

Bend-Insensitive Fiber for Harsh Environments

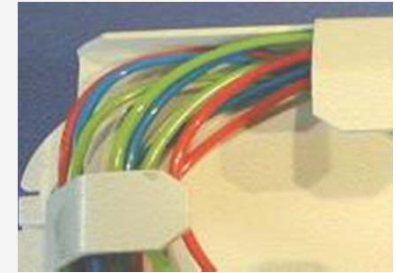
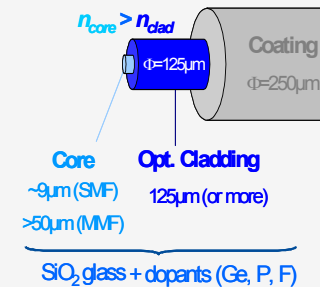
Or the Benefits of BendBright-Technology

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- Introduction
- Draka's bend-insensitive fiber history
- Benefits of Bend Insensitive Fiber
 - BendBright Technology applied to SMF
 - BendBright Technology applied to MMF
- Conclusions and Perspectives



- Optical Fibers are made of High purity Glass and Specific Coating
 - Glass intends to transmit and protect the transmitted signal
 - Coating intends to protect the glass and the signal from the external environment
- With more than 150Mfkm in 2009, Glass Optical Fibers have achieved a decent maturity level into the Telecom Market
- Out of Telecom market, optical fibers are also gaining momentum thanks to their benefits (EMI, weight, bandwidth, ...) but also some additional technical challenges have to be overcome (macro-bending, micro-bending, kink, T°C, ...)
- Optical Fibers with improved glass performances are the 1st mandatory building block to secure the Optical Budget in any Harsh Environment



Improved glass building blocks can bring:

- Higher Bandwidth, Lower Loss
- Higher Reliability, Higher Resistance to Hydrogen, Higher Radiation Resistance
- Improved Geometry and Uniformity
- **Higher Bending Resistance (or the benefits of BendBright technology)**



Draka "invented" Trench-Assisted Bend-Insensitive SM fibers:

- Trench (ring of lower refractive index) just outside core better confines the light to the core, preventing it from escaping in strong fiber bends → BendBright Technology

2002 BendBright $R_{\min} = 10\text{mm}$ ($\leq 0.75\text{dB/turn}$)

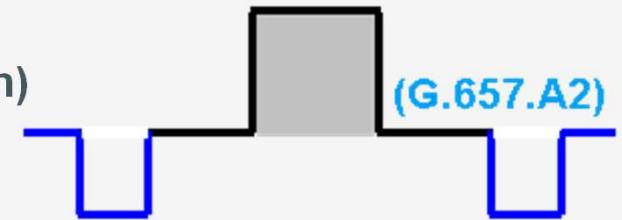
→ Step-Index profile



2006 BendBright-XS $R_{\min} = 7.5\text{mm}$ ($\leq 0.5\text{dB/turn}$)

→ Trench introduced

(BendBright Technology for SMF)



2008 BendBright-Elite $R_{\min} = 5\text{mm}$ ($\leq 0.1\text{dB/turn}$)

→ Trench volume +40% increased



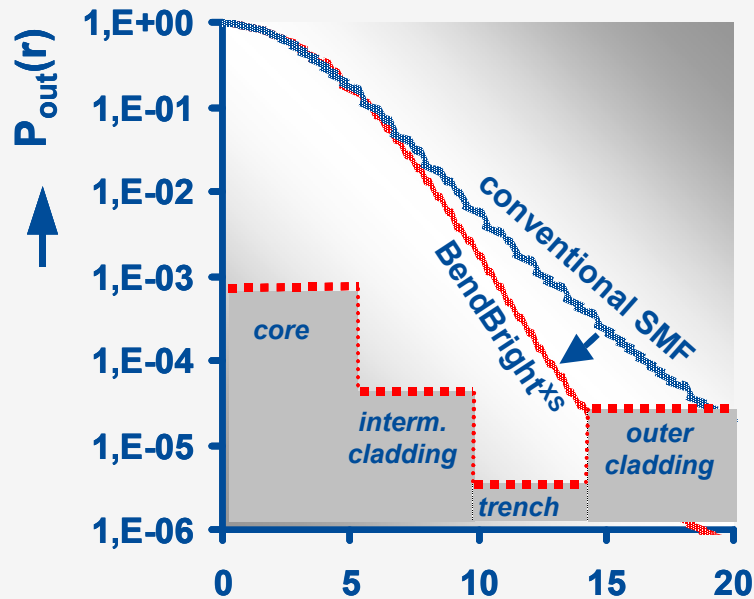
2010 MaxCap-BB-OM4 (Bend-insensitive MMF)

→ Trench introduced

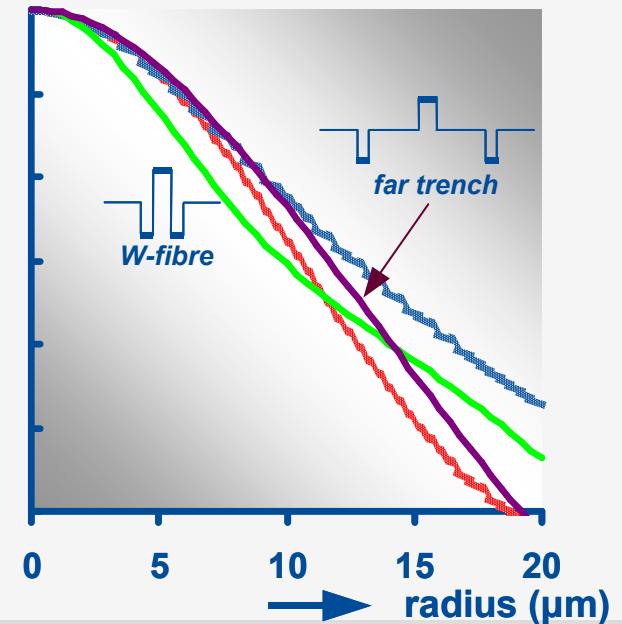
(BendBright Technology for MMF)



Trench benefits for SMF: Backward compatibility



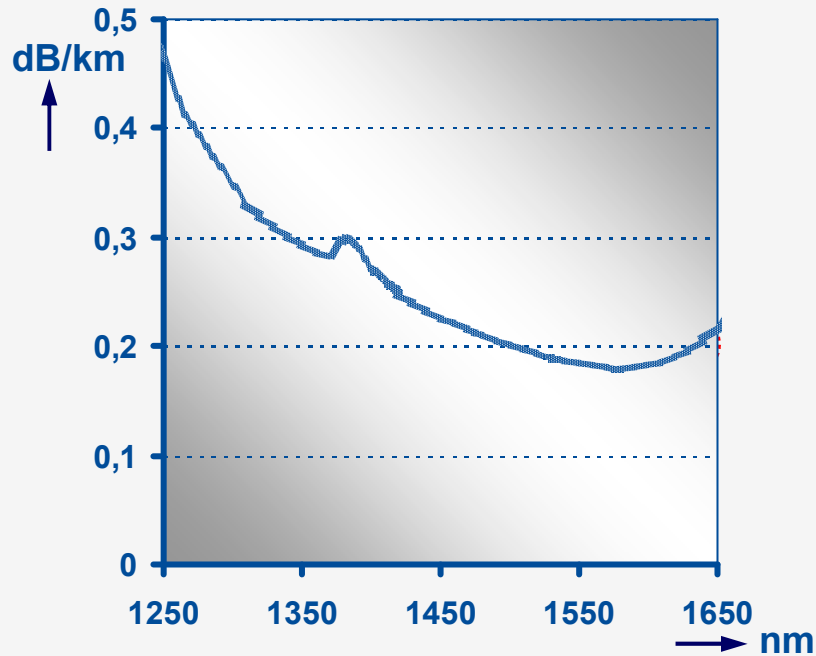
Trench confines the field towards the fibre axis, without changing the field in the core area



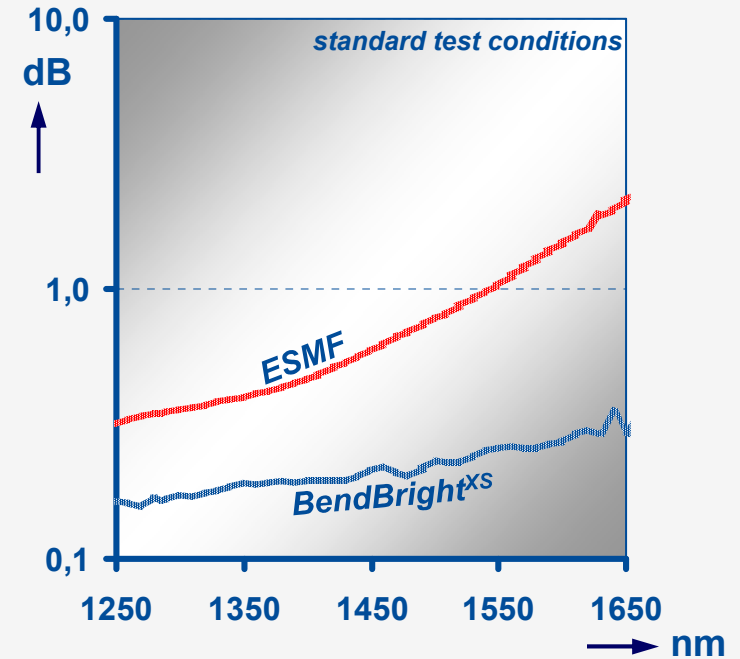
Adequately positioned between the less effective "far trench" and the "W" fibre affecting the mode field

Full backward compatibility thanks to Mode Field Diameter unchanged enabling easy and reproducible splicing and connectorising (versus low mode field diameter/high Numerical Aperture)

Trench benefits for SMF: Micro-bending



Low attenuation

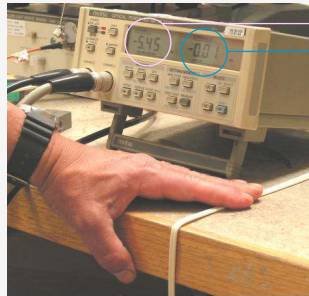


Reduced micro-bending loss

**Low attenuation associated with Increased resistance
to micro-bending for more demanding cable design
over extended T°C variations**

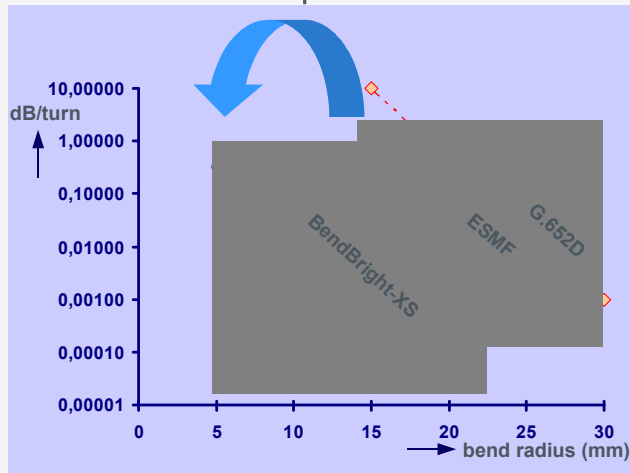
Trench benefits for SMF: Macro-bending

Duplex cable, 90° bend



G.652.D → 5.5dB
BendBright-XS → 0dB!

x100 improvement



2 turns on a pencil



Straight fiber as reference

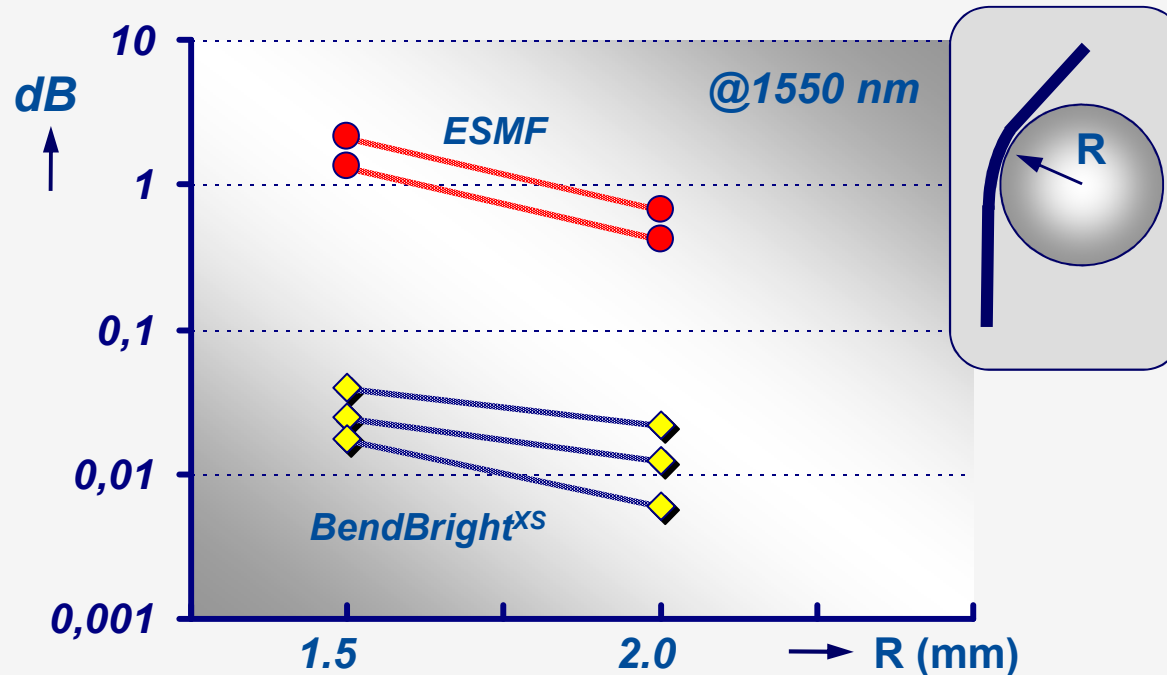


G.652.D → 11dB



BendBright-XS → 0.2dB

Increased resistance to macro-bending for demanding deployments or installations



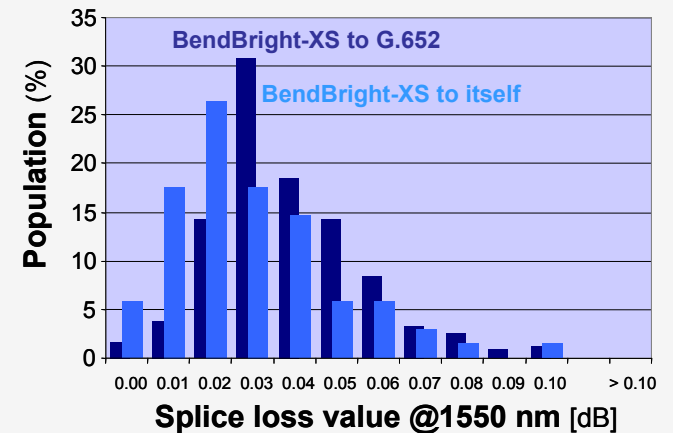
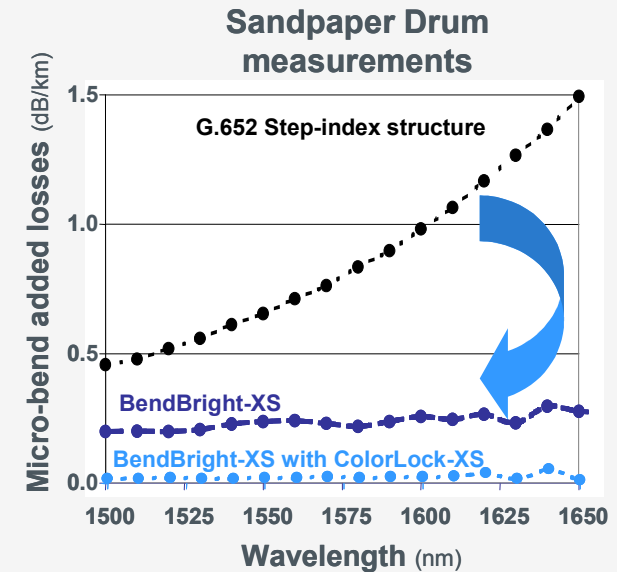
“optical fiber handling like copper wire”

Strongly reduced “kink” losses

Increased resistance to installation or deployment “accidents”

Summary of Trench benefits for SMF BendBright-XS and -Elite

- **100% G.652D compliance**
 - End-to-end consistency, compatible with any evolution scenario
- **Macro-bending**
 - 100x (-XS) to 300x (-Elite) better than G.652
 - Better handle-ability, reduced size connectivity and storage, reliability for demanding deployments (2%-ST for 5mm)
 - Resistance to “accidents”
- **Micro-bending**
 - BIF enable more demanding cable designs
- **Splicing compatibility**
 - Outstanding results on most common splicing machines



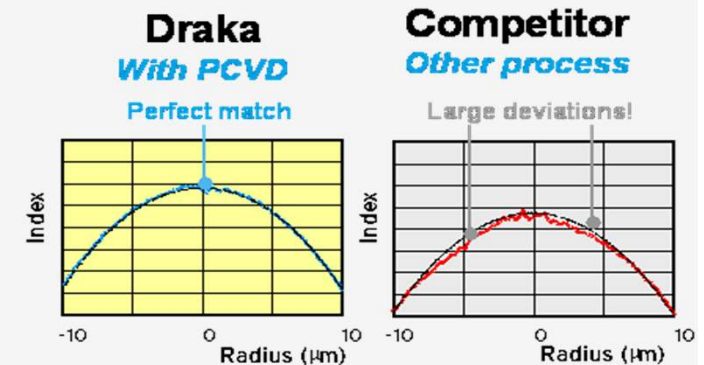
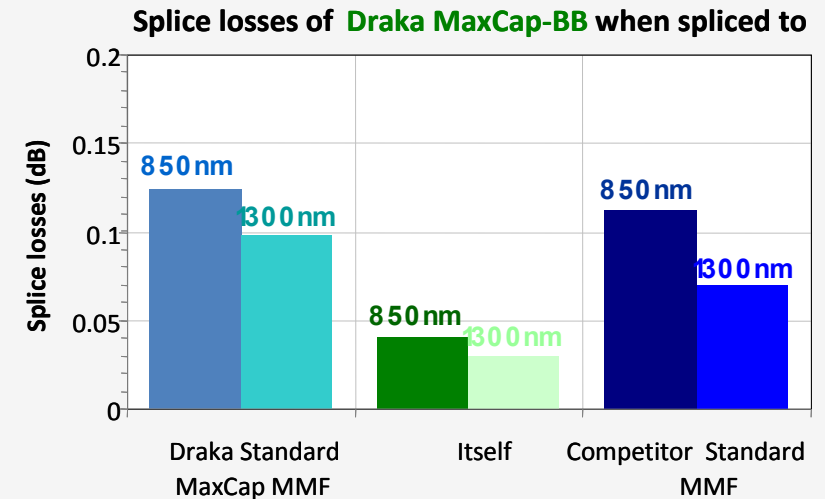
Trench benefits for MMF: Backward compatibility

BendBright technology applied to Draka MaxCap MMF, bringing Bend-Insensitivity to the multimode fiber world !!!

→ Needs special refractive index profile control

→ Offered by the highly flexible and versatile Draka's PCVD process

MaxCap-BB-OMx combines high bandwidth with low bending loss without sacrifice or trade-off on bandwidth or other performance specifications offering full backward compatibility



Trench benefits for MMF: Improved margins & system reliability

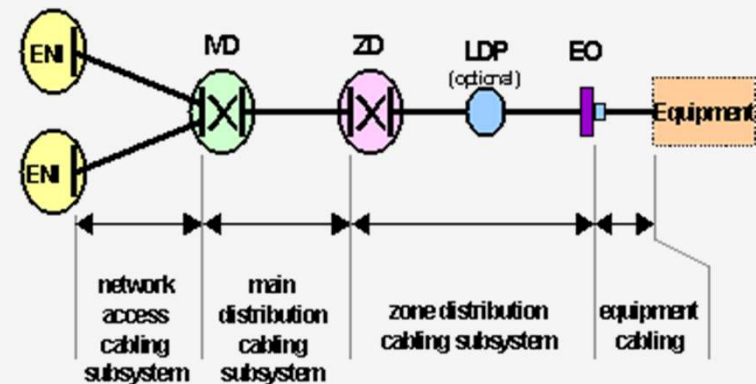
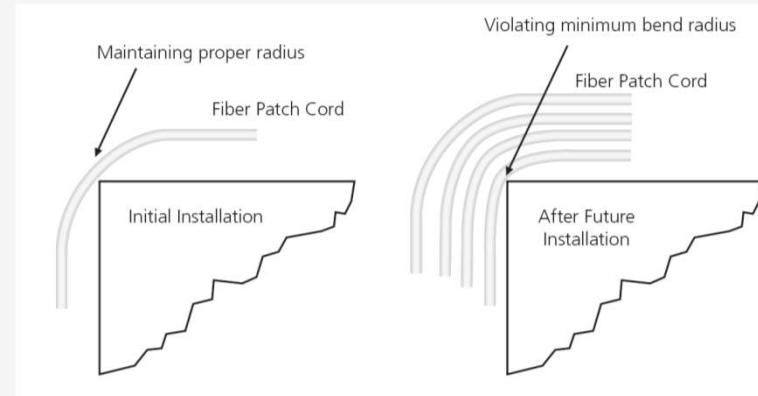
- All 850nm data systems show reduced system margins with increasing system speeds
 → Bend-Insensitive MaxCap-BB-OM3 / OM4 fibers can relax such reduced system margins in current and future networks:

- Improve system reliability**

- Apply more connectors (e.g. planes, tactical cable, ...)

- Future-proof installations**

- MaxCap-BB-OM4 offers additional system margin on top of **extra margin** by high OM4 bandwidth



ENI = Equipment Network Interface LDP = Local Distribution Point
 MD = Main Distributor EO = Equipment Outlet
 ZD = Zone Distributor

Trench benefits for MMF: Macro-bending and “accidents”

4 turns on 4mm
diam. mandrel



Regular OM3
→ 3.37 dB



MaxCap-BB-OM3
→ 0.14dB

2mm indoor cable tested
in sharp 90 degree angle
(pinched fiber)



Regular OM3:
→ 2.75dB



MaxCap-BB-OM3:
→ 0.01dB

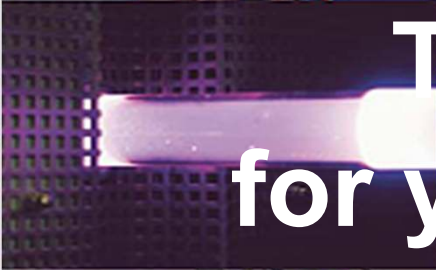
**Increased resistance to macro-bending for
demanding deployments or installations**

Increased resistance to “accidents”

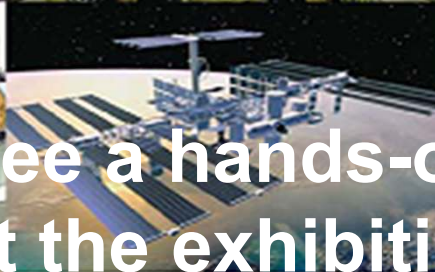
- Benefits of BendBright Technology for Harsh Environments
- Reduced macro-bending loss
- Reduced micro-bending & kink sensitivity
- Back-ward compatibility
- Can be combined with any Draka's coating Building Block and most of Draka's Specialty Building Blocks
- Improved margin and reliability in difficult environments
- Suitable for demanding cable design and tolerant installation and deployments
- Advanced performances without compromise
- Added performances for a quasi-infinite number of solutions for harsh environments
 - BB-XS/Elite HTA
 - MaxCap-BB Silicone



BendBright Technology: the enabling glass building block for harsh environment



Thank you
for your attention



Come see a hands-on demo
at the exhibition

