BRAIDING TECHNOLOGY
Shield Performances

- Braid Shields are usually composed of tinned or bare copper wires interwoven around the conductors in a cable.
- In addition to providing excellent shielding properties, braid shields are very flexible and add to the structural integrity of the cable.
- Braid shields differ widely in their construction. Braid Angle, Strand diameter, wire type, number of ends per carrier and the number of carriers contribute to the effectiveness of the shield.
- Braid Coverage varies between 40% and 95% for the *single braids* and up to 98% for *double braids*.
- Foil/Braid combination shield consists of tinned copper or Aluminum braid over an aluminum/polyester foil tape. Braid coverage varies between 40% and 95%. However, aluminum foil coverage is 100%.
To gain greater shield effectiveness, an additional layer of foil is placed over the existing foil and braid which produces a *Tri shield cable*. The highest grade of shield effectiveness can be obtained in *Quad shield cables*. A quad shield coverage design consists of an aluminum foil with a 60% braid covered by an additional foil and 40% braid.

As shown in the graphs below, combination shields are more effective and offer better transfer impedance properties than single braid shields. Quad shielding also offers better long term performances because it is less effected by repeated flexing.
Shield Effectiveness

Shield effectiveness

![Graph showing shield effectiveness across different frequencies for various materials like Tri & quad, Foil/braid, and 95% copper shield.](image)
Transfer Impedance

![Transfer impedance graph showing different types of shielding effectiveness over frequency. The graph includes lines for 95% copper shield, foil/braid, and Tri & quad shielding.](image)
Braid Coverage

- \( K = (2F - F^2) \times 100 \)
- \( N \times C \times d \)
- \( F = \frac{2L \times \sin \varepsilon}{2\pi \times D} \)
- \( \tan \varepsilon = \frac{L}{D} \)

- \( K = \text{Braid Coverage} \)
- \( F = \text{Single Direction Coverage} \)
- \( N = \text{Number of ends per carrier} \)
- \( C = \text{Number of Carriers} \)
- \( d = \text{Diameter of individual wire}(\text{mm}) \)
- \( D = \text{Diameter before braiding}(\text{mm}) \)
- \( L = \text{Pitch}(\text{mm}) \)
- \( \varepsilon = \text{Braiding Angle} \)
Braiding

- There are three major types of braiding machines.
  - Maypole
  - Deflector
  - Lever Arm

- Maypole braider
  - Produced by many small manufacturers
  - Very Low speed, Very cheap price
  - Almost no tension control

- Deflector type Braider
  - Most popular braiding system
  - Wardwell of the U.S. is the only manufacturer of this braider
  - High Speed
  - Reasonable pricing
  - Acceptable tension control

- Lever Arm type Braider
  - High Speed
  - Very precise Tension Control
  - Expensive
  - Warwell Germany, Kyoritsu
Maypole Braider

- Maypole Braider was originally for the braiding of textiles.
- This machine can be used for wire braiding for limited application.
  - Single layer braiding
  - Not tension sensitive application
- Machine Price is extremely cheap usually. Machine available from USD1,000 ranges.
Deflector Braider

- Main Braiding Machine from Wardwell, U.S.

- For Aluminum Wire Braiding, Rapid Braider is desirable because;
  1. It uses bigger bobbin
  2. It rotates at high speed, 110 RPM.
  3. Less wire breaks

- For copper wire braiding, both Rapid Braider and Speedmaster can be used.
  1. For 16C braiding, Rapid Braider rotates at 75 RPM. However, the size of bobbin is bigger.
  2. Speedmaster rotates at 150 RPM with smaller bobbins.
  3. For 24C braiding, Speedmaster is better.
Rapid Braider
Specifications

- Number of bobbins
- Bobbin rotation speed
- Bobbin capacity
- Jog/creep speed
- Braiding material

- Wires per bobbin
- Central passage
- Core diameter
- Lay length
- Haul-off type (optional with change gears or motorized)
- Motor output
- Noise level
- Integrated take-up & pay-off (optional)

- 12 / 16 / 24
- 50- 150 / 50- 100 rpm
- 180 / 280 / 380 cm³
- 12 / 8 rpm
- aluminum, copper, soft steel, spring steel wires
- ø 0.05 - 0.30 mm
- braiding of flat wire
- Textiles and plastic yarns1 - 10
- 15 / 25 mm
- 14 / 24 mm
- 3- 90 / 6- 120 mm variable
- 380 / 630 mm capstan

- 2.2 / 3.0 kW
- 80 dB(A)
- Reel outer ø max. 800 mm
  (optional 1000 mm)
Speedmaster
Specifications

- Number of bobbins
- Bobbin rotation speed
- Bobbin capacity
- Jog/creep speed
- Braiding material

- Wires per bobbin
- Central passage
- Core diameter
- Lay length
- Haul-off type (optional with change gears or motorized)
- Motor output
- Noise level
- Integrated take-up & pay-off (optional)

- 12 / 16 / 24
- 50-150 / 50-100 rpm
- 180 / 280 / 380 cm³
- 12 / 8 rpm
- aluminum, copper, soft steel, spring steel wires
- ø 0.05 - 0.30 mm
- braiding of flat wire
- Textiles and plastic yarns 1 - 10
- 15 / 25 mm
- 14 / 24 mm
- 3-90 / 6-120 mm variable
- 380 / 630 mm capstan

- 2.2 / 3.0 kW
- 80 dB(A)
- Reel outer ø max. 800 mm (optional 1000 mm)
### Spring Selection Chart

**Wardwell**

- **Spring combinations and tensions for 16 and 24 carrier wire braiders**
- **"speedmaster 150 and 100"**
- **for plain copper and coper coated wires**

**Upper Carriers**

<table>
<thead>
<tr>
<th>Tension Springs</th>
<th>Number of Ends</th>
<th>Number of Ends</th>
<th>Number of Ends</th>
<th>Number of Ends</th>
</tr>
</thead>
<tbody>
<tr>
<td>W16-1032 A pink</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W16-1032 AA white</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W16-1032 B green</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>W16-1032 F brown</td>
<td></td>
<td></td>
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**Lower Carriers**

<table>
<thead>
<tr>
<th>Tension Springs</th>
<th>Number of Ends</th>
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</thead>
<tbody>
<tr>
<td>W16-160 A red</td>
<td></td>
</tr>
<tr>
<td>W16-160 AA white</td>
<td></td>
</tr>
<tr>
<td>W16-160 AAA neutral</td>
<td></td>
</tr>
<tr>
<td>W16-160 B green</td>
<td></td>
</tr>
<tr>
<td>W16-160 C yellow</td>
<td></td>
</tr>
<tr>
<td>W16-160 D blue</td>
<td></td>
</tr>
</tbody>
</table>

**Pawl Springs**

| S16-746 C        |               |
| S16-746 D        |               |
| S16-746 E        |               |
| S16-746 F        |               |

**Tension in Grams**

<table>
<thead>
<tr>
<th>100</th>
<th>150</th>
<th>200</th>
<th>250</th>
<th>300</th>
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<th>450</th>
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<td></td>
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</tr>
</tbody>
</table>

This chart has been compiled from the results of multiple testing and years of experience, but should be used only as a base for determining spring combinations. They may vary slightly depending on the application.
Lever Arm Braider

• This is the most sophisticated braiding system.
• Spirka and Schnellflechter Berlin (Both belong to Wardwell Group) are the representative Lever Arm Machine manufacturers.
• All kinds of Coaxial Cabling Braiding can be done using this type braiders. It is especially powerful and useful for Wireless application coaxial cable braiding.
• Spirka is producing three models.
  - DF & DFT Braider: Mainly for coaxial cable
  - F03A: With 550 spools
  - 48F3H: Mainly for steel wire armoring
• Schnellflechter is producing three models.
  - Dratex: Mainly for coaxial cable
  - Dratex 2450: Mainly for steel wire armoring, vertical
  - Unidra: Mainly for steel wire armoring, horizontal
DRATEX 12, 16, 24

For
Aluminum-, Copper-, Soft Steel-
H.T. Steel Wires and Textile Yarns
Operator Panel OP7 and PLC S7 from Siemens

Motorized or gear-driven Capstan

Integrated Take-up and Pay-off for DIN Reels up to 1000 mm
Braiding Head

Bobbin Size
80 / 100 / 80, 380 ccm
2.3 kg CU or 2.0 kg St

Automatic Central Lubrication
Specifications

- Number of bobbins
  - 12 / 16 / 24
- Bobbin rotation speed
  - 50- 150 / 50- 100 rpm
- Bobbin capacity
  - 180 / 280 / 380 cm³
- Jog/creep speed
  - 12 / 8 rpm
- Braiding material
  - aluminum, copper, soft steel, spring steel wires
  - Ø 0.05 - 0.30 mm
  - braiding of flat wire
  - Textiles and plastic yarns1 - 10
- Wires per bobbin
  - 15 / 25 mm
  - 14 / 24 mm
- Central passage
  - 3- 90 / 6- 120 mm variable
- Core diameter
  - 380 / 630 mm capstan
- Lay length
- Haul - off type (optional with change gears or motorized)
  - 2.2 / 3.0 kW
  - 80 dB(A)
- Motor output
  - Reel outer Ø max. 800 mm (optional 1000 mm)
- Noise level
  - 80 dB(A)
- Integrated take- up & pay- off (optional)
  - optional 1000 mm
Optional Equipment
Tape Attachment

Disk diameter up to 500 mm

Core
Specification

Specification:

- Lengthways to the cable
- Sensor control
- One set of pre-forming dies
Empty Bobbin Detector

Specification:

• Laser Sensor monitoring
• Stopping automatically at the last layer
• Displaying on the Operator Panel “empty bobbin lower carrier” or “empty bobbin upper carrier”
DF 12A, 16A, 24A and DFT 24A

For
Aluminum / Copper / Steel Wires
and Textile yams
Operator Panel

Integrated Take-up and Pay-off for DIN Reels up to 1000 mm
Braiding Head

Motorized Capstan

Automatic Central Lubrication

Bobbin Size
180 / 260 / 380 / 550 ccm
~3.3 kg CU or ~2.9 kg Fe
Specifications

- Number of bobbins
  - 12 & 16 / 24 / 24 (DFT)

- Bobbin rotation speed
  - 150 / 100 / 80 rpm (DFT)

- Bobbin capacity
  - 180 / 260 / 380 / 550 cm³

- Braiding material
  - aluminum, copper & steel wires ø 0.03 - 0.30 mm

- Wires per bobbin
  - Textiles and plastic yarns 1 - 10

- Central passage
  - ø 15 / 40 mm

- Core diameter
  - ø 14 / 25 / 35 mm

- Lay length
  - 3- 90 / 6- 120 / 9- 180 mm

- Haul - off type (optional with change gears or motorized)
  - 500 / 500 / 650 mm capstan

- Motor output
  - 5.0 / 7.5 / 7.5 kW

- Noise level
  - <80 dB(A)

- Integrated take-up & pay-off
  - Reel outer ø max. 1000 mm
DRATEX 2450

For
Copper / Steel Wires and Textile Yarns
Operator Panel OP7 and PLC S7 from Siemens
Bobbins sizes
550 ccm, 3.36 kg Cu or textile
or
780 ccm, 4.89 kg Cu or textile
or
735 ccm, 4.07 kg steel or textile

Automatic Central Lubrication

Motorized Capstan ø 915 mm
Specifications

- Number of bobbins: 24
- Bobbin rotation speed: 50 - 80 rpm
- Bobbin capacity: 550 / 735 / 780 cm³
- Jog/creep speed: 7 rpm
- Braiding material:
  - Copper wire (up to 350 N/mm²) ø 0.15 - 0.40 mm
  - Steel wire (up to 400 N/mm²) ø 0.15 - 0.40 mm
  - H.T. steel wire (up to 2800 N/mm²) ø 0.20 - 0.32 mm
  - Textiles and plastic yarns
- Wires per bobbin: 3 - 10
- Central passage: 55 mm
- Core diameter: 6 - 45 mm
- Lay length: 6 - 120 mm variable
- Diameter of capstan: 915 mm
- Motor output: 7.5 kW
- Noise level: 80 dB(A)
UNIDRA 2410

For
Copper / Steel Wires and Textile / Plastic Yarns
Bobbin Size
1,070 ccm, 6.8 kg CU or 6.0 kg St
or
550 ccm, 3.36 kg Cu or textile

Tension Range from
0.6 - 12 kg or
6 - 120 N
Specifications

- Number of bobbins: 24
- Bobbin rotation speed: 10 - 80 rpm
- Bobbin capacity: 1,070 cm³ / 550cm³
- Jog/creep speed: 4 rpm
- Braiding material:
  - Copper wire (up to 350 N/mm²) ø 0.20 - 0.40 mm
  - Steel wire (up to 420 N/mm²) ø 0.20 - 0.40 mm
  - H.T. steel wire (up to 2800 N/mm²) ø 0.20 - 0.32 mm
  - Textile and plastic yarns
- Wires per bobbin: 3 - 10
- Central passage: 55 mm
- Core diameter: 6 - 45 mm
- Lay length: 12 - 200 mm variable
- Motor output: 5.5 kW / 7.5 kW
- Noise level: 80 dB(A)
Bobbin Carriers for different Applications

Type 2056.3

Specification:

Tension: 50 - 120 N
Type of bobbin: 120 x 120 / 102
Capacity of bobbin: 1,070 cm³
Type of brake: rope brake
16/24 & 32/36 F03A

For
Aluminum / Copper / Steel Wires
and Textile yarns
### 16/24 F03A

<table>
<thead>
<tr>
<th>Specification</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pitch</td>
<td>mm 9 - 200</td>
</tr>
<tr>
<td>Centre passage</td>
<td>mm Ø 50</td>
</tr>
<tr>
<td>Noise level</td>
<td>dB(A) &lt; 80</td>
</tr>
<tr>
<td>Motor power, approx. kVA</td>
<td>4,0</td>
</tr>
<tr>
<td>Floor space, approx. mm</td>
<td>1.400x1.800</td>
</tr>
<tr>
<td>Height, approx.</td>
<td>mm 2.500</td>
</tr>
<tr>
<td>Weight</td>
<td>kg 1.450</td>
</tr>
<tr>
<td>Bobbin volume, max. cm³</td>
<td>550</td>
</tr>
<tr>
<td>Carrier speed, max. rpm</td>
<td>135/80</td>
</tr>
<tr>
<td>Bunch tension</td>
<td>N 5 - 35</td>
</tr>
<tr>
<td>Materials -</td>
<td>Al, Cu, Fe, Textile</td>
</tr>
<tr>
<td>Bunch cross section mm²</td>
<td>0.06 - 0.80</td>
</tr>
<tr>
<td>Capstan mm</td>
<td>Ø 850</td>
</tr>
</tbody>
</table>
Layout of installation

Machine: 16F03A
Pay-off: DALM 100
Take-up: DALM 100
Bobbins sizes
550 ccm, 3.36 kg Cu or textile

16 & 24 F03A

32 & 36 F03A
32/36 F03A

Pitch mm 10 - 280
Centre passage mm Ø 70
Noise level dB(A) < 80
Motor power, appr. kVA 7.5
Floor space, appr. mm 3.000x2.350
Height, approx. mm 2.650
Weight kg 3.900

Bobbin volume, max. cm³ 550
Carrier speed, max. rpm 40
Bunch tension N 5 - 35
Materials- Al, Cu, Fe, Textile
Bunch cross section mm² 0.06 - 0.80
Capstan mm Ø 1.200
# Specifications

- **Number of bobbins**: 16/24 / 32/36
- **Bobbin rotation speed**: 135/80/40 rpm
- **Bobbin capacity**: 550 cm³
- **Braiding material**: aluminum, copper & steel wires ø 0.10 - 0.30 mm
- **Wires per bobbin**: braiding of flat wire
- **Central passage**: Textiles and plastic yarns
- **Lay length**: 1 - 10
- **Haul-off type**: 48 / 70 mm
- **Motor output**: 6- 120 mm (16F03A)
- **Noise level**: 9- 200 mm (24F03A)
- **Lay length**: 10- 280 mm (36F03A)
- **Haul-off type**: 850 / 1,200 mm capstan
- **Motor output**: 4.0 & 7.5 kW
- **Noise level**: < 80 dB(A)
48 S3H

For
Aluminum / Copper / Steel Wires
and Textile yams
Bobbin size
1,440 ccm, ~10 kg
Specifications

- Number of bobbins: 48
- Bobbin rotation speed: 18 rpm
- Bobbin capacity: 1,440 cm³
- Braiding material: aluminum, copper & steel wires ø 0.10 - 0.60 mm, braiding of flat wire, textiles and plastic yarns
- Wires per bobbin: 1 - 15
- Central passage: 250 mm
- Haul-off type: Caterpillar
- Motor output: 28 kW
Bobbin Winder

For
Copper, Aluminum, Soft Steel Wires, H.T. Steel Wires and Textile Yarns
Winding Program

For Cu, Al, soft Steel, Textile

- W8- 940S  4- spindle Automatic Winder
- W8- 920S  2- spindle Automatic Winder
- W8- 903  2- or 3- spindle Manual Winder
- 5030.3  2- spindle Manual Winder

For soft & H.T. Steel

- 5031.3  2- spindle Manual Winder
Manual vs. Automatic Winder

• Usually, one manual winder with 2 spindles can cover 10~15 braiding machine.
• Usually, one automatic winder with 4 spindles can cover 30~40 braiding machines.
• The winder should be selected according to the number of braiding machines it should cover.
• For automatic wider, it is necessary to use snap rings. Today, bobbins with snap ring is available for most of bobbin ranges.
Winder Details

- Empty bobbins magazine
- Entrance guide pulleys.

- Operator desk including Siemens OP 3 panel control

**Four tracks, 10 empty bobbins each**

**Four entrance guiding pulleys**

**Operator keypad and display**
Winder Details

- Full bobbins collector
- Main motor view

- Bobbins handling

Main Brush-less motor

Four unloading tracks collecting 10 bobbins each position

Pneumatic controlled bobbins transfer
Specifications

- fully automatic two or four spindle winder
  for Flange diameter 66 to 120 mm and max. traverse length 330 mm, with or without clip
- PLC and Operator Panel from Siemens
- data storage for 3 types of bobbins
- dual mode, constant revolution speed between 500 and 6,000 rpm or
- constant linear speed max. 850 m/min
- controlled acceleration and deceleration ramps
- full bobbin collection device each spindle on separate rail
- 2 kW brushless electric motor with digital converter
Specifications

- semi automatic two spindle winder
- Flange diameter up to 125 mm (120 mm for Steel wire)
- Overall length 40 to 110 mm
- PLC and Operator Panel from Siemens
- constant linear speed max. 60 - 540 m/min
- controlled acceleration and deceleration ramps
- 4.3 kW brushless electric motor with digital converter
Motorized and Static Pay-Off`s

For
Copper, Aluminum, Soft Steel Wires and Textile Yarns
Pay-off Program

For Cu, Al, Soft Steel, Textile

- W9-630M single reel motorized pay-off
- W9-250M 8-positions motorized pay-off
- W9-250S 6-positions static pay-off
- W9-250U 9-positions static pay-off
- 5030-400 4-positions static pay-off

For Soft & H.T.Steel

- 5031-400 12-positions static pay-off
Pay-Off Details

- Payoff threading
- Payoff tension adjustment
Specifications

• motorized pay-off for unwinding of copper multi-wire from reels Ø 400 to 630 mm according to DIN 46395
• for unwinding wire bunches from 4 x 0.10 up to 10 x 0.20 mm or alternatively 6 x 0.30 mm
• max. linear speed 850 m/min
• all rotating parts on sealed bearings
• accumulator with contactless potentiometer for the set tension value between 0.2 and 2 kg
• pneumatic emergency brake system
• bobbin driven by 7.5 kW AC motor
• power supply: 380 V 50/60 Hz
Specifications

• motorized pay-off suitable for unwinding of Aluminum and Steel wire in combination with high speed automatic winding machines
• for unwinding of single aluminum wires from reels Ø 250 mm according to DIN 46395
• wire diameter: 0.10 to 0.25 mm - 1 end
• max. full reel weight: 20 kg
• ramp up-down: 8 sec
• self adjustable speed up to 850 m/min
• positions driven by 1.1 kW DC vector motor
• power supply: 380V 50/60 Hz
Specifications

- static overhead pay-off stand for unwinding of single end copper wires
- modular construction, 3 bobbins in a columns, for min. 2 columns.
- for unwinding of single copper wire from reels Ø 250mm according to DIN 46395
- wire diameter: 0.08 to 0.16 mm - 1 end
- wire guide on ball bearings
- adjustable braking unit type V- RED (hysterisis)
- wire end and break sensors on request
W9- 250U
Specifications

- Pay-off for the unrolling of wire from reels Ø from 150 to 250 mm for unrolling of single end soft steel wires.
- Reversing and accumulator pulleys diameter. 40 mm.
- Max linear speed 500 m/min
- Max bobbin weight 30 Kg
- Minimum Ramp up/down 10 sec
- Wire Tension from 150 to 1000 g
- All rotating parts on sealed bearings lubricated for life
- Accumulator with break lever for the adjustment of the set tension value, by spring pressure
- Each side frame supports up to 9 spindles double sided 18 positions
# Winding Calculation

<table>
<thead>
<tr>
<th>Bobbin selection</th>
<th>Material selection</th>
<th>Wire selection</th>
<th>Ends #</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ref #</td>
<td>Model</td>
<td>Flange Ø</td>
<td>Barrel Ø</td>
</tr>
<tr>
<td>1</td>
<td>WSN 01</td>
<td>66.3</td>
<td>34.5</td>
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<table>
<thead>
<tr>
<th>Const. Wire speed</th>
<th>Const. Spindle speed</th>
<th>L.W.S</th>
</tr>
</thead>
<tbody>
<tr>
<td>Start speed rpm</td>
<td>Final speed rpm</td>
<td>Speed on the bobbin barrel m/min</td>
</tr>
<tr>
<td>6000</td>
<td>3122</td>
<td>2132</td>
</tr>
<tr>
<td>Speed on the full bobbin m/min</td>
<td>Average speed m/min</td>
<td>Bobbins / hour n</td>
</tr>
<tr>
<td>650</td>
<td>2133</td>
<td>650</td>
</tr>
<tr>
<td>650</td>
<td>2133</td>
<td>650</td>
</tr>
<tr>
<td>187</td>
<td>159</td>
<td>159</td>
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</table>

<table>
<thead>
<tr>
<th>Production / Hour Kg/hour</th>
<th>Production / Hour % eff</th>
<th>Efficiency %</th>
<th>Length of wire mt</th>
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<tr>
<td>137</td>
<td>303</td>
<td>85</td>
<td>705</td>
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<td>117</td>
<td>257</td>
<td>85</td>
<td>1555</td>
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**WINDING CALCULATOR 2**

rel. 2 - 5/02

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**WARDWELL**
<table>
<thead>
<tr>
<th>Maker</th>
<th>Type</th>
<th>Snap Ring</th>
<th>Flange</th>
<th>Width</th>
<th>Volume</th>
<th>Remarks</th>
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<tbody>
<tr>
<td>Spirka</td>
<td>S1</td>
<td>Yes</td>
<td>75mm</td>
<td>100mm</td>
<td>180</td>
<td>DF, DFT</td>
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<tr>
<td>Spirka</td>
<td>S2</td>
<td>Yes</td>
<td>75mm</td>
<td>100mm</td>
<td>260</td>
<td>DF, DFT</td>
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<td>Spirka</td>
<td>S3 SB</td>
<td>Yes</td>
<td>80mm</td>
<td>100mm</td>
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<td>DF, DFT Dratex</td>
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<tr>
<td>Spirka</td>
<td>S4 SB</td>
<td>Yes</td>
<td>98mm</td>
<td>100mm</td>
<td>550</td>
<td>DFT,F03A 2450</td>
</tr>
<tr>
<td>Spirka</td>
<td>S5 SB</td>
<td>No</td>
<td>110mm</td>
<td>108mm</td>
<td>780</td>
<td>Dratex 16, 2450, Unidra</td>
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<tr>
<td>SB</td>
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