257 - Panda Vacuum System

Prototype titanium vacuum chamber with IP-cross

PANDA collaboration meeting from 30. May to 03. June 2022

Björn Rottland, Ralf Schmitz, Herbert Schneider, Stephan Schönen

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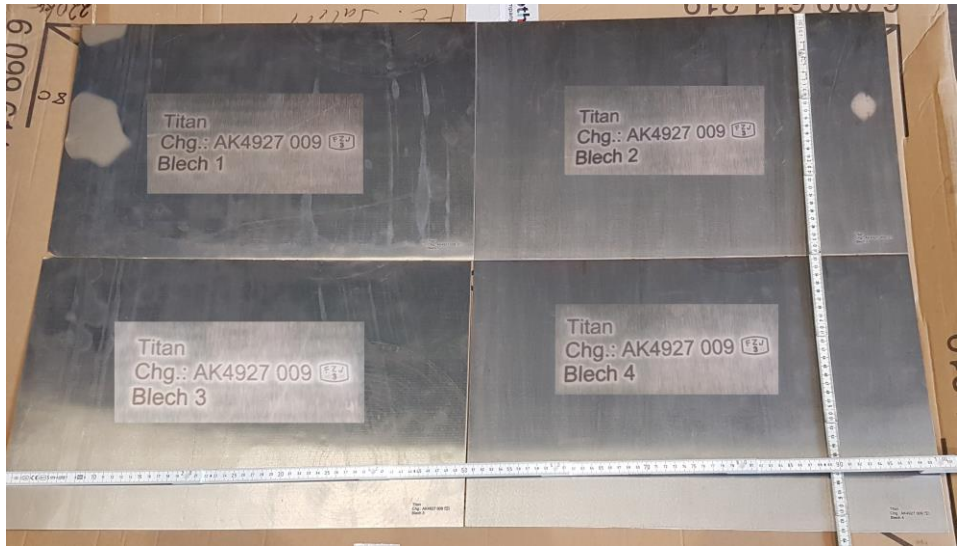
Prototype titanium vacuum chamber with IP-cross

- Titanium sheet 0,85 mm – variation in wall thickness
  Proposal: Manufacturing the D = 77,3 mm pipes out of 0,8 mm sheet, because this sheet is available in the market.

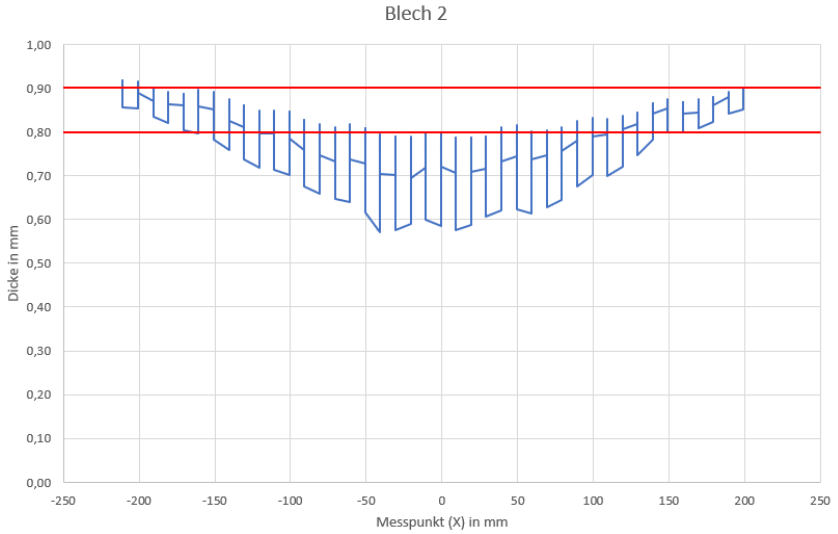
- Pipes (wall thickness 0,85 mm and 2 mm) longitudinally welded and rerolled
  2 Pipes 2 mm with centring edges circumferentially welded

- IP-crosses with wall thickness 0,2 mm and 0,3 mm
  Maximum variation of wall thickness from 0,16 mm to 0,33 mm, most values in the range from 0,22 mm to 0,28 mm
  Question: Which variation in the wall thickness is acceptable ?

Prototype titanium vacuum chamber



Picture 1: Titanium sheet – **nominal wall thickness 0,85 mm**



Picture 2: Titanium sheet 2 – **measurement of wall thickness**

Remark: The variation in the wall thickness is caused by a bad/incomplete/insufficient planing process. The aim was a reduction of the thickness from 1 mm to 0,85 mm ± 0,05 mm.

Proposal: Manufacturing the D = 77,3 mm pipes out of 0,8 mm sheet, because this sheet is available in the market.

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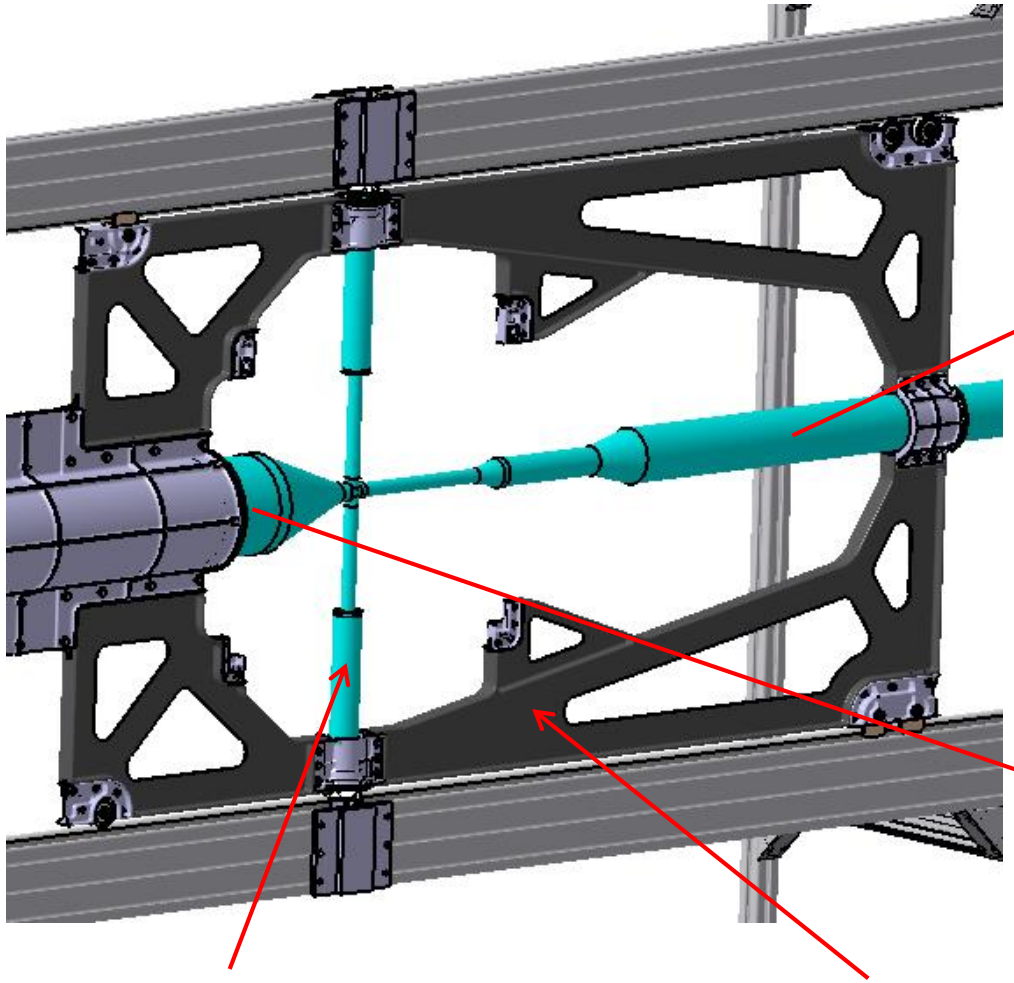
Prototype titanium vacuum chamber



Picture 3: Titanium vacuum chamber – supported by the central support frame (CSF)

Picture 4:
Vacuum pipes before welding
Wall thickness 0,85 mm
Inner diameter 77,3 mm

Picture 5:
Vacuum pipes before welding
Wall thickness 2 mm
Inner diameter 140 mm

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Prototype titanium vacuum chamber

Picture 6:
Vacuum pipes welded and rerolled
Wall thickness 2 mm
Inner diameter 140 mm

Picture 7:
Vacuum pipes welded and rerolled
Wall thickness 0,85 mm
Inner diameter 77,3 mm

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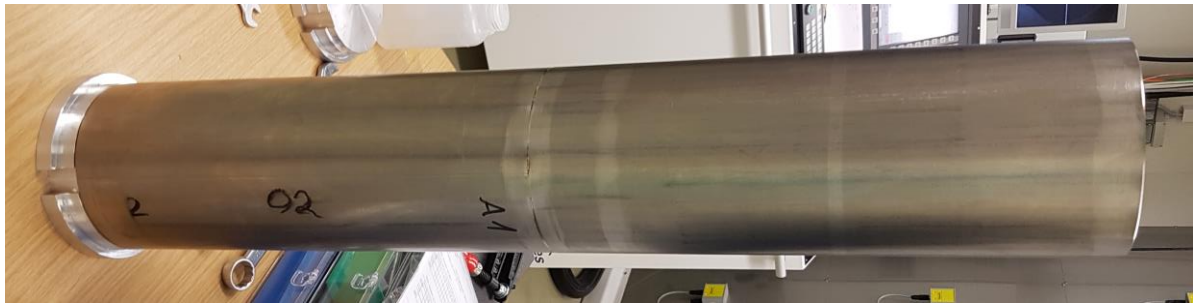
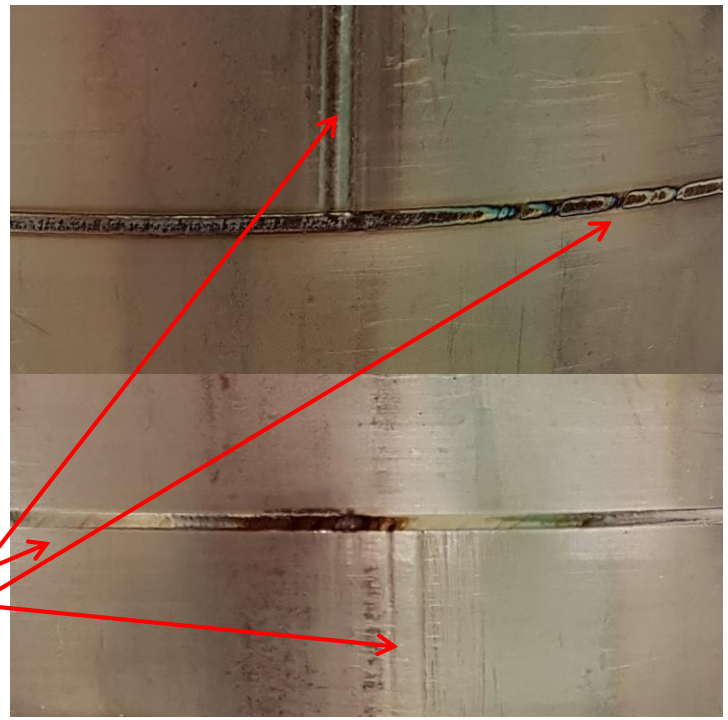
Prototype titanium vacuum chamber

Picture 8:
Vacuum pipes welded and rerolled
Wall thickness 2 mm
Inner diameter 140 mm



Picture 9:
2 x vacuum pipes welded,
centred by circumferential edges
Wall thickness 2 mm
Inner diameter 140 mm



Picture 10:
2 x Vacuum pipes welded
longitudinally by electron beam
circumferentially by laser beam
Wall thickness 2 mm
Inner diameter 140 mm

Picture 11:
2 x Vacuum pipes welded
view inside
Wall thickness 2 mm
Inner diameter 140 mm

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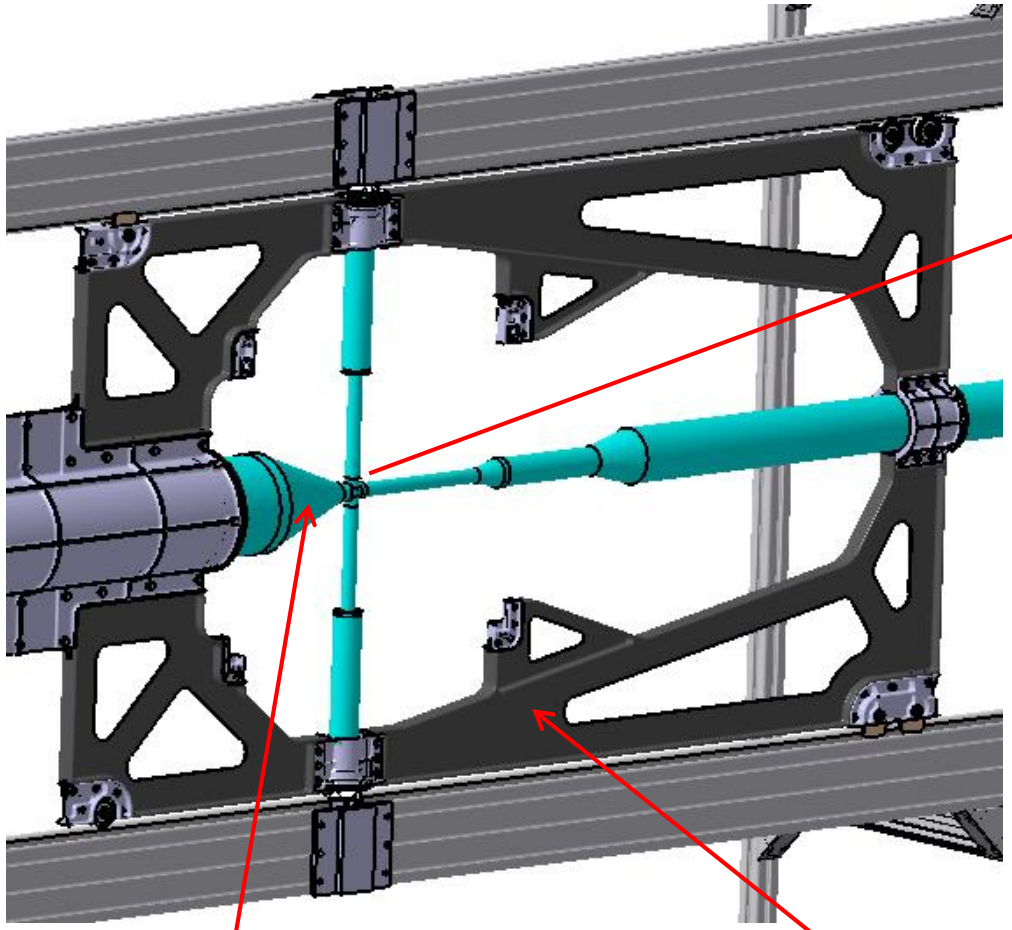
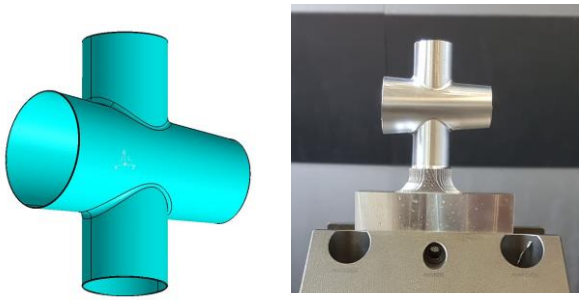
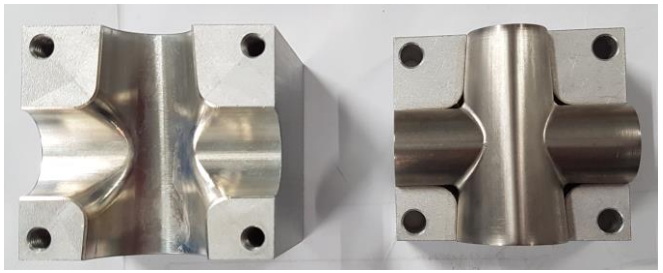
Prototype titanium vacuum chamber



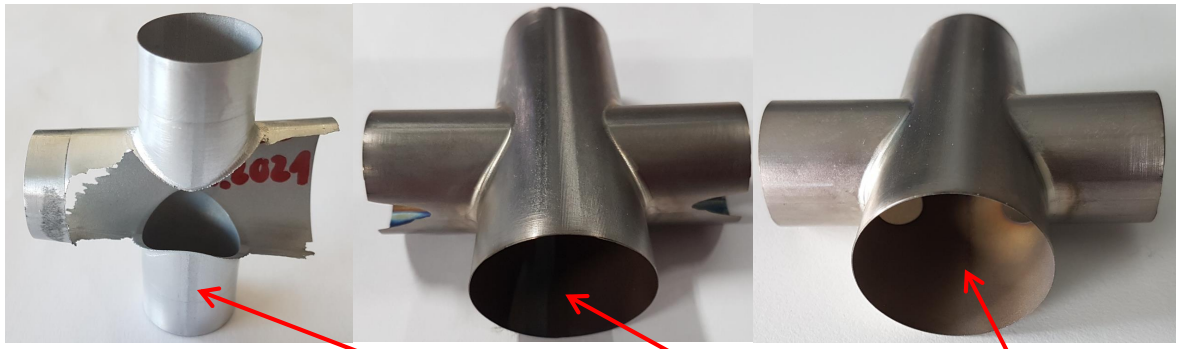
Picture 12: Titanium vacuum chamber – supported by the central support frame (CSF)



Picture 13: IP-cross – **conical D_{inner} 20 mm to 28 mm**



Picture 14: IP-cross – **for eroding kept in a “negative form”**



Picture 15: IP-crosses – aluminium (0,2 mm) – titanium (0,2 mm) – titanium (0,3 mm)

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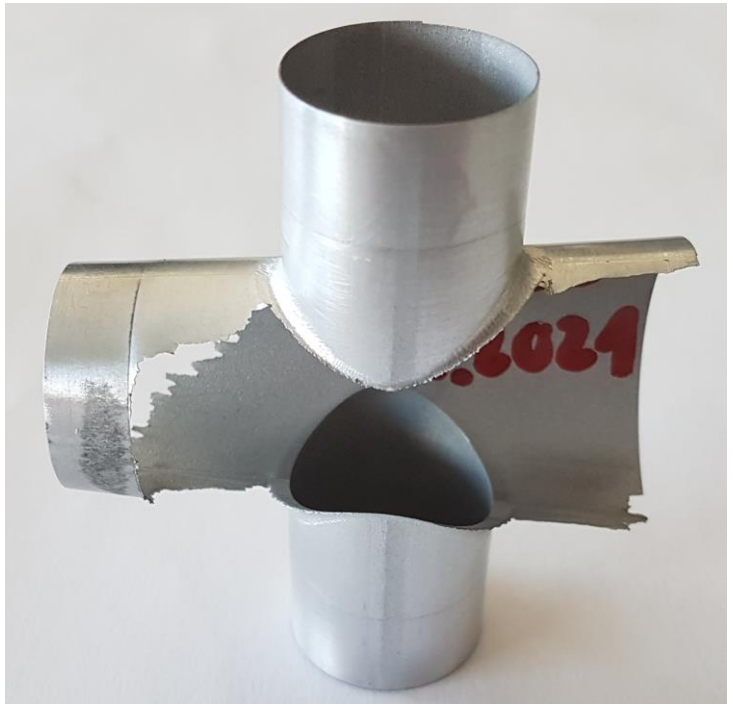
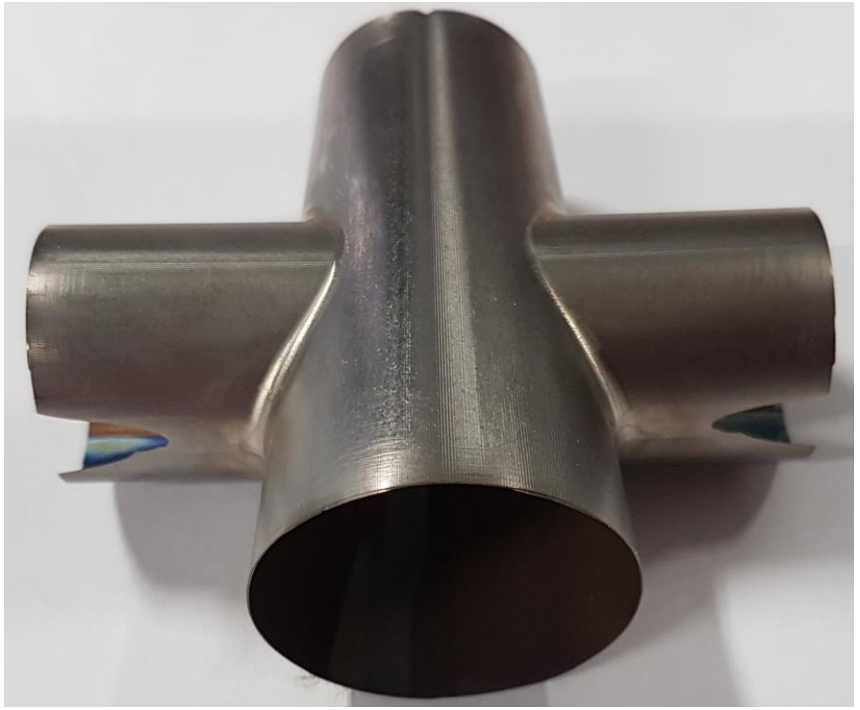
Prototype titanium vacuum chamber



Picture 16: IP-cross – **aluminium (0,2 mm)**



Picture 17: IP-cross – **titanium (0,2 mm)**

Picture 18: IP-cross – **titanium (0,3 mm)**

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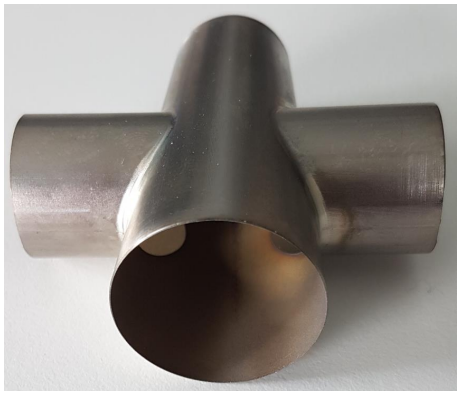
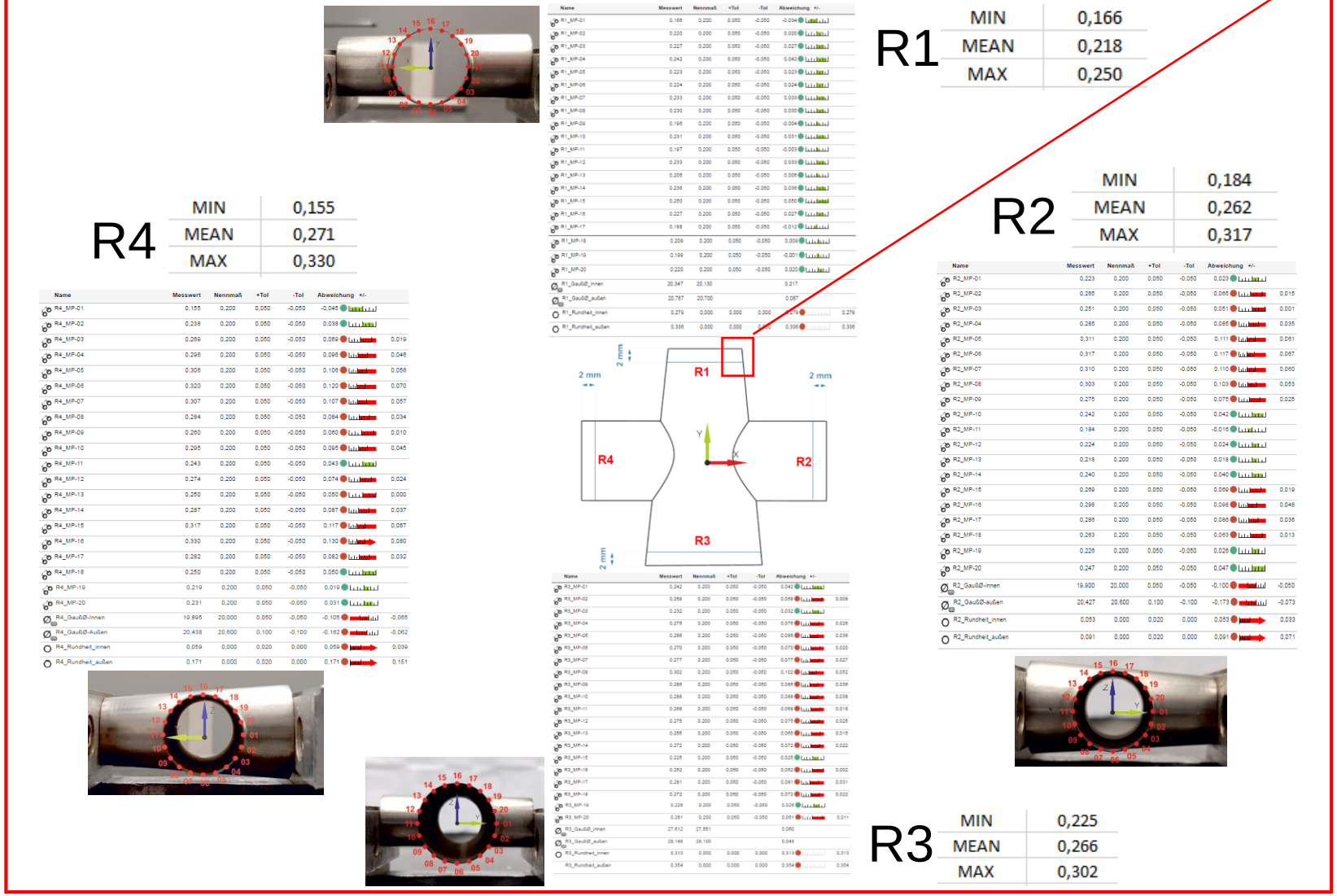
Prototype titanium vacuum chamber



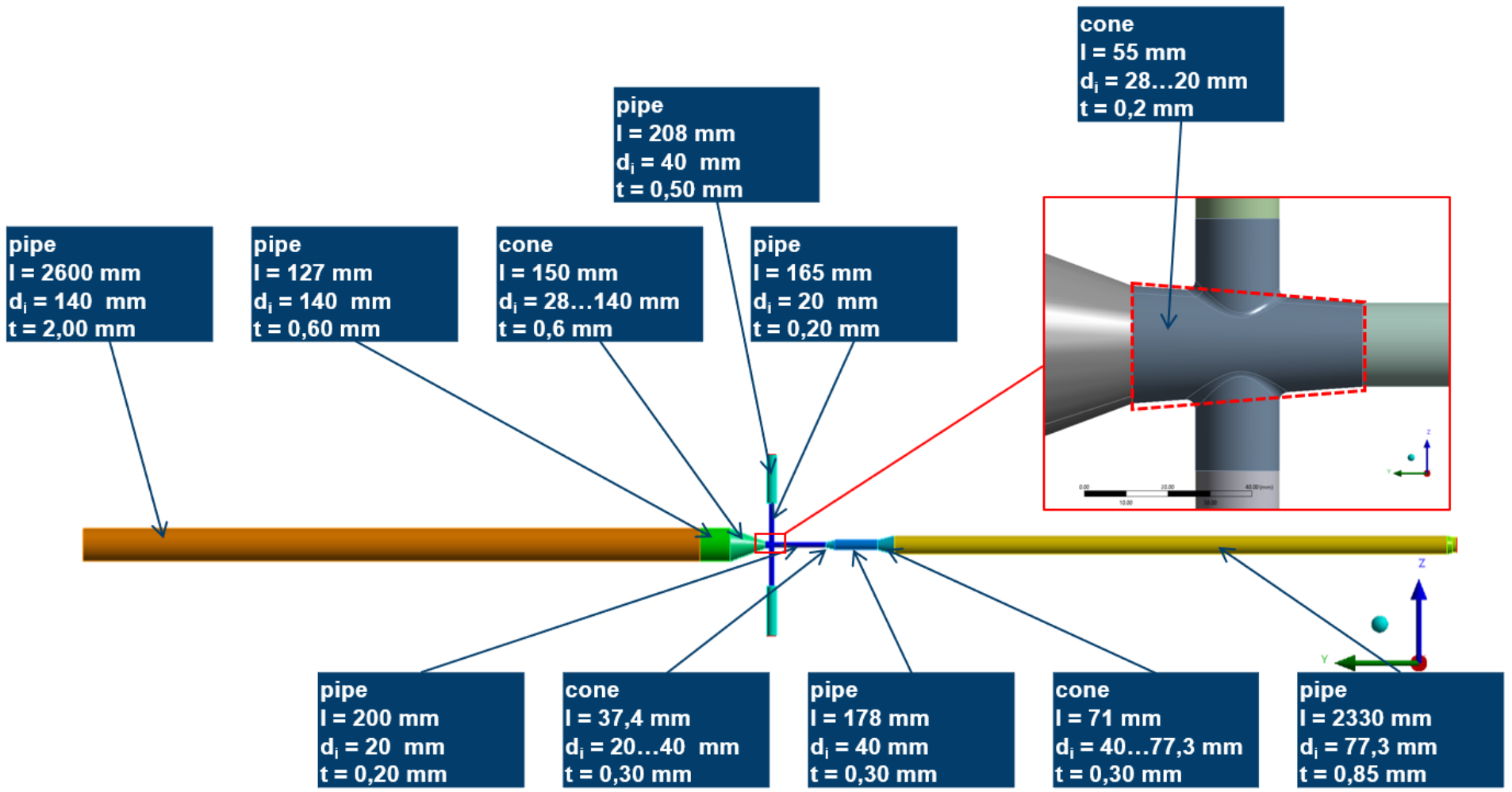
Picture 19: IP-cross **titanium (0,3 mm)**



Picture 20: IP-cross **titanium (0,3 mm) – wall thickness and circularity**

Prototype titanium vacuum chamber

This table shows the wall thickness of each part of the vacuum-pipe respecting a safety factor S_k = 3,0 (related to AD2000 standard)



This values will be applied at the vacuum-chamber

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257 - Panda MVD

Prototype half cylinder with BL4 staves

PANDA collaboration meeting from 30. May to 03. June 2022

Björn Rottland, Ralf Schmitz, Herbert Schneider, Stephan Schönen

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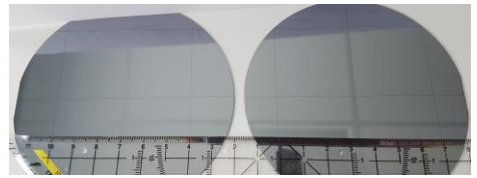
Prototype half cylinder with BL4 staves

- Result of the analysis/comparison between un-/irradiated stave materials:
  Most materials seem to be unaffected by irradiation – except ROHACELL
  Proposal: Foam ROHACELL should be substituted by a rigid CFRP plate
  (more stability, simplification of the sensor window)

- Agreement with colleagues from UNI Gießen:
  - Measurement of the geometry (±0,01 mm) of the sensors available at UNI Gießen

measurement at ZEA-1:	sensor dummies	width/length	35 mm/60 mm ±0,05 mm
	adhesive form	length	35,12 mm and 60,12 mm
		width	35,17 mm
		thickness	0,278 mm ±0,003 mm



  - Coordination of the bonding procedure has to be continued

- ZEA-BL4-staves 2 are manufactured

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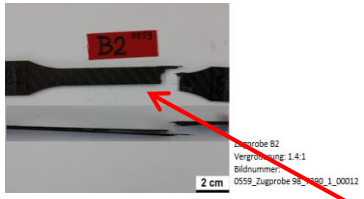
BL4-Stave

CFRP plate (inlay) tension/tensile test

bestrahlte Proben			
Probe B1	irradiated	24154,71	1073,54
Probe B2		24585,51	1092,69
Probe B3		22937,78	1019,46
Probe B4		25257,55	1122,56
unbestrahlte Proben			
Probe U1		25188,60	1119,49
Probe U2	unirradiated	23719,51	1054,51
Probe U3		24550,36	1091,13
Probe U4		24895,59	1106,47



O-Ring NBR/EPDM tension/tensile test

unirradiated

(a) unbestrahlte Charge

Probe	Δl_{max} / mm	F_{max} / N	$E / \frac{N}{mm^2}$
1	160,15	208,5	7,094(4)
2	126,76	167,6	7,139(5)
3	132,35	169,9	6,931(5)
4	159,16	200,1	6,880(4)
			7,01(13)

irradiated

(b) bestrahlte Charge 1

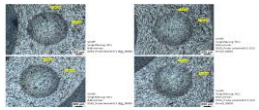
Probe	Δl_{max} / mm	F_{max} / N	$E / \frac{N}{mm^2}$
1	145,58	210,0	8,052(5)
2	110,62	216,8	10,08(3)
3	123,71	194,1	8,649(5)
4	79,94	180,2	12,588(8)
5	81,85	172,1	12,129(7)
			10,3(9)

(c) bestrahlte Charge 2

Probe	Δl_{max} / mm	F_{max} / N	$E / \frac{N}{mm^2}$
1	178,81	139,2	4,478(4)
2	173,02	129,4	4,272(3)
3	128,94	108,8	4,423(4)
4	93,55	80,6	4,200(3)
5	94,27	87,9	4,649(4)
			4,40(8)

Tube fittings

Brinell test



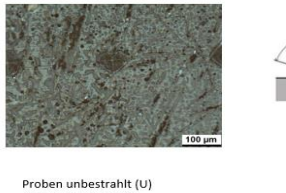
Prüfkörper 5mm Prüfkraft 30kp

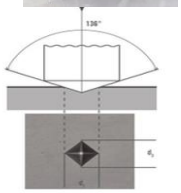
Probe	d vertikal (µm)	d horizontal (µm)	Mittelwert (µm)	
B3_1	1142	1161	1151,5	
B3_2	1153	1160	1156,5	
B3_3	1140	1156	niedrigster	1148
B3_4	1160	1177	höchster	1168,5
B3_5	1146	1152	1149	
Mittelwert B3			1154,7µm	
U3_1	1137	1164	höchster	1150,5
U3_2	1121	1119	1120	
U3_3	1068	1070	niedrigster	1069
U3_4	1150	1136	1143	
U3_5	1122	1149	1135,5	
Mittelwert U3			1123,6 µm	

irradiated

unirradiated

Vickers test





Proben unbestrahlt (U)
Proben bestrahlt (B)

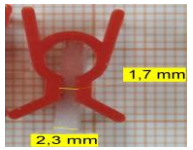
	unirradiated			irradiated		
1	32,25	HV0,1	24,61 HV0,1	32,89	HV0,1	22,84 HV0,1
2	33,54	HV0,1	26,35 HV0,1	26,82	HV0,1	21,09 HV0,1
3	29,9	HV0,1	28,04 HV0,1	28,55	HV0,1	31,64 HV0,1
4	33,54	HV0,1	25,24 HV0,1	23,21	HV0,1	25,03 HV0,1
5	**43,62***	HV0,1	24,61 HV0,1	32,89	HV0,1	23,21 HV0,1
6	30,18	HV0,1	25,24 HV0,1	35,98	HV0,1	26,59 HV0,1
7	31,34	HV0,1	27,06 HV0,1	32,89	HV0,1	27,79 HV0,1
8	**38,28***	HV0,1	28,82 HV0,1	30,46	HV0,1	25,46 HV0,1
9	33,54	HV0,1	27,54 HV0,1	25,04	HV0,1	28,82 HV0,1
10	29,35	HV0,1	23,41 HV0,1	27,06	HV0,1	29,62 HV0,1
Mittelwert	31,705	HV0,1	26,092 HV0,1	29,579	HV0,1	26,209 HV0,1

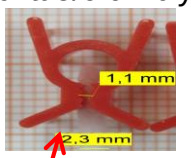
Foam Rohacell "visual/hand" test

unirradiated irradiated

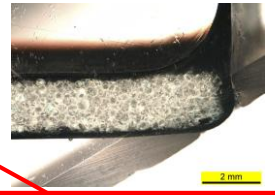
Probe of foam Rohacell

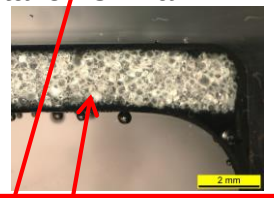
elastic/ductile brittle/crumbly

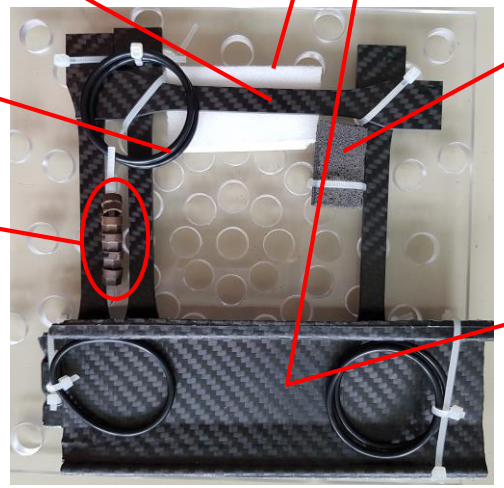




Cross-section of stave - similar



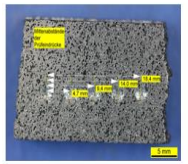




Probes prepared on carrier for radiant exposure

Foam POCO HTC Brinell test

Graphit unbestrahlt

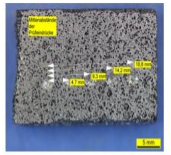


unirradiated

Eindruck Nr.	d horizontal (mm)	d vertikal (mm)	d Mittelwert (mm)	HBW 5/10
1	2,5	2,6	2,55	1,88
2	3,3	3,2	3,25	1,1
3	2,8	2,9	2,85	1,4
4	2,5	2,4	2,45	2,0
5	2,7	2,8	2,75	1,5

Mittelwert: 1,576 HBW 5/10

Graphit bestrahlt

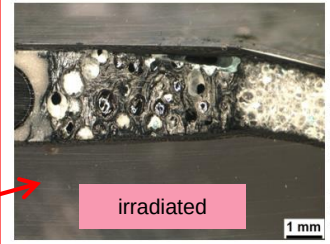


irradiated

Eindruck Nr.	d horizontal (mm)	d vertikal (mm)	d Mittelwert (mm)	HBW 5/10
1	2,8	2,9	2,85	1,4
2	2,9	2,9	2,9	1,4
3	2,6	2,4	2,5	1,9
4	2,3	2,4	2,35	2,2
5	2,6	2,8	2,7	1,6

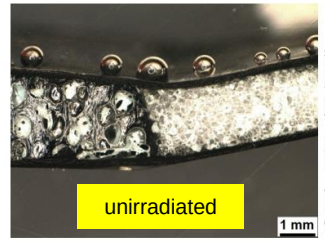
Mittelwert: 1,7 HBW 5/10

Stave visual (microscope) test



Schliff: S3217
Bereich mit Graphit- (links) und Schaumstofffüllung (rechts), partiell blau schimmernder Bereich durch farbkodiertes Poliermittel (blau pigmentiert), an der Probe: anhaftende Gasblasen (Luft) im Epoxidharz

Vergrößerung: 10:1
Bildnummer:
0559_S3217 Stave bestrahlt_00004



Schliff: S3216 unbestrahlt
Bereich mit Graphitfüllung (links) Schaumstofffüllung (rechts), partiell blau schimmernder Bereich durch farbkodiertes Poliermittel (blau pigmentiert), an der Probe: anhaftende Gasblasen (Luft) im Epoxidharz

Vergrößerung: 10:1
Bildnummer:
0559_S3216 Stave unbestrahlt_00004

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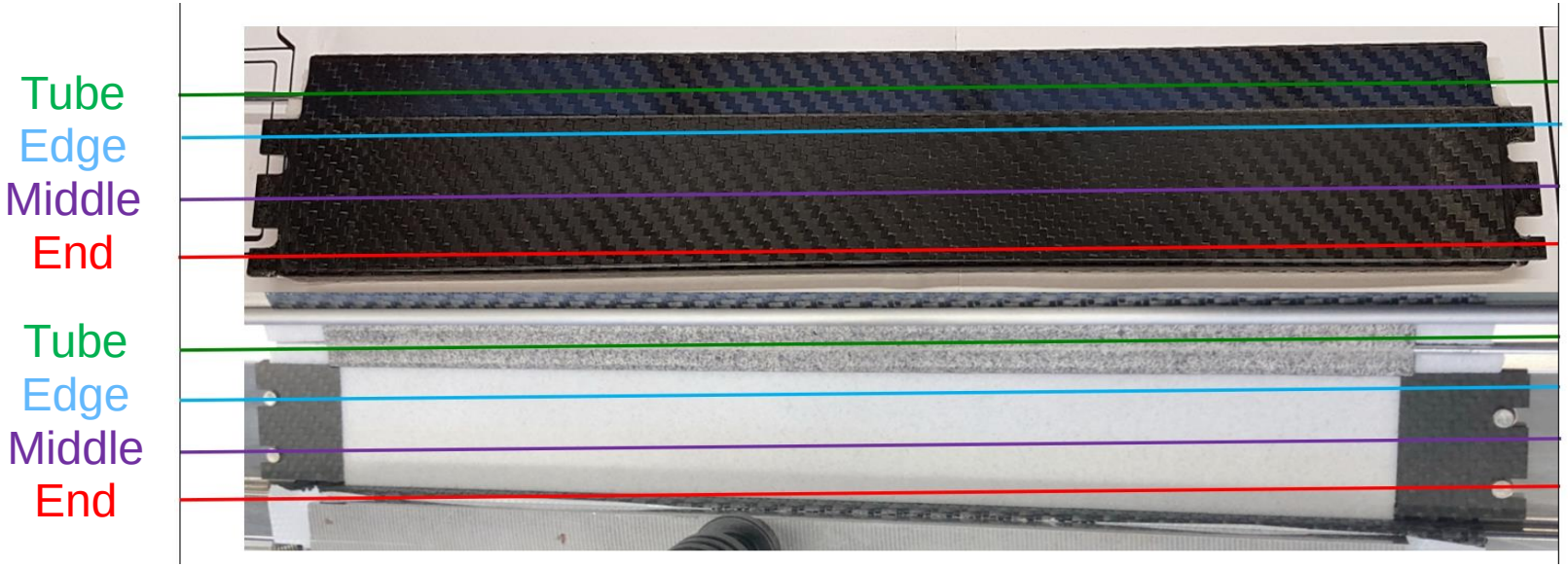
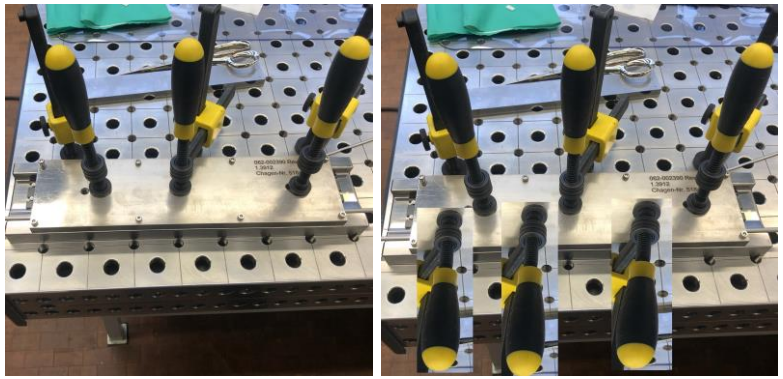
BL4-Stave



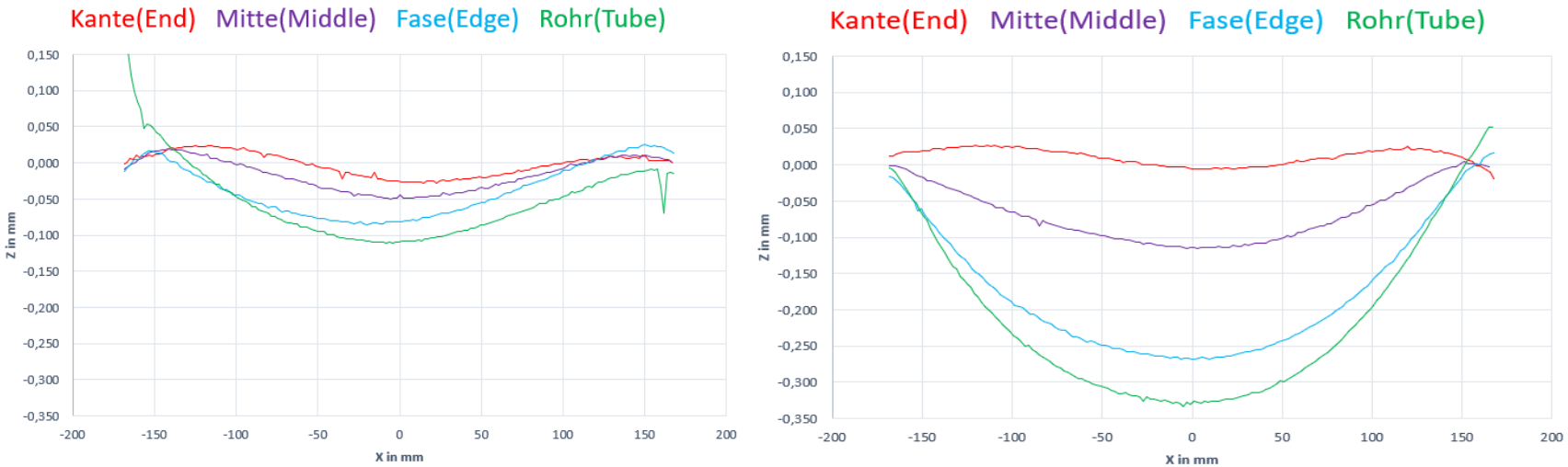
Picture 2: ZEA-BL4-Stave Z01 with measurement lines – top: stave after backing – bottom: laying layers

Change in the clamping procedure

Z01 Z02



Picture 1: Change of clamping



Picture 3: Deviation in the lines – left: Z01– right: Z02

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