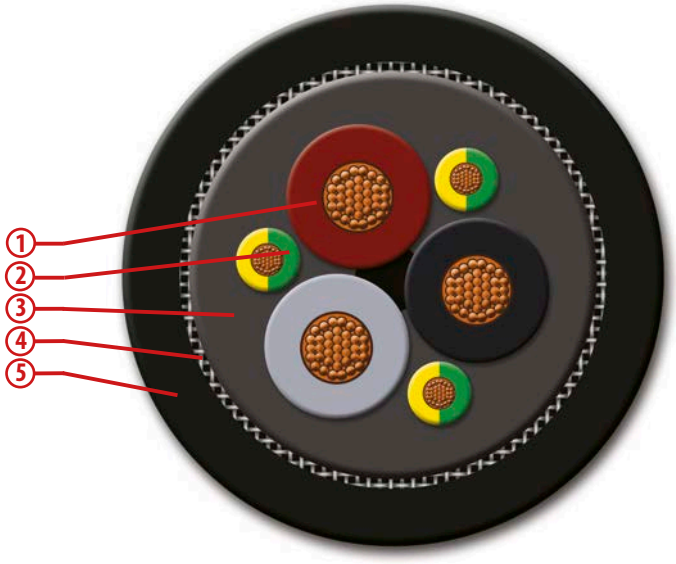
Tratos' new compound increases the safety of cable, its resistance to the most invasive and corrosive elements in the environment and its performance. It also offers significant reduction of fire propagation while continuing to function.

LOW VOLTAGE POWER CABLES - (N)SHTÖU-J VDE 0250 p.814

# TRATOSMART® - (N)SHTÖU-J
# TRATOSMART® - (N)SHTÖU-JK(1)
# TRATOSGREEN® - (N)SHTÖU-J(1) - Reduced halogens and reduced toxicity(2)(3)

Reduced dimension cable laid on ground for **reeling end feed application**.

## FEATURES AND PERFORMANCES

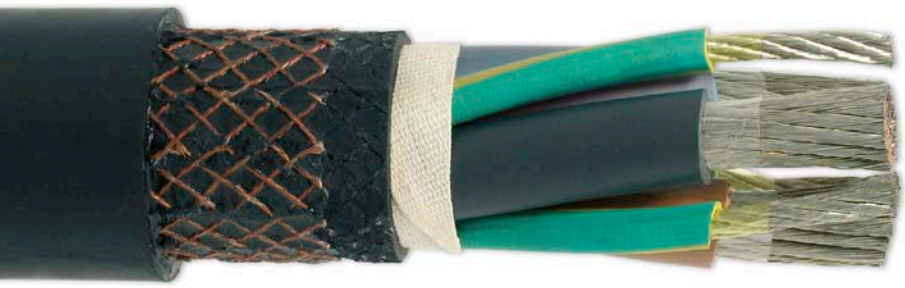



### CONSTRUCTION

1) Tinned flexible conductor Cl. 5 VDE 0295
2) Insulation special compound Tratosmart-I®, better than EPR 3GI3 quality
3) Inner sheath special compound Tratosmart-IS®, better than GM1B quality
4) Antitorsional protection
5) Outer sheath black colour special compound Tratos-JBA-OS®, better than 5GM3 (or 5GM5 if required) quality

### TECHNICAL SPECIFICATIONS

- Rated Voltage 0,6/1 kV
- Max Voltage AC 0,7/1,2 kV
- AC Voltage Test 3,5 kV



| Working Ambient Temperature: | TRATOSMART | Type K |
|---|---|---|
| **Fixed installation** | -40 °C to +80 °C | -60 °C to +60 °C |
| **In operation** | -25 °C to +80 °C | -40 °C to +80 °C |

| Travel Condition: | | |
|---|---|---|
| **Main application** | Monospiral Reel | - |
| **Suitable** m/min Max | - | Festoon |
| **Operating max speed** (mt/min) | 200 | 240 |

(1) Produced on request
(2) Toxicity index on finished cable <5
(3) Upon request special construction with copper braid screen according to **atex recommendations**

## **TRATOSMART-**(N)SHTÖU-JZ - **TRATOSMART-**(N)SHTÖU-JZK - **TRATOSGREEN-**(N)SHTÖU-JZ

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Temperature of the Conductor During Operation °C | Maximum Temperature of the Conductor During Short Circuit °C | Max. Tensile Load During Installation and Operation N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|---|
| FSA401 | 4x1,5 | 1,6 | 13,7 | 90 | 250 | 120 | 12,0 | 14,0 | 0,240 |
| FSA402 | 4x2,5 | 2,1 | 8,21 | 90 | 250 | 200 | 13,3 | 15,3 | 0,350 |
| FSA404 | 4x4 | 2,5 | 5,09 | 90 | 250 | 320 | 16,0 | 18,0 | 0,470 |
| FSA406 | 4x6 | 3,1 | 3,39 | 90 | 250 | 480 | 17,6 | 19,6 | 0,630 |
| FSA410 | 4x10 | 4,2 | 1,95 | 90 | 250 | 800 | 21,5 | 23,5 | 0,940 |
| FSA416 | 4x16 | 5,4 | 1,24 | 90 | 250 | 1280 | 24,0 | 27,0 | 1,260 |
| FSA425 | 4x25 | 6,5 | 0,795 | 90 | 250 | 2000 | 28,5 | 31,5 | 1,840 |
| FSA435 | 4x35 | 7,9 | 0,565 | 90 | 250 | 2800 | 32,5 | 35,0 | 2,540 |
| FSA350 | 3x50+3x25/3 | 9,5/4,2 | 0,393/0,795* | 90 | 250 | 3000 | 34,3 | 37,5 | 2,750 |
| FSA370 | 3x70+3x35/3 | 11,4/4,8 | 0,277/0,565* | 90 | 250 | 4200 | 40,2 | 43,2 | 3,950 |
| FSA395 | 3x95+3x50/3 | 13,0/5,4 | 0,210/0,393* | 90 | 250 | 5700 | 44,0 | 47,0 | 5,100 |
| FSA30A | 3x120+3x70/3 | 14,7/6,5 | 0,164/0,277* | 90 | 250 | 7200 | 50,2 | 54,2 | 6,350 |
| FSA30B | 3x150+3x70/3 | 16,5/6,5 | 0,132/0,277* | 90 | 250 | 9000 | 53,8 | 57,8 | 7,600 |
| FSA30C | 3x185+3x95/3 | 18,3/7,8 | 0,108/0,210* | 90 | 250 | 11000 | 60,2 | 64,2 | 9,000 |
| FSA30D | 3x240+3x120/3 | 20,7/9,3 | 0,0817/0,164* | 90 | 250 | 14400 | 67,0 | 71,0 | 12,000 |
| FSA501 | 5x1,5 | 1,6 | 13,7 | 90 | 250 | 150 | 12,8 | 14,8 | 0,320 |
| FSA502 | 5x2,5 | 2,1 | 8,21 | 90 | 250 | 250 | 14,8 | 16,8 | 0,380 |
| FSA504 | 5x4 | 2,5 | 5,09 | 90 | 250 | 400 | 17,0 | 19,2 | 0,500 |
| FSA506 | 5x6 | 3,1 | 3,39 | 90 | 250 | 600 | 19,5 | 21,0 | 0,700 |
| FSA510 | 5x10 | 4,2 | 1,95 | 90 | 250 | 1000 | 24,0 | 26,0 | 1,100 |
| FSA516 | 5x16 | 5,4 | 1,24 | 90 | 250 | 1600 | 27,8 | 29,8 | 1,550 |
| FSA410402** | 4x10+4x2,5 | 4,2/2,1 | 1,95/8,21 | 90 | 250 | 800 | 23,2 | 25,2 | 1,030 |
| FSA416402** | 4x16+4x2,5 | 5,4/2,1 | 1,24/8,21 | 90 | 250 | 1280 | 25,6 | 27,6 | 1,300 |
| FSA425402** | 4x25+4x2,5 | 6,5/2,1 | 0,795/8,21 | 90 | 250 | 2000 | 29,5 | 32,5 | 1,850 |
| FSA435402** | 4x35+4x2,5 | 7,8/2,1 | 0,565/8,21 | 90 | 250 | 2800 | 33,0 | 36,0 | 2,500 |

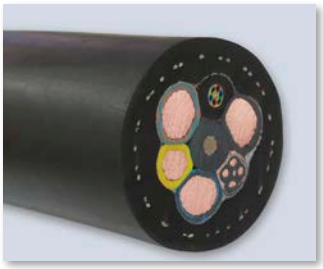
* Value of three conductors in parallel connection
** Mechanical grabs

Single, two and three cores cable produced upon request

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2019

### Tratos-JBA® compound

TRATOSMART® and TRATOSGREEN® are made with award winning Tratos-JBA® compound. Tratos UK Ltd, has won a Queen's Award for Enterprise - Innovation for its technologically advanced Tratos-JBA® compound.
Tratos' new compound increases the safety of cable, its resistance to the most invasive and corrosive elements in the environment and its performance. It also offers significant reduction of fire propagation while continuing to function.

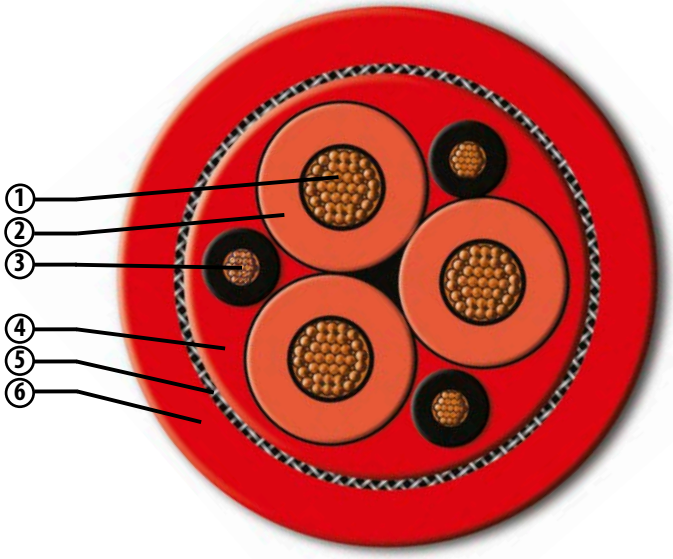


MEDIUM VOLTAGE POWER CABLES - (N) TSCGEWÖU VDE 0250 p.813 (as applicable) & HD 620 S1 p.9

# TRATOSFLEX-ESDB® - High speed, high pull & torsion resistance

High speed, high pull & torsion resistance for **reeling end and centre feeds application**.

## FEATURES AND PERFORMANCES




### CONSTRUCTION

1) Conductor more flexible than Cl. 5 VDE 0295
2) Semiconducting layer + Insulation Tratosflex-ESDB-I®, equivalent to or better than HEPR + Semiconducting layer*
3) Ground conductor with semiconducting layer
4) Inner sheath red colour elastomeric compound Tratos-JBA-IS®
5) Antitorsional protection
6) Outer sheath red colour elastomeric compound Tratosflex-JBA-OS®, better than 5GM5 quality

### TECHNICAL SPECIFICATIONS

| | | | | |
|---|---|---|---|---|
| • Rated Voltage | 3,6/6 kV | 6/10 kV | 8,7/15 kV | 12/20 kV |
| • Max Voltage AC | 4,2/7,2 kV | 6,9/12 kV | 10,4/18 kV | 13,9/24 kV |
| • AC Voltage Test | 11 kV | 17 kV | 24 kV | 29 kV |

| Working Ambient Temperature: | TRATOSFLEX-ESDB | Type K |
|---|---|---|
| **Fixed installation** | -40 °C to +80 °C | -60 °C to +60 °C |
| **In operation** | -30 °C to +80 °C | - |

| Travel Condition: | | | | |
|---|---|---|---|---|
| **Main application** | Monospiral Reel End feed | Monospiral Reel Centre feed | Random | - |
| **Suitable** m/min Max | - | - | - | Tender System |
| **Operating max speed** (mt/min) | **300** | **200** | 60 | 60 |

***Very special semiconducting compound which acts as a screen: the resistance between the ground conductor and semiconductive external layer of phase conductor must be maximum 500 Ohm measured according to VDE 0472 part 512**

## TRATOSFLEX-ESDB - High speed, high pull & torsion resistance

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Permanent Tensile Load N | Maximum Dynamical Tensile Load During Acceleration Processt N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|
| **3,6/6 kV (N)TSCGEWÖU** | | | | | | | | |
| FDC325 | 3x25+3x10 | 6,5/4,2 | 0,795/0,795* | 3000 | **4125** | 42,5 | 45,5 | 2,560 |
| FDC335 | 3x35+3x10 | 7,8/4,2 | 0,565/0,795* | 3000 | **4125** | 44,2 | 47,2 | 3,050 |
| FDC350 | 3x50+3x10 | 9,5/4,2 | 0,393/0,795* | 3600 | **5250** | 47,3 | 50,2 | 3,520 |
| FDC370 | 3x70+3x16 | 11,4/5,4 | 0,277/0,565* | 5000 | **7500** | 50,0 | 54,2 | 4,950 |
| FDC395 | 3x95+3x16 | 13,0/5,4 | 0,210/0,393* | 6500 | **8900** | 54,0 | 58,0 | 5,780 |
| FDC30A | 3x120+3x25 | 14,7/6,5 | 0,164/0,277* | 7500 | **10800** | 59,0 | 63,0 | 6,800 |
| FDC30B | 3x150+3x25 | 16,5/6,5 | 0,132/0,277* | 9000 | **12000** | 64,0 | 68,0 | 8,200 |
| | | (1) (2) | (1) (2) | | | | | |
| **6/10 kV (N)TSCGEWÖU** | | | | | | | | |
| FDD325 | 3x25+3x10 | 6,5/4,2 | 0,795/0,795* | 3000 | **4125** | 42,5 | 45,5 | 2,560 |
| FDD335 | 3x35+3x10 | 7,8/4,2 | 0,565/0,795* | 3000 | **4125** | 44,2 | 47,2 | 3,050 |
| FDD350 | 3x50+3x10 | 9,5/4,2 | 0,393/0,795* | 3600 | **5250** | 46,2 | 49,2 | 3,520 |
| FDD370 | 3x70+3x16 | 11,4/5,4 | 0,277/0,565* | 5000 | **7500** | 50,0 | 54,2 | 4,700 |
| FDD395 | 3x95+3x16 | 13,0/5,4 | 0,210/0,393* | 6500 | **8900** | 54,5 | 58,5 | 5,880 |
| FDD30A | 3x120+3x25 | 14,7/6,5 | 0,164/0,277* | 7500 | **10800** | 59,0 | 63,0 | 6,950 |
| FDD30B | 3x150+3x25 | 16,5/6,5 | 0,132/0,277* | 9000 | **12000** | 64,0 | 68,0 | 8,200 |
| **8,7/15 kV (N)TSCGEWÖU** | | | | | | | | |
| FDE325 | 3x25+3x10 | 6,5/4,2 | 0,795/0,795* | 3000 | **4125** | 43,5 | 47,0 | 2,750 |
| FDE335 | 3x35+3x10 | 7,8/4,2 | 0,565/0,795* | 3000 | **4125** | 47,1 | 50,1 | 3,250 |
| FDE350 | 3x50+3x10 | 9,5/4,2 | 0,393/0,795* | 3600 | **5250** | 50,0 | 54,0 | 3,890 |
| FDE370 | 3x70+3x16 | 11,4/5,4 | 0,277/0,565* | 5000 | **7500** | 54,0 | 58,0 | 5,100 |
| FDE395 | 3x95+3x16 | 13,0/5,4 | 0,210/0,393* | 6500 | **8900** | 59,1 | 63,1 | 6,270 |
| FDE30A | 3x120+3x25 | 14,7/6,5 | 0,164/0,277* | 7500 | **10800** | 64,5 | 68,5 | 7,700 |
| FDE30B | 3x150+3x25 | 16,5/6,5 | 0,132/0,277* | 9000 | **12000** | 69,5 | 73,5 | 8,600 |
| **12/20 kV (N)TSCGEWÖU** | | | | | | | | |
| FDF325 | 3x25+3x10 | 6,5/4,2 | 0,795/0,795* | 3000 | **4125** | 48,0 | 51,0 | 3,060 |
| FDF335 | 3x35+3x10 | 7,8/4,2 | 0,565/0,795* | 3000 | **4125** | 50,2 | 54,2 | 3,590 |
| FDF350 | 3x50+3x10 | 9,5/4,2 | 0,393/0,795* | 3600 | **5250** | 55,4 | 59,4 | 4,470 |
| FDF370 | 3x70+3x16 | 11,4/5,4 | 0,277/0,565* | 5000 | **7500** | 59,0 | 63,0 | 5,490 |
| FDF395 | 3x95+3x16 | 13,0/5,4 | 0,210/0,393* | 6500 | **8900** | 63,6 | 67,6 | 6,900 |
| FDF30A | 3x120+3x25 | 14,7/6,5 | 0,164/0,277* | 7500 | **10800** | 69,0 | 73,0 | 8,150 |
| FDFE30B | 3x150+3x25 | 16,5/6,5 | 0,132/0,277* | 9000 | **12000** | 73,0 | 77,0 | 9,150 |

(1) = Phase conductor
(2) = Protective conductors

Special dimensions produced upon request

* Value of three conductors in parallel connection

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2019

### Tratos-JBA® compound

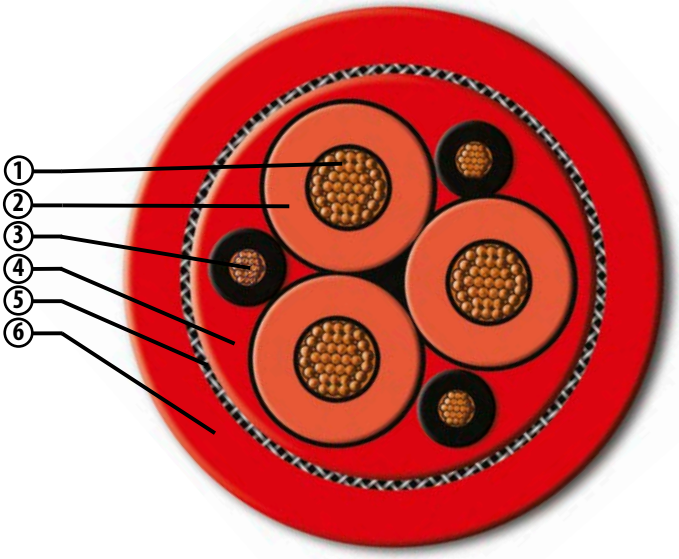
TRATOSFLEX-ESDB® is made with award winning Tratos-JBA® compound. Tratos UK Ltd, has won a Queen's Award for Enterprise - Innovation for its technologically advanced Tratos-JBA® compound.
Tratos' new compound increases the safety of cable, its resistance to the most invasive and corrosive elements in the environment and its performance.

MEDIUM VOLTAGE POWER CABLES - (N) TSCGEWÖU VDE 0250 p.813 (as applicable) & HD 620 S1 p.9

# TRATOSFLEX-ES3® - (Extruded Screen) - Reduced weight and dimension
# TRATOSGREEN-ES3® - Reduced halogens and reduced toxicity(1)(2)

Extruded screen. Reduced weight and dimension for **reeling end feed application**.

## FEATURES AND PERFORMANCES




### CONSTRUCTION

1) Conductor more flexible than cl. 5 VDE 0295
2) Semiconducting layer + insulation Tratosflex-ES3-I®, equivalent to HEPR + Semiconducting layer*
3) Ground conductor with semiconducting layer
4) Inner sheath high grade compound Tratosflex-ES3-IS®, better than GM1b quality
5) Antitorsional protection
6) Outer sheath red colour polychloroprene Tratosflex-ES3-OS®, equivalent to or better than 5GM3 (or 5GM5 if required) quality

### TECHNICAL SPECIFICATIONS

| | | | | |
|---|---|---|---|---|
| • Rated Voltage | 3,6/6 kV | 6/10 kV | 8,7/15 kV | 12/20 kV |
| • Max Voltage AC | 4,2/7,2 kV | 6,9/12 kV | 10,4/18 kV | 13,9/24 kV |
| • AC Voltage Test | 11 kV | 17 kV | 24 kV | 29 kV |

| Working Ambient Temperature: | TRATOSFLEX-ES3 |
|---|---|
| **Fixed installation** | -40 °C to +80 °C |
| **In operation** | -35 °C to +80 °C |

| Travel Condition: | |
|---|---|
| **Main application** | Monospiral Reel End feed |
| **Suitable** m/min Max | - |
| **Operating max speed** (mt/min) | 200 |

***Very special semiconducting compound which acts as a screen: the resistance between the ground conductor and the semiconductive external layer of phase conductor must be maximum 500 Ohm measured according to VDE 0472 part 512**

(1) Toxicity index on finished cable <5

(2) Upon request special construction with copper braid screen according to atex recommendations

## **TRATOSFLEX-ES3** - Reduced weight and dimension / **TRATOSGREEN-ES3** - Reduced weight and dimension

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Permanent Tensile Load ** N | Maximum Dynamical Tensile Load ** During Acceleration Processt N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|
| **6/10 kV (N)TSCGEWÖU** | | | | | | | | |
| F3ED325 | 3x25+3x10 | 6,5/4,2 | 0,795/0,795* | 1500 | 2250 | 40,0 | 43,0 | 2,470 |
| F3ED335 | 3x35+3x10 | 7,8/4,2 | 0,565/0,795* | 2100 | 3150 | 42,5 | 45,5 | 2,970 |
| F3ED350 | 3x50+3x10 | 9,5/4,2 | 0,393/0,795* | 3000 | 4500 | 45,5 | 48,5 | 3,470 |
| F3ED370 | 3x70+3x16 | 11,4/5,4 | 0,277/0,565* | 4200 | 5250 | 50,0 | 54,0 | 4,600 |
| F3ED395 | 3x95+3x16 | 13,0/5,4 | 0,210/0,393* | 5700 | 7000 | 54,5 | 58,5 | 5,800 |
| F3ED30A | 3x120+3x25 | 14,7/6,5 | 0,164/0,277* | 7200 | 9000 | 59,0 | 63,0 | 6,950 |
| F3ED30B | 3x150+3x25 | 16,5/6,5 | 0,132/0,277* | 9000 | 11250 | 64,0 | 67,5 | 8,200 |
| F3ED30C | 3x185+3x35 | 18,3/7,8 | 0,108/0,210* | 11100 | 13800 | 68,0 | 72,0 | 9,700 |
| **8,7/15 kV (N)TSCGEWÖU** | | | | | | | | |
| F3EE325 | 3x25+3x10 | 6,5/4,2 | 0,795/0,795* | 1500 | 2250 | 43,5 | 46,5 | 2,780 |
| F3EE335 | 3x35+3x10 | 7,8/4,2 | 0,565/0,795* | 2100 | 3150 | 46,0 | 49,0 | 3,240 |
| F3EE350 | 3x50+3x10 | 9,5/4,2 | 0,393/0,795* | 3000 | 4500 | 49,4 | 53,4 | 3,990 |
| F3EE370 | 3x70+3x16 | 11,4/5,4 | 0,277/0,565* | 4200 | 5250 | 54,0 | 58,0 | 5,050 |
| F3EE395 | 3x95+3x16 | 13,0/5,4 | 0,210/0,393* | 5700 | 7000 | 58,5 | 62,5 | 6,180 |
| F3EE30A | 3x120+3x25 | 14,7/6,5 | 0,164/0,277* | 7200 | 9000 | 63,2 | 67,2 | 7,580 |
| F3EE30B | 3x150+3x25 | 16,5/6,5 | 0,132/0,277* | 9000 | 12000 | 68,3 | 72,3 | 9,000 |
| **12/20 kV (N)TSCGEWÖU** | | | | | | | | |
| F3EF325 | 3x25+3x10 | 6,5/4,2 | 0,795/0,795* | 1500 | 2250 | 46,8 | 49,8 | 3,050 |
| F3EF335 | 3x35+3x10 | 7,8/4,2 | 0,565/0,795* | 2100 | 3150 | 49,0 | 52,0 | 3,570 |
| F3EF350 | 3x50+3x10 | 9,5/4,2 | 0,393/0,795* | 3000 | 4500 | 53,5 | 57,5 | 4,440 |
| F3EF370 | 3x70+3x16 | 11,4/5,4 | 0,277/0,565* | 4200 | 5250 | 57,5 | 61,5 | 5,460 |
| F3EF395 | 3x95+3x16 | 13,0/5,4 | 0,210/0,393* | 5700 | 7000 | 62,3 | 66,3 | 6,780 |
| F3EF30A | 3x120+3x25 | 14,7/6,5 | 0,164/0,277* | 7200 | 9000 | 66,5 | 70,5 | 8,050 |
| F3EF30B | 3x150+3x25 | 16,5/6,5 | 0,132/0,277* | 9000 | 12000 | 71,60 | 75,6 | 9,900 |

(1) = Phase conductor
(2) = Protective conductors

* Value of three conductors in parallel connection
** Please respect minimum bending radius

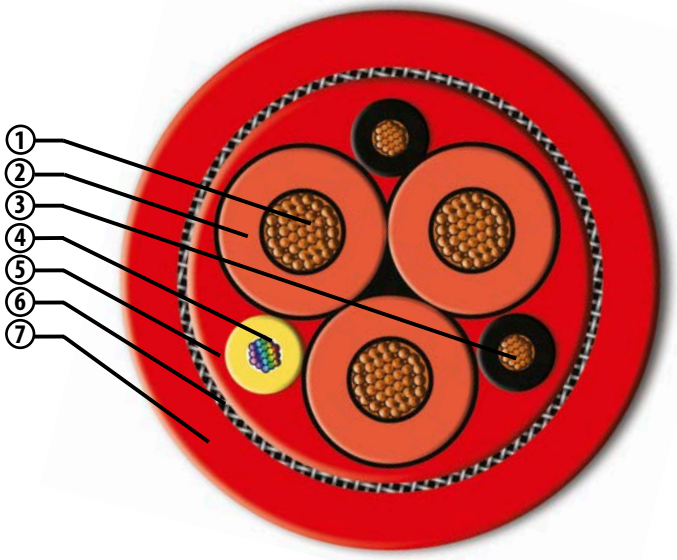
Cables for rated voltage >= 18/30 kV are produced upon request.

MEDIUM VOLTAGE POWER CABLES (N)TSCGEWÖU+LWL VDE 0250 p.813 (as applicable) & HD 620 S1 p.9

# TRATOSFLEX-ESDB-FO® - High speed, high pull & torsion resistance

High speed, high pull & torsion resistance for reeling end and **centre feed application wtih optical fibre.**

## FEATURES AND PERFORMANCES




### CONSTRUCTION

1) Conductor more flexible than Cl. 5 VDE 0295
2) Semiconducting layer + Insulation Tratosflex-ESDB-I®, equivalent to or better than HEPR + Semiconducting layer*
3) Ground conductor with semiconducting layer
4) Optical Fibre cable
5) Inner sheath red colour elastomeric compound Tratos-JBA-IS®
6) Antitorsional protection
7) Outer sheath red colour elastomeric compound TTratos-JBA-OS®, better than 5MG5 quality

### TECHNICAL SPECIFICATIONS

| | | | | |
|---|---|---|---|---|
| • Rated Voltage | 3,6/6 kV | 6/10 kV | 8,7/15 kV | 12/20 kV |
| • Max Voltage AC | 4,2/7,2 kV | 6,9/12 kV | 10,4/18 kV | 13,9/24 kV |
| • AC Voltage Test | 11 kV | 17 kV | 24 kV | 29 kV |

| Working Ambient Temperature: | TRATOSFLEX-ESDB-FO |
|---|---|
| **Fixed installation** | -40 °C to +80 °C |
| **In operation** | -30 °C to +80 °C |

| Travel Condition: | | | | |
|---|---|---|---|---|
| **Main application** | Monospiral Reel End feed | Monospiral Reel Centre feed | Random | - |
| **Suitable** m/min Max | - | - | - | Tender System |
| **Operating max speed** (mt/min) | **300** | **200** | 60 | 60 |

***Very special semiconducting compound which acts as a screen: the resistance between the ground conductor and semiconductive external layer of phase conductor must be maximum 500 Ohm measured according to VDE 0472 part 512**

## TRATOSFLEX-ESDB-FO - High speed, high pull & torsion resistance

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Permanent Tensile Load N | Maximum Dynamical Tensile Load During Acceleration Processt N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|
| **3,6/6 kV (N)TSCGEWÖU** | | | | | | | | |
| FDC325F | 3x25+2x25/2+FO** | 6,5/4,8 | 0,795/0,795* | 3000 | **4125** | 42,5 | 45,5 | 2,560 |
| FDC335F | 3x35+2x25/2+FO** | 7,8/4,8 | 0,565/0,795* | 3000 | **4125** | 44,2 | 47,2 | 3,050 |
| FDC350F | 3x50+2x25/2+FO** | 9,5/4,8 | 0,393/0,795* | 3600 | **5250** | 47,3 | 50,2 | 3,520 |
| FDC370F | 3x70+2x35/2+FO** | 11,4/5,4 | 0,277/0,565* | 5000 | **7500** | 52,2 | 54,2 | 4,950 |
| FDC395F | 3x95+2x50/2+FO** | 13,0/6,4 | 0,210/0,393* | 6500 | **8900** | 54,0 | 58,0 | 5,780 |
| FDC30AF | 3x120+2x70/2+FO** | 14,7/7,8 | 0,164/0,277* | 7500 | **10800** | 59,0 | 63,0 | 6,800 |
| FDC30BF | 3x150+2x70/2+FO** | 16,5/7,8 | 0,132/0,277* | 9000 | **12000** | 64,0 | 68,0 | 8,600 |
| FDC30CF | 3x185+2x95/2+FO** | 18,3/9,3 | 0,108/0,210* | 11100 | **14000** | 69,0 | 73,0 | 10,100 |
| | | (1) (2) | (1) (2) | | | | | |
| **6/10 kV (N)TSCGEWÖU** | | | | | | | | |
| FDD325F | 3x25+2x25/2+FO** | 6,5/4,8 | 0,795/0,795* | 3000 | **4125** | 42,5 | 45,5 | 2,560 |
| FDD335F | 3x35+2x25/2+FO** | 7,8/4,8 | 0,565/0,795* | 3000 | **4125** | 44,2 | 47,2 | 3,050 |
| FDD350F | 3x50+2x25/2+FO** | 9,5/4,8 | 0,393/0,795* | 3600 | **5250** | 47,2 | 50,2 | 3,520 |
| FDD370F | 3x70+2x35/2+FO** | 11,4/5,4 | 0,277/0,565* | 5000 | **7500** | 50,0 | 54,2 | 4,700 |
| FDD395F | 3x95+2x50/2+FO** | 13,0/6,4 | 0,210/0,393* | 6500 | **8900** | 54,5 | 58,5 | 5,880 |
| FDD30AF | 3x120+2x70/2+FO** | 14,7/7,8 | 0,164/0,277* | 7500 | **10800** | 59,0 | 63,0 | 6,950 |
| FDD30BF | 3x150+2x70/2+FO** | 16,5/7,8 | 0,132/0,277* | 9000 | **12000** | 64,0 | 68,0 | 8,600 |
| FDD30CF | 3x185+2x95/2+FO** | 18,3/9,3 | 0,108/0,210* | 11100 | **14000** | 69,3 | 73,3 | 10,300 |
| **8,7/15 kV (N)TSCGEWÖU** | | | | | | | | |
| FDE325F | 3x25+2x25/2+FO** | 6,5/4,8 | 0,795/0,795* | 3000 | **4125** | 44,5 | 47,5 | 2,840 |
| FDE335F | 3x35+2x25/2+FO** | 7,8/4,8 | 0,565/0,795* | 3000 | **4125** | 47,1 | 50,1 | 3,250 |
| FDE350F | 3x50+2x25/2+FO** | 9,5/4,8 | 0,393/0,795* | 3600 | **5250** | 50,0 | 54,0 | 3,890 |
| FDE370F | 3x70+2x35/2+FO** | 11,4/5,4 | 0,277/0,565* | 5000 | **7500** | 54,0 | 58,0 | 5,100 |
| FDE395F | 3x95+2x50/2+FO** | 13,0/6,4 | 0,210/0,393* | 6500 | **8900** | 59,1 | 63,1 | 6,270 |
| FDE30AF | 3x120+2x70/2+FO** | 14,7/7,8 | 0,164/0,277* | 7500 | **10800** | 64,5 | 68,5 | 7,700 |
| FDE30BF | 3x150+2x70/2+FO** | 16,5/7,8 | 0,132/0,277* | 9000 | **12000** | 69,0 | 73,0 | 9,200 |
| FDE30CF | 3x185+2x95/2+FO** | 18,3/9,3 | 0,108/0,210* | 11100 | **14000** | 75,0 | 79,0 | 11,000 |
| **12/20 kV (N)TSCGEWÖU** | | | | | | | | |
| FDF325F | 3x25+2x25/2+FO** | 6,5/4,8 | 0,795/0,795* | 3000 | **4125** | 48,6 | 51,0 | 3,180 |
| FDF335F | 3x35+2x25/2+FO** | 7,8/4,8 | 0,565/0,795* | 3000 | **4125** | 51,5 | 54,5 | 3,800 |
| FDF350F | 3x50+2x25/2+FO** | 9,5/4,8 | 0,393/0,795* | 3600 | **5250** | 55,0 | 59,0 | 4,470 |
| FDF370F | 3x70+2x35/2+FO** | 11,4/5,4 | 0,277/0,565* | 5000 | **7500** | 59,0 | 63,0 | 5,800 |
| FDF395F | 3x95+2x50/2+FO** | 13,0/6,4 | 0,210/0,393* | 6500 | **8900** | 63,6 | 67,6 | 6,900 |
| FDF30AF | 3x120+2x70/2+24FO* | 14,7/7,8 | 0,164/0,277* | 7500 | **10800** | 69,0 | 73,0 | 8,150 |

(1) = Phase conductor
(2) = Protective conductors
* Value of two conductors in parallel connection
** Upon request available special construction with 6 up to 24 integrated optical fires. Standard fibres type 62,5/125 (also available 50/125 and monomode E9/125)

THE QUEEN'S AWARDS FOR ENTERPRISE: INNOVATION 2019

### Tratos-JBA® compound

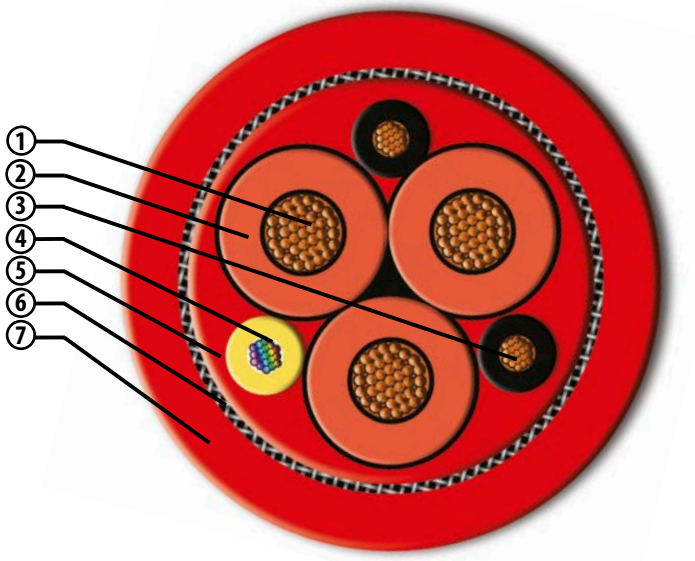
TRATOSFLEX-ESDB® is made with award winning Tratos-JBA® compound. Tratos UK Ltd, has won a Queen's Award for Enterprise - Innovation for its technologically advanced Tratos-JBA® compound.
Tratos' new compound increases the safety of cable, its resistance to the most invasive and corrosive elements in the environment and its performance.

MEDIUM VOLTAGE POWER CABLES (N)TSCGEWÖU+LWL VDE 0250 p.813 (as applicable) & HD 620 S1 p.9

# TRATOSFLEX-ES3-FO® - (Extruded Screen) - Reduced weight and dimension
# TRATOSGREEN-ES3-FO® - Reduced halogens and reduced toxicity(1)(2)

Extruded screen. Reduced weight and dimension for reeling **end feed application** wtih optical fibre.

## FEATURES AND PERFORMANCES




### CONSTRUCTION

1) Conductor more flexible than cl. 5 VDE 0295
2) Semiconducting layer + insulation Tratosflex-ES3-I®, equivalent to HEPR + Semiconducting layer*
3) Ground conductor with semiconducting layer
4) Optical Fibre cable
5) Inner sheath high grade compound Tratosflex-ES3-IS®, better than GM1b quality
6) Antitorsional protection
7) Outer sheath red colour polychloroprene Tratosflex-ES3-OS®, equivalent to or better than 5GM3 (or 5GM5 if required) quality

### TECHNICAL SPECIFICATIONS

| | | | | |
|---|---|---|---|---|
| • Rated Voltage | 3,6/6 kV | 6/10 kV | 8,7/15 kV | 12/20 kV |
| • Max Voltage AC | 4,2/7,2 kV | 6,9/12 kV | 10,4/18 kV | 13,9/24 kV |
| • AC Voltage Test | 11 kV | 17 kV | 24 kV | 29 kV |

| Working Ambient Temperature: | TRATOSFLEX-ES3-FO |
|---|---|
| **Fixed installation** | -40 °C to +80 °C |
| **In operation** | -35 °C to +80 °C |

| Travel Condition: | |
|---|---|
| **Main application** | Monospiral Reel End feed |
| **Suitable** m/min Max | - |
| **Operating max speed** (mt/min) | 200 |

***Very special semiconducting compound which acts as a screen: the resistance between the ground conductor and semiconductive external layer of phase conductor must be maximum 500 Ohm measured according to VDE 0472 part 512**

(1) Toxicity index on finished cable <5

(2) Upon request special construction with copper braid screen according to atex recommendations

## TRATOSFLEX-ES3-FO / TRATOSGREEN-ES3-FO - Reduced weight and dimension

| Part Number | Nominal Cross Section mm² | Nominal Conductor Diameter mm | Maximum Conductor DC Resistance at 20 °C Ω/Km | Maximum Permanent Tensile Load N | Maximum Dynamical Tensile Load During Acceleration Processt N | Minimum Overall Diameter mm | Maximum Overall Diameter mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|---|---|
| **6/10 kV (N)TSCGEWÖU** | | | | | | | | |
| F3ED325F | 3x25+2x25/2+ FO** | 6,5/4,8 | 0,795/0,795* | 1500 | 2250 | 40,5 | 43,5 | 2,510 |
| F3ED335F | 3x35+2x25/2+ FO** | 7,8/4,8 | 0,565/0,795* | 2100 | 3150 | 42,8 | 45,8 | 2,980 |
| F3ED350F | 3x50+2x25/2+ FO** | 9,5/4,8 | 0,393/0,795* | 3000 | 4500 | 45,7 | 48,7 | 3,550 |
| F3ED370F | 3x70+2x35/2+ FO** | 11,4/5,4 | 0,277/0,565* | 4200 | 5250 | 49,8 | 53,8 | 4,800 |
| F3ED395F | 3x95+2x50/2+ FO** | 13,0/6,4 | 0,210/0,393* | 5700 | 7000 | 54,5 | 58,5 | 5,800 |
| F3ED30AF | 3x120+2x70/2+ FO** | 14,7/7,8 | 0,164/0,277* | 7200 | 9000 | 59,3 | 63,3 | 7,400 |
| F3ED30BF | 3x150+2x70/2+ FO** | 16,5/7,8 | 0,132/0,277* | 9000 | 11250 | 64,2 | 68,2 | 8,500 |
| F3ED30CF | 3x185+2x95/2+ FO** | 18,3/9,3 | 0,108/0,210* | 11100 | 13800 | 69,0 | 73,0 | 10,000 |
| **8,7/15 kV (N)TSCGEWÖU** | | | | | | | | |
| F3EE325F | 3x25+2x25/2+ FO** | 6,5/4,8 | 0,795/0,795* | 1500 | 2250 | 44,0 | 47,0 | 2,950 |
| F3EE335F | 3x35+2x25/2+ FO** | 7,8/4,8 | 0,565/0,795* | 2100 | 3150 | 46,4 | 49,4 | 3,340 |
| F3EE350F | 3x50+2x25/2+ FO** | 9,5/4,8 | 0,393/0,795* | 3000 | 4500 | 49,3 | 53,3 | 4,150 |
| F3EE370F | 3x70+2x35/2+ FO** | 11,4/5,4 | 0,277/0,565* | 4200 | 5250 | 54,0 | 58,0 | 5,300 |
| F3EE395F | 3x95+2x50/2+ FO** | 13,0/6,4 | 0,210/0,393* | 5700 | 7000 | 59,0 | 63,0 | 6,100 |
| F3EE30AF | 3x120+2x70/2+ FO** | 14,7/7,8 | 0,164/0,277* | 7200 | 9000 | 63,0 | 67,0 | 7,700 |
| F3EE30BF | 3x150+2x70/2+ FO** | 16,5/7,8 | 0,132/0,277* | 9000 | 11250 | 69,0 | 73,0 | 9,300 |
| **12/20 kV (N)TSCGEWÖU** | | | | | | | | |
| F3EF325F | 3x25+2x25/2+ FO** | 6,5/4,8 | 0,795/0,795* | 1500 | 2250 | 47,2 | 50,2 | 3,250 |
| F3EF335F | 3x35+2x25/2+ FO** | 7,8/4,8 | 0,565/0,795* | 2100 | 3150 | 50,0 | 54,0 | 3,800 |
| F3EF350F | 3x50+2x25/2+ FO** | 9,5/4,8 | 0,393/0,795* | 3000 | 4500 | 53,8 | 57,8 | 4,650 |
| F3EF370F | 3x70+2x35/2+ FO** | 11,4/5,4 | 0,277/0,565* | 4200 | 5250 | 57,7 | 61,7 | 5,670 |
| F3EF395F | 3x95+2x50/2+ FO** | 13,0/6,4 | 0,210/0,393* | 5700 | 7000 | 64,0 | 68,0 | 6,690 |
| F3EF30AF | 3x120+2x70/2+ FO** | 14,7/7,8 | 0,164/0,277* | 7200 | 9000 | 68,3 | 72,3 | 8,350 |
| F3EF30BF | 3x150+2x70/2+ FO** | 16,5/7,8 | 0,132/0,277* | 9000 | 11250 | 74,0 | 78,0 | 10,500 |

(1) = Phase conductor
(2) = Protective conductors

* Value of two conductors in parallel connection
** Upon request available special construction with 6 up to 24 integrated optical fires. Standard fibres type 62,5/125 (also available 50/125 and monomode E9/125)

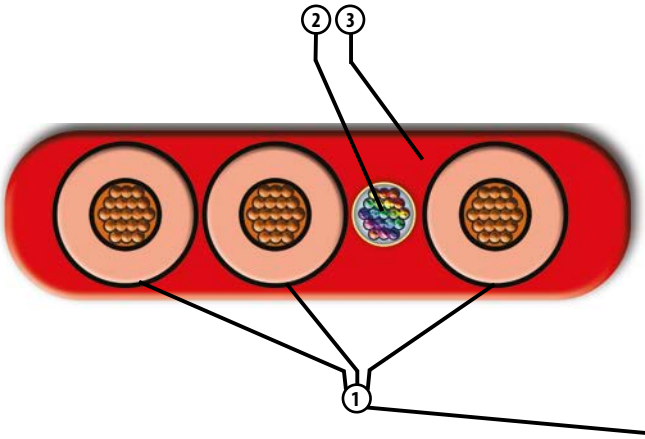
Cables for rated voltage >= 18/30 kV are produced upon request.

MEDIUM VOLTAGE FLAT CABLE for reeling application

# TRATOSFLAT®
# TRATOSFLAT-FO®

Medium voltage flat cable.

## FEATURES AND PERFORMANCES

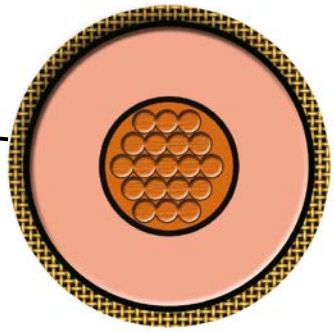


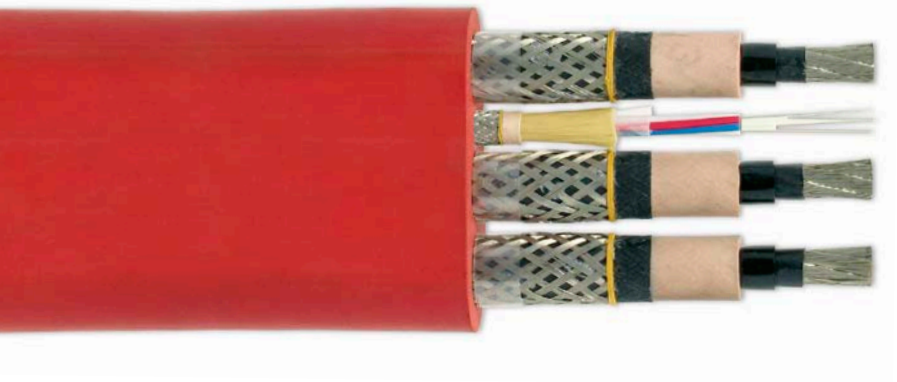

### CONSTRUCTION

1) Screened phase conductors
2) Optical fibre cable
3) Outer sheath red colour polychloroprene Tratoflat-OS®, equivalent to or better than 5GM3 (or 5GM5 if required) quality

### TECHNICAL SPECIFICATIONS

| | | |
|---|---|---|
| • Rated Voltage | 3,6/6 kV | 6/10 kV |
| • Max Voltage AC | 4,2/7,2 kV | 6,9/12 kV |
| • AC Voltage Test | 11 kV | 17 kV |





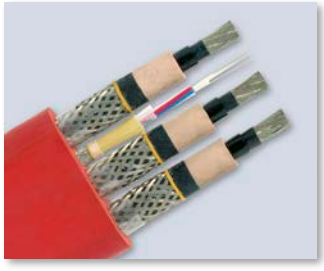
| Working Ambient Temperature: | TRATOSFLAT |
|---|---|
| **Fixed installation** | -40 °C to +80 °C |
| **In operation** | -30 °C to +80 °C |

| Travel Condition: | |
|---|---|
| **Main application** | Monospiral Reel End feed |
| **Suitable** m/min Max | - |
| **Operating max speed** (mt/min) | 200 |

## TRATOSFLAT / TRATOSFLAT-FO

| Part Number | Nominal Cross Section mm² | Maximum Temperature of the Conductor During Operation °C | Maximum Temperature of the Conductor During Short Circuit °C | Maximum Tensile Load During Installation and Operation N | Maximum Dimension mm | Nominal Cable Weight Kg/m |
|---|---|---|---|---|---|---|
| **3,6/6 kV (N)TSCGEWÖU** | | | | | | |
| FT3DB435F | 3x35+4x25/4E+OFE12x62,5/125 | 90 | 250 | 1575 | 87 x 30,0 | 4,000 |
| FT3DB450F | 3x50+4x25/4E+OFE12x62,5/125 | 90 | 250 | 2250 | 92 x 32,5 | 4,700 |
| **6/10 kV (N)TSCGEWÖU** | | | | | | |
| FT3DC435F | 3x35+4x25/4E+OFE12x62,5/125 | 90 | 250 | 1575 | 89 x 30,5 | 4,100 |
| FT3DC450F | 3x50+4x25/4E+OFE12x62,5/125 | 90 | 250 | 2250 | 95 x 33,0 | 5,100 |
| **8,7/15 kV (N)TSCGEWÖU** | | | | | | |
| FT3DD435F | 3x35+4x25/4E+OFE12x62,5/125 | 90 | 250 | 1620 | 93 x 32,0 | 4,800 |
| FT3DD450F | 3x50+4x25/4E+OFE12x62,5/125 | 90 | 250 | 2300 | 97 x 33,5 | 5,200 |

Standard fibres type 62,5/125 or 50/125 on request

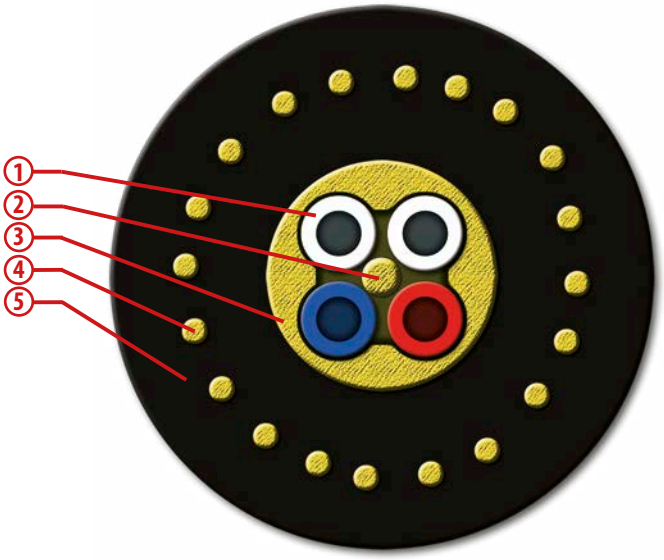


FIBRE CABLE

# TRATOSFIBRE-DB®

Fibre optic cable.

## FEATURES AND PERFORMANCES




### CONSTRUCTION

1) Optical fibre
2) Central support
3) Kevlar reinforcement
4) Antitorsional protection
5) Outer sheath black colour Tratosfibre-DB-OS®

### TRATOSFIBRE-DB

| Part Number | FIbres | Types (1) | Nominal Overall Diameter mm | Maximum Tensile Load N | Nominal Cable Weight Kg/Km | Minimum Bendig Radius mm |
|---|---|---|---|---|---|---|
| TFBG06 | multiple-mode grade index | 6 G 62,5/125 | 14 | 5000 | 225 | 130 festoon application<br>250 reeling application |
| TFBG12 | multiple-mode grade index | 12 G 62,5/125 | 14 | 5000 | 225 | |
| TFBG18 | multiple-mode grade index | 18 G 62,5/125 | 14 | 5000 | 225 | |
| TFBG24 | multiple-mode grade index | 24 G 62,5/125 | 14 | 5000 | 225 | |
| TFBE06 | monomode | 6 E 9/125 | 14 | 5000 | 225 | |
| TFBE12 | monomode | 12 E 9/125 | 14 | 5000 | 225 | |
| TFBE18 | monomode | 18 E 9/125 | 14 | 5000 | 225 | |
| TFBE24 | monomode | 24 E 9/125 | 14 | 5000 | 225 | |

(1) 50/125 type produced upon request

## TRATOSFIBRE-DB

| OPTICAL parameters | Grade index fibre 62,5/125 | Monomode fibre E9/125 |
|---|---|---|
| Max attenuation at wavelength 850 nm | 3,2 dB/km | - |
| Max attenuation at wavelength 1300 nm | 0,9 dB/km | 0,4 dB/km |
| Max attenuation at wavelength 1550 nm | - | 0,3 dB/km |
| Bandwidth at 850 nm | ≥ 400 MHz | - |
| Bandwidth at 1300 nm | ≥ 600 MHz | - |
| Numerical aperture | 0,275 ± 0,015 | 0,140 ± 0,02 |
| Attenuation on completed cable (max) at wavelength 1300 nm | 5,00 dB/km | 2,00 dB/km |

| THERMAL parameters | TRATOSFIBRE-DB | Type K |
|---|---|---|
| Fully flexible operation (ambient temperature) | -40 °C to +80 °C | -60 °C to +60 °C |
| Fixed installation | -30 °C to +80 °C | -60 °C to +60 °C |

| OTHER parameters | |
|---|---|
| Max tensile strength | 5000 N |
| Minimum bending radius for fixed installation | 130 mm |
| Minimum bending radius for cilindrical reel | 250 mm |
| Travel speed for festoon systems | up to 240 m/min |

| CHEMICAL parameters<br>Trasmission data of the fibre-optics | |
|---|---|
| Weather resistance | Resistant to ozone, UV and moisture |
| Resistance to oil | Acc. to DIN VDE 0473 |

| Travel Condition: | | |
|---|---|---|
| Main application | Monospiral Reel End feed | Festoon |
| Suitable m/min Max | - | - |
| Operating max speed (mt/min) | 300 | 240 |

SPECIAL CABLES TAILORED

## BESPOKEN CABLES

"**Cables Tailor Made**" is a special division of Tratos Cavi S.p.A. Working with our customers Cables Tailor Made are able to offer custom designed and built solutions to the most demanding of circumstances. Using our **40 years of cable design and construction experience** we can examine the challenges facing our customers and bring together our expertise and cutting edge technology to provide the ideal tailor made solution. Our **special cable**s can incorporate power, control, signalling and fibre-optic elements.

# TRATOXFLEX® - Reeling Cables

**https://tratosgroup.com/products/special-cables/reeling-cables/**

# Let's take another turn

*Our cables have been continually working for many years with high speed applications all around the world.*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June 2020