FIA summer seminar 2019
Ribbon fibres & cables

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2019-06-03

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Ribbon fibres & cables - history

- Not a new technology, just not widely deployed in Europe
  - Early 1990s: most carriers and fibre or cable manufacturers in Europe were investigating ribbon technologies.

- Carrier network deployment
  - Italy: Telecom Italia used ribbon in the 90s, but reverted to multiple single fibres in tubes for preferred cable designs

  - Sweden: Telia (at that time Televerket Sverige) were early adopters and ribbon is still widely installed by carriers in Sweden

  - UK: Around year 2000, Level 3 and Metromedia Fibre Networks tried building city networks using OSP materials they had installed in the USA, including fibre ribbons, not without problems.

  - Widely deployed in Asia, especially in Japan. Also seen in USA.

  - The European consensus seemed to be “Not for us”

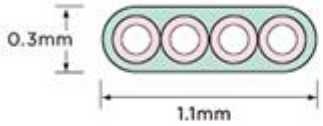
- Data networks
  - Hyperscale data centre owners: Google, Facebook, Amazon etc., have adopted ribbon technologies as the only way to meet the required high fibre density in their ducts.

Ribbon fibres – ribbon types

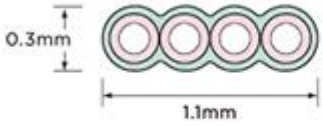
- What is a fibre ribbon?
  - Fibres arranged in one plane with material to bind them together.

  - Originally two formats
    - Encapsulated ribbon
      - Smooth outer surface
      - Originally ~400um thick, now 300~320um is universal as it's easier to strip and break-out.
    - Edge bonded ribbon
      - Fibres bonded together with little surrounding matrix
      - Very easy to strip & separate the fibres, sometimes too easy
      - Sumitomo brand is "EZbranch™"

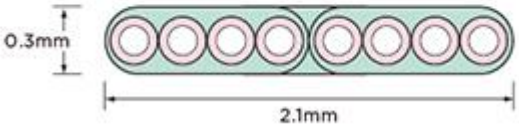
4-fiber ribbon [fiber ribbon code: 4]



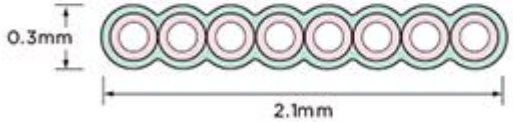
4-fiber EZbranch™ [fiber ribbon code: 4/(EZB)]



Split type 8-fiber ribbon [fiber ribbon code: 8]



8-fiber EZbranch™ ribbon [fiber ribbon code: 8/(EZB)]



- New developments?
  - "Pliable" or "Rollable" ribbons for higher packing density

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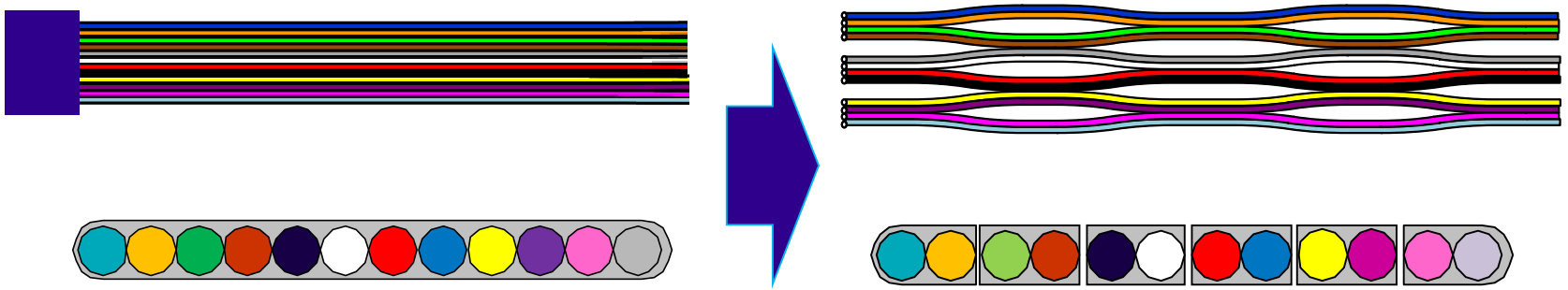
Ribbon fibres – ribbon types

- What is a pliable fibre ribbon?
  - Ribbons made with gaps in the binding material that allow it to the rolled or curved around its longitudinal axis
  - Technology originated from a request by NTT to increase fibre density
  - Fibre dimensions, core pitch and slit patterns vary between vendors

Sumitomo's process for making Freeform™ ribbon



Made as conventional ribbon

Slits added to the ribbon

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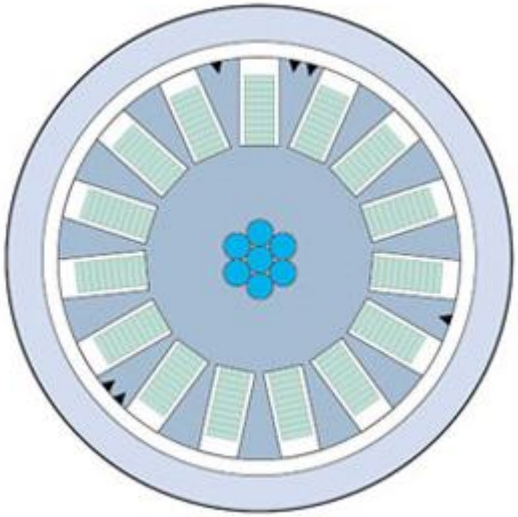
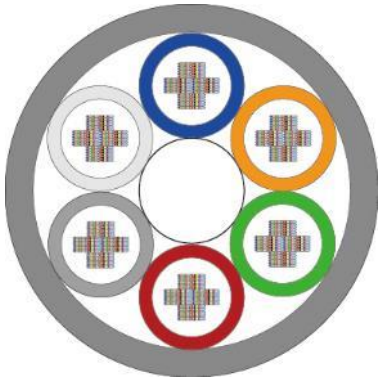
Ribbon fibres – ribbon cables

- What does a ribbon cable look like?
  - Many types
    - Slotted core helical stranded
      - Probably the oldest design
      - With a central strength member
    - Slotted core S-Z stranded
      - For easy mid span breakout
      - Usually deployed in aerial distribution networks
    - Central tube
      - Original ‘higher density’ designs
      - Can be best choice for air blown installation
    - Ribbon in loose tube
    - Ultra high fibre count, “UHFC”
      - Commonly deployed in hyperscale data centres
      - 3456 fibres in a 28mm diameter cable is commercially available
      - Maximum fibre counts continue to increase

Ribbon fibres – ribbon cables, standard types



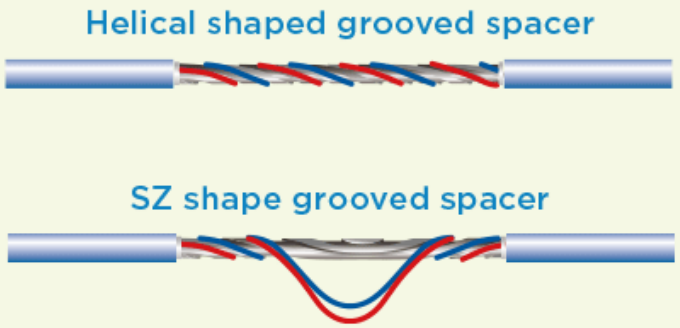
Slotted core, helical or SZ



Ribbon in loose tubes

Central tube type

- Conventional helical grooved spacer has a merit of high fiber density in a cable, but it takes time and labor to take out fiber ribbon out of the groove in the mid-span. Probability is that you are forced to place the branching point at the jointing box.
- With SZ-shape grooved spacer all you have to do to take the fiber of the groove is removing the jacket. You can access to the fiber anywhere you want and it gives you a flexible design for the network, especially in aerial distribution cable.



Mid-span breakout: helical versus SZ stranding design

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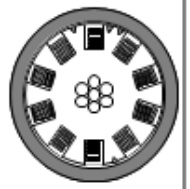
Ribbon fibres – ribbon cables, standard types

Ribbon Type	4-Fiber "EZbranch™" Ribbon					8-Fiber "EZbranch™" Ribbon		
Fiber Count	**24**	**60**	**100**	**200**	**300**	**400**	**640**	**800**
Cross section								
Fiber Type	PureAccess®-PB Bend Insensitive (ITU-T G657.A1)							
Strength member	Steel							
Cable Diameter [mm]	9	10	11.5	15.5	20.5	20	22	28.5
Cable Weight [kg/km]	65	75	110	180	320	290	420	600
Tensile Strength [N]	900	1180	1850	2440	3120	3120	5700	5700
Bending radius [mm]	10 x Cable Diameter							

Typical cable dimensions for standard ribbon cable types

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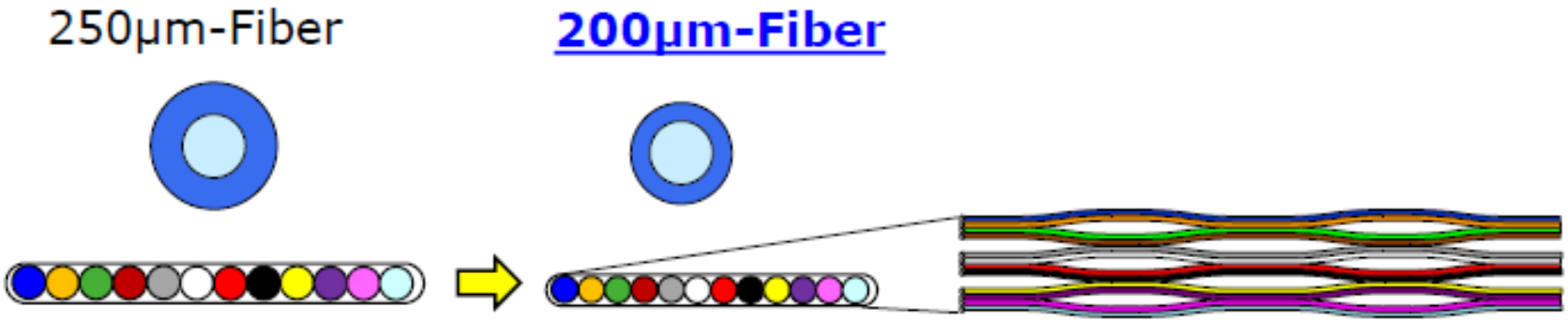
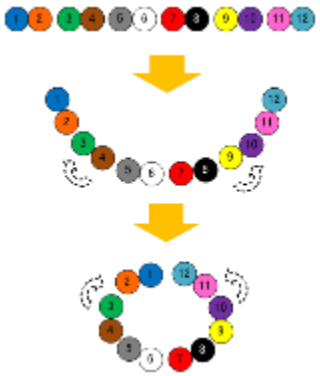
Ribbon fibres – ribbon cables, ultra high fibre count types

200um diameter fibres on 200um pitch give the highest fibre density



Rolls around its longitudinal axis



Ribbon packing in a real cable

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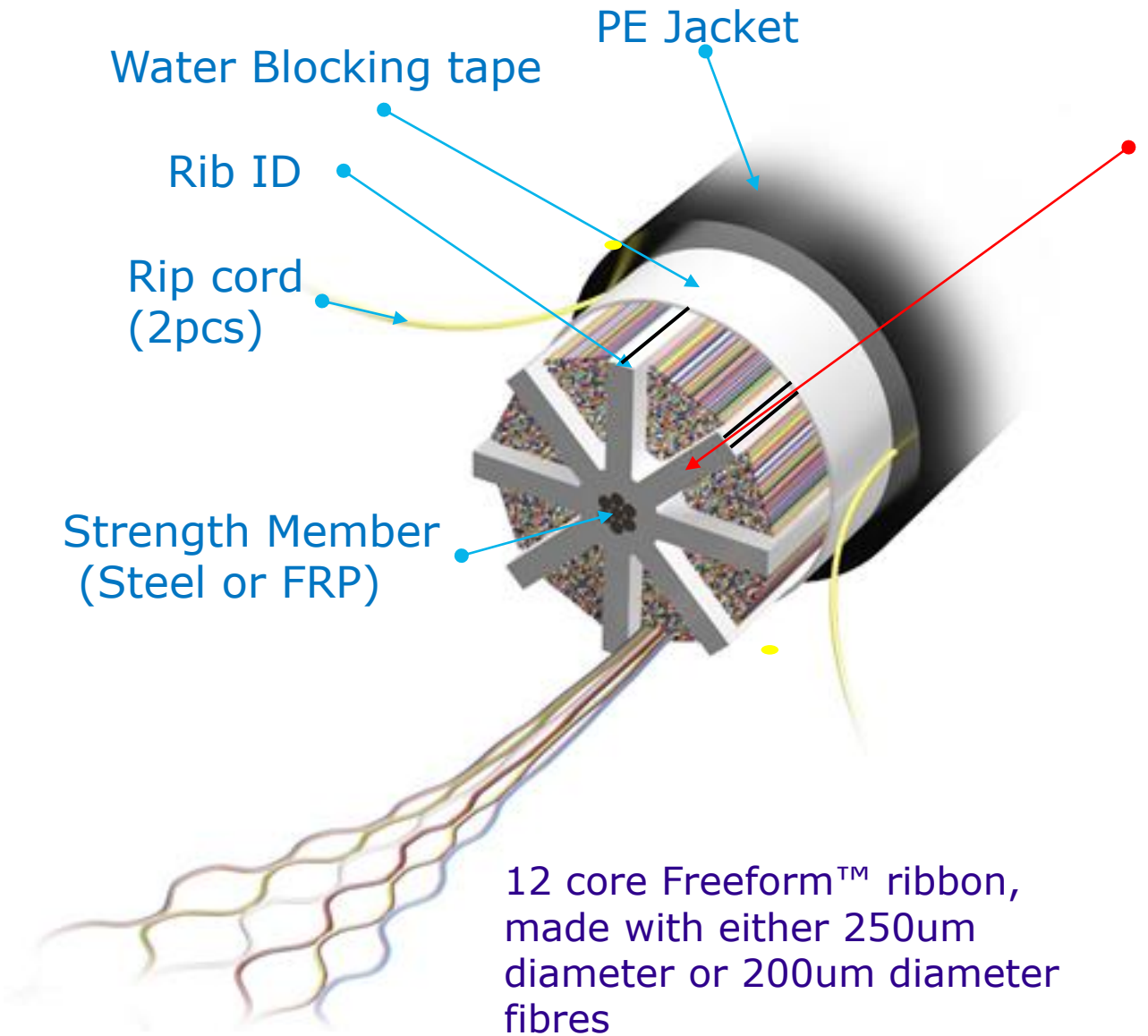
Ribbon fibres – ribbon cables, ultra high fibre count types



Slotted core
- Most space for fibres
- Central strength member
- Dry core, no gel

12 core Freeform™ ribbon, made with either 250um diameter or 200um diameter fibres

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Ribbon fibres – ribbon cables, ultra high fibre count types

Fiber Count	864	1152f	1728f		3456f	
Fiber type	250um	250um	**200um**	250um	**200um**	250um
Ribbon type	**12 fiber Free-Form Ribbon ™**					
Cross section	 144f × 6slots	 192f × 6slots	 288f × 6slots	 288f × 6slots	 576f × 6slots	 576f × 6slots
Strength Member	Dielectric (If necessary, steel strength member can be applied)					
Cable Diameter [mm]	21	22	22	26	28	32
Cable Weight [kg/km]	300	320	370	450	540	700
Tensile strength [N]	2670					
Bending Radius [mm]	400	450	450	400	450	450
Duct Size	1.25 inch			1.5 inch		2.0inch

Typical cable dimensions for UHFC ribbon cable types

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Ribbon fibres – splicing, what you need

Ribbon splicer

Ribbon cleaver

Stripping tool

...plus lint free wipes, IPA or other cleaning fluid, splice protection sleeves and appropriate fibre holders

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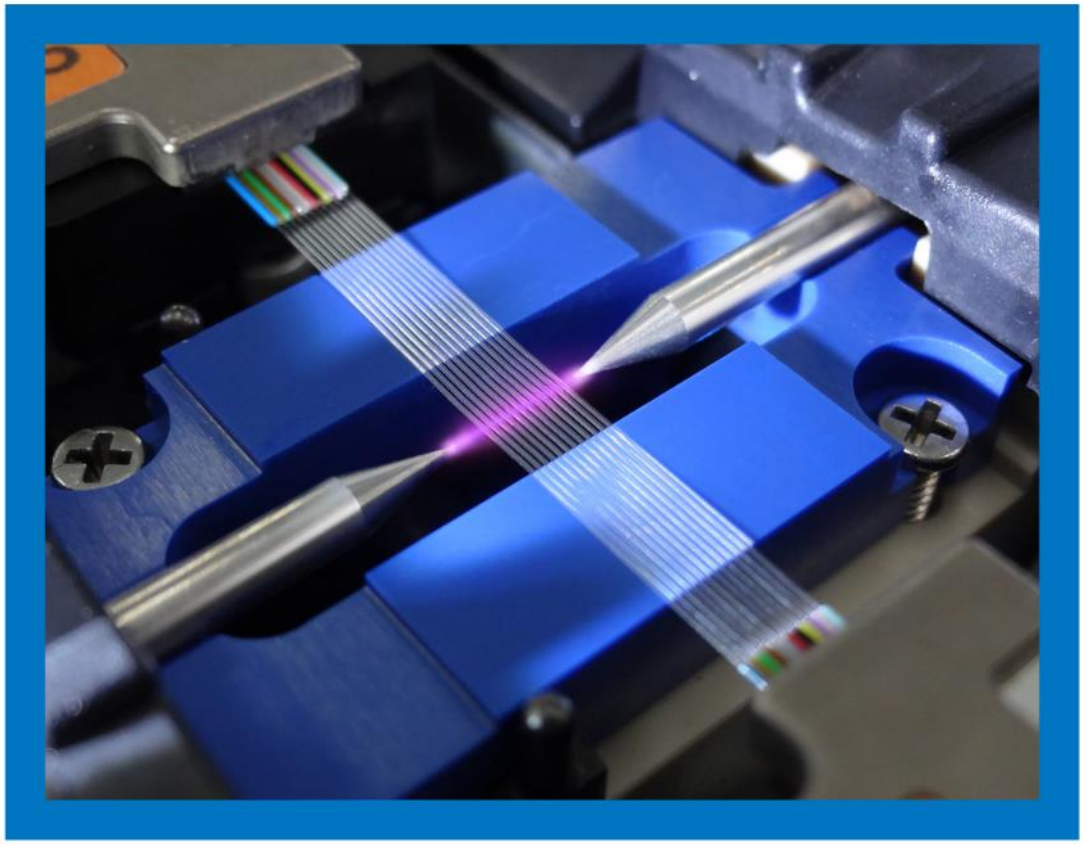
Ribbon fibres – splicing, under the hood



- All ribbon splicers are fixed v-groove splicers
- They cannot see the fibre cores and cannot do core to core alignment
- Cleanliness of the fibres and v-grooves is the key to successful splicing

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Ribbon fibres – splicing, pre-splice checks

- Fibre count
- Cleave angles, all of them
- Crack or chip on all fibre ends
- Dust or dirt on all fibres
- Irregularity
  - Difference in length between longest and shortest fibre on left ribbon and on right ribbon
- Gap
  - Distance between opposing left and right fibres at each position
- Offset
  - Distance between cladding centres of opposing left and right fibres at each position

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Ribbon fibres – splicing, post-splice results

- Fibre count
- Offset
- Cleave angles
- Gap
- Irregularity
- Estimated loss
- Splice program
- Time stamp
- Record number
- Memo entered by user

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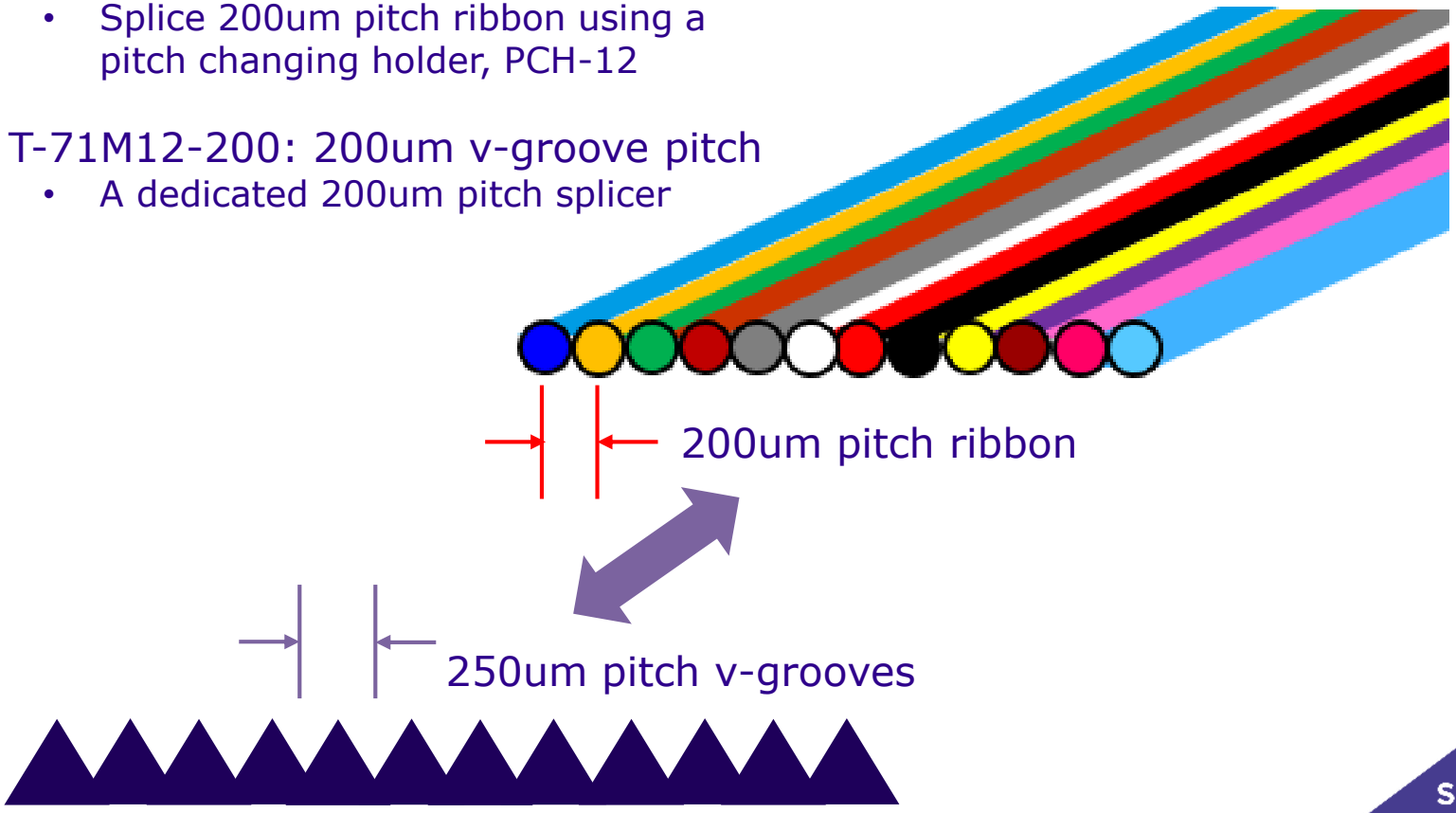
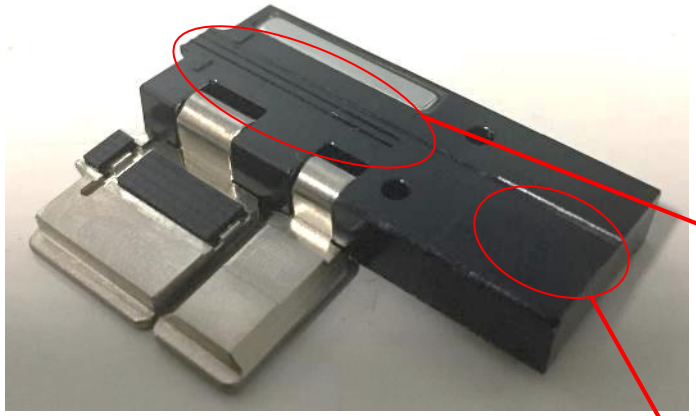
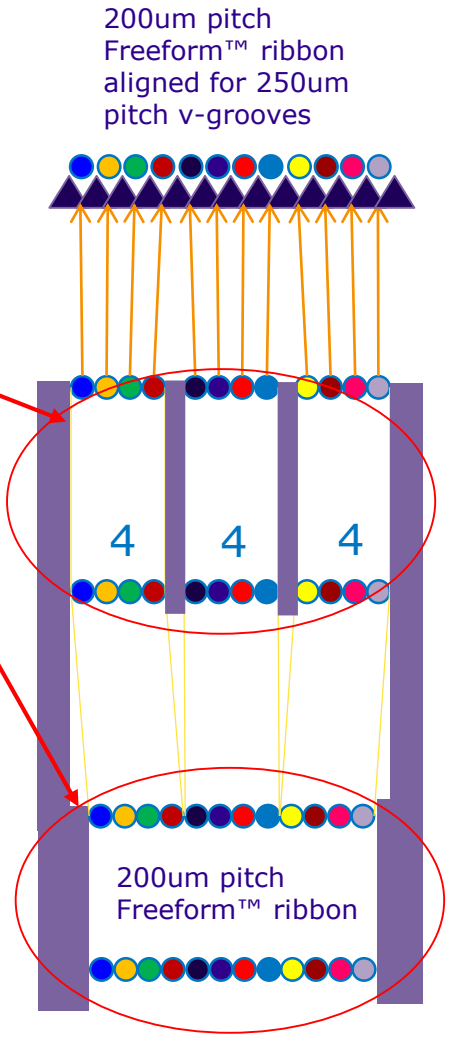
Ribbon fibres – splicing pliable 200um pitch ribbon

- The practicalities
  - Ribbon splicer v-groove pitch has historically been only 250um
- T-71M12: 250um v-groove pitch
  - Splice 250um pitch ribbon
  - Splice 200um pitch ribbon using a pitch changing holder, PCH-12
- T-71M12-200: 200um v-groove pitch
  - A dedicated 200um pitch splicer



Ribbon fibres – splicing 200um pitch ribbon on 250um pitch splicer





- PCH-12 pitch changing holder
  - Cleave the Freeform™ ribbon at the point where the matrix is 3x 4 fibres.
  - Position each 4 fibre sub-ribbon into individual channels in the holder
  - The fibres are now sufficiently splayed to align with 250um pitch v-grooves

The End

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