G657 fibres and how to splice them

Sumitomo Electric Europe

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What is a G657 fibre?

- G657 is a new class of single mode fibre which can be bent more severely than normal G652 fibre without losing the signal.

- The ITU defines 4 classes of G657 fibre as below...

- G657A1
  - 10mm minimum bend radius, other specs as G652
- G657A2
  - 7.5mm minimum bend radius, other specs as G652
- G657B2
  - 7.5mm minimum bend radius, other specs may deviate from G652
- G657B3
  - 5mm minimum bend radius, other specs may deviate from G652

Compatibility to G652.D

Parameter	G657.A	G657.B
MFD	8.6-9.5 um	6.3-9.5 um
attenuation coefficient at 1310nm	0.4dB/km	0.5dB/km
attenuation coefficient at 1550nm	0.3dB/km	0.3dB/km
wavelength limit (cable cut-off)	1260 nm	1260 nm
chromatic dispersion	G652.D	TBD
PMD	G652.D	TBD

G 657 bend insensitivity comparison

Fibre class	A1	A2	B2	A1	A2	B2	B3	A2	B2	B3	B3
Bending radius [mm]	15			10				7,5			5
Number of loops	10	10	10	1	1	1	10	1	1	1	1
Max. attenuation at 1550 nm [dB]	0,25	0,03	0,03	0,75	0,1	0,1	0,03	0,5	0,5	0,08	0,15
Max. attenuation at 1625 nm [dB]	1	0,1	0,1	1,5	0,2	0,2	0,1	1,0	1,0	0,25	0,45

What are the G657 fibres required to withstand?

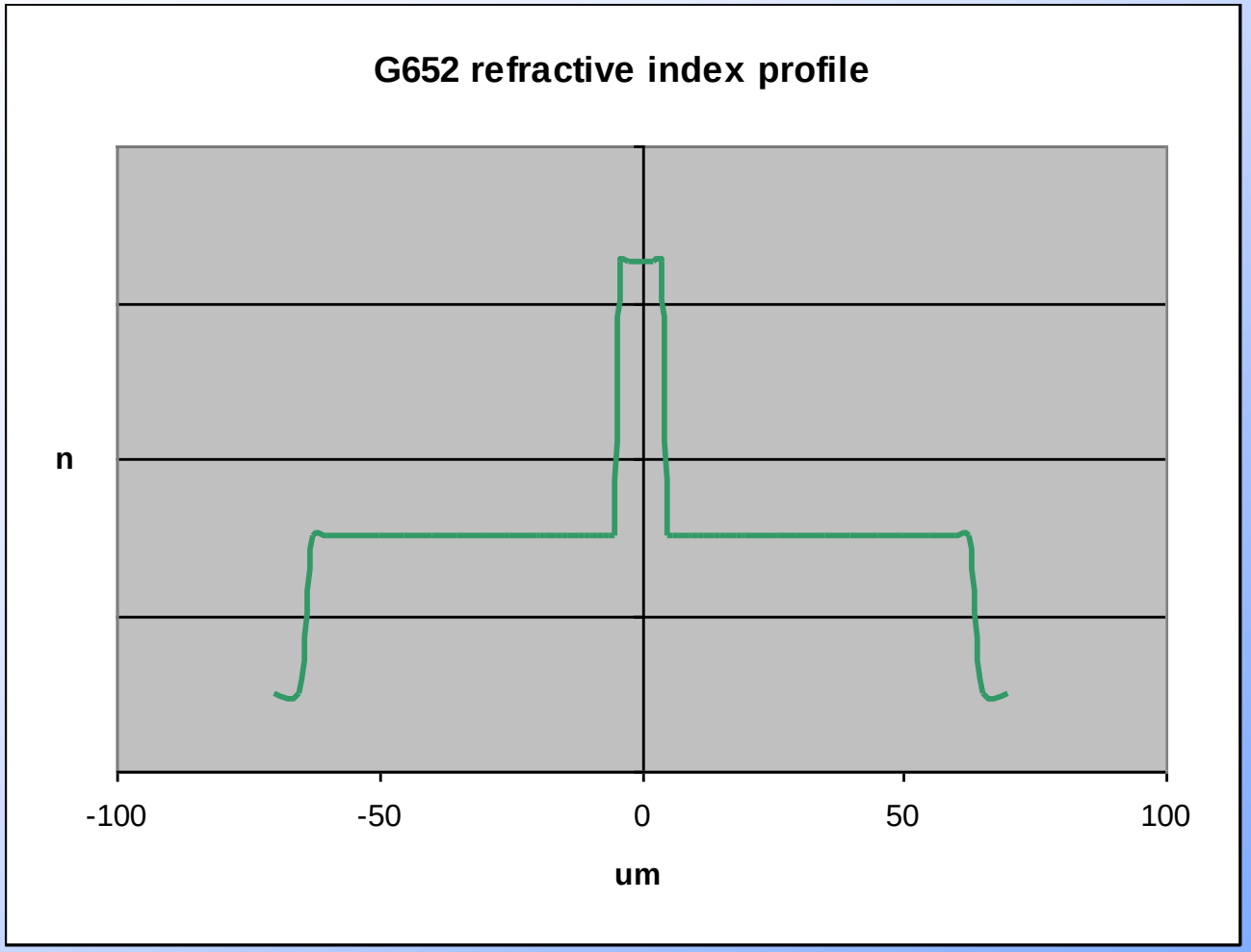
How does a G657 fibre work?

- G657A fibres often have a design similar to G652D
  - may have a slightly taller, thinner core
  - some A2 types have a trench around the core
  - Sumitomo's PureAccess[A2] has no trench

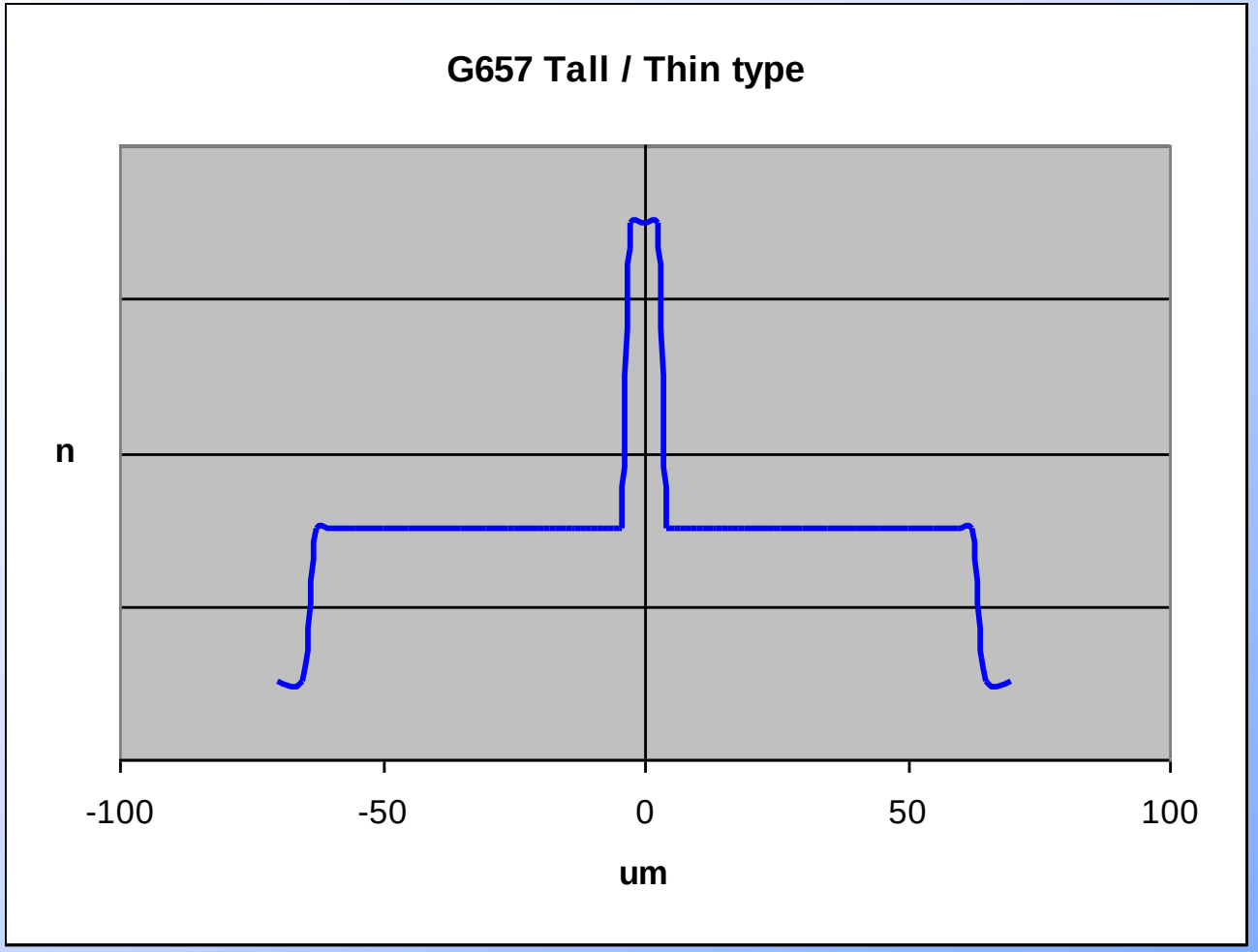
- G657B fibres adopt different designs to G652
  - Trench around the core
  - Trench and ring around the core
  - Voids around the core

- The structure around the core changes the power distribution and more strongly guides the light

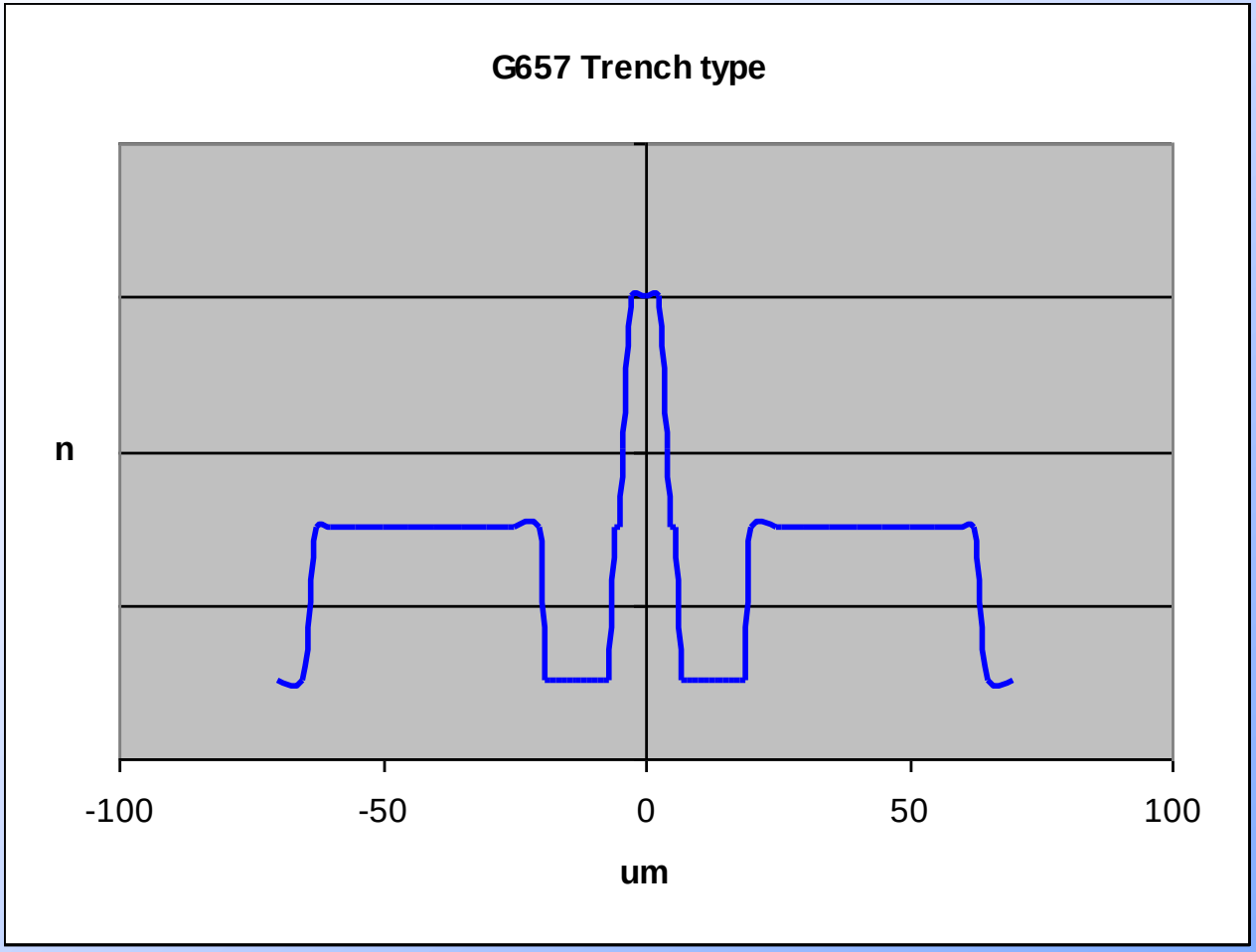
G652 refractive index profile



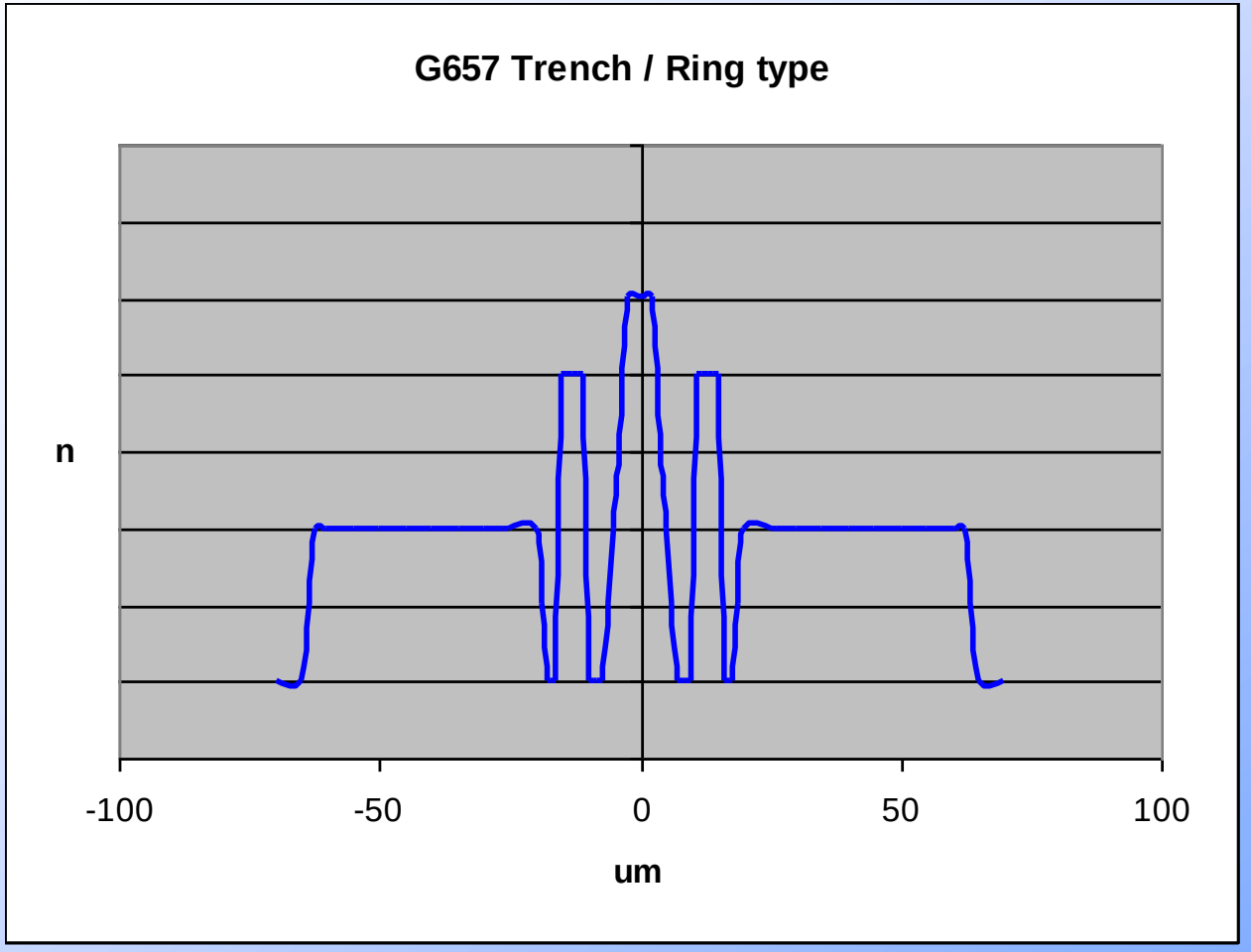
G657 - taller thinner core design



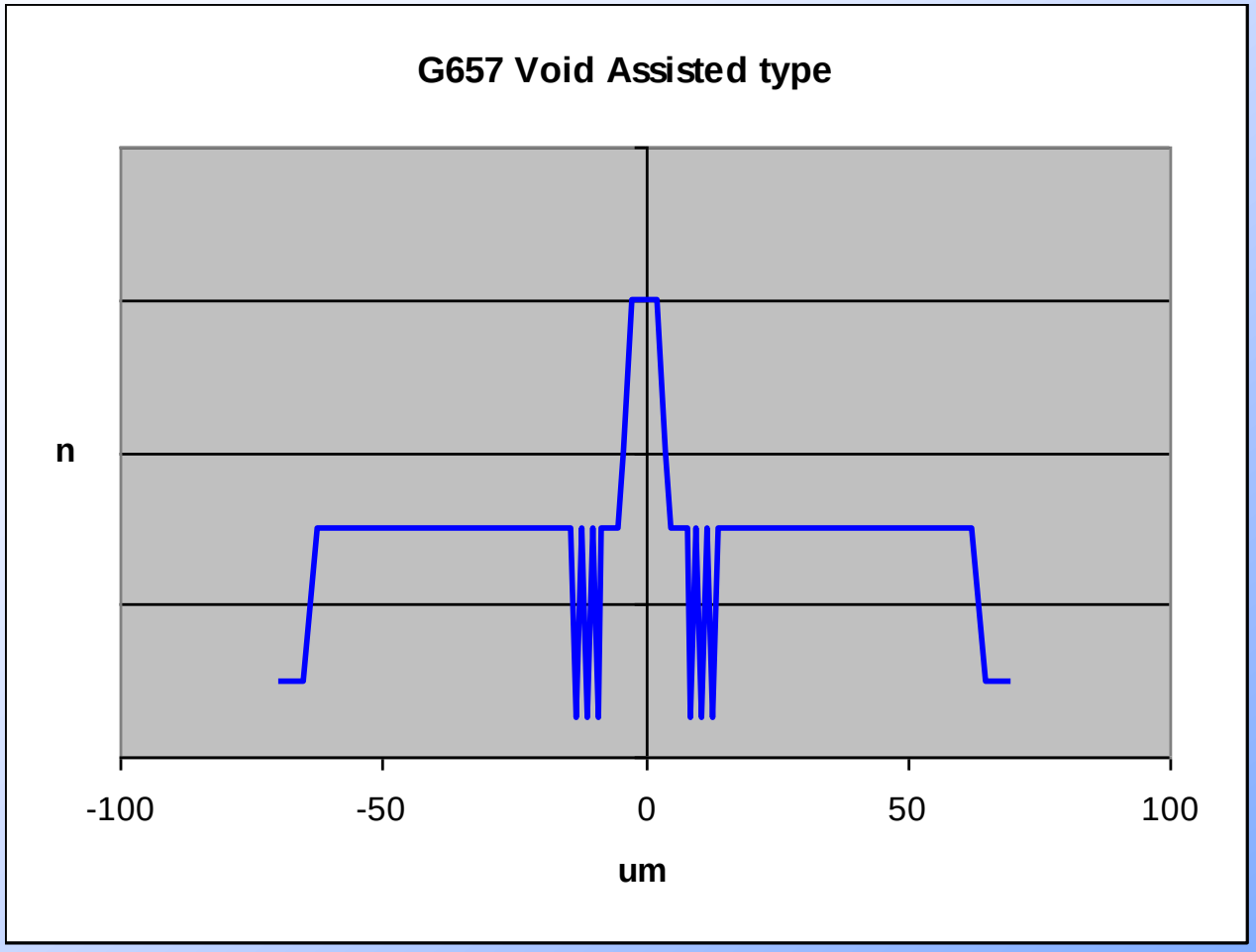
G657 – trench around the core design



G657 – ring + trench around the core design



G657 – voids around the core design



Who makes these fibres?

- Sumitomo PureAccess Ultra released 2004
  - Pioneering design with a tall, very thin core
  - 7.5mm allowable bend radius
  - Released before ITU defined “G657”
  - Poor G652 compatibility due to MFD mismatch
  - No longer in production

- Sumitomo PureAccess released 2004
  - 10mm allowable bend radius
  - Released before ITU defined “G657”
  - Now classed as G657A1
  - More than 7M km delivered

Designs, manufacturers, classes

Design	Producer	G657A1	G657A2	G657B2	G657B3
Tall/thin core	Sumitomo	PureAccess	PureAccessA2		
Tall/thin core	Corning	ClearCurve XB			
Tall/thin core	OFS	AllWave Flex			
Tall/thin core	Prysmian	CasaLight			
Trench	Sumitomo				PureAccess R5
Trench	Draka	BendBright	BendBright^{XS}		BendBright Elite
Trench + ring	OFS				EZ-Bend
Trench	Corning		ClearCurve LBL		ClearCurve ZBL
Voids	Prysmian			CasaLight Plus	CasaLight Xtreme

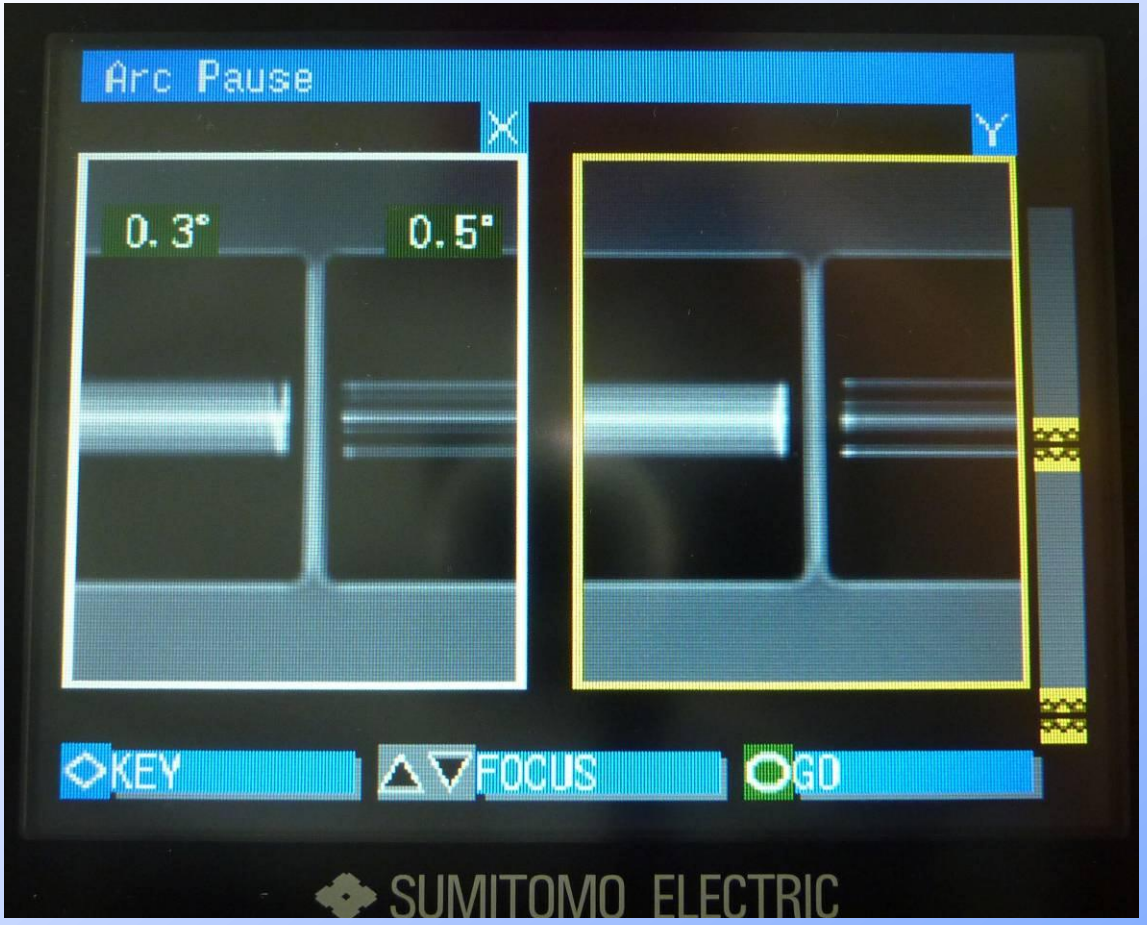
Corning ClearCurve has changed

- The original ClearCurve was a G657.B3 fibre using a Void Assisted Fibre (VAF) design. It had a ring of tiny holes or “nano-structures” around the core to achieve B3 level bending performance.

- Sumitomo developed a T-39 splice program for VAF type ClearCurve
  - This program collapsed the voids, to make the core visible for alignment
  - It’s available from software versions 1.29, 1.49 and 1.69 onwards

- In 2010 Corning withdrew the original design of ClearCurve from the market. Their present G657 product line up includes...
  - G657.A1 ClearCurve XB — Tall/thin core type
  - G657.A2 ClearCurve LBL — Trench type
  - G657.B3 ClearCurve ZBL — Trench type

New ClearCurve x Original ClearCurve



- New ClearCurve ZBL on the left, original type on the right

What are the issues in splicing these fibres?

- MFD mismatch with G652
  - Increased loss when MFD is not the same as G652D
- Mode profile mismatch with G652
  - Non-Gaussian mode profiles (power distribution)
- Different melting point to G652
  - Extra dopants may alter the melting point
- Evolving designs
  - Manufacturers are still improving their G657 fibre designs. Changes to their design can affect splice-ability

Using a fixed v-groove splicer

- Fixed v-groove splicers cannot image the core
- They “don’t care” the core differs from a G652
- The only consideration is the correct melting point

- How to splice using T-25e or T-66?
  - Choose SMF Standard program
  - Make an Arc Test
  - Start splicing

Using a core aligning splicer

- Core aligning splicers must process the core image to make a core alignment
- Extra structure around the core can distort or shield the core image
- G657B, and some G657.A2 core images differ from a G652 core and may need a special processing algorithm.

Using a Sumitomo T-39 splicer

- Sumitomo has worked with other fibre manufacturers to create & test splice programs for commonly available G657 fibres

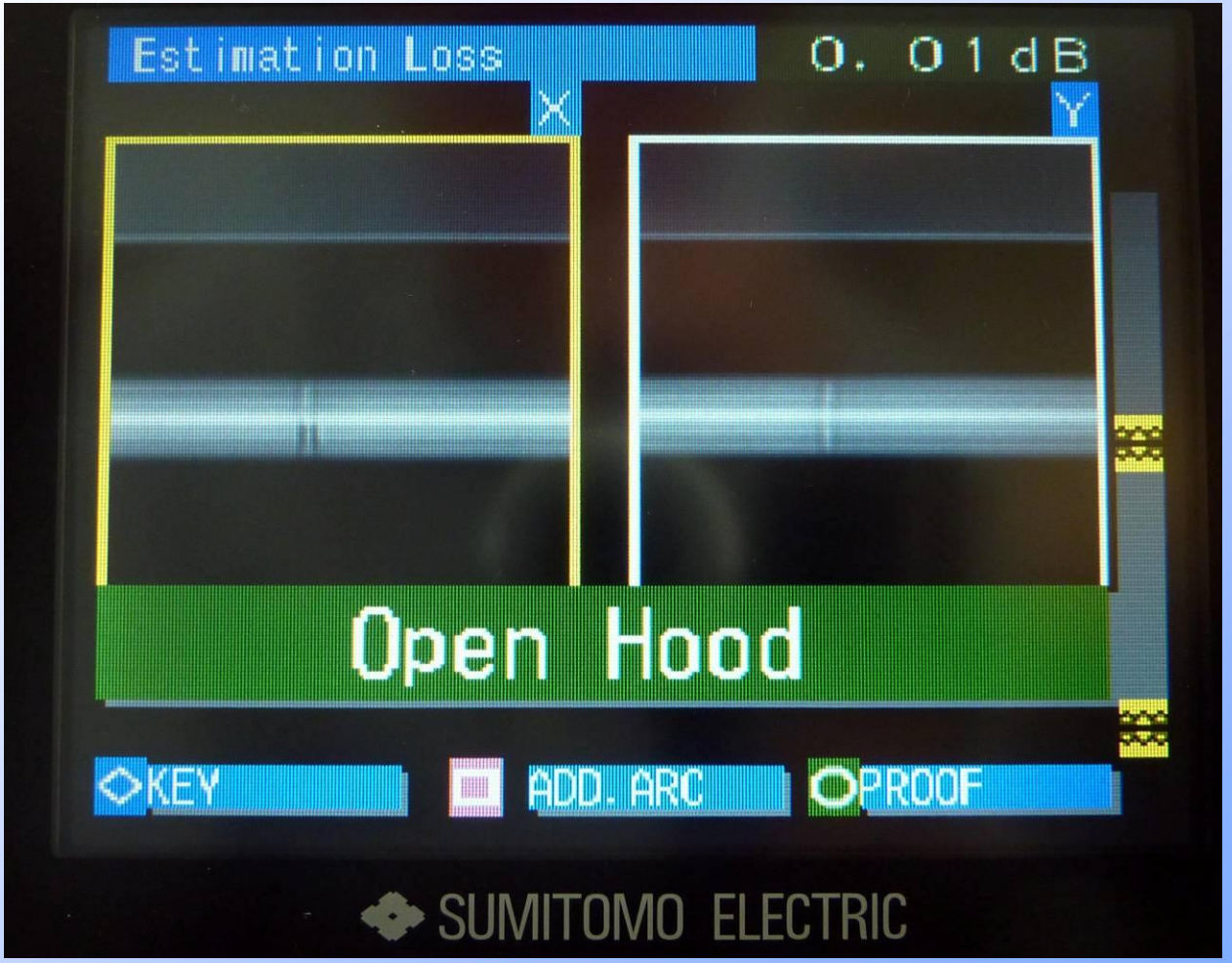
- T-39 has Core Alignment splice programs for current G657 fibres made by Prysmian, Corning, OFS & Draka-Comteq and of course, Sumitomo fibres

- T-39's 'AUTO' and 'BIF Adaptive' programs can also be used for G657 splicing. They attempt a Core Alignment splice, if this isn't possible, they revert to Diameter Alignment.

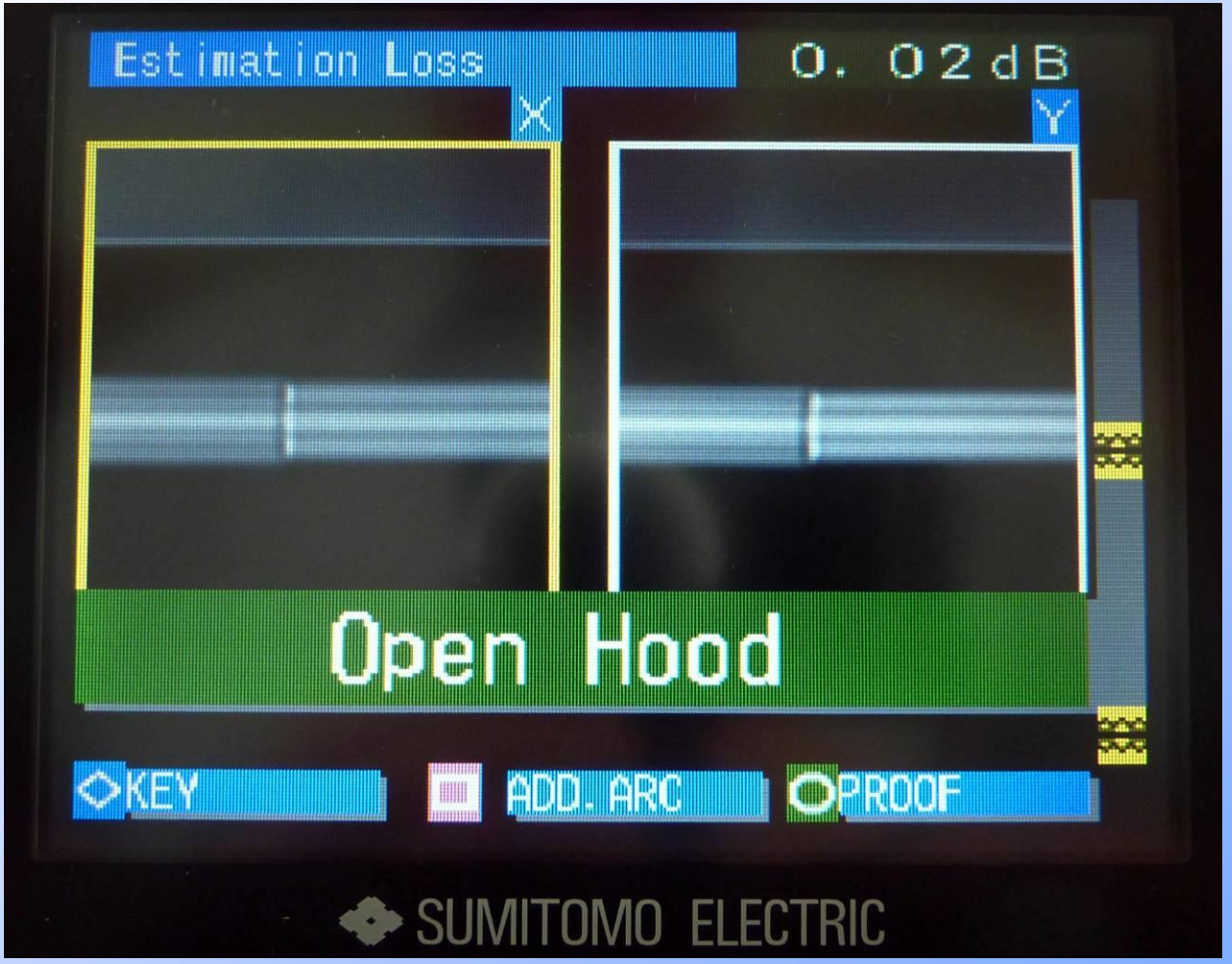
Examples of Core Alignment splices

The following slides show T-39 Core Alignment splices of various G657 fibres

ClearCurve ZBL x ClearCurve ZBL on T-39



ClearCurve ZBL x G652 on T-39

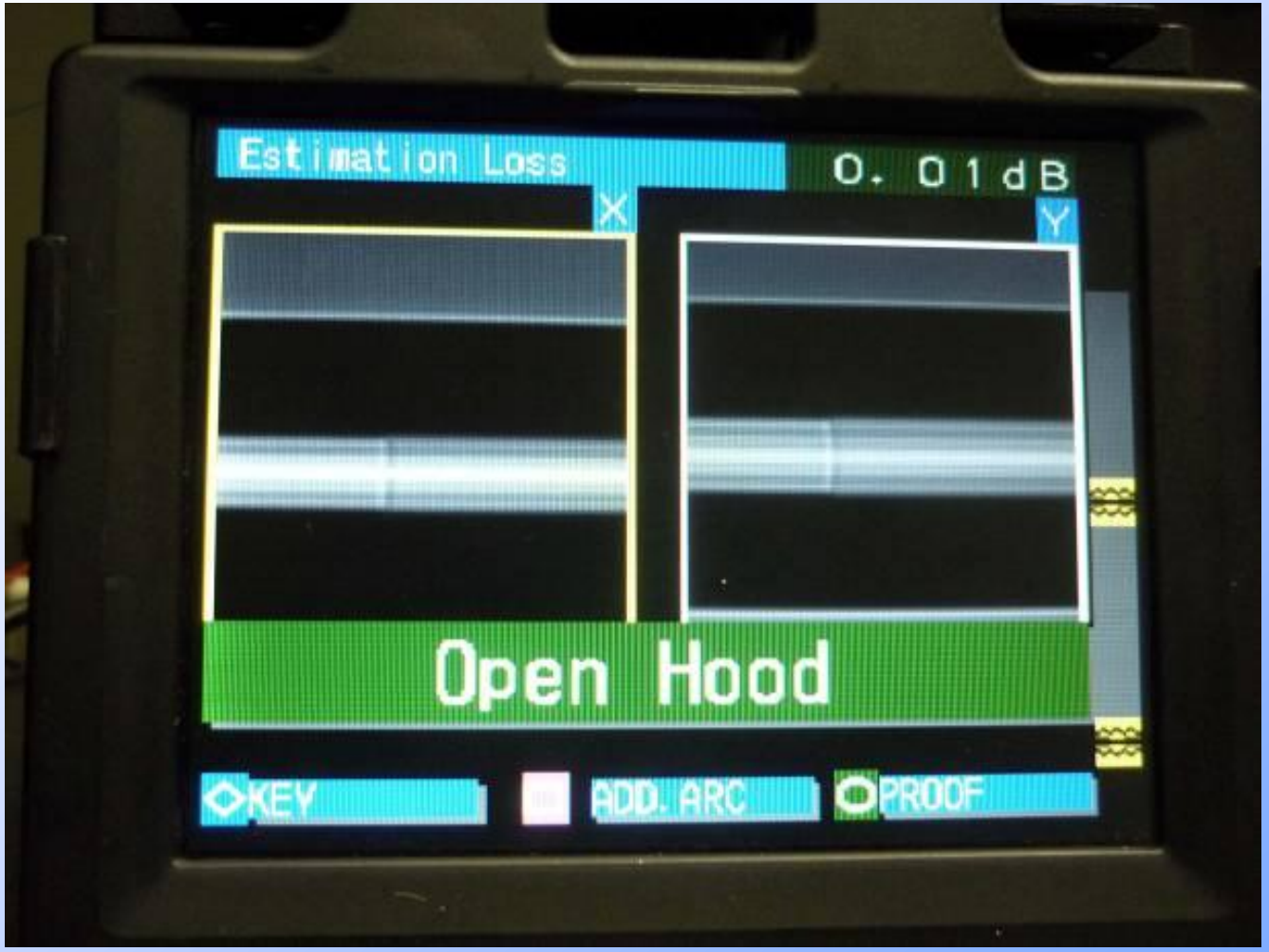


EZ-Bend x G652 on T-39

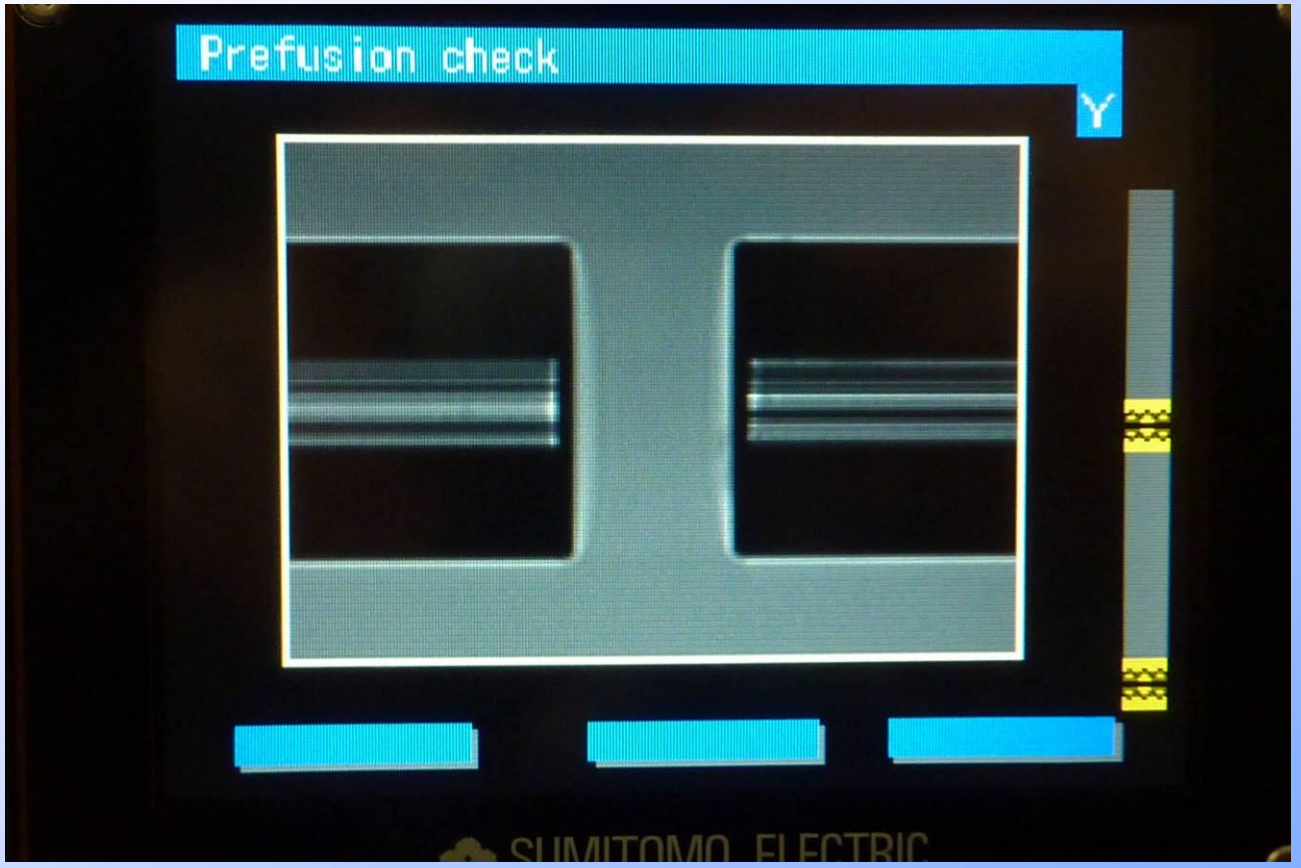
BendBright^{XS} x G652 on T-39

BendBright-Elite x G652 on T-39

BendBright^{XS} x BendBright-Elite on T-39

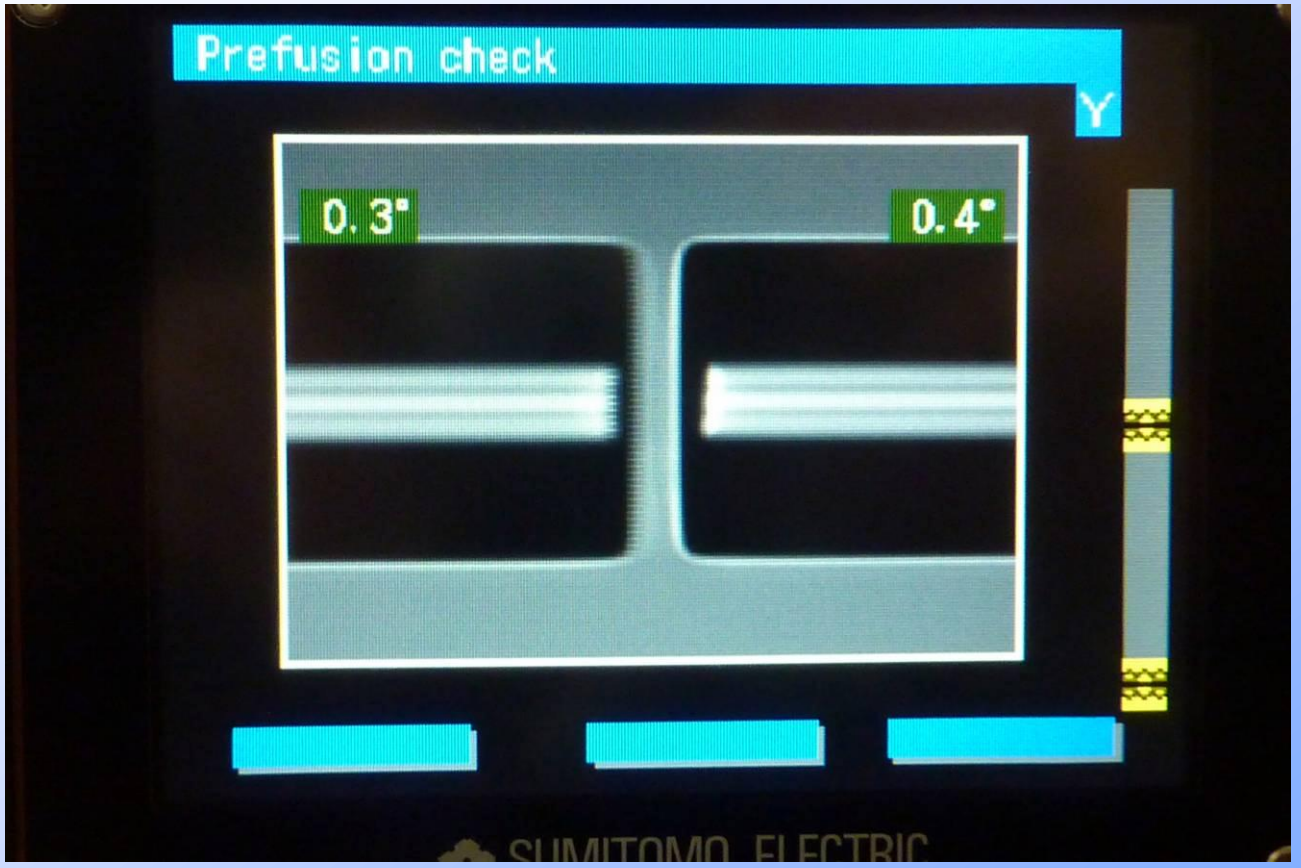


CasaLight-Plus x CasaLight-Plus on T-39



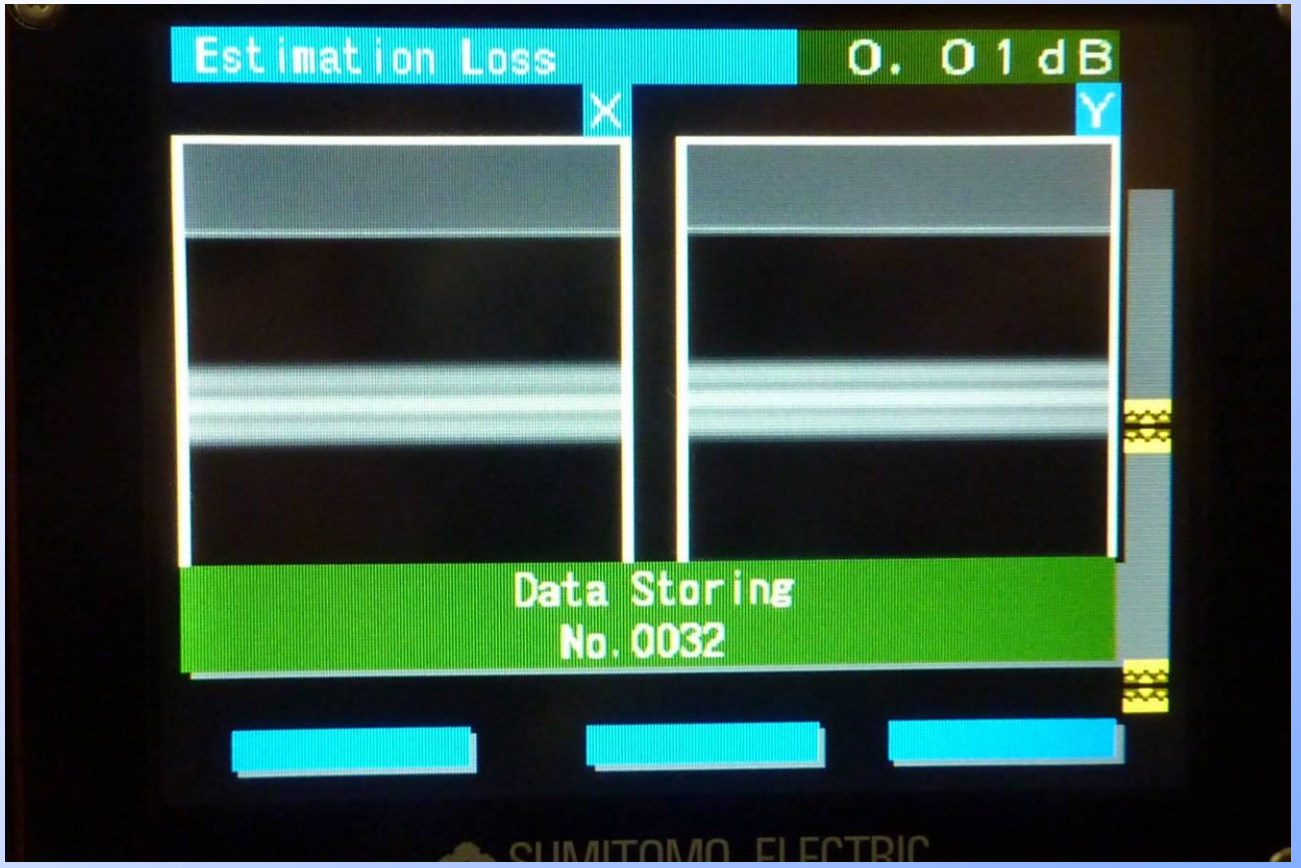
- Initially the core image is shielded by the cladding voids

CasaLight-Plus x CasaLight-Plus on T-39



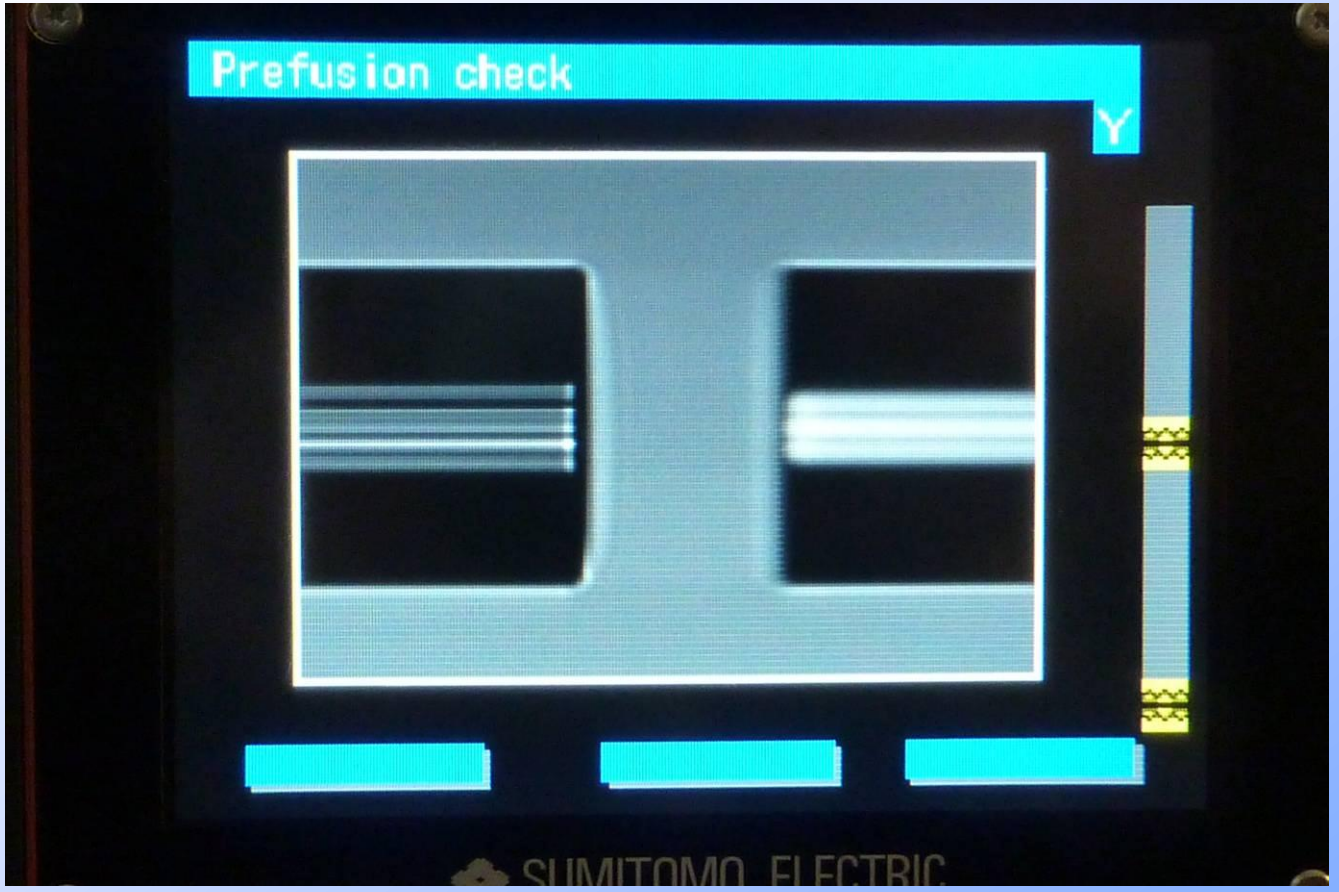
- T-39 collapses the voids so it can see the core

CasaLight-Plus x CasaLight-Plus on T-39



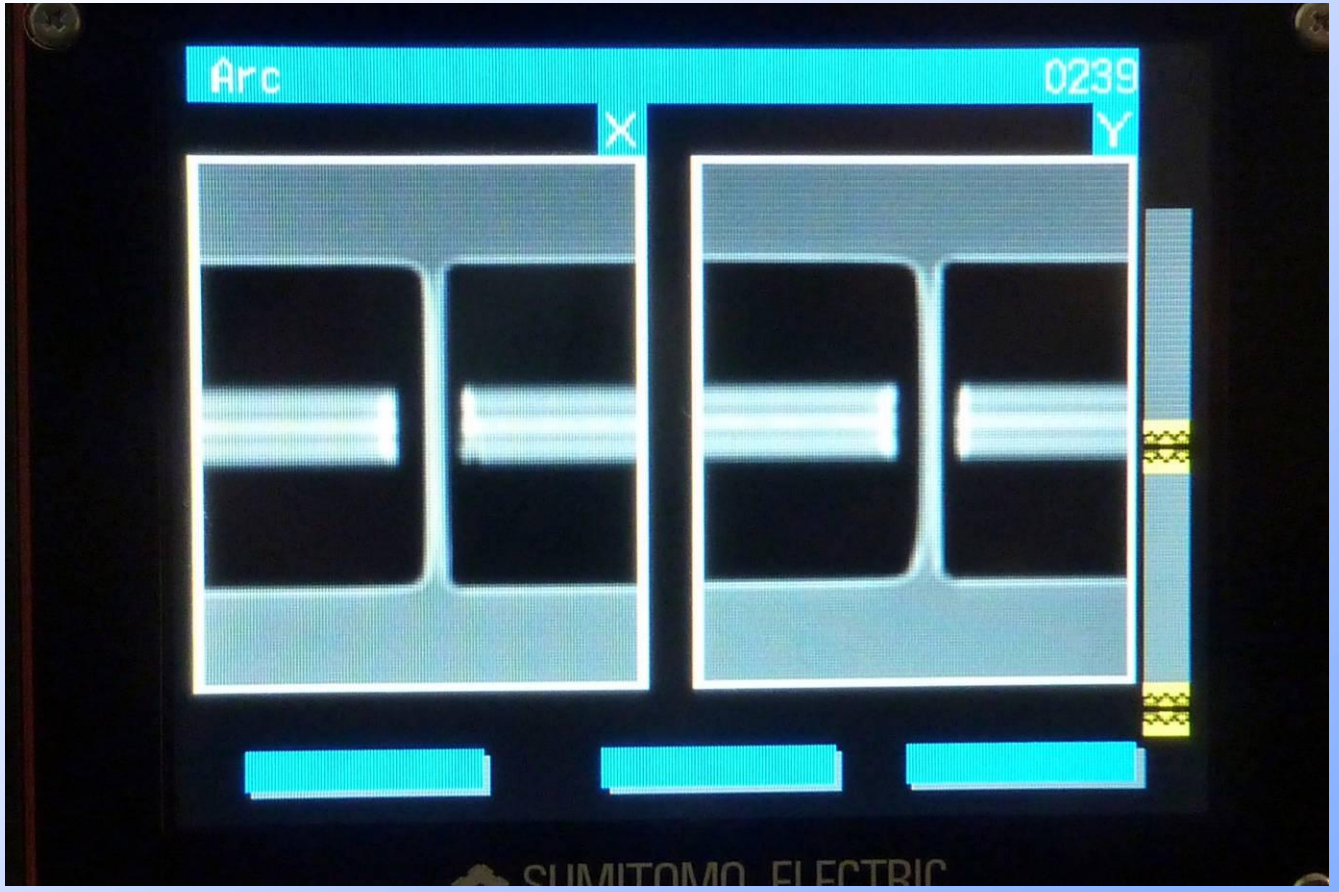
- Finished splice

CasaLight-Plus x G652 on T-39



- CasaLight-Plus on the left, G652 on the right

CasaLight-Plus x G652 on T-39



- T-39 collapses the voids to image the core of the CasaLight

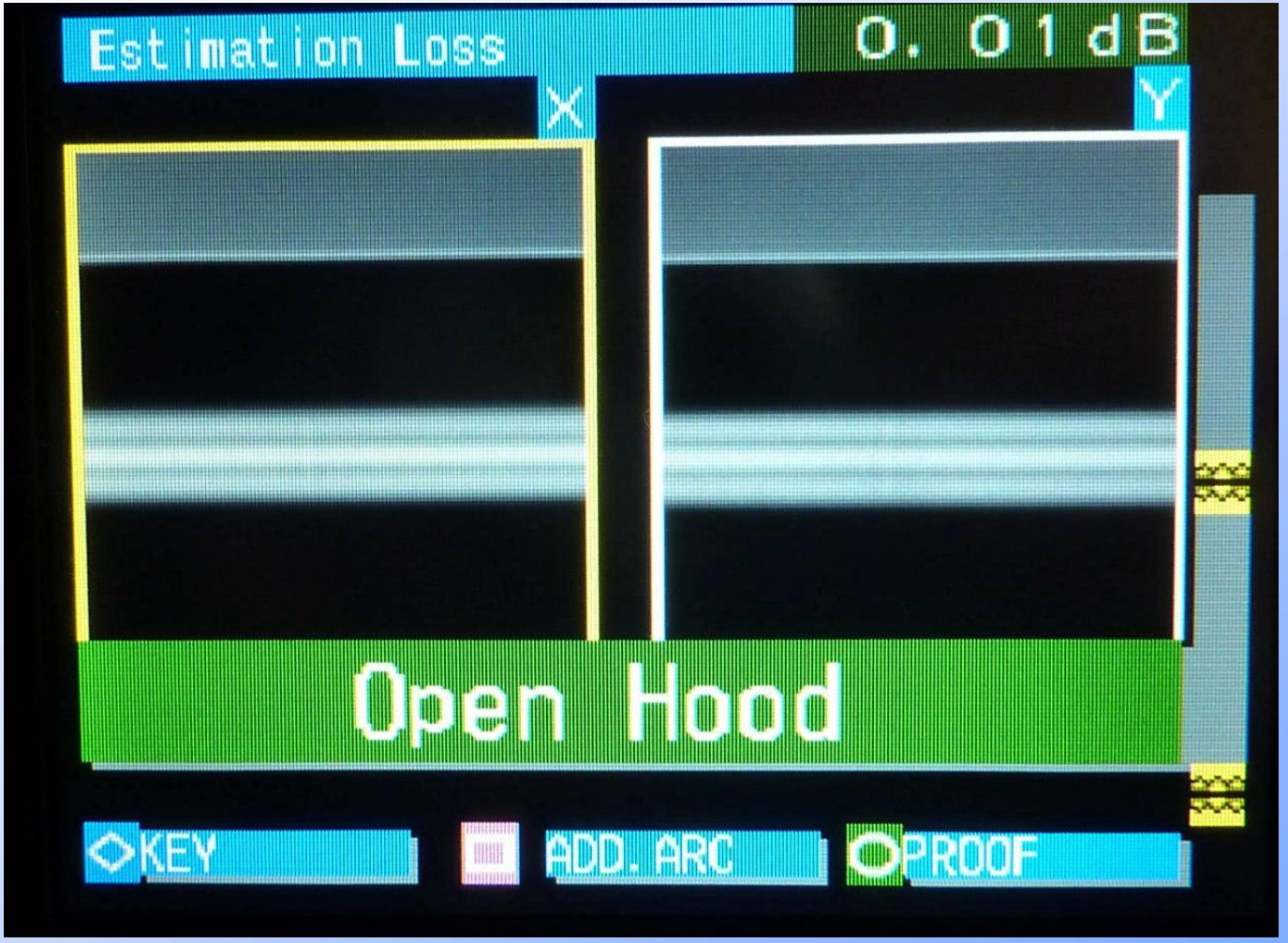
CasaLight-Plus x G652 on T-39

- Finished splice

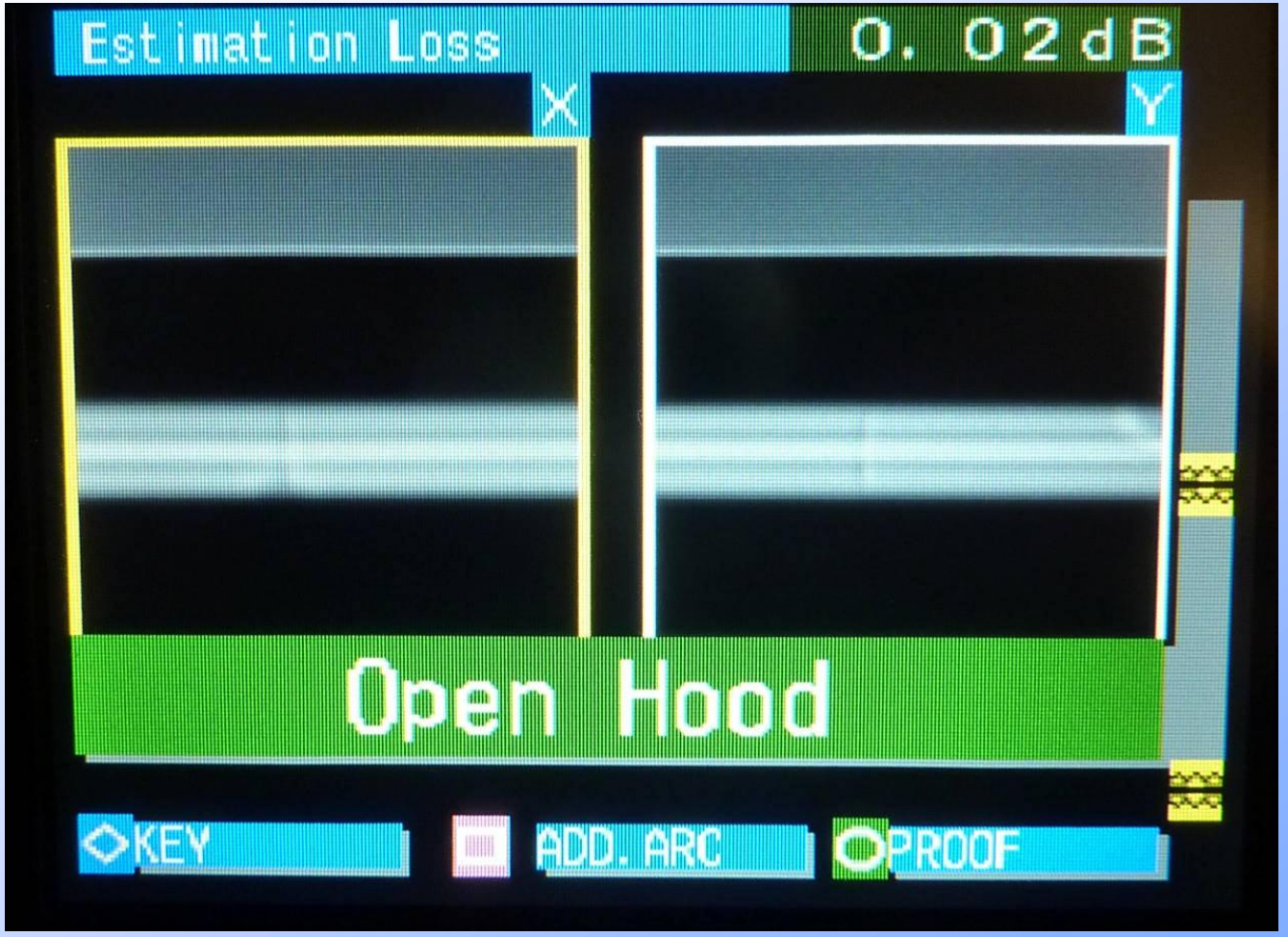
PureAccess[R5] x PureAccess[R5] on T-39

PureAccess[R5] x G652 on T-39

PureAccess[A2] x PureAccess[A2] on T-39



PureAccess[A2] x G652 on T-39



Let’s go ahead with G657 !

Thank you for your attention.