

# High current, low AC loss HTS cable for fusion and high energy physics applications

1PoM01-08

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MT-28 International Conference on Magnet Technology Aix-en-Provence, France, 10-15 September 2023

## DESIGNATION

1. Fusion application
2. Accelerators dipole
3. Detectors for high-energy physics

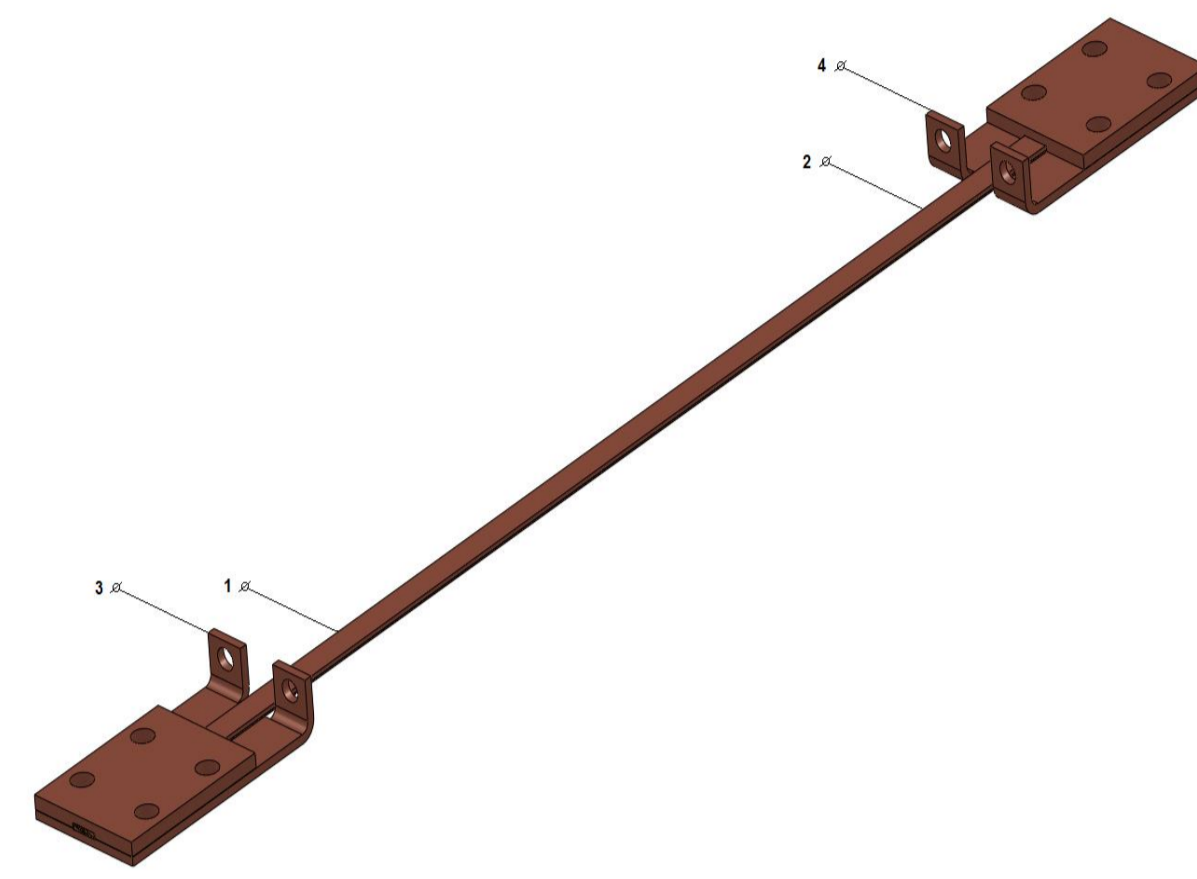
## TECHNICAL SPECIFICATION

Property	Value
Width	16 mm
Thickness	3,5 mm
Numbers of HTS tapes	35
HTS tilt angle	18°
Min bending diameter	150 mm
Joint resistance @ 20K	5-10 nOhm
Ic @ 77K SF	3 kA
Ic @ 20K 20T	8 kA
Ic @ 4,2K 12T	22 kA

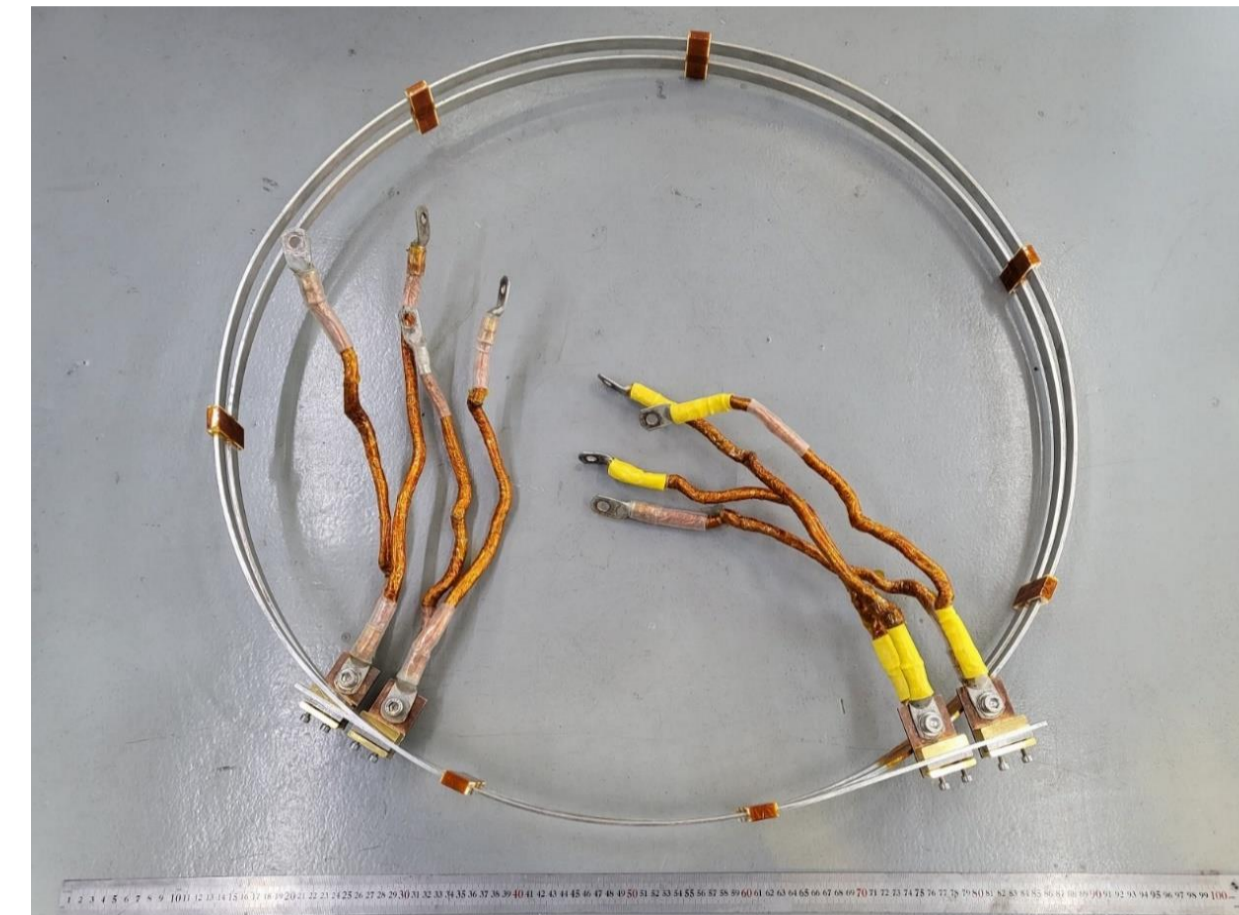
## ADVANTAGES

1. Current distribution between HTS is provided by leaning design (HTS equal lengths)
2. Smaller bending diameter is provided by stacking HTS tape at an angle
3. Due to reel-to-reel process production capacity can be increased up to hundreds of meters
4. Safety production technology (no degradation critical current)
5. Cable architecture provides easy joint production (no cable disassembling)

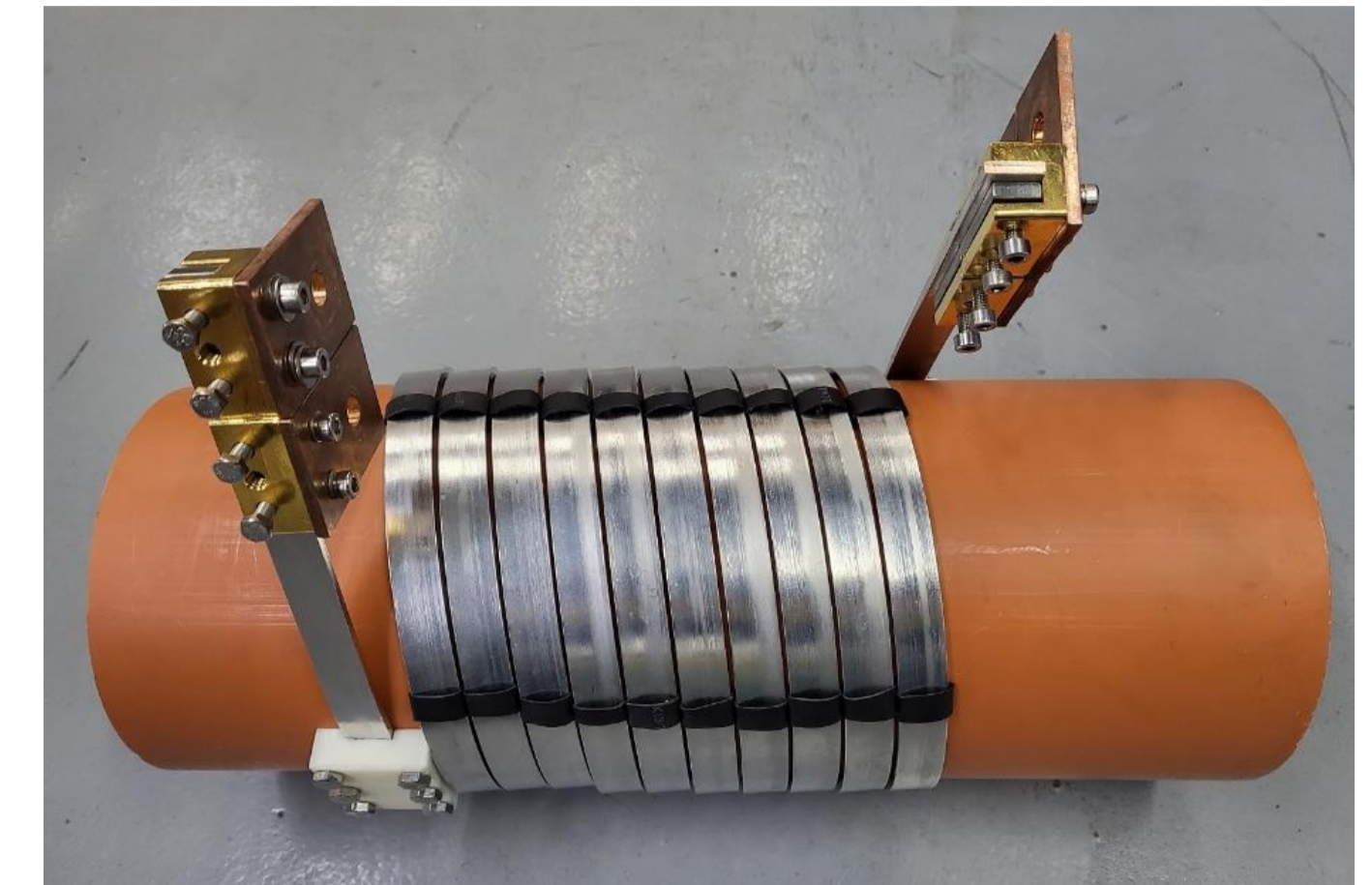
## SAMPLES



0,8 m short sample



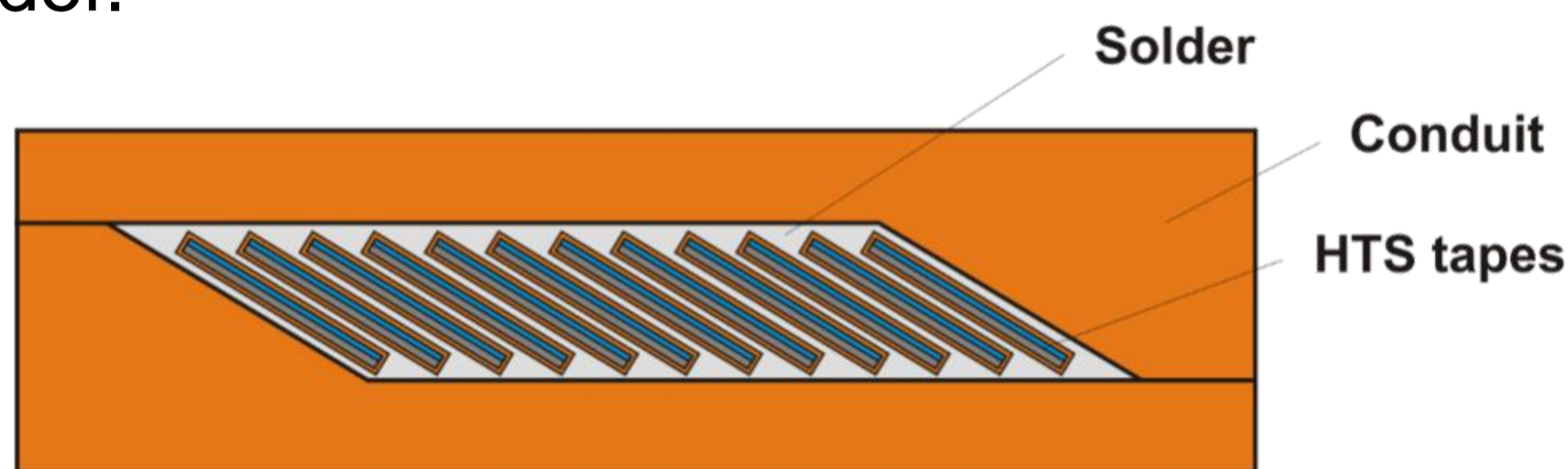
One layer, 2,5 turns, 0,8 m diameter solenoid



One layer, 11 turns, 160 mm diameter solenoid

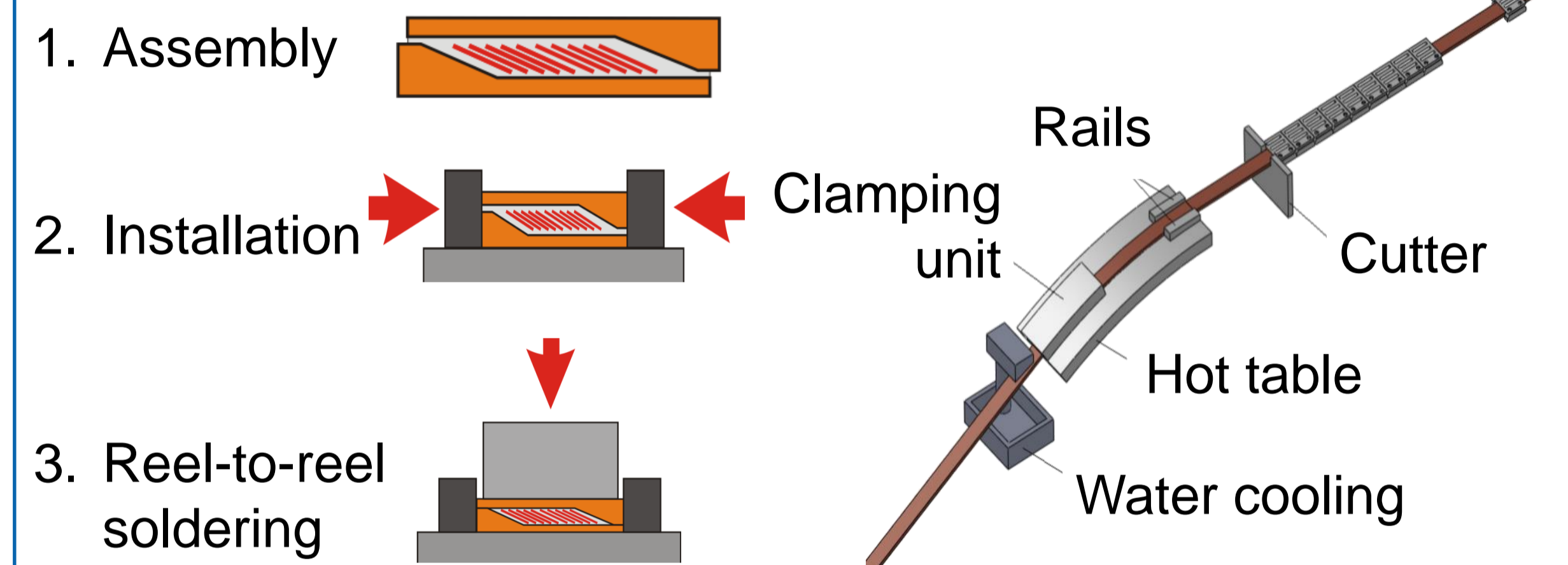
## ARCHITECTURE

Cable is constructed using an inclined 2G HTS stack soldered between two parts of the rectangular copper jacket with all voids filled by solder.



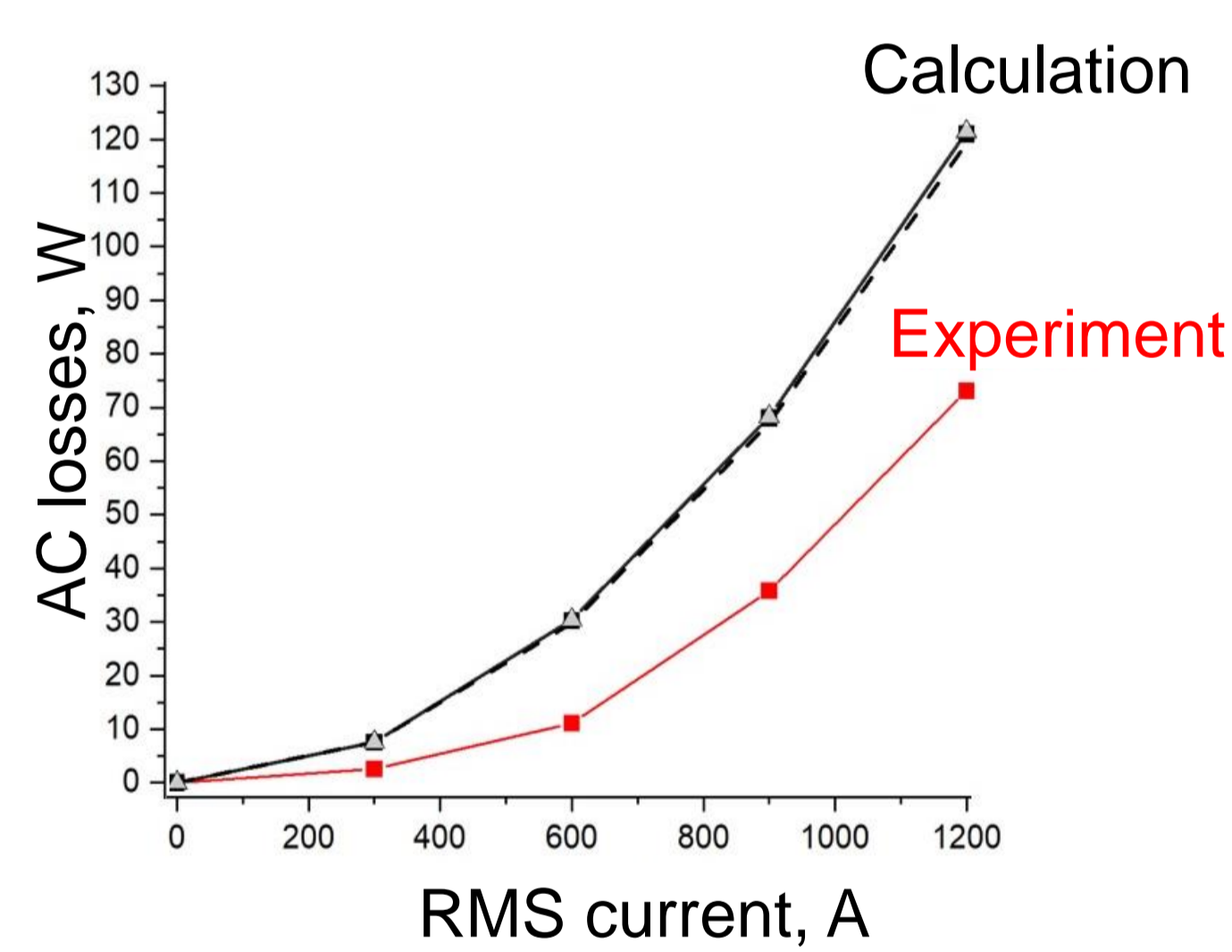
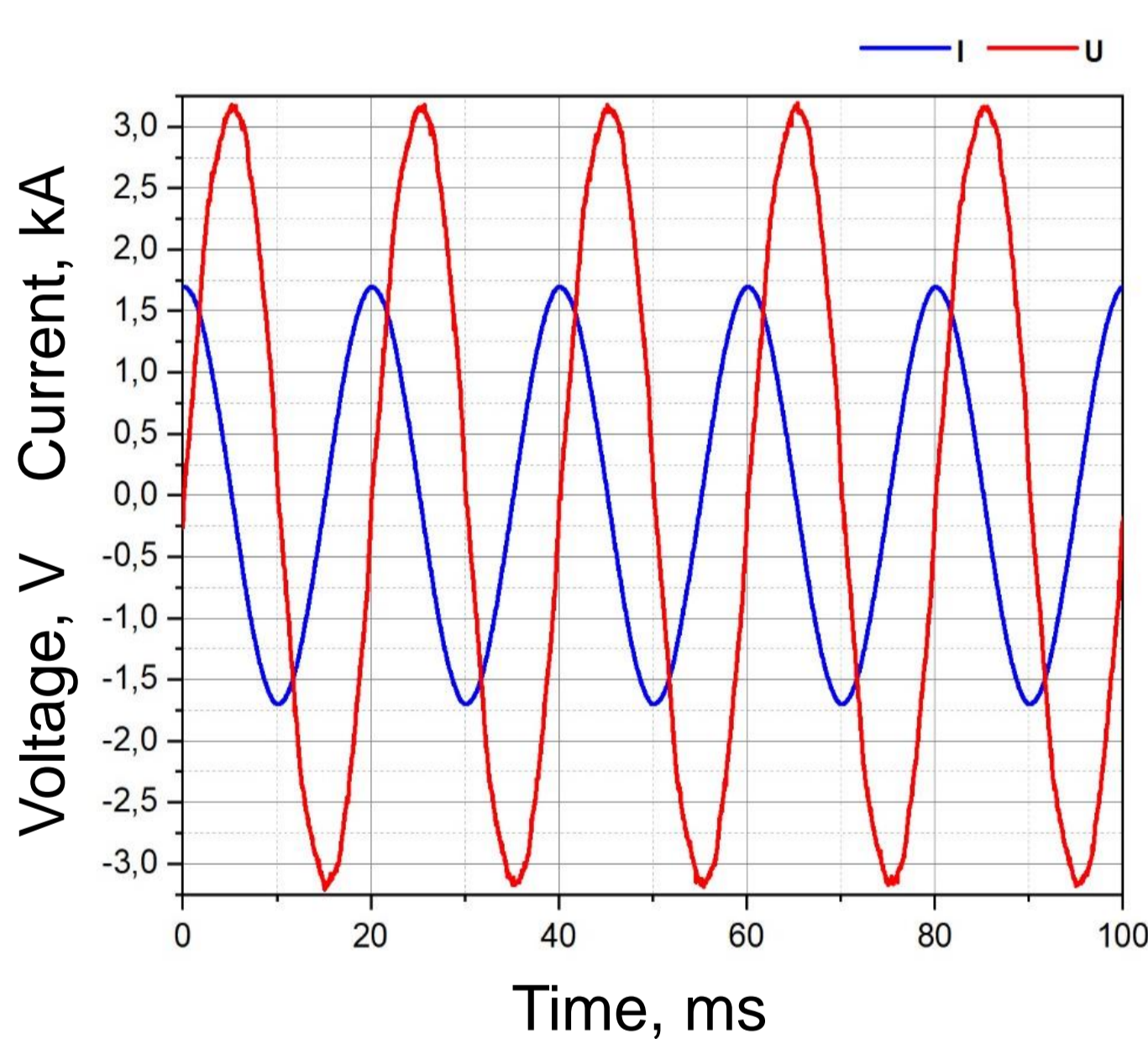
Superconductor	4 mm S-innovations
Substrate	Ni alloy 38 μm
HTS (YBCO)	2,5 μm
Silver (face/back)	2/1 μm
Copper (per side)	5 μm
Solder (per side)	5-10 μm
Thickness	60-70 μm
Ic average @ 77K, SF	165-185 A

## REEL-TO-REEL PRODUCTION



Two cables were produced by 7 m each one

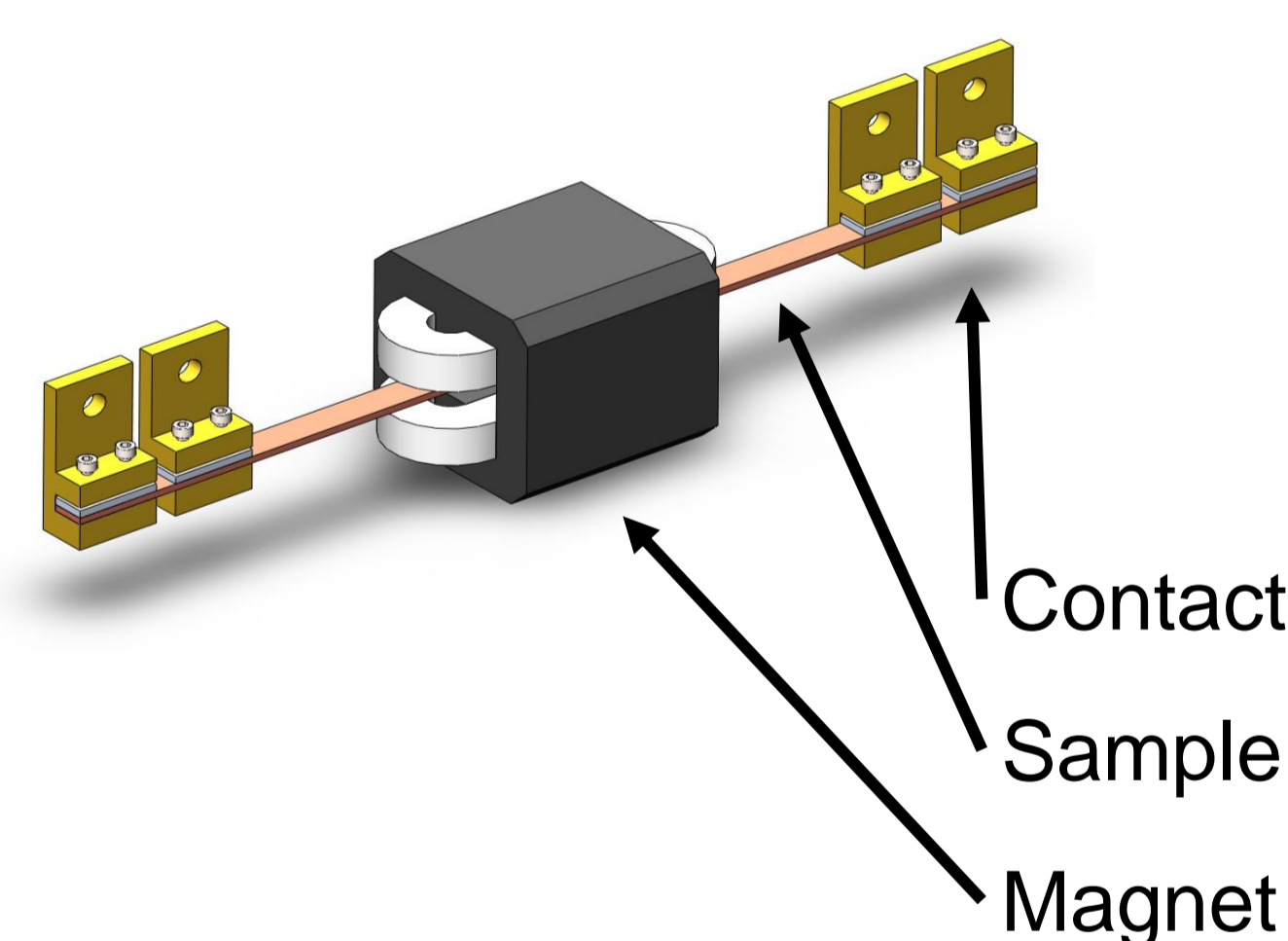
## AC LOSS @ 77K



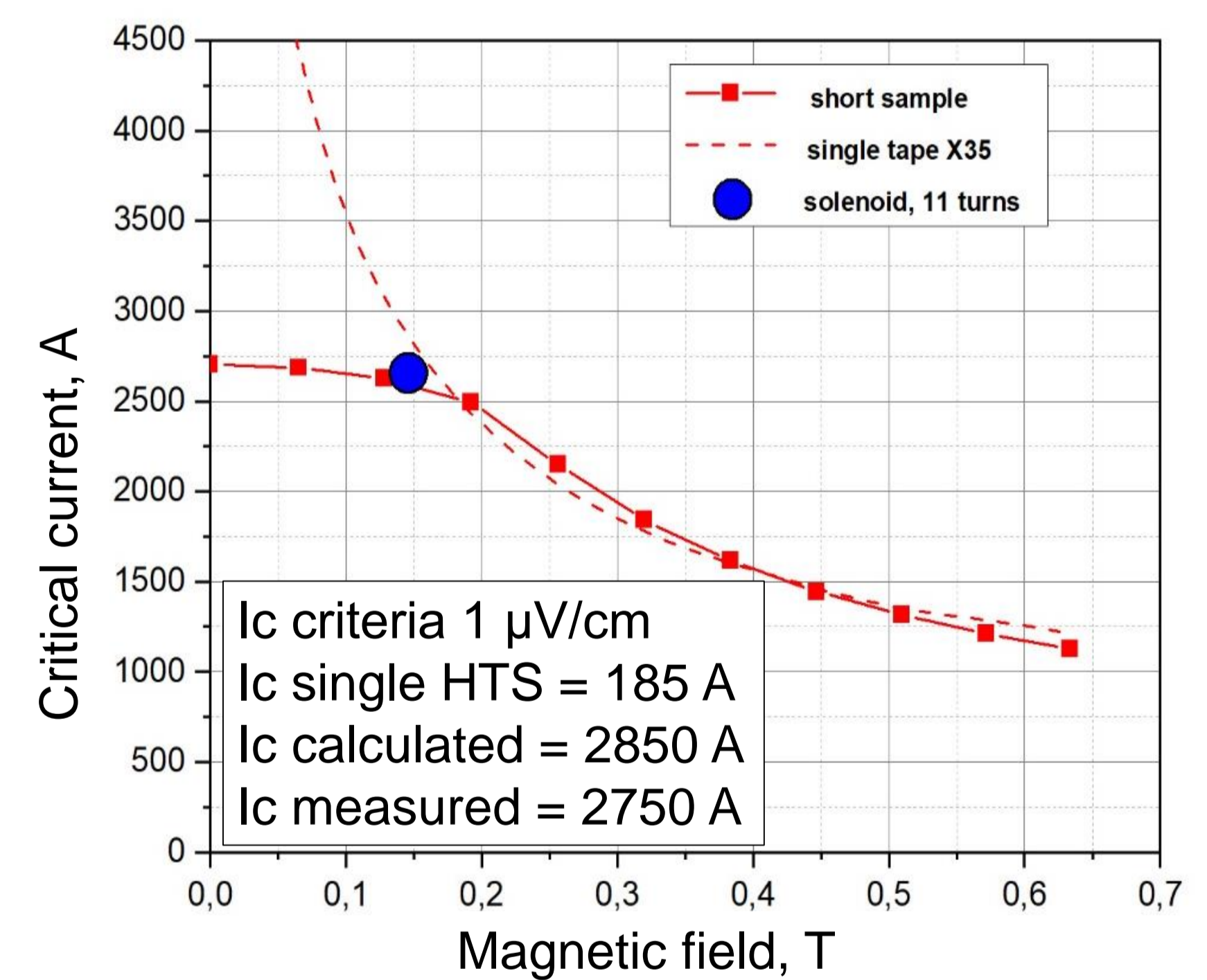
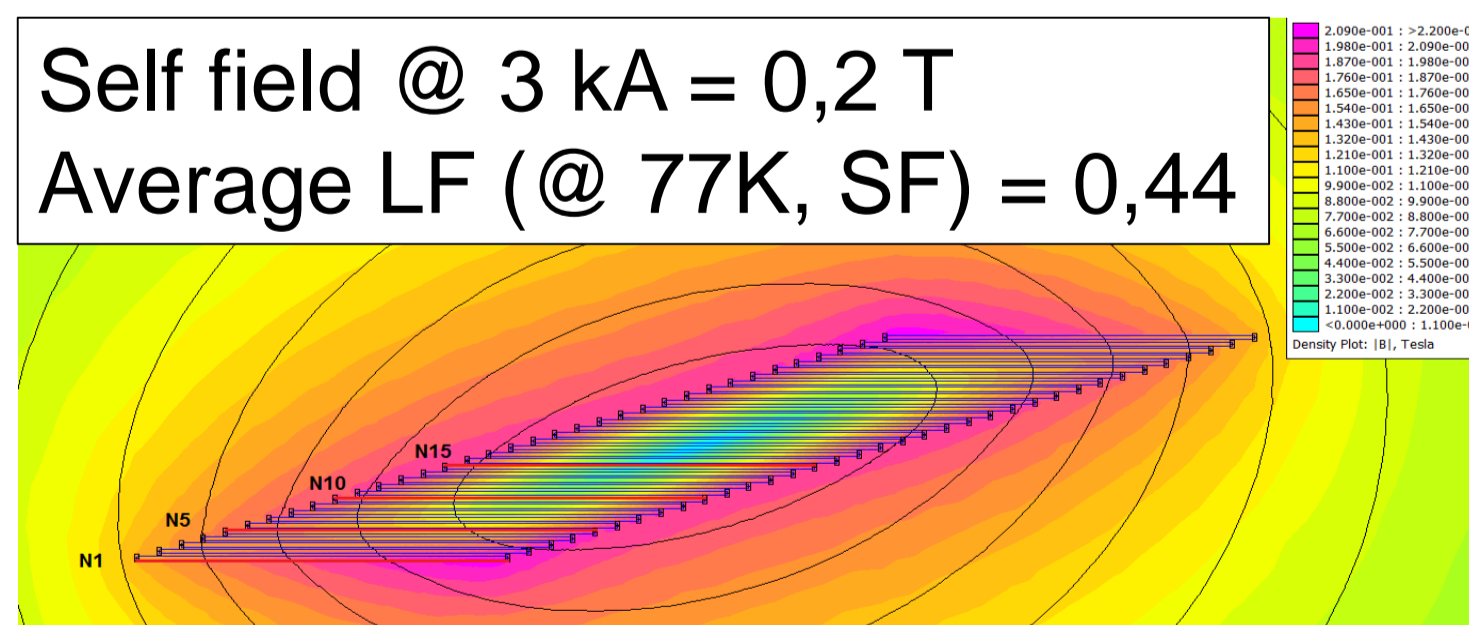
160 mm diameter solenoid  
RMS current = 1,2 kA  
RMS field = 70 mT

AC losses are caused by eddy currents in copper

## LIQUID NITROGEN TEST



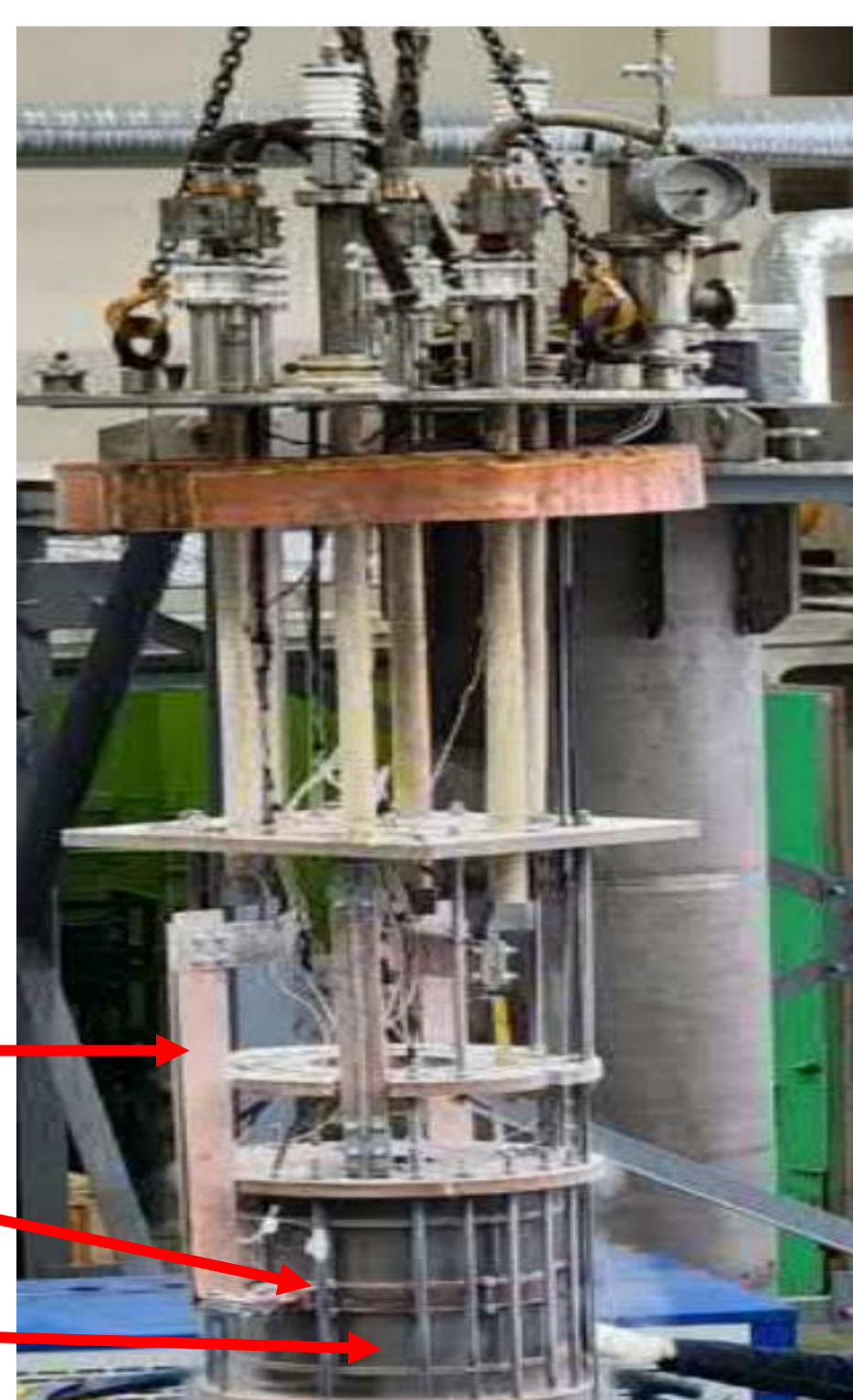
Self field @ 3 kA = 0,2 T  
Average LF (@ 77K, SF) = 0,44



The critical current of cable is equal to the sum of the critical currents of the individual tapes.

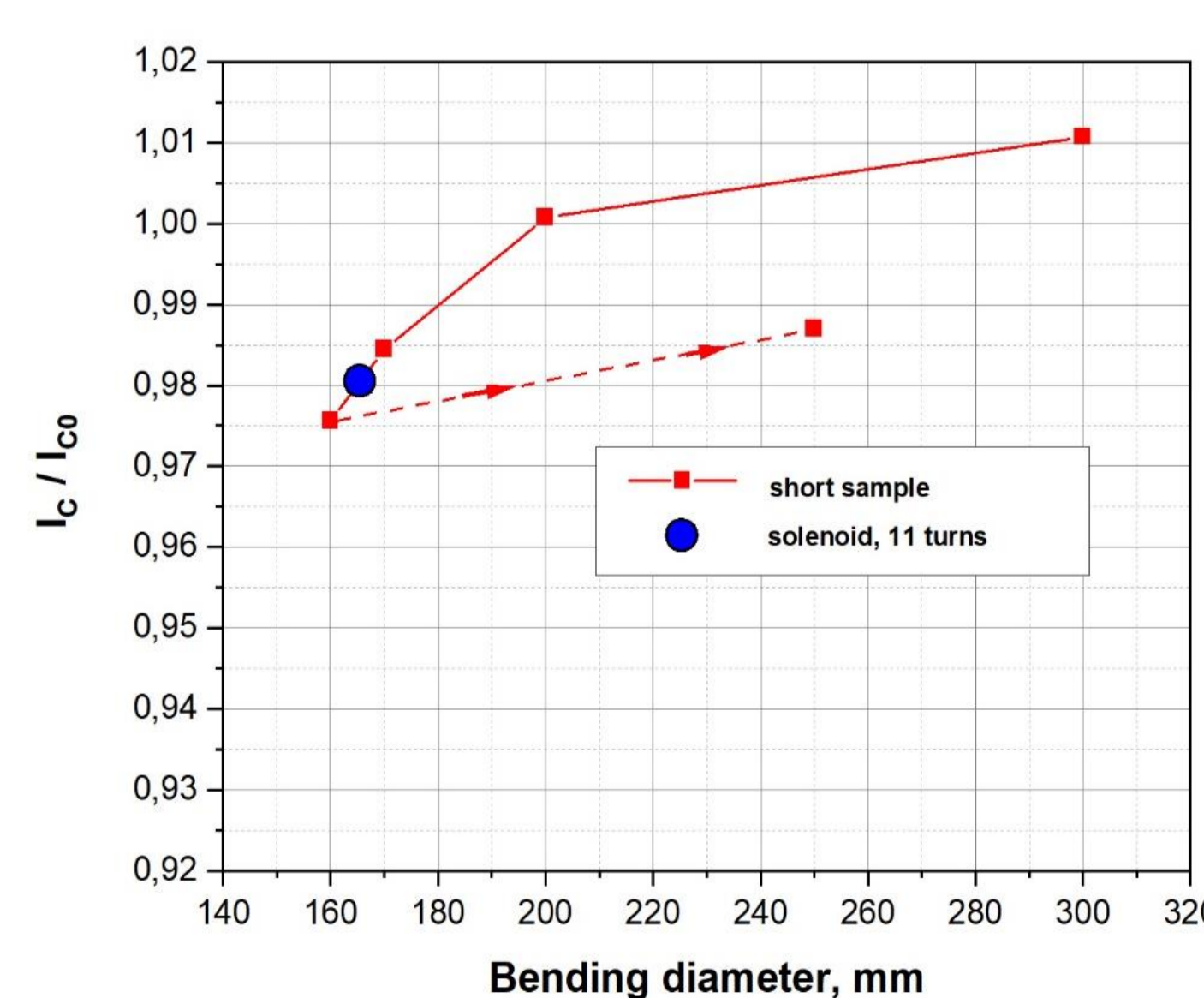
## LIQUID HELIUM TEST

TEST CONDITIONS	
Temperature	18 K
Magnetic field	7 T
Current ramp rate	0,5 kA/c
Reached current	7,8 kA
Estimated Ic	15 kA

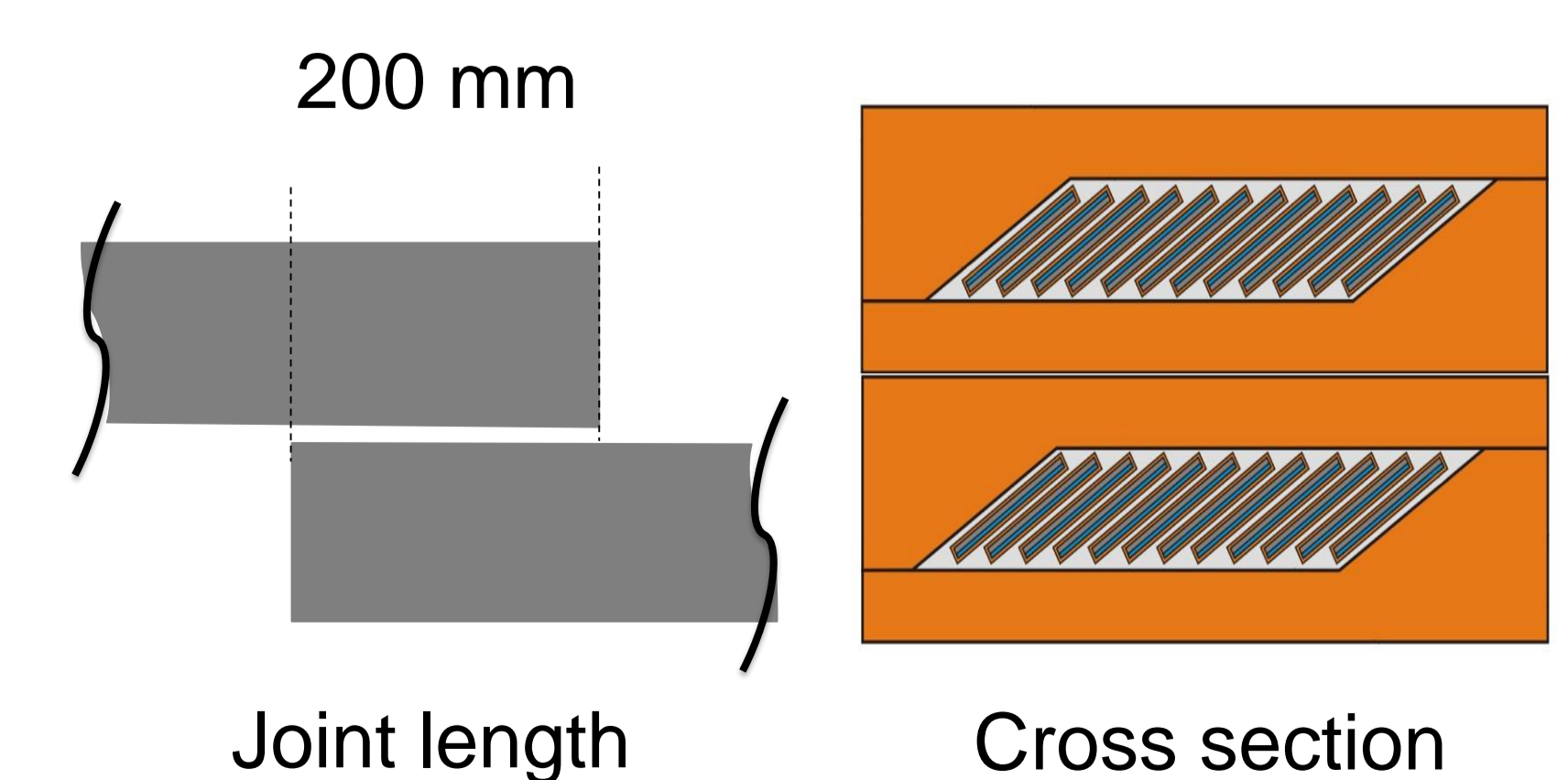


Bus bar  
Sample  
Magnet

## BENDING DIAMETER



## JOINT PRODUCTION



## AKNOWLEDGEMENT

This work was provided with support of JSC NIIIEFA, Saint-Petersburg, Russia.