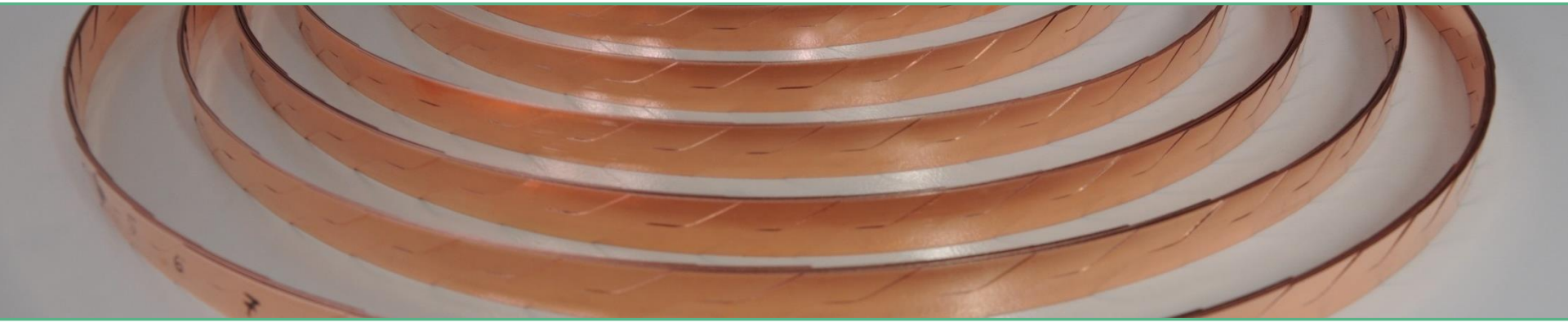
Progress and plan for Roebel

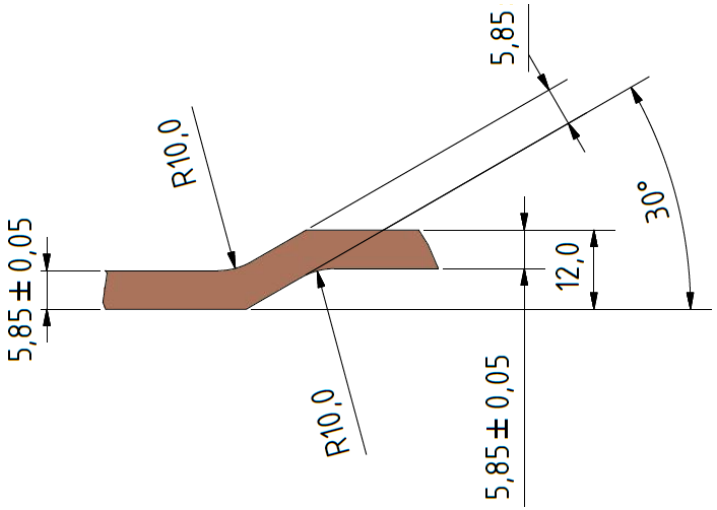


A. Kario, S. Otten, A. Kling, W. Goldacker

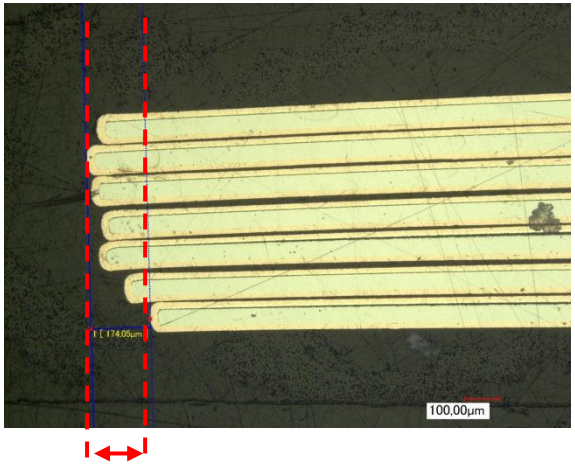
Institute for Technical Physics, Karlsruhe Institute of Technology, Karlsruhe

New punching tool and cable geometry SuperPower, 7 µm:

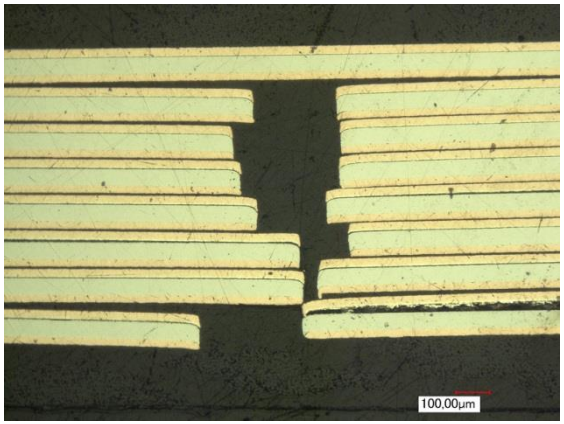
- New geometry now possible in punching tool
  - 5.85 mm strand width
  - 300 mm transposition length

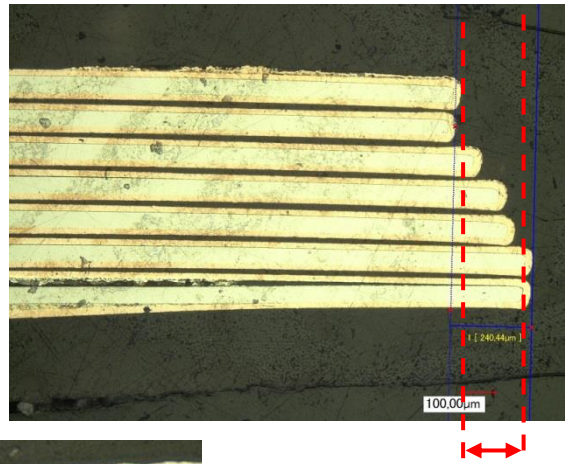


- Baseline for next EuCARD-2 cables



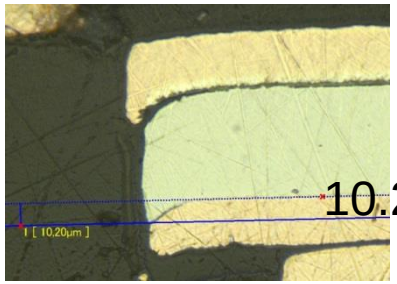
174 µm





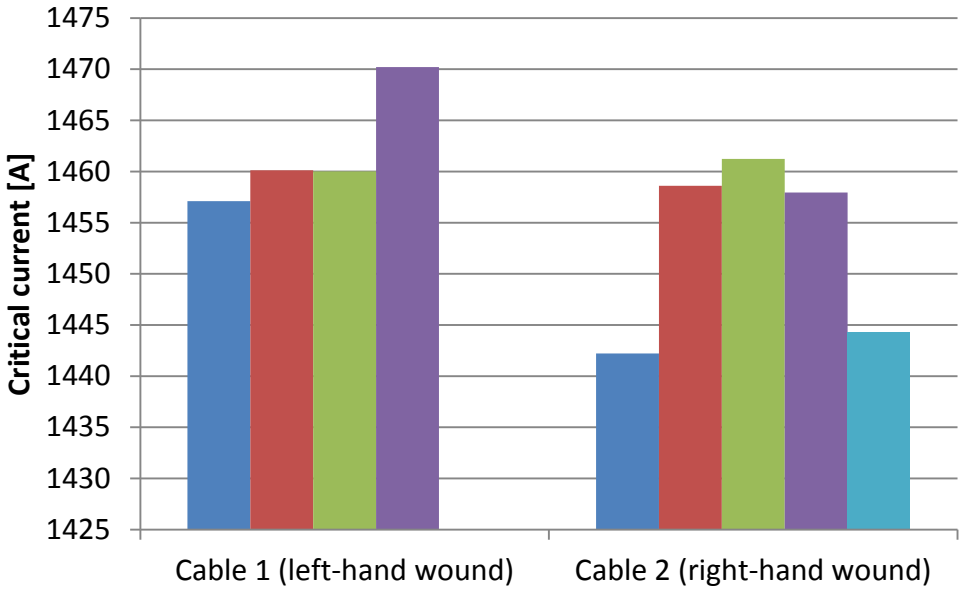
240 µm

Cross-section of first punched cable with new geometry (15 strands)

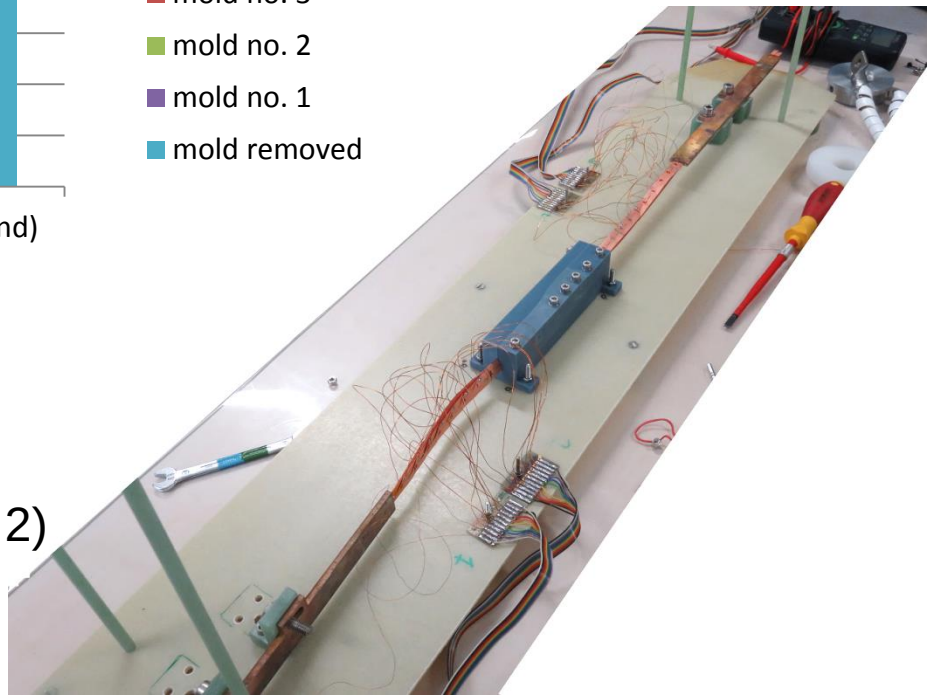


No degradation of I_c with all used molds:

Roebel cables in CEA torsion mold (*T* = 77 K, self-field)



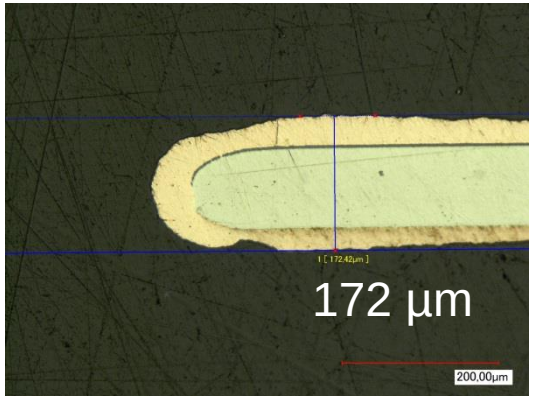
	Twist pitch [mm]	Bending radius [mm]
Mold 3	535	-
Mold 2	389	-
Mold 1	389	22

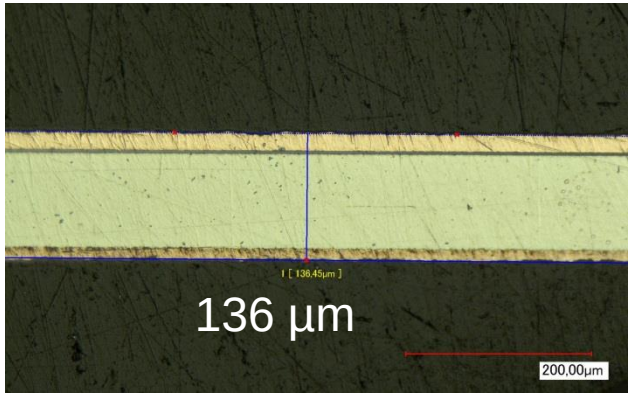


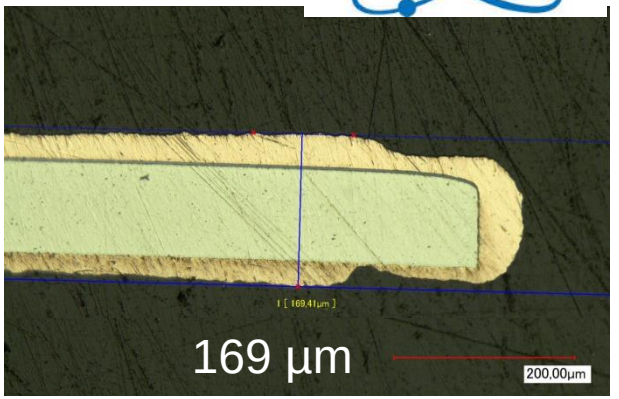
- No degradation observed
- Small I_c increase (reversible in cable 2)
- CEA - M. Durante, C. Lorin

Bruker punch and coat strand for Twente transversal stress cable sample:

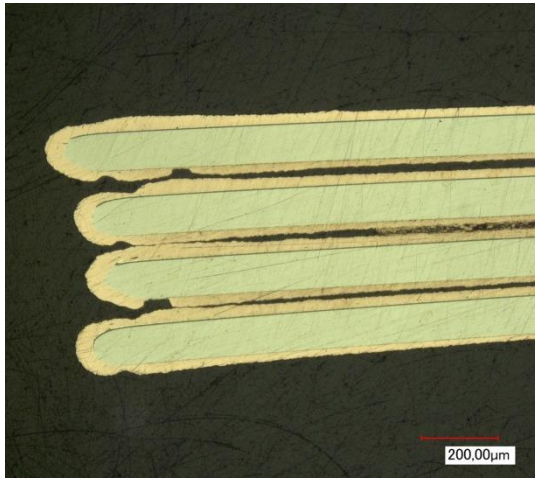
Cross-section of one tape:

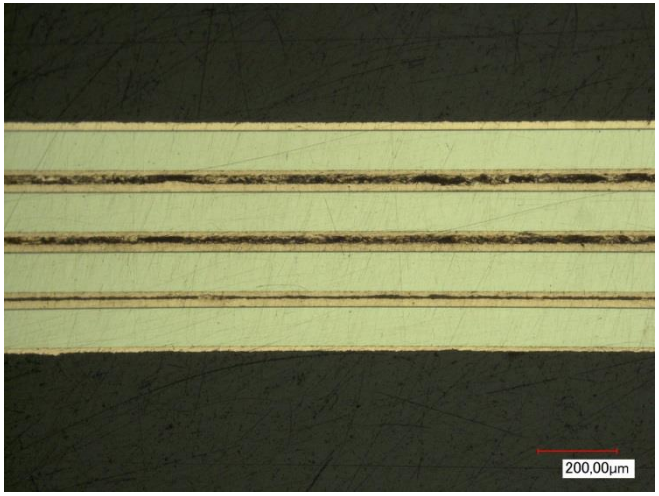


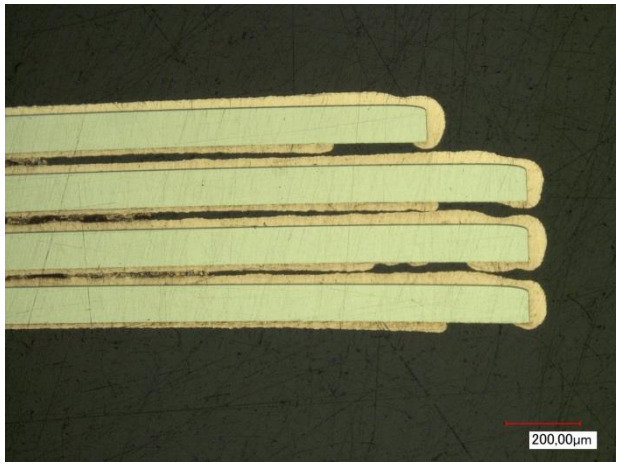




Cross-section of tape stacks:



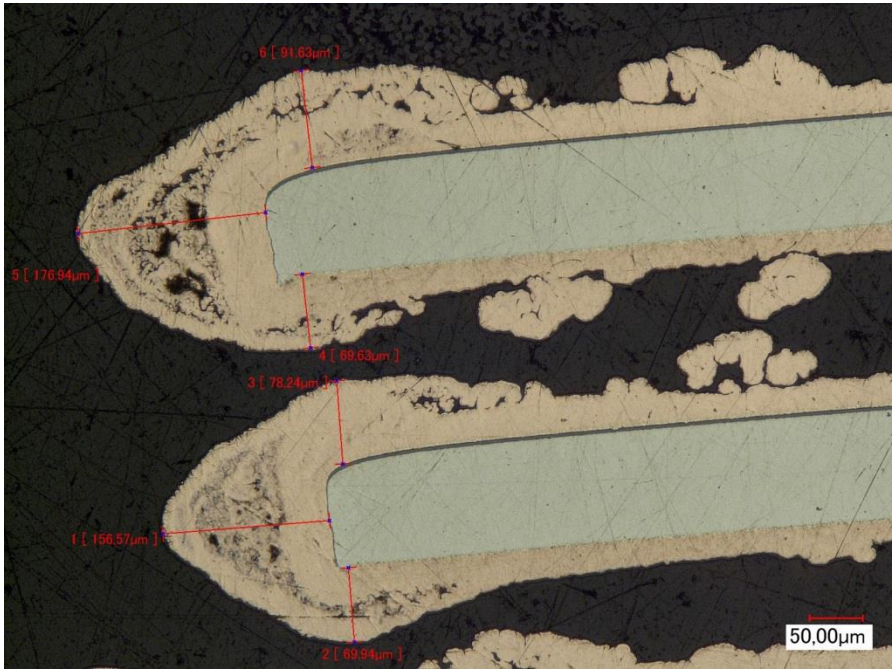


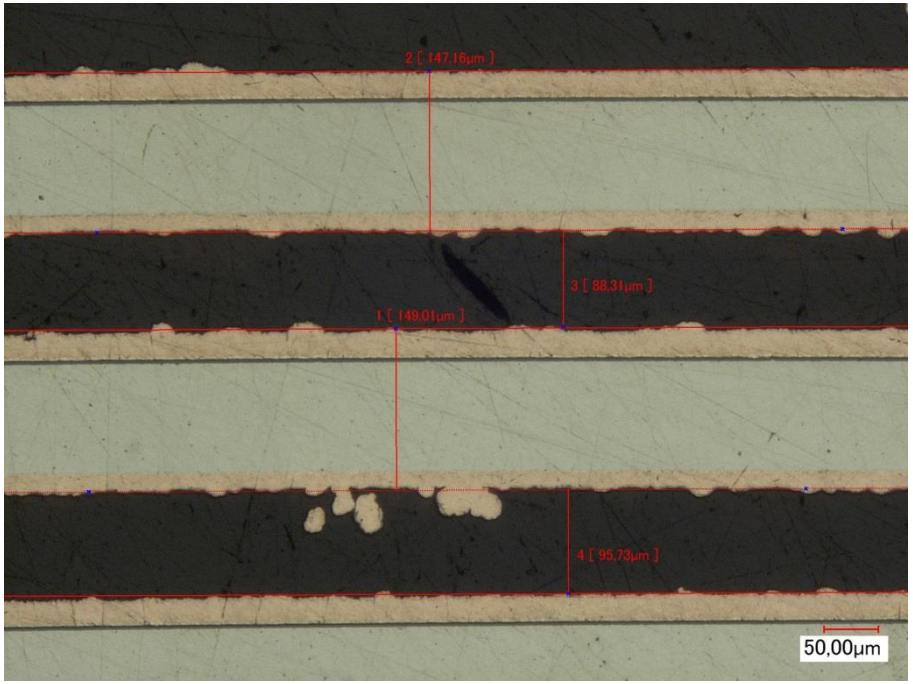


- Bruker: A. Usoskin, A. Rutt

Bruker punch and coat strand for FRESCA cable sample (first attempt):

Cross-section of one tape:

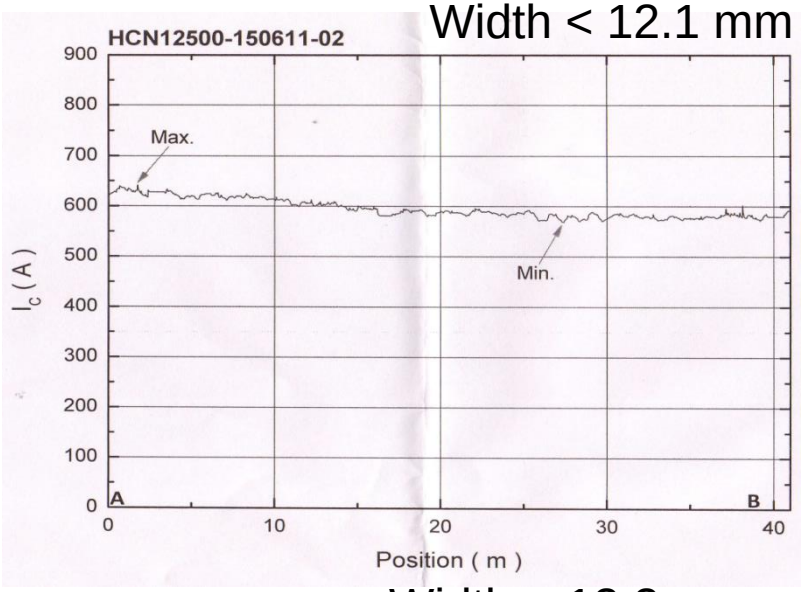


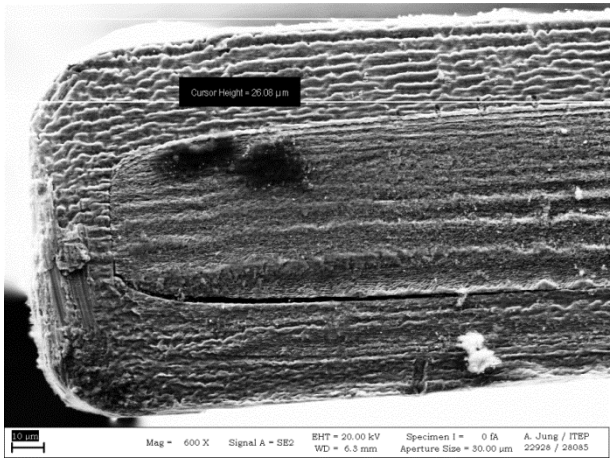


- thickness in center: 147-150 µm
- thickness on edge: 220-260 µm
- Bruker: A. Usoskin, A. Rutt

SuNAM- CERN delivery:

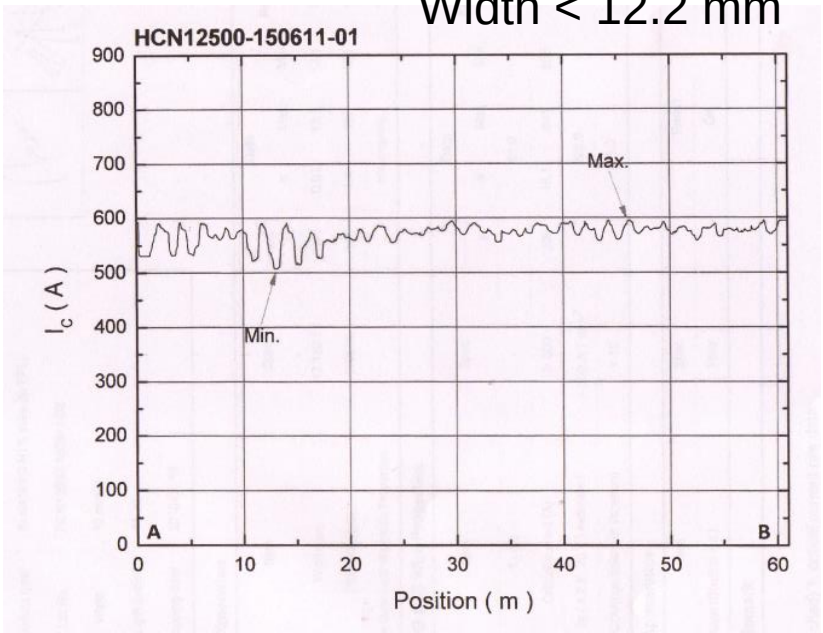
Width < 12.1 mm





HCN12500-02

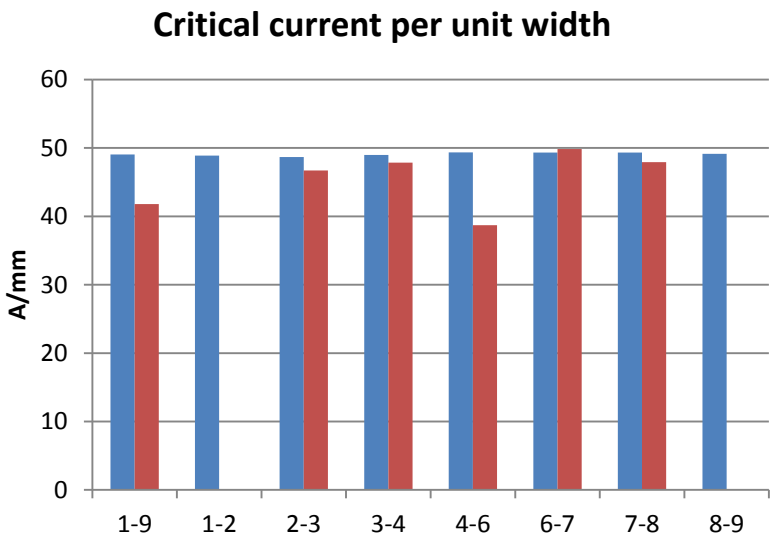
Width < 12.2 mm

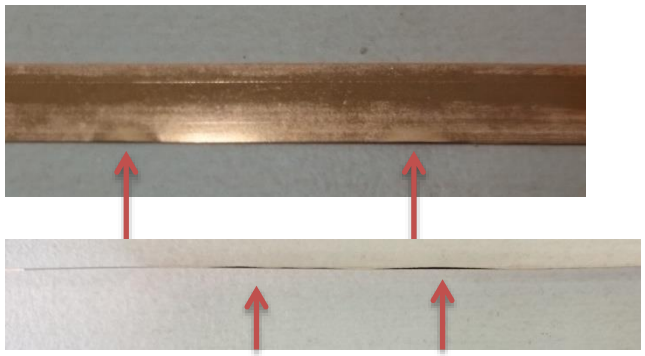


- Delivered from CERN
  to KIT for punching test 20 + 20 + 40 m
- Change in punching tool needed
  (tape width)

SuNAM - HCN12500-150611-02 – short punching test:

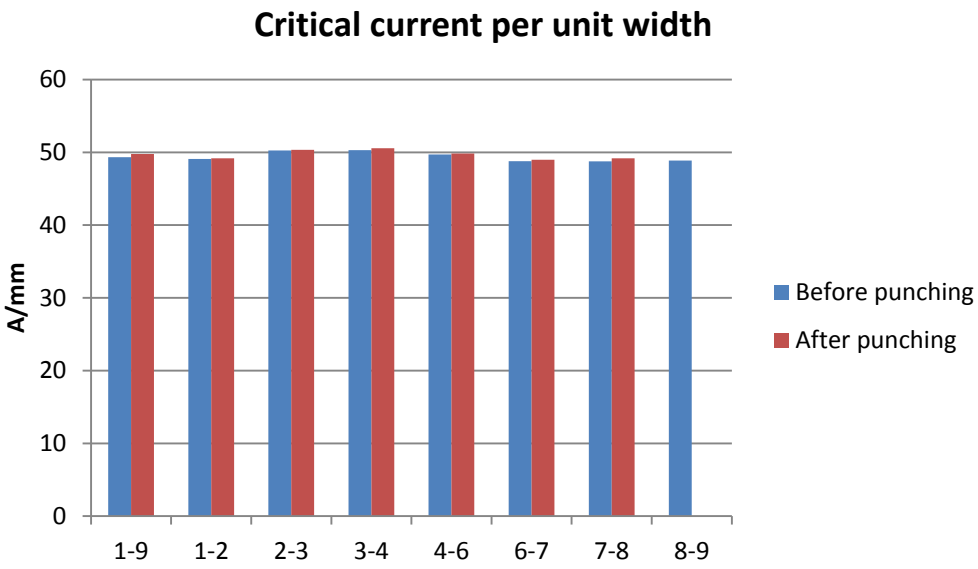
7 µm tool

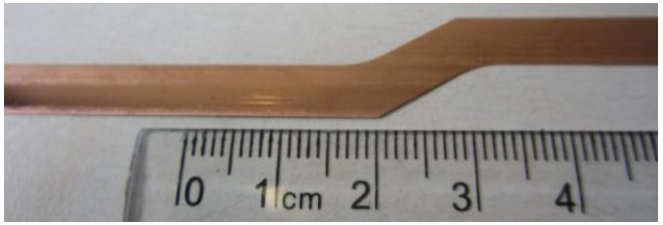




- I_c tape (77K, sf) ~ 589 A
- I_c strand (77K, sf) ~ 270 A
- 14.7% degradation

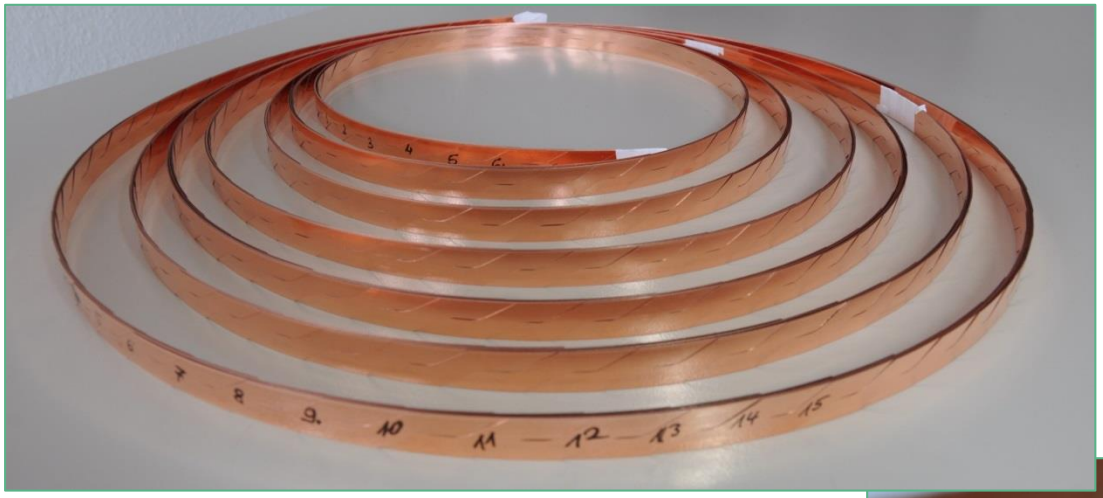
17 µm tool

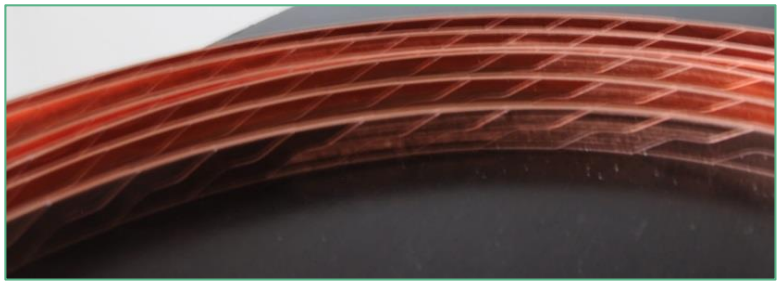


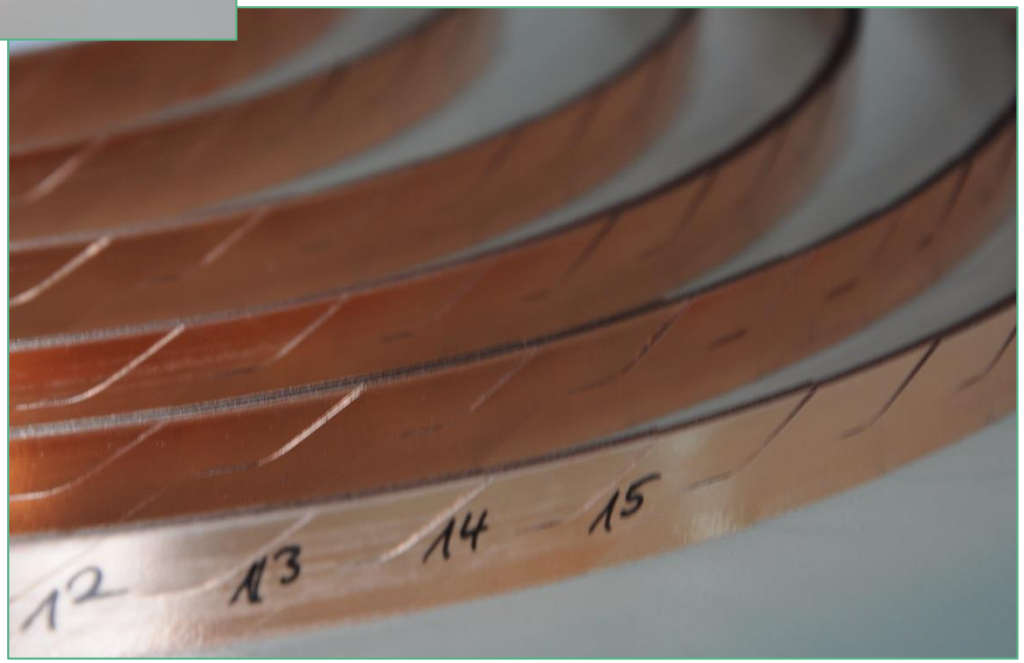


- I_c tape (77K, sf) ~ 593 A
- I_c strand (77K, sf) ~ 277 A
- no I_c degradation

Delivery of 5.94 m long SuNAM cable:



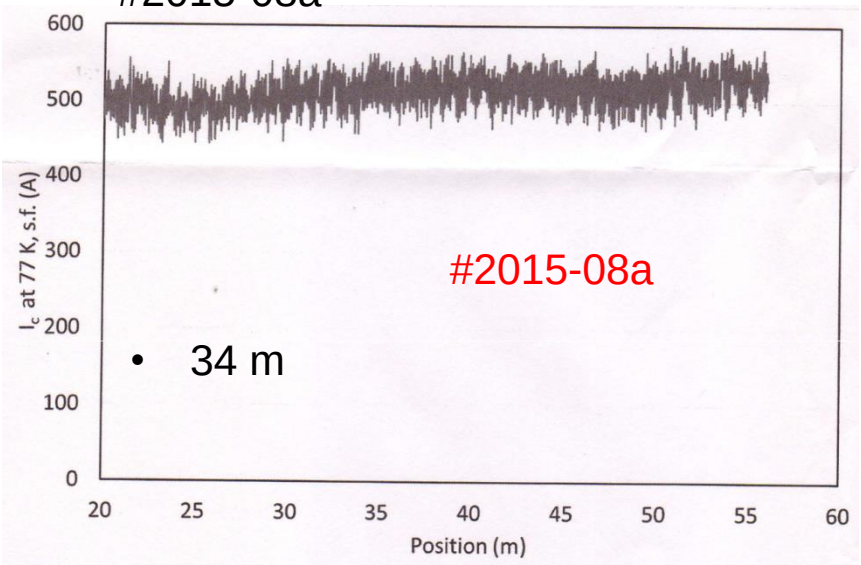


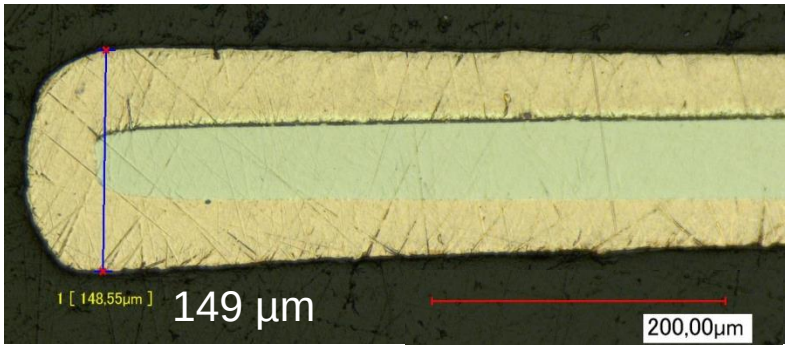


- TL: 300 mm, 5.85 mm strand width
- 15 strands, 5.94 m long
- 17 µm tool, *RE*BCO up
- No material left for cross-section
- 2 + 3 strands HCN12500-150611-02
- 10 strands HCN12500-150611-01

SuperOx- CERN delivery:

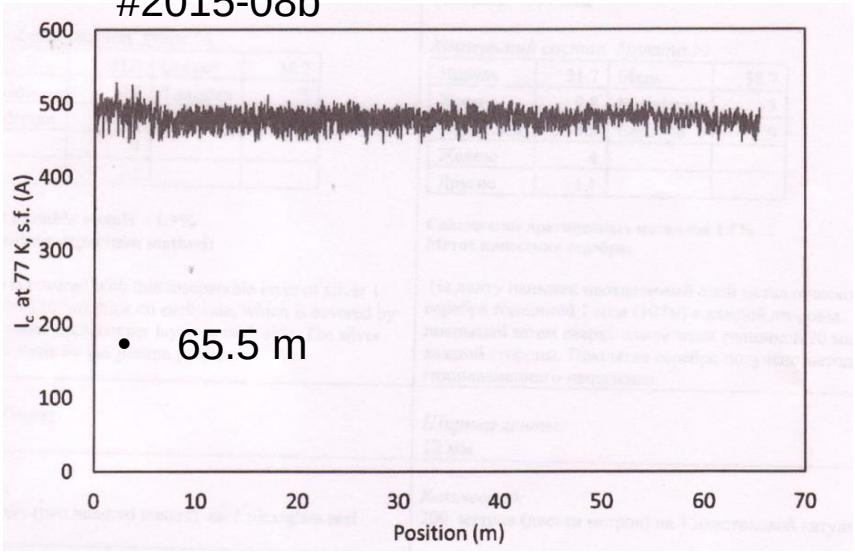
#2015-08a



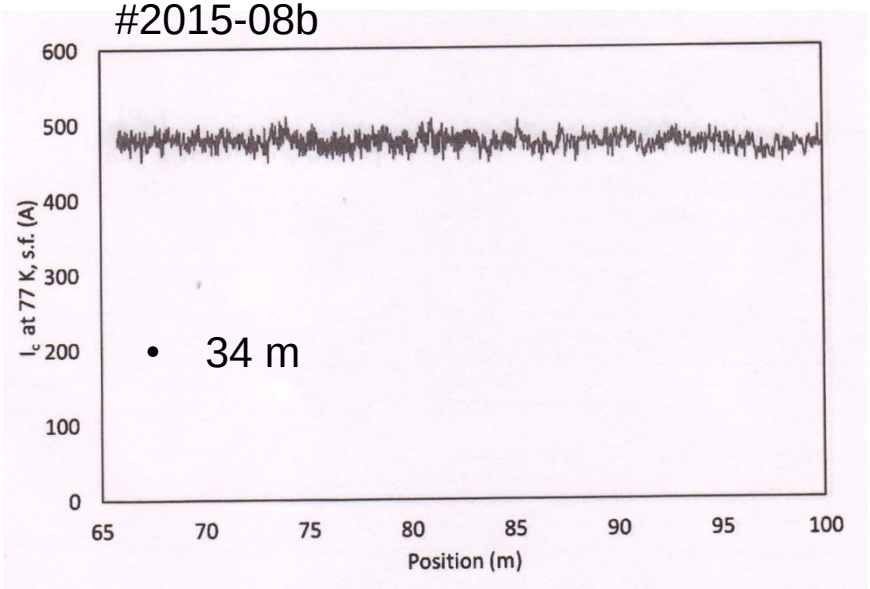


- Dog boning observed in tape ‘‘a‘‘

#2015-08b



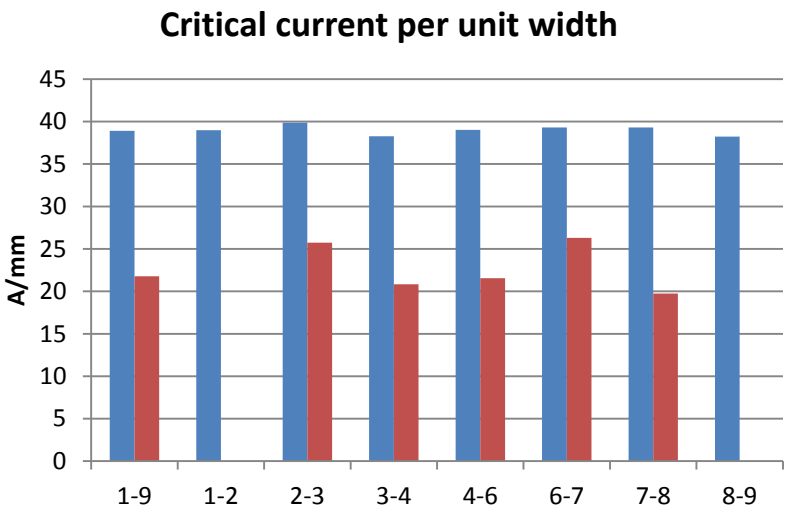
#2015-08b



SuperOx 2015-08a – short punching test:

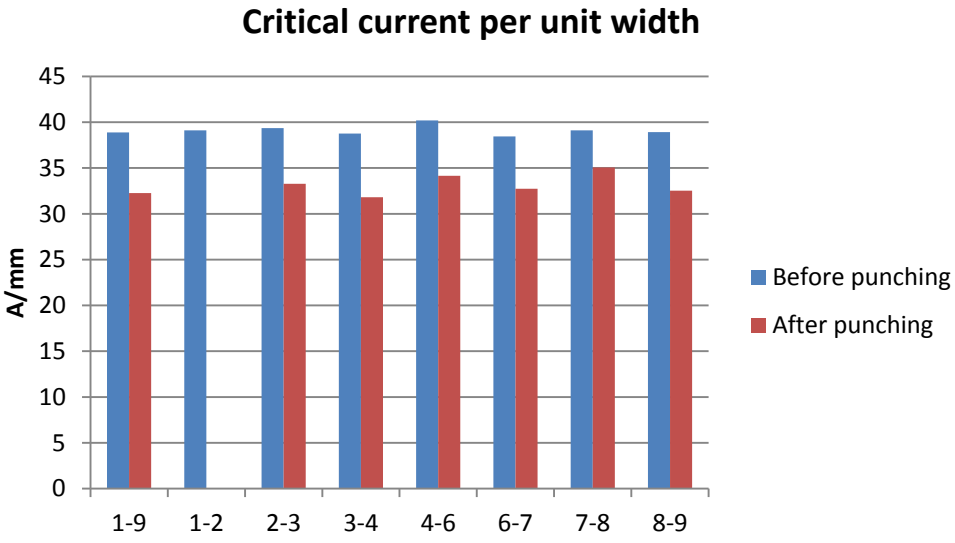
Karlsruhe Institute of Technology

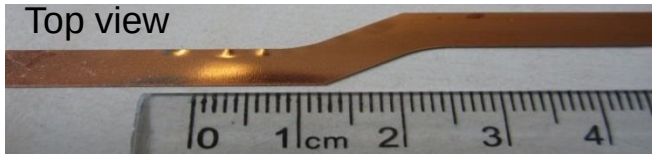
7 µm tool



- I_c tape (77K, sf) ~ 468 A
- I_c strand (77K, sf) ~ 134 A
- Delamination up to 4 mm
- 44 % degradation

17 µm tool

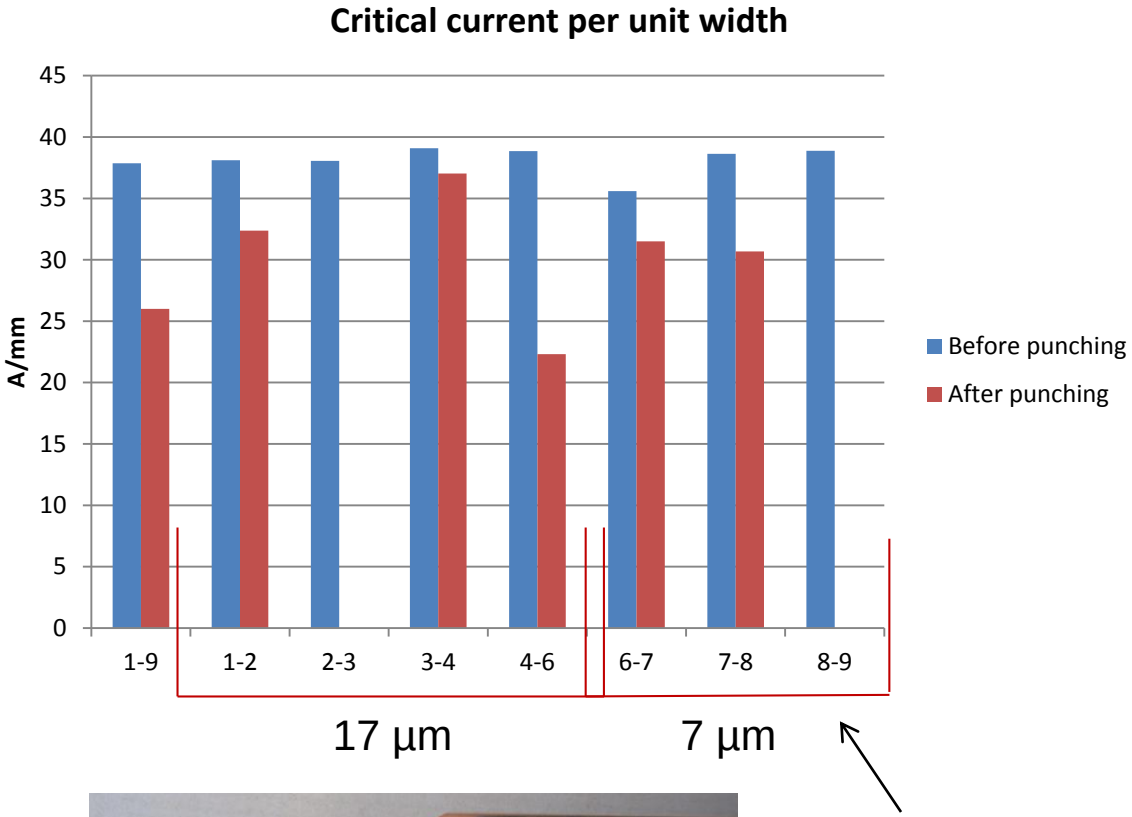




- I_c tape (77K, sf) ~ 470 A
- I_c strand (77K, sf) ~ 195 A
- Delamination up to 2 mm
- 15 % degradation

SuperOx 2015_08a – short punching test:

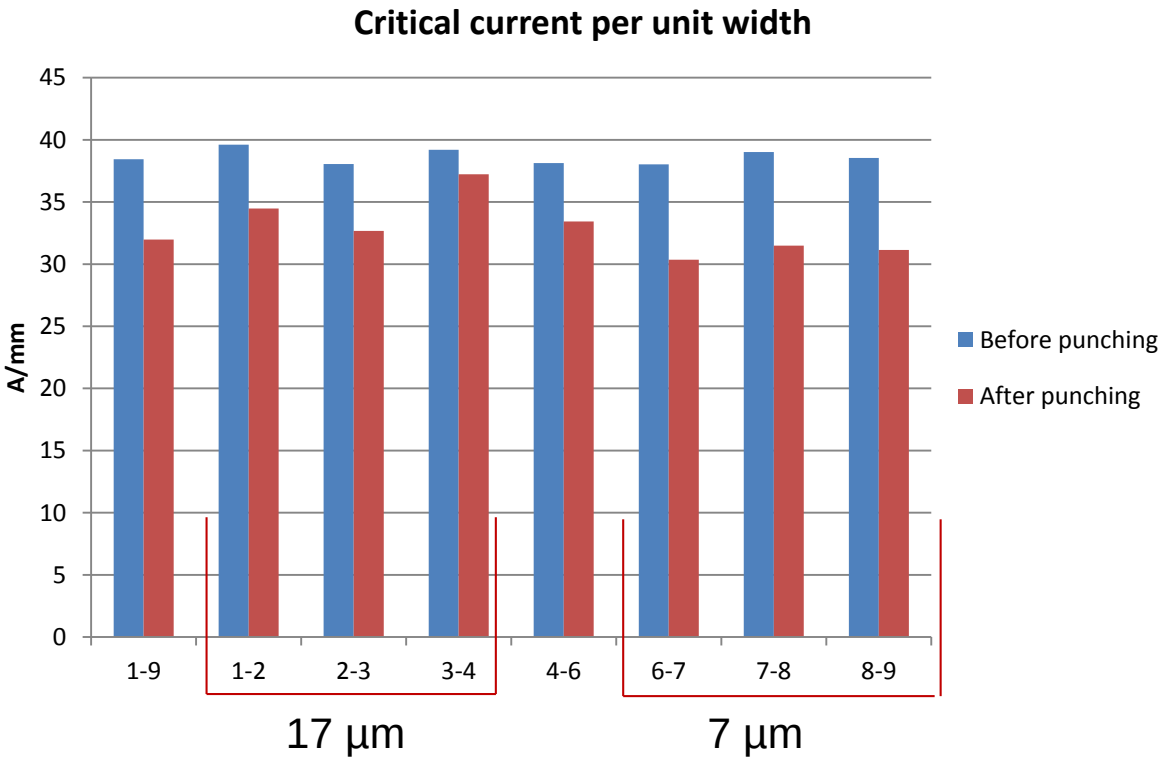
- Delamination after I_c measurement



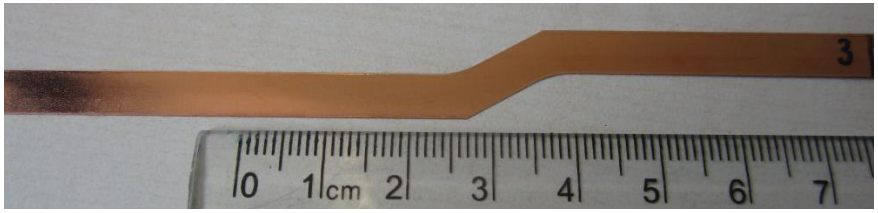
- I_c tape (77K, sf) ~ 458 A
- I_c strand (77K, sf) ~ 180 A
- 31 % degradation

Delamination up to 2 mm wide

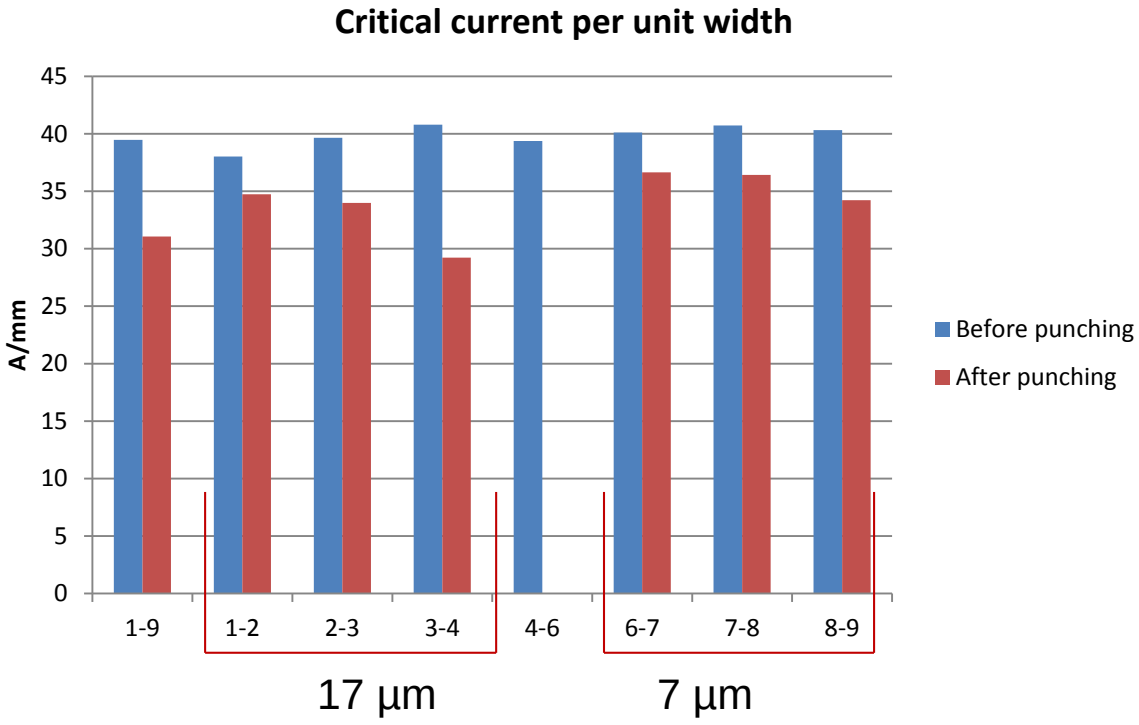
SuperOx 2015_08a – short punching test:



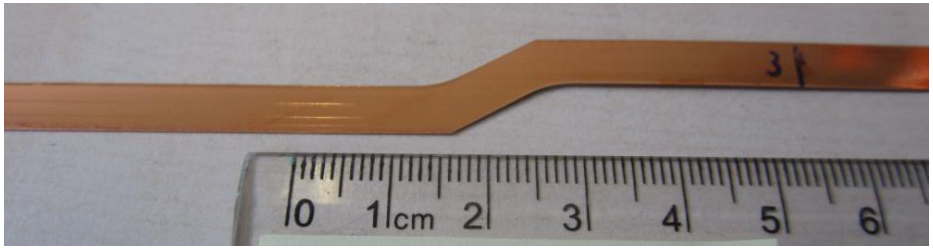
- I_c tape (77K, sf) ~ 464 A
- I_c strand (77K, sf) ~ 193 A
- 14.7 % degradation
- No delamination after punching



SuperOx 2015_08b – short punching test:



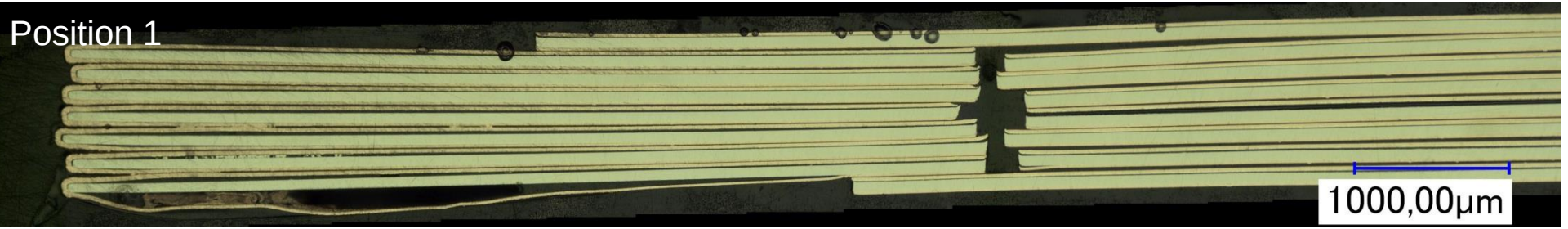
- I_c tape (77K, sf) ~ 478 A
- I_c strand (77K, sf) ~ 200 A
- 21 % degradation
- No delamination after punching

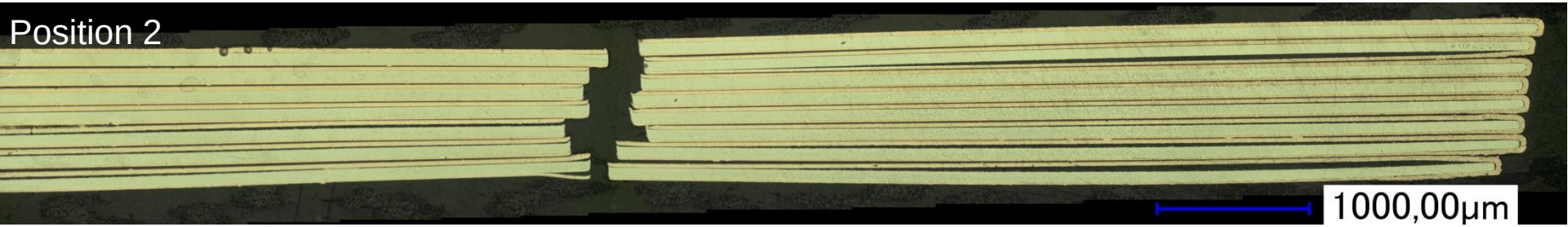


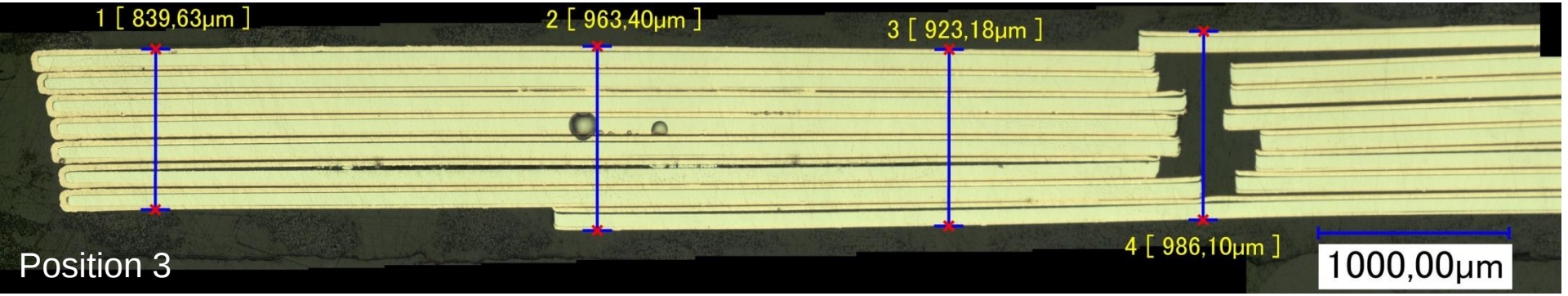
SuperOx cable delivery:

- TL: 300 mm, 5.85 mm strand width
- 15 strands, 6.15 m long
- 7 µm tool, *RE*BCO down
- 15 cm used for cross-section
- 5 strands #2015_08b
- 10 strands #2015_08a

Cross-section of the SuperOx cable:

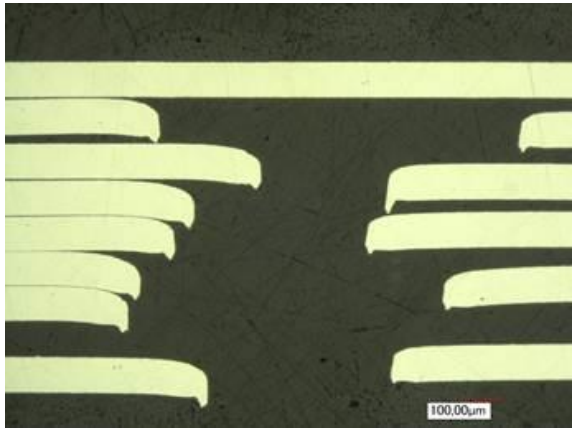




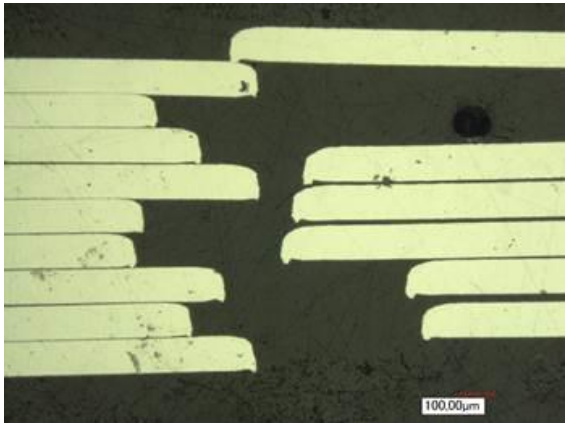


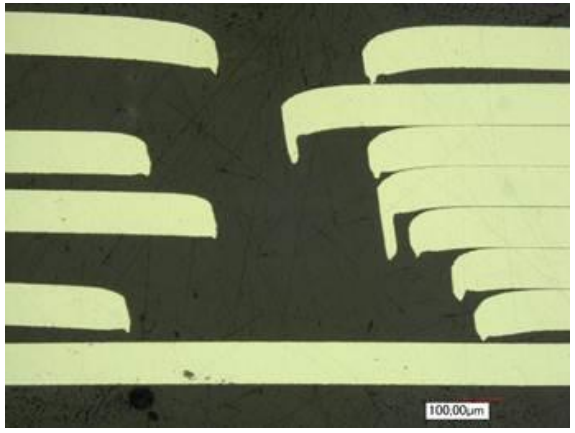
Cross-sections of the cables with different tools:

100 µm SS, 17 µm die:

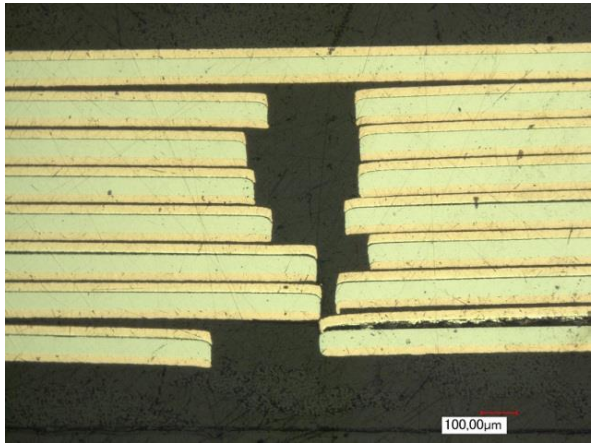


100 µm SS, 17 µm die, pressed:





SC, SuperPower, 7 µm die, pressed:



Summary:

- New punching tool available since beginning of the new year
- New Roebel geometry applied
- Successful cos-theta coil end test with new cable design
- Significant reduction of dog-boning on Roebel strand (Bruker)

- Sample for Twente test - SuperPower material -delivered
- 6 m cable for Feather-0, SuNAM - delivered
- 6 m cable for Feather-0, SuperOx - delivered

Plans for Roebel cable:

- Sample for Twente test (SuperPower material)
- 6 m cable for Feather-0 – Fujikura tape
- 200 m stainless steel substrate – Bruker
- 4 x ~30 m Bruker Ag tape for 24 m long cable (0.14 mm thick, Feather-2)
- CEA Saclay 24 m long dummy (beginning of June)
- CEA Saclay 24 m long dummy (second week of June)
- 34 m long cable for Feather-2 June- no superconducting material available !
- Roebel with filaments – University of Southampton

Recalling table from last meeting:

Model	Dummy UL	Short cable UL	Long cable UL	Other Tape	Other Cable
AB	-	5 x 6m	6 x 32 m	20 m	3 m
CT	3 x 24 m		3 x 24 m		6 m