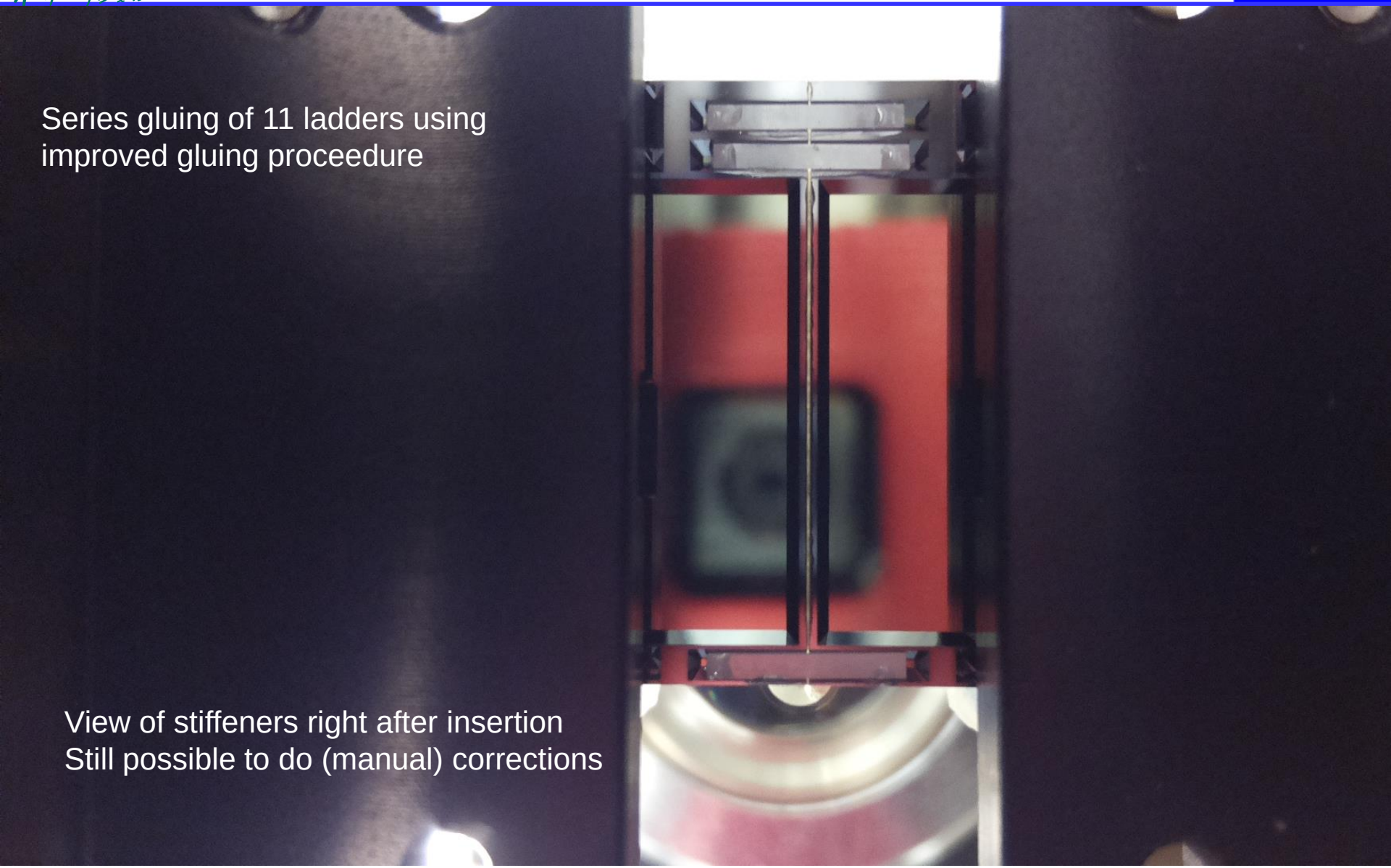
Ladder Assembly

Series gluing of 11 ladders using improved gluing proceedure



View of stiffeners right after insertion
Still possible to do (manual) corrections

Review

Review held end of February

Reviewers: Jelena Ninkovic, Ariane Frey, Igor Konorov, Hans Krüger, Christian Irmler
Participants: Carsten Niebuhr, Laci Andricek, Karl-Heinz Ackermann, Hans-Günther Moser

Many proposals and recommendation which were implemented

Follow up Report July 8, Final Meeting July 23.

Production started already in June, since critical issues were resolved by then.

Cleanroom

Unused equipment removed

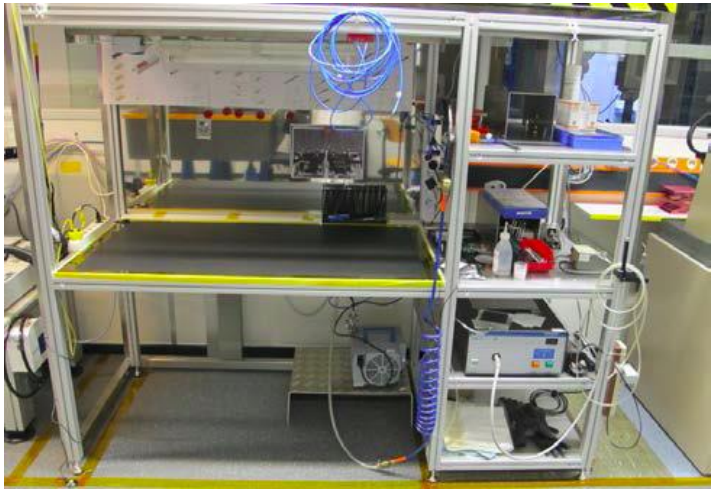
Better access to alignment setup

ESD mats on floor and tables

No loose cables etc (easier cleaning)

2x cleaning/week

Overall view



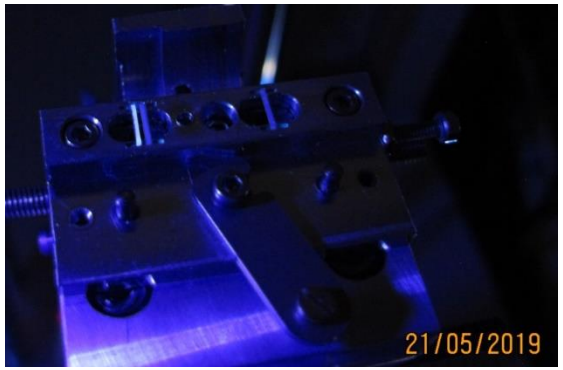
Assembly workspace (flowbox)

Alignment setup, Mitotoyo CMM

Inspection

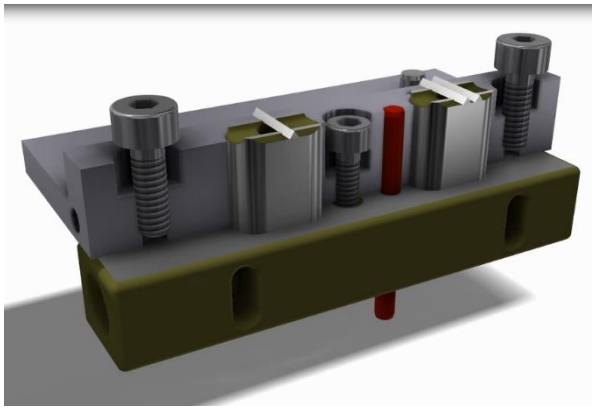
New Features

Control of glue dispensing using UV light
(with bare eye even better)



Additional guiding pin (red) to reduce roll and pitch of lifter

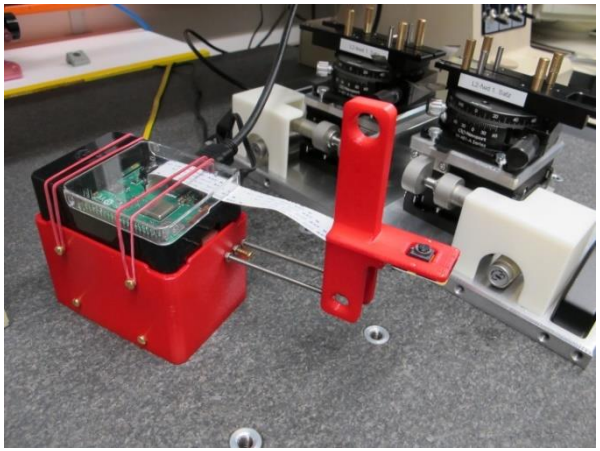
=> Exact positioning of stiffeners

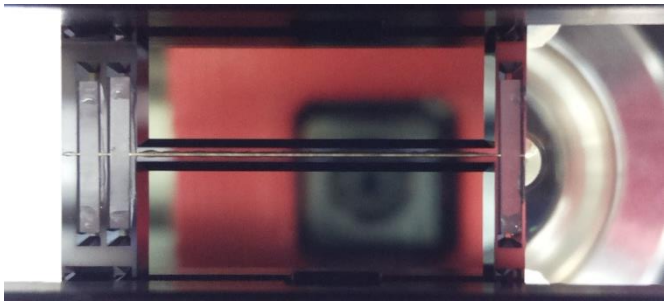


Raspberry Pi camera for control of stiffener insertion

Life picture after insertion

Enables manual corrections





Work Flow

K. Ackermann Klebewoche für Ladder.docx 14.08.2019

Ladder Klebungen

(Einteilung für 2 Klebungen pro Woche [v3.0])

Wochentag	Montag	Dienstag	Mittwoch	Donnerstag	Freitag
08:00-10:00	Ausbau		Ladder härtet aus	Ausbau	Reserve
10:00-11:00	E-Messung	Reserve		E-Messung	L-Klebung
11:00-12:00	K-Messung			K-Messung	
13:00-14:00	E-Messung	Reserve		E-Messung	Ladder
14:00-16:30	Reserve oder L-Klebung	L-Klebung		Reserve oder L-Klebung	härtet aus

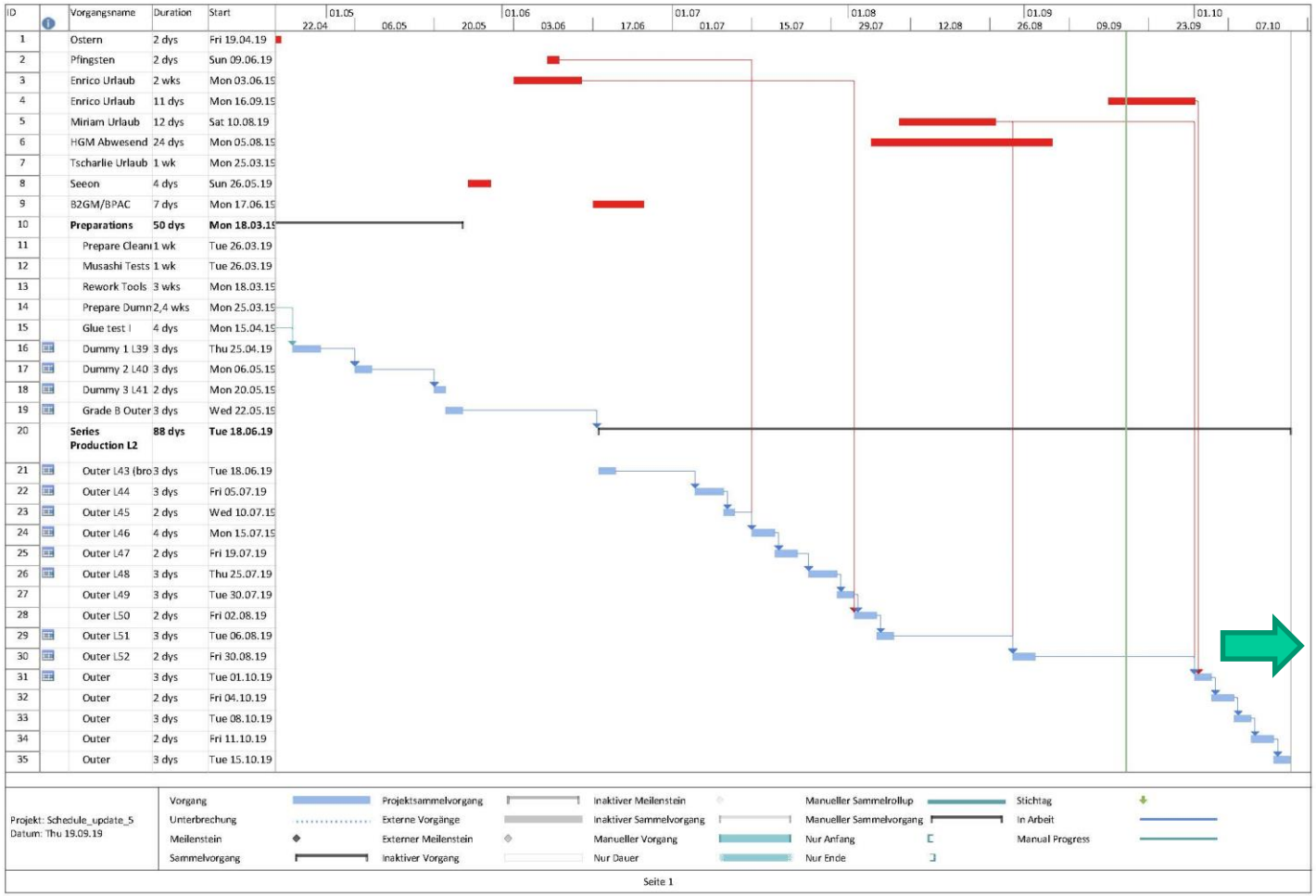
Gluing procedure needs ~1:40h (plus time for module test & inspection)
Curing time >40h (24h sufficient)
1h to take out and pack plus survey (‘K-Messung’) and electrical tests (‘E-Messung)
Can comfortably glue and test two ladders a week

We want to keep to ‘gluing campains’ with continuous gluing over several week
Most efficient in terms of organisation, setting priorites, sharing manpower with other projects and especially routine of operators.

Ladders glued

#	Nr	fwd	bwd	grade	elec. Test	comment	
1	LK 42	W02 OF1	W03 OB1	B	ok		
2	LK 43	W09 OF1	W09 OB1	A	ok	cracked during inspection	
3	LK 44	W32 OF2	W32 OB2	A	ok		
4	LK 45	W33 OF1	W42_OB1	A	ok		
5	LK 46	W33 OF2	W46 OB2	A	ok		
6	LK 47	W46 OF1	W45 OB2	A	ok		
7	LK 48	W13 OF2	W46 OB1	A	ok		
8	LK 49	W08 OF2	W08 OB1	A	ok		
9	LK 50	W46 OF2	W08 OB2	A	ok		
10	LK 51	W45 OF1	W42 OB2	A	ok		
11	LK 52	W43 OF1	W33 OB1	A	ok		

Timeline



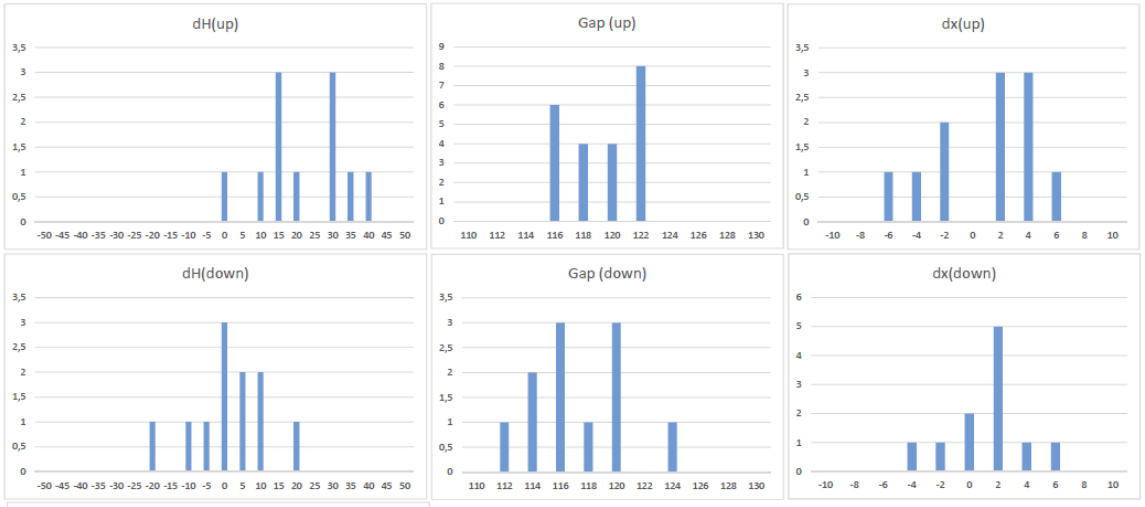
ID	Vorgangsname	Duration	Start
1	Ostern	2 dys	Fri 19.04.19
2	Pfingsten	2 dys	Sun 09.06.19
3	Enrico Urlaub	2 wks	Mon 03.06.19
4	Enrico Urlaub	11 dys	Mon 16.09.19
5	Miriam Urlaub	12 dys	Sat 10.08.19
6	HGM Abwesend	24 dys	Mon 05.08.19
7	Tscharlie Urlaub	1 wk	Mon 25.03.19
8	Seeon	4 dys	Sun 26.05.19
9	B2GM/BPAC	7 dys	Mon 17.06.19
10	**Preparations**	**50 dys**	**Mon 18.03.19**
11	Prepare Cleani	1 wk	Tue 26.03.19
12	Musashi Tests	1 wk	Tue 26.03.19
13	Rework Tools	3 wks	Mon 18.03.19
14	Prepare Dumn	2,4 wks	Mon 25.03.19
15	Glue test I	4 dys	Mon 15.04.19
16	Dummy 1 L39	3 dys	Thu 25.04.19
17	Dummy 2 L40	3 dys	Mon 06.05.19
18	Dummy 3 L41	2 dys	Mon 20.05.19
19	Grade B Outer	3 dys	Wed 22.05.19
20	**Series Production L2**	**88 dys**	**Tue 18.06.19**
21	Outer L43 (bro	3 dys	Tue 18.06.19
22	Outer L44	3 dys	Fri 05.07.19
23	Outer L45	2 dys	Wed 10.07.19
24	Outer L46	4 dys	Mon 15.07.19
25	Outer L47	2 dys	Fri 19.07.19
26	Outer L48	3 dys	Thu 25.07.19
27	Outer L49	3 dys	Tue 30.07.19
28	Outer L50	2 dys	Fri 02.08.19
29	Outer L51	3 dys	Tue 06.08.19
30	Outer L52	2 dys	Fri 30.08.19
31	Outer	3 dys	Tue 01.10.19
32	Outer	2 dys	Fri 04.10.19
33	Outer	3 dys	Tue 08.10.19
34	Outer	2 dys	Fri 11.10.19
35	Outer	3 dys	Tue 15.10.19

Run out of tested modules August 30.

Alignment

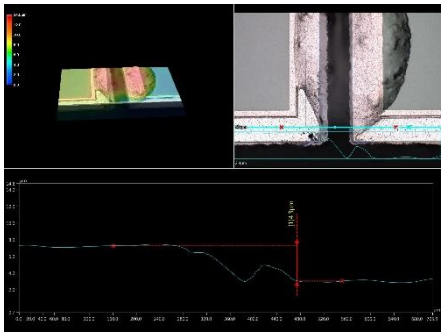
dH (up)	dH(down)	gap(up)	gap(down)	dx(up)	dx(down)	
15,4	-6,2	115	114	5,7	4,7	
30,8	-0,5	116,8	117,5	2,8	1,7	
-4,9	-24,1	122	123,4	-3	-2,8	
8,3	-3,4	120,2	114,8	2,3	3,4	
13,8	0,8	114,2	111,9	0,2	0,3	
15	-4,3	119,7	115,4	0,7	0,1	
39	16,9	114,8	114,4	3,3	0,7	
27	6,2	119,8	113,6	-2,5	-1,3	
29,5	2,9	120,2	118,2	-6,1	-0,4	
25,5	8,9	116,9	118,1	0,7	0,4	
14,4	-13,3	121,8	119,2	-5,7	-5,6	
19,44	-1,46	118,31	116,41	-0,15	0,11	Mean
11,74	10,51	2,72	3,10	3,60	2,67	RMS

Up: at small balcony Down: at wide balcony

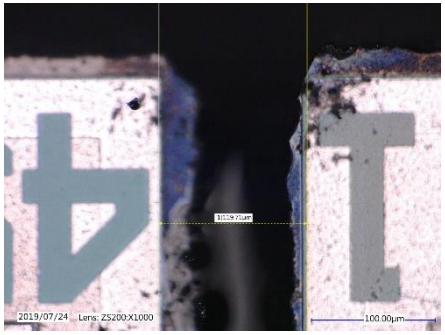


All figures in µm

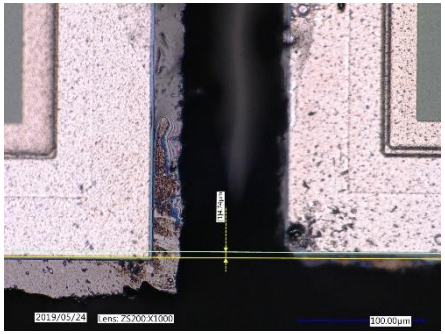
dH: step between modules



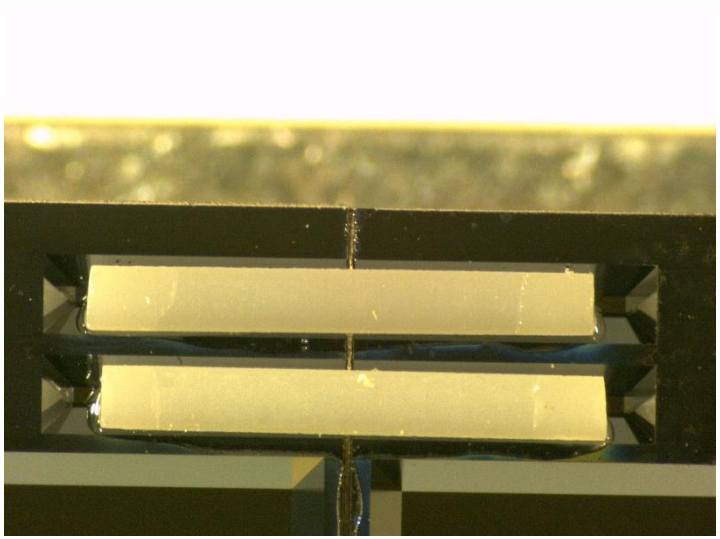
gap: glue gap between Al



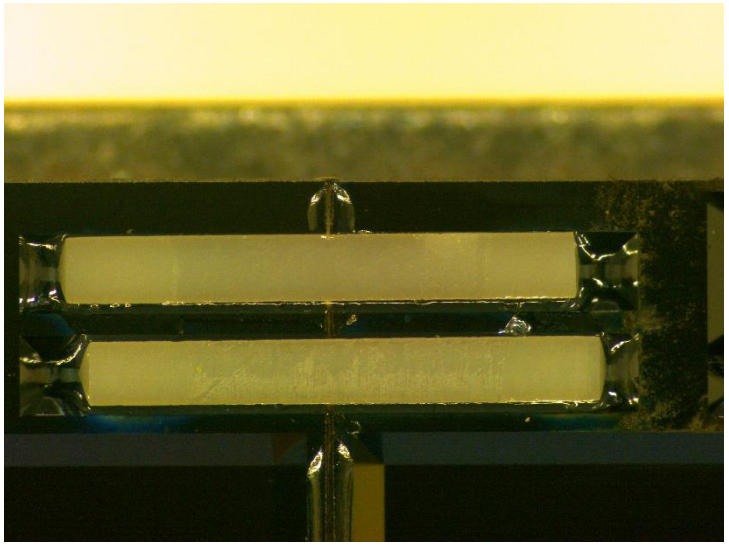
dx: lateral displacement



Glue



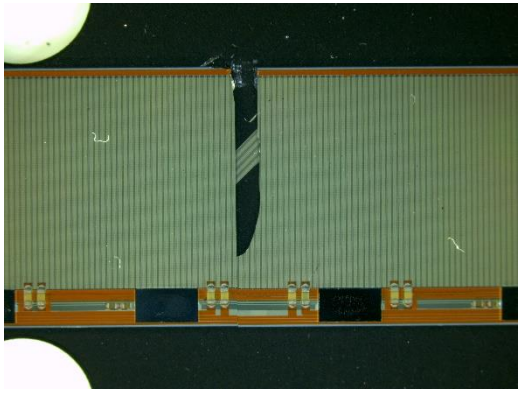
LK 42: glue did not spill out, difficult to judge which area is glued
(nevertheless, the joint is well glued)



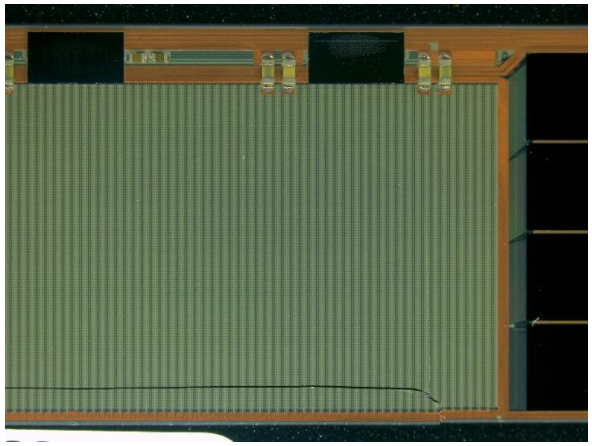
LK 51: Excess glue essentially visible everywhere (tolerances of slot)

Issues

High speed links of our ladder setup were unstable: not possible to test ladders reliably after gluing.
Indirectly this lead to a loss of one ladder during inspection (LK-43, hit by a microscope lens which detached itself (fixed)
Had to use module setups for testing => no module characterization in parallel
Turned out to be a grounding problem in the ladder setup (two branches), understood, ifxed (need DHH)



One module (W12_OF1) failed the electrical test before gluing (high currents). Turned out that had a crack.
Had already been tested im May and was ok then. Stored with other modules and not touched since. Not known what happend.



Summary

Assembly procedure changed:

sensor surface not touched,
stiffeners inserted from below using a tool

Method and facilities were reviewed (incl. follow up)

(Most) suggestions realized

Test with dummy (1 simple dummy, 3 Kapton dummies)

Some improvements needed
last assemblies very successful

11 ladders successfully glued, no loss related to gluing
(however: one ladder lost during inspection)

Gluing procedure needs 1:40h (plus time for module test & inspection)
Curing time >4h
Can comfortably glue two ladders a week