

WP10.2 – Status

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tapes

Tape ID	Delivery	Length	Width	Thickness	Substrate	REBCO	Ag	Cu	Ic(77 K, s.f.)		Ic(4.2 K, 18 T)	Je(4.2 K, 18 T)
									minimum	average		
		(m)	(mm)	(μm)	(μm)	(μm)	(μm)	(μm)	(A)	(A)	(A)	(A/mm**2)
E2B-T003	13.6.2013	2	4.05	130	97	1	1	30		110	120	228
E2B-T002-C	19.7.2013	2	4.05	150	97	3.8	1	50		130	235	387
E2B-T053-C	8.2.2014	1.5	12	160	97	2.2	1.2	30		210		
E2B-T189D-C	8.2.2014	22	4	150	97	1.7	1.8	25		52	334	557
E2B-T190D-C	24.3.2014	2	4.2	195	97	2	1.8	45		47	502	613
E2B-T191D-C	11.4.2014	2	4.2	200	97	2	1.8	50		54	420	500
SP-KIT-2013030			12	100					362	364		
SP-KIT-20130729			12	100					278	283		
E2B-14-T254	11.12.2014	21	12	155	97	1.3	1.8	20		125	684	368
E2B-14-T252D	18.12.2014	17.8	12	150	97	1.5	1.8	20		145	933	518
E2B-14-T255D	18.12.2014	18	12	150	97	1.3	1.8	20		126	808	449
E2B-15-T270D-1	8.1.2015	13	12	140	97	1.8	1.8	20		130	1284	765
E2B-15-T270D-2	8.1.2015	22.1	12	140	97	1.8	1.8	20		130	1284	765
E2B-14-T253	3.6.2015	20	12									
E2B-15-T280D	Q1 2015	20	12							129	913	
E2B-15-T281D	30.4.2015	23.2	12		97					133	940	
E2B-15-T283D	15.6.2015	36	12	140	97	1.6	1.8	20		130	1188	705
E2B-15-T284D	15.6.2015	25	12	140	97	1.5	1.8	20		120	1001	596
E2B-T278D	26.6.2015	7.3	4.2	195	97	1.7	1.8	47		47	343	419
E2M-T12500-150611-02	13.6.2015	100	12.1	105					568	595		
E2X-T2015_08a(20-56)	1.9.2015	200	12	103	60	1	2	20	450			
E2B-14016-2-1-0_T275D-A_Ag	26.10.2015	5.2	4	100	97	1.3	1.8			45	240	600
E2F-XXXX	11.2015	200	12									
S	Feb-16	200	12									
B	Q1 2016 (T8D)	750	12									
B	Q3 2016 (T8D)	750	12									
-	Q1 2016 (T8D)	750	12									
-	Q3 2016 (T8D)	750	12									

760 m of tape produced (EuCARD2 partner Bruker) and procured (CERN)

We are covered for the small coil program (Feather0)

We still need the large production for the program bulk (estimated at 3 km total)

cables

Cable samples catalogue - superconducting														
Name	Length (m)	Delivery	Width (mm)	Pitch (mm)	Thickness (mm)	SC Tapes (-)	Cu Tapes (-)	Tape origin	Tape width (mm)	Tape thickness (mm)	Tape Ic		Expected cable Ic	
											77 K, s.f. (A)	4.2 K, 20 T	77 K, s.f. (A)	4.2 K, 20 T
E2S-15/5.5-001	1.6	6.11.2014	12	226	0.8	15	0	SP-KIT-2013030	12	0.1	362		1443	
E2S-15/5.5-002	1.8	6.11.2014	12	226	0.8	15	0	SP-KIT-20130729	12	0.1	278		1126	
E2B-15/5.5-003	5	1.5.2015	12	226	1.12	15	0	E2B-14-T252D, E2B-14-T255D, E2B-15-T270D-1, E2B-15-T270D-2, E2B-15-T281D	12	0.14	133	1050	896	4253
E2B-15/5.5-004	2	Sep-15	12	226	1.12	15	0	E2B-15-T283D	12	0.14	130	1188	878	4813
Cable samples catalogue - dummies														
E2B-15/5.5-005	1	Sep-15	12	226										
E2M-15/5.5-006	35	Dec-15	12	300										
Name	Length (m)	Delivery	Width (mm)	Pitch (mm)	Thickness (mm)	SC Tapes (-)	Cu Tapes (-)	Tape origin	Tape width (mm)	Tape thickness (mm)				
E2S-15/5.5	10	Sep-15												
E2X-15/5.5	10	Oct-15												
E2M-15/5.5	6	Oct-15												
E2F-15/5.5	10	Oct-15												
E2_-15/5.5	30	Dec-15												
E2_-15/5.5	30	Dec-15												
E2_-15/5.5	30	Dec-15												
E2D-15/5.5-001	3	4.4.2014	12	226	0.8	15	0	dummy SS	12	0.1				
E2D-15/5.5-002	3	4.4.2014	12	226	1.5	15	15	dummy SS	12	0.1				
E2D-15/5.5-003	20	13.5.2014	12	226	0.8	15	0	dummy SS	12	0.1				
E2D-15/5.5-004	6	6.11.2014	12	226	0.8	15	0	dummy SS	12	0.1				
E2S-15/4.5-005	13	1.10.2014	10	426	0.8	15	0	dummy SS	10	0.1				
E2D-15/5.5-006	20	1.5.2015	12	226	1.2	15	0	dummy SS	12	0.15				
E2D-15/5.5-007	32	1.8.2015	12	300	0.8	15	0	dummy Hastelloy+Cu	12	0.1				
E2D-15/5.5-008	32	1.8.2015	12	300	0.8	15	0	dummy Hastelloy+Cu	12	0.1				
E2D-15/5.5-009	5	1.8.2015	12	226	0.8	15	0	dummy SS	12	0.1				
E2D-15/5.5-010	5	1.8.2015	12	226	0.8	15	0	dummy SS	12	0.1				
E2D-15/5.5-011	5	1.8.2015	12	226	0.8	15	0	dummy SS	12	0.1				
E2D-15/5.5-012	2	1.8.2015	12	226	0.8	15	0	dummy SS	12	0.1				
E2D-15/5.5	40	Aug-15												
E2D-15/5.5	20	Oct-15												
E2D-15/5.5	20	Oct-15												

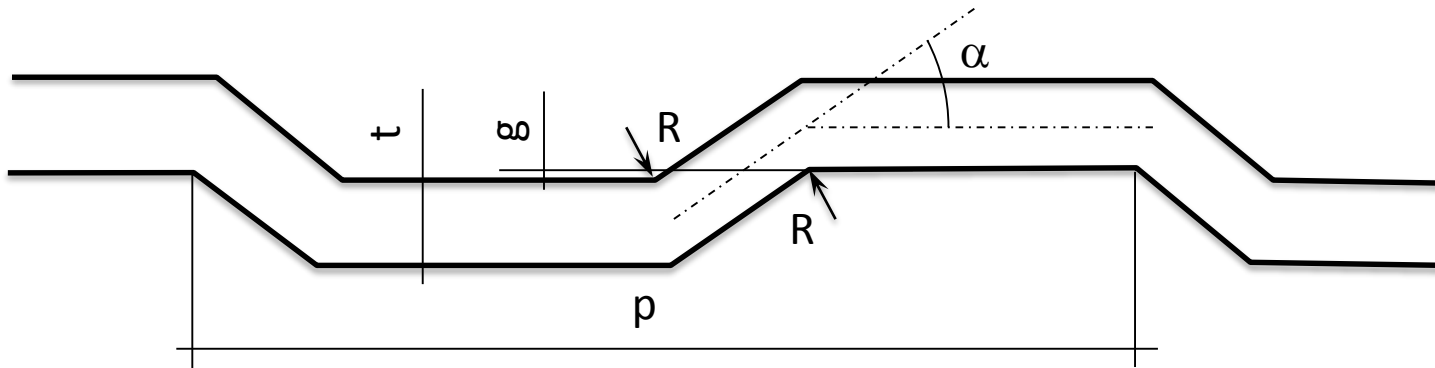
140 m of dummy cable + 10 m SC cable produced (EuCARD2 partner KIT) and procured (CERN)
 Additional procurement action for 35 m SC cable to meet milestone MS66 (CERN): **first full length !**

REBCO tapes specs

- Tape width: 12 mm
- Tape thickness: 0.1 mm (SP, SuperOX, Sunam) ... 0.14 (BHTS) mm
- Electrodeposited copper layer (after punching): 2 x 20 μm
- Engineering current density (20 T, 4.2 K) > 400 A/mm² (target 600 A/mm²)
- Critical current (20 T, 4.2 K) > 500 A (target 670 A)
- Unit length: minimum **50 m** (> 30 m needed for magnet winding)
 - UL for Aligned Blocks: 20 m (1.2 mm thick cable) to 28 m (0.8 mm thick cable)
 - UL for Cos Theta: 17 m (1.2 mm thick cable)

cut tape geometry

- Optimal geometry as defined by KIT



$t = 5.85 \dots 5.9 \text{ mm}$

$g = 0.2 \text{ mm}$

$\alpha = 30^\circ$

$p = 300 \text{ mm}$

$R = 10 \text{ mm}$

baseline cable designs

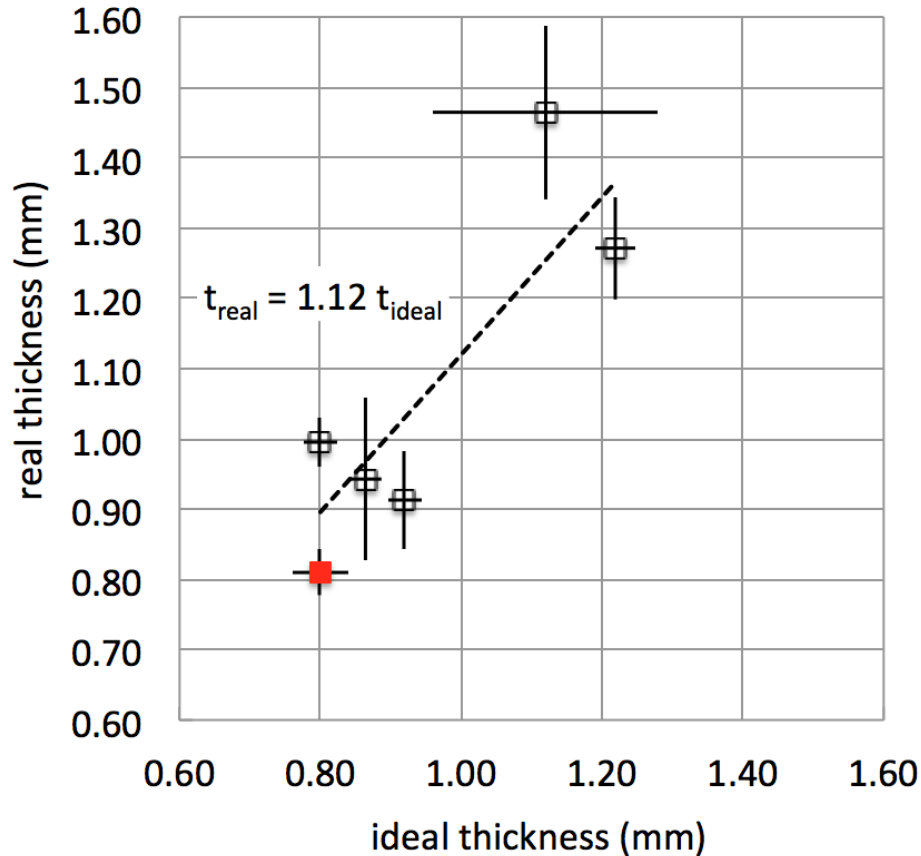
Skinny Roebel (AB) (out of 0.1 mm tapes)

Number of tapes	(-)	15
Width	(mm)	12
Thickness	(mm)	0.9±0.1
Transposition pitch	(mm)	300
Critical current (4.2 K, 20 T _{perpendicular})	(kA)	≥ 4.8

Fat Roebel (CT+AB) (out of 0.14 mm tapes)

Number of tapes	(-)	13
Width	(mm)	12
Thickness	(mm)	1.1±0.1
Transposition pitch	(mm)	300
Critical current (4.2 K, 20 T _{perpendicular})	(kA)	≥ 5.8

measured cable thickness



- Measured Roebel cable thickness is about 10 % higher than ideal one

$$t_{\text{measured}} \approx 1.12 t_{\text{ideal}}$$

- Spread is relatively large, and physical (cross-overs, center vs. edges,...), typically ± 0.1 mm

summary

- Tape production
 - Bruker PLD300 restart planned for end of January 2016, PLD 600 will be used to produce 12 mm tape for the next EuCARD2 delivery (A. Usoskin)
 - CERN procurement feeds magnet R&D in the meantime (A. Ballarino)
- Cable production
 - KIT new tool imminent, production to restart in January with new geometry (W. Goldacker)
- Transverse pressure experiment on Roebel cable
 - KIT, Twente finalizing test geometry and procedure (W. Goldacker, M. Dhalle)
- AC loss measurement and analysis
 - Twente, Southampton, CERN completed first iteration, hysteresis dominates, and collective cable effects are important (M. Dhalle, Y. Yang) – next step ?
- Quench experiment
 - Bruker, KIT provided tape samples (to be Cu-coated), Twente ready to measure (M. Dhalle) – next step ?
- BSCCO cable test
 - CERN HT holder and “vintage” cable at NHMFL, discussions to schedule HT in the OPHT furnace