



Measurement of remaining thickness on CFRP

A4A NDT Forum - Tulsa (OK), USA

Alfredo RODRÍGUEZ, AIRBUS - NDT Engineering - Ho NDT In-Service & Tests

22nd September 2026

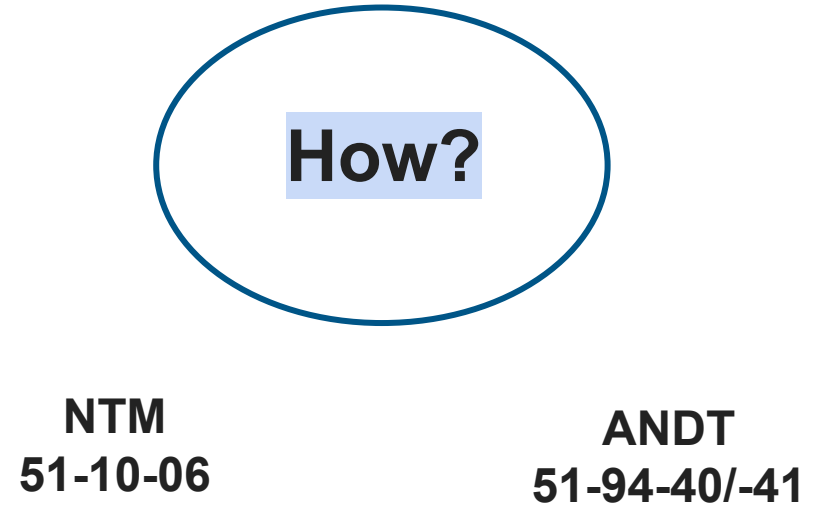
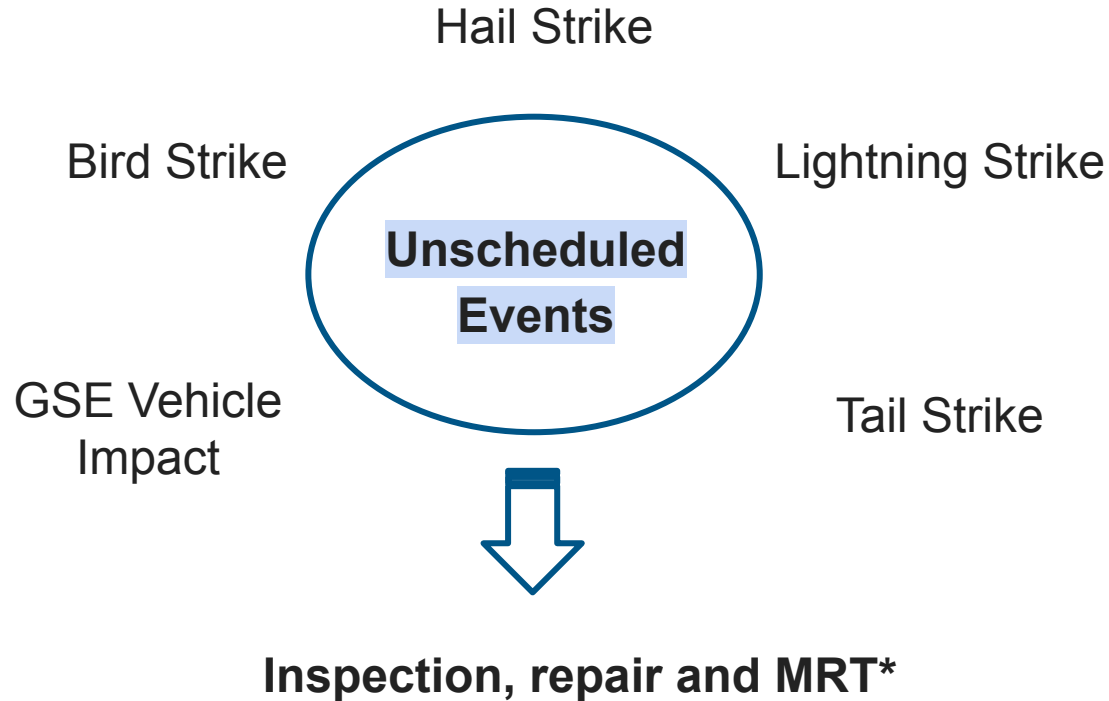
AIRBUS

Agenda

1. CFRP is not Aluminum
2. Let's go on the aircraft
 - Small areas vs large areas inspection
 - Development of a fit-for-purpose solution
3. Conclusions

CFRP is not Aluminum

Introduction - Why and How?

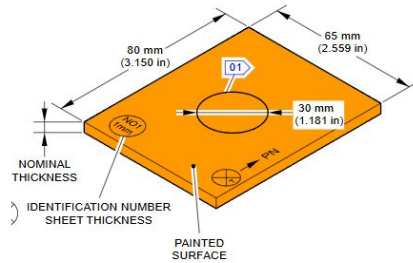


No specific ANDT / NTM** for this purpose

* MRT - Measurement of Remaining Thickness
** ANDT - NTM - Non Destructive Testing Manual

Equipment

NTM 51-10-06 and ANDT 51-94-40/-41



With such procedures the objective is to DETECT, not to MEASURE

CFRP is not Aluminum - Challenges and Way-Forward

More influencing
parameters than Al

Al



Similar material adjustment - Inspection

NTM 51-10-04

CFRP



Anisotropic behaviour, Many configurations,
Wider Backwall

WAY FORWARD - Objective is to measure, not to detect

Measurement
Accuracy

Exactly same
configuration for
adjustment

CFRP Tape
up to 10 mm



Airlines for
America®



Airbus Amber

Let's go on the aircraft

MRT - How do we do it today?

Small inspection areas vs Large inspection areas

5x5 or 10x10 Grid: Point-by-point measurement

- Preparation time
- Average value in a cell
- + Relatively quick and easy to report
- + Better accessibility. Not PAUT dependant

No improvement solution needed. In fact for some areas it is important to count on Single Element Pulse Echo inspection

Roller Probe or X-Y Scanner PAUT

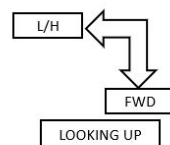
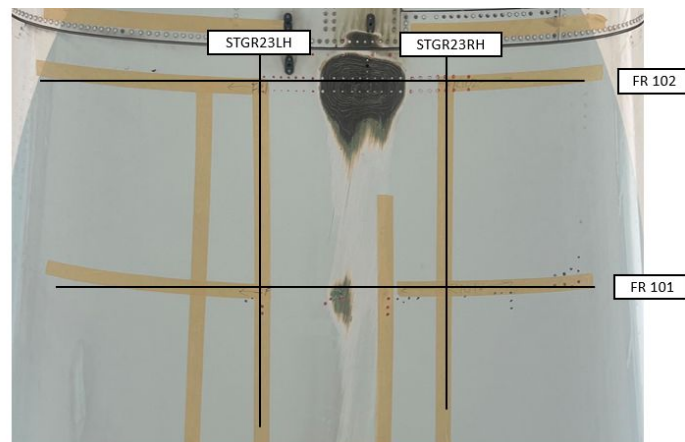
- PAUT knowledge
- More tooling and equipment
- + Quicker and more efficient on large areas

Improvement solution - Post treatment software

Large areas inspection and reporting

Real life example - Tail strike on A350

How to proceed? How to inspect? How to report?



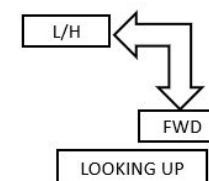
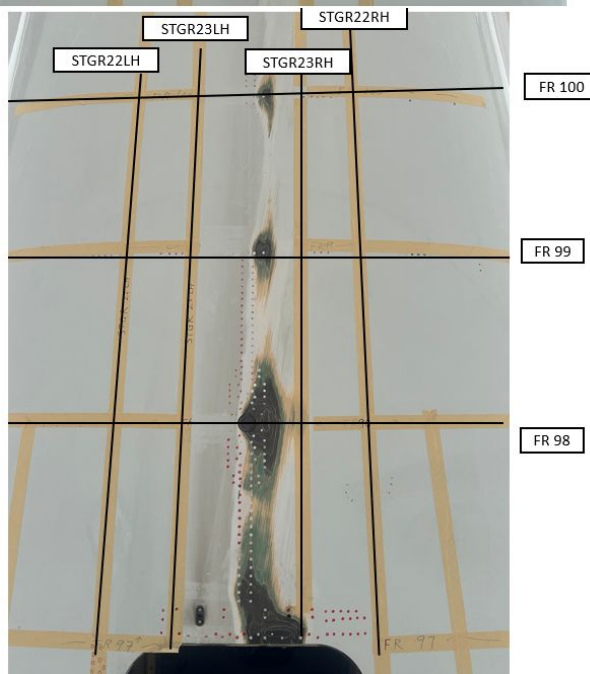
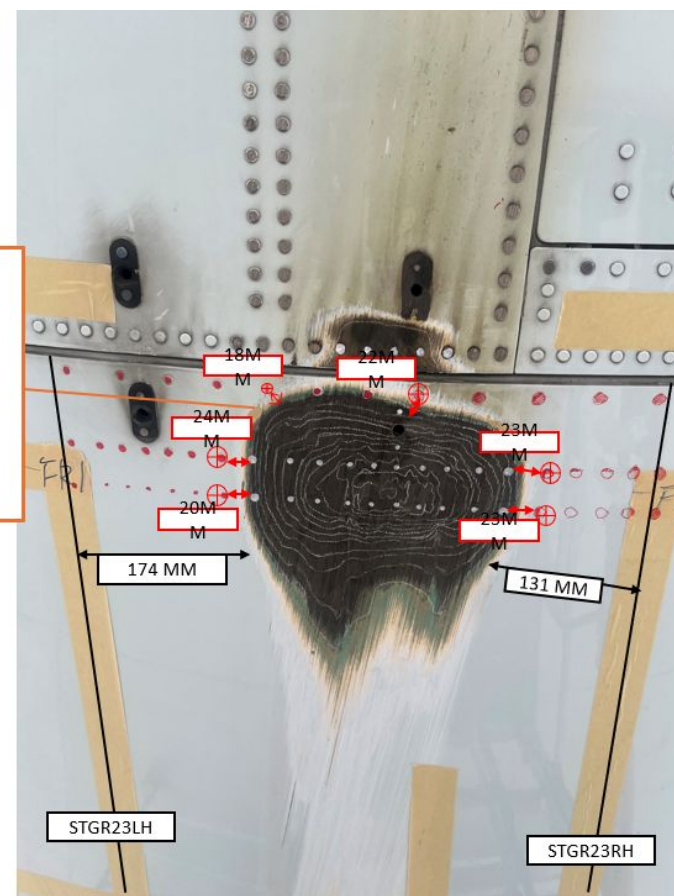
FR102 Damage Overview



Rivet

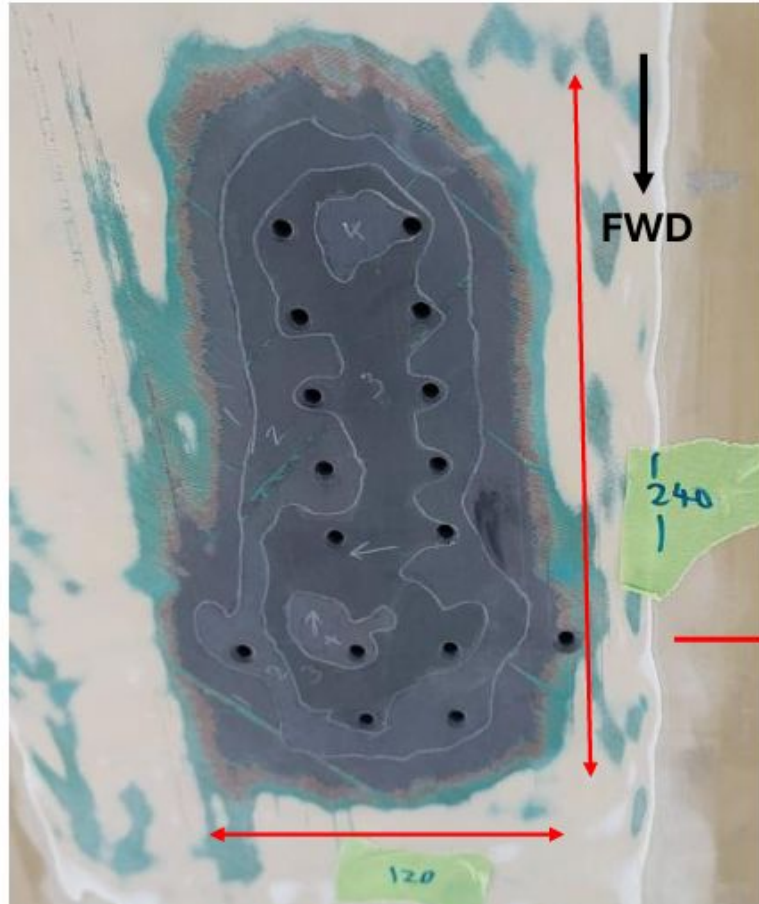
DAMAGE H3

Size: 250 MM x 280 MM
MAX. EST. Missing CFRP plies:12
Missing GF plies :1
Missing ECF :1



Large areas inspection and reporting - 1

Option 1. Grid mapping 10 mm x 10 mm and UTPE measurement cell by cell



FR100 - Blend out measuring 240 mm x 120 mm and max 3 plies deep (4th ply exposed)



Grid Mapping with over 400 measurement points

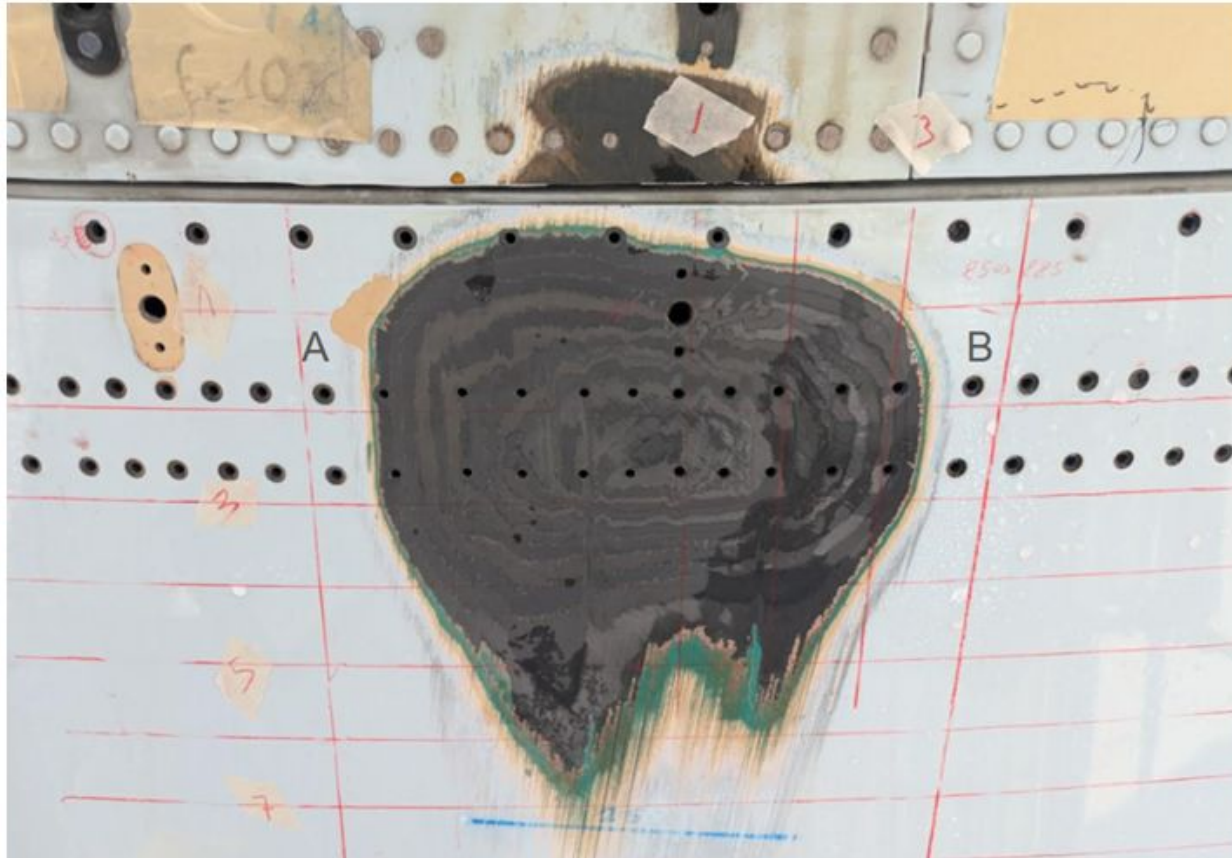
RH
FWD

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	4.24	4.26	4.26	2.40	2.38	2.38	2.35	2.34	2.39	2.39	2.37	2.33	4.30	4.14	4.09
2	4.32	4.24	4.27	2.44	2.36	2.31	2.36	2.28	2.31	2.34	2.34	2.32	4.28	4.13	4.11
3	4.33	4.28	4.29	2.47	2.37	2.22	2.18	2.13	2.25	2.46	2.42	2.46	4.29	4.20	4.12
4	4.28	4.27	4.32	2.50	2.26	2.10	2.09	1.73	2.02	2.22	2.30	2.44	4.32	4.22	4.18
5	4.26	4.27	4.35	2.46	2.20	2.30	1.89	1.76	1.76	2.00	2.16	2.42	4.28	4.24	4.12
6	4.28	4.22	4.36	2.44	2.21	1.95	1.86	1.64	1.63	2.12	2.69	4.26	4.16	4.07	
7	4.24	4.27	4.30	2.45	2.20	1.96	1.88	1.67	1.75	1.95	2.10	2.28	4.23	4.17	4.04
8	4.26	4.25	4.25	2.47	2.17	1.95	1.87	1.73	1.79	1.99	2.11	2.27	4.17	4.20	4.10
9	4.30	4.22	4.27	2.37	2.16	2.02	1.94	1.80	1.76	1.96	2.11	2.19	4.23	4.18	4.09
10	4.29	4.24	4.21	2.43	2.15	1.98	1.95	1.79	2.22	2.00	2.06	2.21	4.19	4.16	4.07
11	4.29	4.24	4.21	2.40	2.18	1.98	1.92	1.82	1.82	1.96	2.06	2.22	4.19	4.16	4.07
12	4.35	4.23	4.27	2.43	2.25	2.01	1.98	2.18	2.18	1.94	2.02	2.17	4.17	4.19	4.10
13	4.35	4.20	4.24	2.24	2.17	1.96	1.84	1.78	2.06	2.15	4.16	4.20	4.08		
14	4.29	4.19	4.21	3.94	2.07	1.91	1.92	1.79	1.74	1.89	2.09	2.20	4.18	4.21	4.09
15	4.26	4.19	4.17	4.01	1.95	1.82	1.85	1.80	1.73	1.90	2.06	2.15	4.16	4.17	4.10
16	4.25	4.14	4.20	3.89	1.90	1.73	1.84	1.76	1.73	1.95	2.00	2.12	4.16	4.16	4.08
17	4.40	4.51	4.39	4.18	2.37	2.06	2.20	2.21	2.22	2.30	2.32	2.23	4.66	4.17	4.60
18	4.70	4.55	4.46	4.39	3.91	2.21	2.32	2.23	2.37	2.50	2.50	2.65	4.54	4.70	4.68
19	4.64	4.56	4.50	4.45	4.01	2.20	2.25	2.24	2.64	2.40	2.45	2.59	4.54	4.70	4.68
20	4.67	4.51	4.55	4.38	4.46	2.28	2.30	2.31	2.33	2.53	2.65	4.30	4.71	4.67	
21	4.64	4.62	4.61	4.48	4.20	2.34	2.35	2.36	2.41	2.54	2.55	2.74	4.72	4.73	4.70
22	4.72	4.65	4.67	4.56	2.60	2.36	2.40	2.46	2.48	2.55	2.60	2.74	4.70	4.80	4.70
23	4.72	4.66	4.62	4.50	2.59	2.50	2.50	2.52	2.52	2.60	2.69	2.76	4.73	4.80	4.73
24	4.75	4.65	4.64	4.53	3.08	2.64	2.67	2.60	2.65	2.73	2.83	2.88	4.67	4.83	4.71
25	4.80	4.68	4.75	4.62	2.89	2.82	2.80	2.74	2.78	2.91	2.96	2.99	4.62	4.85	4.79
26	4.83	4.73	4.77	4.74	2.99	2.96	2.96	2.94	2.93	2.94	2.99	2.94	4.74	4.82	4.79
27	4.78	4.76	4.80	4.68	3.02	3.02	3.04	3.01	3.00	3.00	3.01	2.96	4.77	4.84	4.82

Readings in mm

Large areas inspection and reporting - 2

Option 2. PAUT Inspection with PAUT Transducer/RollerProbe and/or Glider Scan

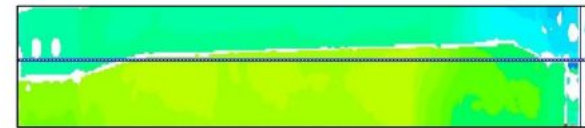
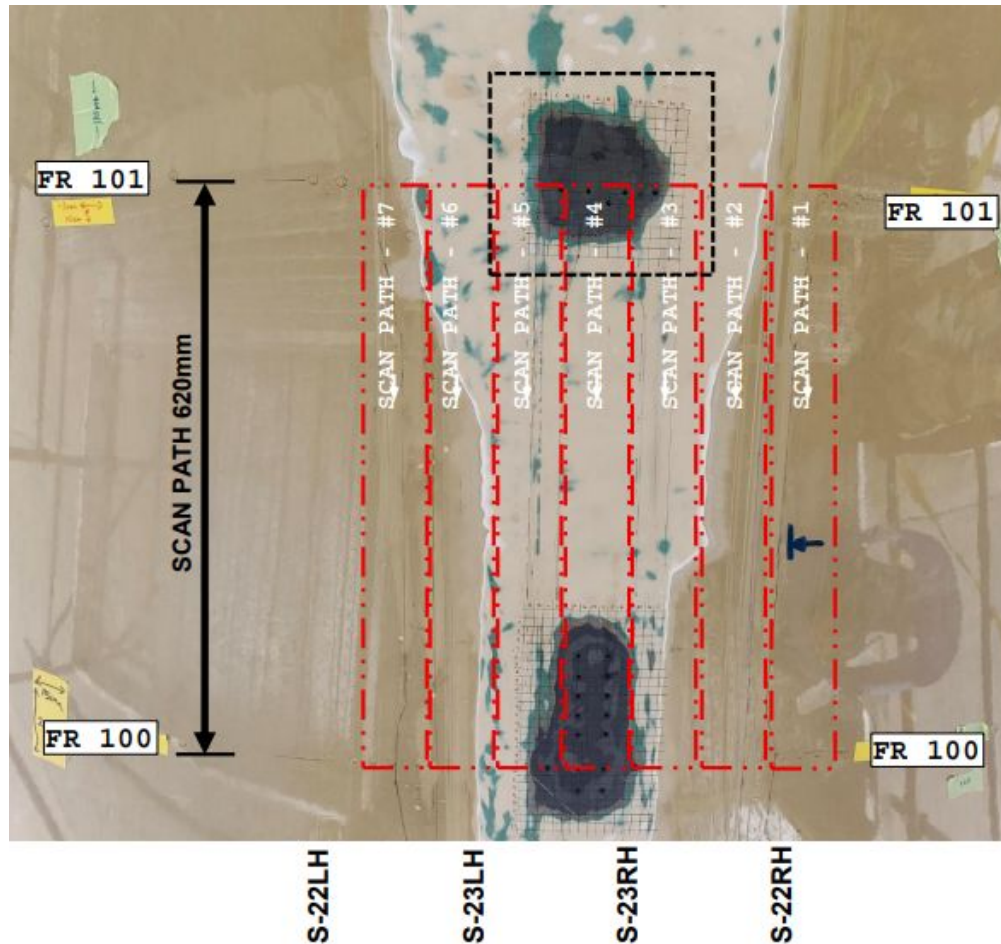


FR102 - Blend out measuring 250 mm x 280 mm and max 12 plies deep



Large areas inspection and reporting - 2a

Post-Treatment Software NOT USED



SCAN PATH - #1



SCAN PATH - #2



SCAN PATH - #3



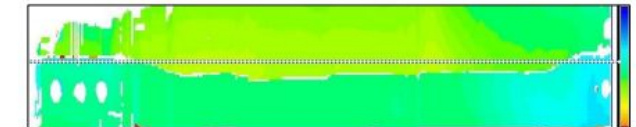
SCAN PATH - #4



SCAN PATH - #5



SCAN PATH - #6



SCAN PATH - #7

- Difficult to know what is what.
- Difficult to run a proper analysis:
 - No full C-Scan Amplitude and ToF
 - No scale or same reference to interpret data
 - No edition/post-treatment available as per end-user's request



Airlines for
America

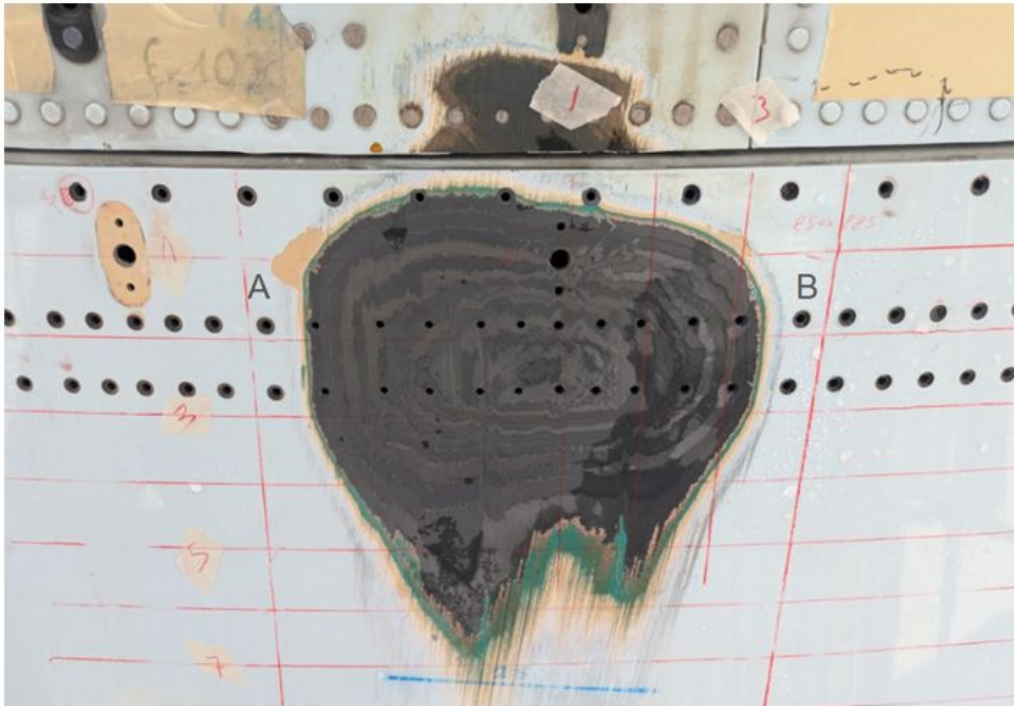


Airbus Amber

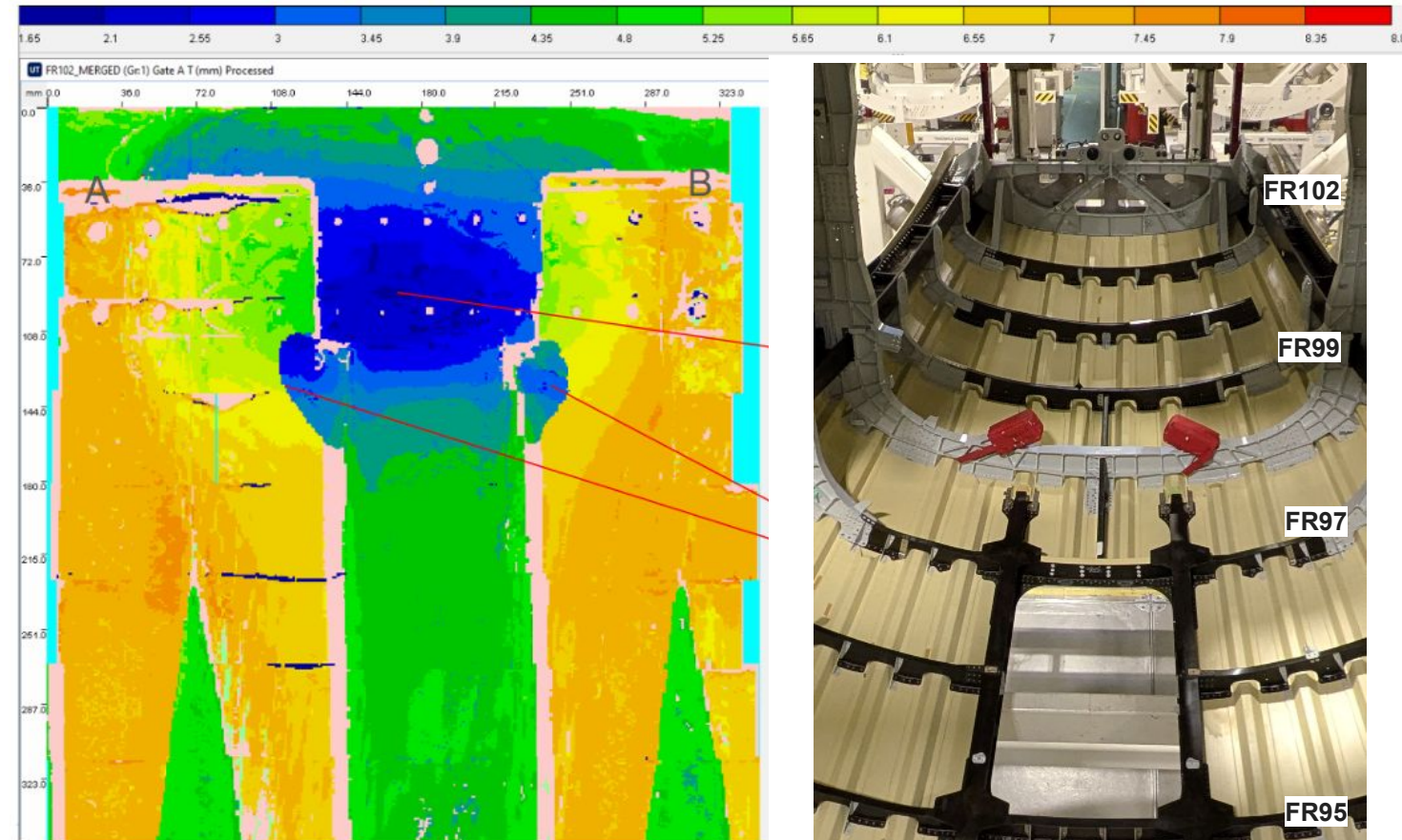
Large areas inspection and reporting - 2b

Post-Treatment Software USED

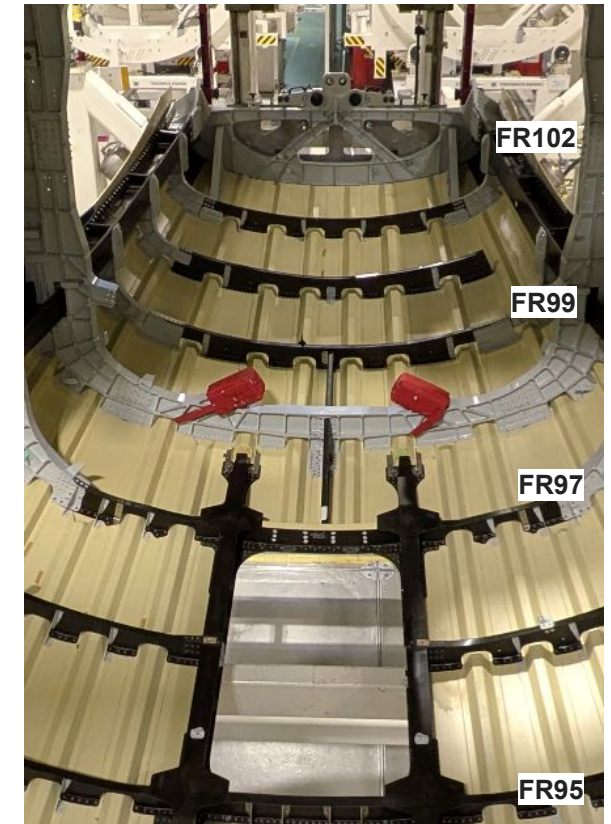
NDTKit UT Software



FR102 - Blend out measuring 250 mm x 280 mm and max 12 plies deep



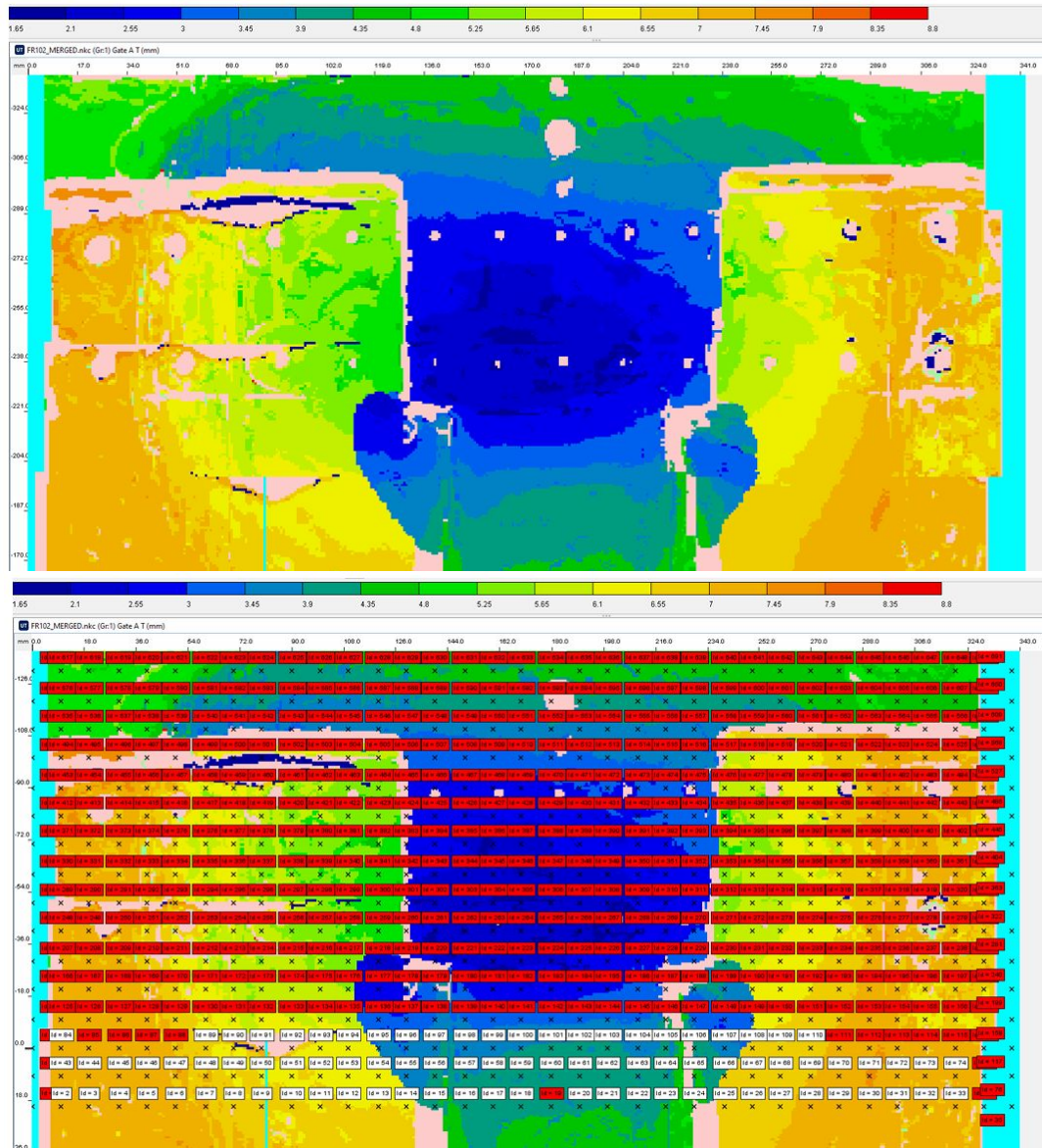
FR102 - PAUT TOF Scan with 2x Debondings



A350 S19 - Exemplary internal overview looking AFT-DOWN

And now...How to report?

Large areas inspection and reporting - 2b



Required for reporting:

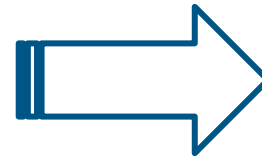
- Split the scan for evaluation
- Create a grid with an ID per cell - No direct readings available
- Data export to a table with thousands of entries
- All in all, time consuming and exhaustive reporting

n°	X[mm]	Y[mm]	Media	61	180.0	10.0	4.183	121	380.0	0.0	-	181	180.0	-20.0	2.802	241	350.0	-50.0	-	301	130.0	-50.0	NoE
1	0.0	20.0	NaN	82	200.0 <th>10.0</th> <th>4.43</th> <td>122</td> <td>390.0<th>0.0</th><th>-</th><td>182</td><th>170.0</th><th>-20.0</th><th>2.802</th><td>242</td><th>360.0</th><th>-50.0</th><th>-</th><td>302</td><th>140.0</th><th>-50.0</th><th>2.445</th></td>	10.0	4.43	122	390.0 <th>0.0</th> <th>-</th> <td>182</td> <th>170.0</th> <th>-20.0</th> <th>2.802</th> <td>242</td> <th>360.0</th> <th>-50.0</th> <th>-</th> <td>302</td> <th>140.0</th> <th>-50.0</th> <th>2.445</th>	0.0	-	182	170.0	-20.0	2.802	242	360.0	-50.0	-	302	140.0	-50.0	2.445
2	10.0	20.0	7.257	83	210.0	10.0	3.454	123	400.0	-10.0	3.454	183	190.0	-20.0	2.833	243	370.0	-50.0	-	303	150.0	-50.0	2.445
3	20.0	20.0	7.241	84	220.0	10.0	4.168	124	0.0	-10.0	NaN	184	190.0	-20.0	2.879	244	380.0	-50.0	-	304	160.0	-50.0	2.190
4	30.0	20.0	7.303	85	230.0	10.0	4.432	125	10.0	-10.0	7.288	185	200.0	-20.0	2.973	245	390.0	-50.0	-	305	170.0	-50.0	2.190
5	40.0	20.0	7.305	86	240.0	10.0	6.78	126	20.0	-10.0	7.228	186	210.0	-20.0	3.112	246	400.0	-50.0	-	306	180.0	-50.0	2.845
6	50.0	20.0	7.288	87	250.0	10.0	6.719	127	30.0	-10.0	7.288	187	220.0	-20.0	3.112	247	410.0	-50.0	NaN	307	190.0	-50.0	4.14
7	60.0	20.0	7.101	88	260.0	10.0	6.822	128	40.0	-10.0	7.288	188	230.0	-20.0	3.749	248	10.0	-50.0	7.179	308	200.0	-50.0	2.491
8	70.0	20.0	6.991	89	270.0	10.0	6.977	129	50.0	-10.0	6.991	189	240.0	-20.0	3.842	249	20.0	-50.0	1.793	309	210.0	-50.0	2.94
9	80.0	20.0	6.968	90	280.0	10.0	7.241	130	60.0	-10.0	6.968	190	250.0	-20.0	4.112	250	30.0	-50.0	6.325	310	220.0	-50.0	2.94
10	90.0	20.0	6.806	91	290.0	10.0	7.505	131	70.0	-10.0	6.512	191	260.0	-20.0	5.335	251	40.0	-50.0	6.807	311	230.0	-50.0	2.805
11	100.0	20.0	6.512	92	300.0	10.0	7.179	132	80.0	-10.0	6.201	192	270.0	-20.0	5.543	252	50.0	-50.0	6.543	312	240.0	-50.0	6.542
12	0.0	30.0	6.574	93	310.0	10.0	7.184	133	90.0	-10.0	6.108	193	280.0	-20.0	5.189	253	60.0	-50.0	6.45	313	250.0	-50.0	6.542
13	120.0	20.0	6.574	94	320.0	10.0	7.148	134	100.0	-10.0	6.108	194	290.0	-20.0	7.148	254	70.0	-50.0	6.108	314	260.0	-50.0	6.015
14	130.0	20.0	6.527	95	330.0	10.0	NaN	135	110.0	-10.0	5.891	195	300.0	-20.0	7.055	255	80.0	-50.0	6.005	315	270.0	-50.0	6.232
15	140.0	20.0	6.997	96	340.0	10.0	NaN	136	120.0	-10.0	3.174	196	310.0	-20.0	6.884	256	90.0	-50.0	6.905	316	280.0	-50.0	6.434
16	150.0	20.0	4.183	97	350.0	10.0	3.128	137	130.0	-10.0	3.128	197	320.0	-20.0	6.880	257	100.0	-50.0	6.880	317	290.0	-50.0	6.434
17	160.0	20.0	4.166	98	360.0	10.0	-	138	140.0	-10.0	3.438	198	330.0	-20.0	6.861	258	110.0	-50.0	6.861	318	300.0	-50.0	2.772
18	170.0	20.0	4.322	99	370.0	10.0	3.338	139	150.0	-10.0	3.438	199	340.0	-20.0	NaN	259	120.0	-50.0	6.053	319	310.0	-50.0	NoE
19	0.0	30.0	4.301	100	380.0	10.0	-	140	160.0	-10.0	3.262	200	350.0	-20.0	NaN	260	130.0	-50.0	5.953	320	320.0	-50.0	NoE
20	190.0	20.0	4.307	101	390.0	10.0	-	141	170.0	-10.0	3.314	201	360.0	-20.0	-	261	140.0	-50.0	6.202	321	330.0	-50.0	7.614
21	200.0	20.0	4.339	102	400.0	10.0	-	142	180.0	-10.0	3.345	202	370.0	-20.0	-	262	150.0	-50.0	6.274	322	340.0	-50.0	NaN
22	210.0	20.0	4.245	103	0.0	0.0	NaN	143	190.0	-10.0	3.278	203	380.0	-20.0	-	263	160.0	-50.0	6.189	323	350.0	-50.0	-
23	220.0	20.0	4.37	104	10.0	0.0	7.21	144	200.0	-10.0	3.407	204	390.0	-20.0	-	264	170.0	-50.0	6.243	324	360.0	-50.0	-
24	230.0	20.0	NoE	105	20.0	0.0	7.195	145	210.0	-10.0	3.438	205	400.0	-20.0	-	265	180.0	-50.0	6.243	325	370.0	-50.0	-
25	240.0	20.0	6.538	106	30.0	0.0	7.241	146	220.0	-10.0	NaN	206	0.0	0.0	NaN	266	190.0	-50.0	1.793	326	380.0	-50.0	-
26	250.0	20.0	6.807	107	40.0	0.0	7.303	147	230.0	-10.0	3.345	207	10.0	-50.0	7.257	267	200.0	-50.0	6.325	327	390.0	-50.0	-
27	260.0	20.0	6.931	108	50.0	0.0	6.948	148	240.0	-10.0	3.174	208	20.0	-50.0	7.21	268	210.0	-50.0	2.041	328	400.0	-50.0	-
28	270.0	20.0	7.101	109	60.0	0.0	6.807	149	250.0	-10.0	3.159	209	30.0	-50.0	7.21	269	220.0	-50.0	2.383	329	0.0	-50.0	NaN
29	280.0	20.0	7.219	110	70.0	0.0	6.905	150	260.0	-10.0	6.827	210	40.0	-50.0	7.003	270	230.0	-50.0	2.681	330	10.0	-50.0	-
30	290.0	20.0	7.385	111	80.0	0.0	6.805	151	270.0	-10.0	6.713	211	50.0	-50.0	6.990	271	240.0	-50.0	6.434	331	20.0	-50.0	4.12
31	300.0	20.0	7.101	112	90.0	0.0	NaN	152	280.0	-10.0	6.962	212	60.0	-50.0	6.124	272	250.0	-50.0	6.80	332	30.0	-50.0	6.731
32	310.0	20.0	7.179	113	100.0	0.0	6.541	153	290.0	-10.0	7.272	213	70.0	-50.0	6.375	273	260.0	-50.0	6.001	333	40.0	-50.0	6.915
33	320.0	20.0	7.179	114	110.0	0.0	6.728	154	300.0	-10.0	7.101	214	80.0	-50.0	5.950	274	270.0	-50.0	6.325	334	50.0	-50.0	6.41
34	330.0	20.0	NaN	115	120.0	0.0	3.490	155	310.0	-10.0	6.490	215	90.0	-50.0	6.248	275	280.0	-50.0	6.434	335	60.0	-50.0	6.077
35	340.0	20.0	NaN	116	130.0	0.0	3.478	156	320.0	-10.0	6.78	216	100.0	-50.0	6.549	276	290.0	-50.0	7.055	336	70.0	-50.0	6.232
36	0.0	30.0	6.968	117	140.0	0.0	3.764	157	330.0	-10.0	6.791	217	110.0	-50.0	6.791	277	300.0	-50.0	6.990	337	80.0	-50.0	6.462
37	350.0	20.0	-	118	150.0	0.0	3.749	158	340.0	-10.0	6.791	218	120.0	-50.0	2.414	278	310.0	-50.0	NaN	338	90.0	-50.0	6.462
38	370.0	20.0	-	119	160.0	0.0	3.795	159	350.0	-10.0	-	219	130.0	-50.0	2.090	279	320.0	-50.0	7.055	339	100.0	-50.0	6.528
39	380.0	20.0	-	120	170.0	0.0	3.904	160	360.0	-10.0	-	220	140.0	-50.0	2.352	280	330.0	-50.0	7.241	340	110.0	-50.0	6.434
40	390.0	20.0	-	121	180.0	0.0	3.94	161	370.0	-10.0	-	221	150.0	-50.0	2.491	281	340.0	-50.0	6.119	341	120.0	-50.0	6.115
41	400.0	20.0	-	122	190.0	0.0	3.985	162	380.0	-10.0	-	222	160.0	-50.0	2.368	282	350.0	-50.0	-	342	130.0	-50.0	NoE
42	0.0	10.0	NaN	123	200.0	0.0	3.985	163	390.0	-10.0	-	223	170.0	-50.0	2.48	283	360.0	-50.0	-	343	140.0	-50.0	3.475
43	10.0	10.0	7.241	124	210.0	0.0	3.718	164	400.0	-10.0	-	224	180.0	-50.0	2.807	284	370.0	-50.0	-	344	150.0	-50.0	6.434
44	20.0	10.0	7.241	125	220.0	0.0	3.907	165	0.0	-20.0	NaN	225	190.0	-50.0	2.584	285	380.0	-50.0	-	345	160.0	-50.0	2.181
45	30.0	10.0	7.303	126	230.0	0.0	4.23	166	10.0	-20.0	7.257	226	200.0	-50.0	2.74	286	390.0	-50.0	-	346 <th>170.0</th> <th>-50.0</th> <th>2.195</th>	170.0	-50.0	2.195
46	40.0	10.0	7.305	127	240.0	0.0	6.828	167	20.0	-20.0	7.21	227	210.0	-50.0	2.805	287	400.0	-50.0	-	347	180.0	-50.0	2.445
47	50.0	10.0	6.948	128	250.0	0.0	6.82	168	30.0	-20.0	7.195	228	220.0	-50.0	3.143	288	0.0	-50.0	NaN	348	190.0	-50.0	2.459
48	60.0	10.0	6.962	129	260.0	0.0	6.828	169	40.0	-20.0	6.991	229	230.0	-50.0	3.143	289	10.0	-50.0	NaN	349	200.0	-50.0	2.491
49	70.0	10.0	6.496	130	270.0	0.0	6.807	170	50.0	-20.0	6.8	230	240.0	-50.0	4.023	290	20.0	-50.0	NoE	350	210.0	-50.0	2.845
50	80.0	10.0	6.512	131	280.0	0.0	7.117	171	60.0	-20.0	6.512	231	250.0	-50.0	4.112	291	30.0	-50.0	6.325	351	220.0	-50.0	2.94
51	90.0	10.0	6.481	132	290.0	0.0	7.395	172	70.0	-20.0	6.51	232	260.0	-50.0	5.248	292	40.0	-50.0	6.807	352	230.0	-50.0	2.895
52	100.0	10.0	6.512	133	300.0	0.0	7.179	173	80.0	-20.0	6.584	233	270.0	-50.0	6.434	293	50.0	-50.0	6.593	353	240.0	-50.0	6.511
53	0.0	30.0	6.45	134	310.0	0.0	7.148	174	90.0	-20.0	6.451	234	280.0	-50.0	7.148	294	60.0	-50.0	6.45	354	250.0	-50.0	6.511
54	120.0	10.0	6.45	135	320.0	0.0	7.117</																

Large areas inspection and reporting - 2b

Some facts:

- CScan Analysis and Post-treatment
- Grid creation + identification and proper representation
- Results transfer and export
- Report formatting

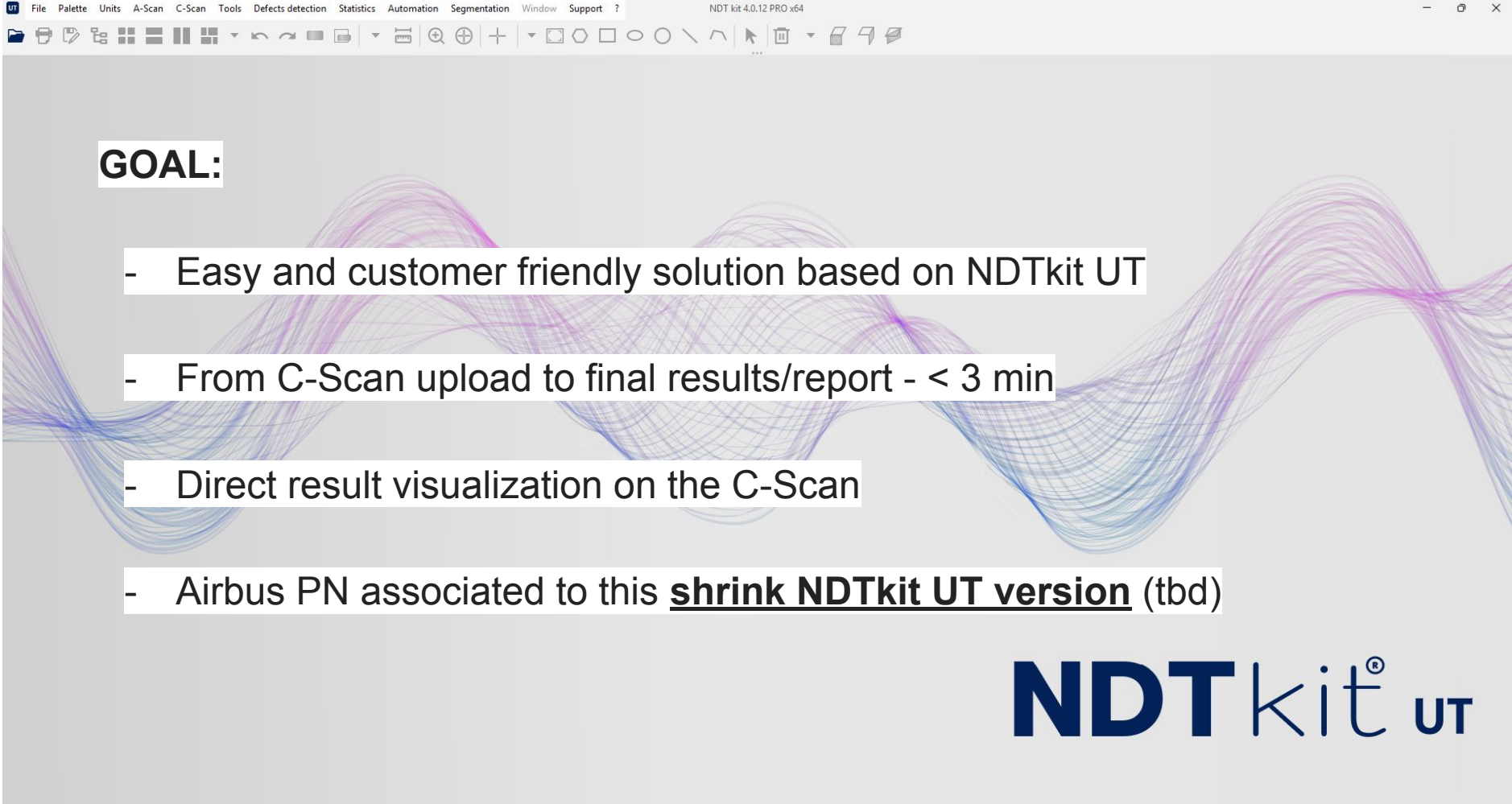


90 min per C-Scan split

An inspection area can consist of several C-Scans

SOLUTION - DEVELOPMENT of a FIT-FOR-PURPOSE solution

Solution 3 - Development of a fit-for-purpose software

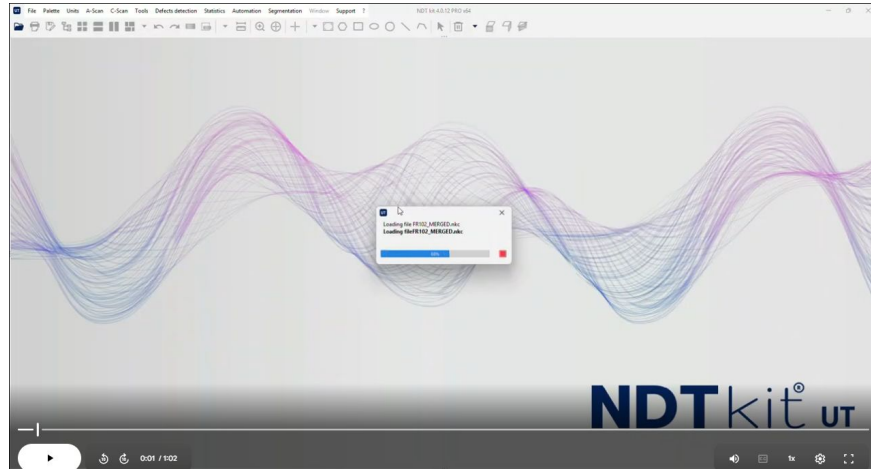


GOAL:

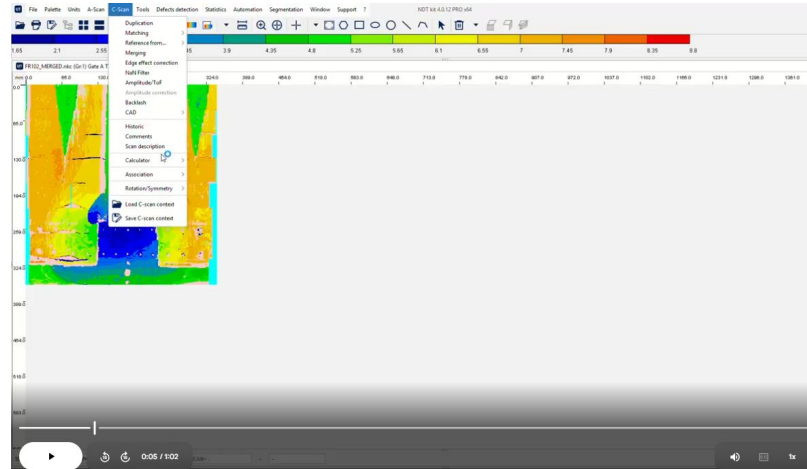
- Easy and customer friendly solution based on NDTkit UT
- From C-Scan upload to final results/report - < 3 min
- Direct result visualization on the C-Scan
- Airbus PN associated to this shrink NDTkit UT version (tbd)

NDTkit[®] UT

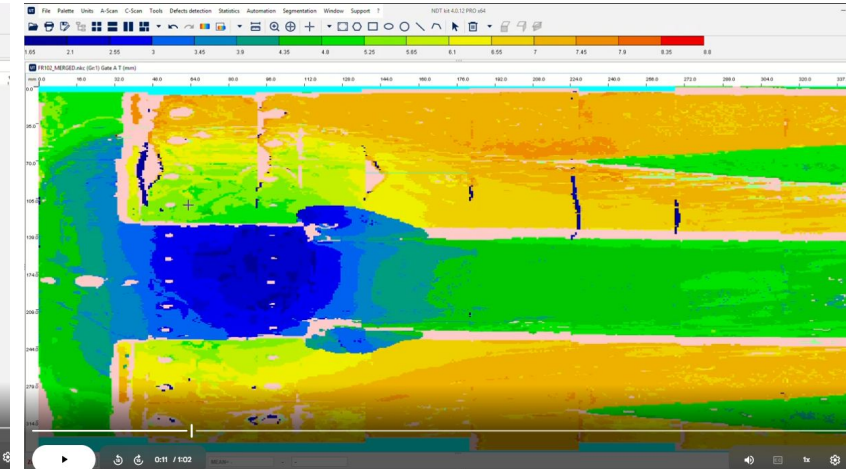
Solution 3 - Development of a fit-for-purpose software



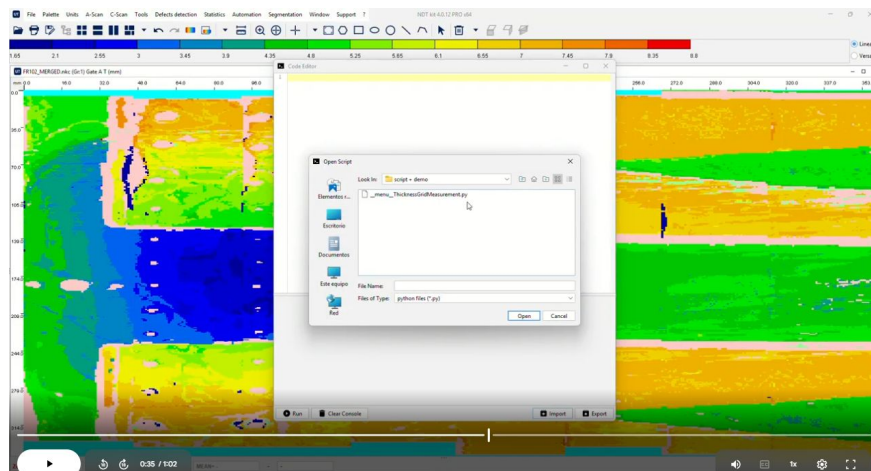
C-Scan Upload



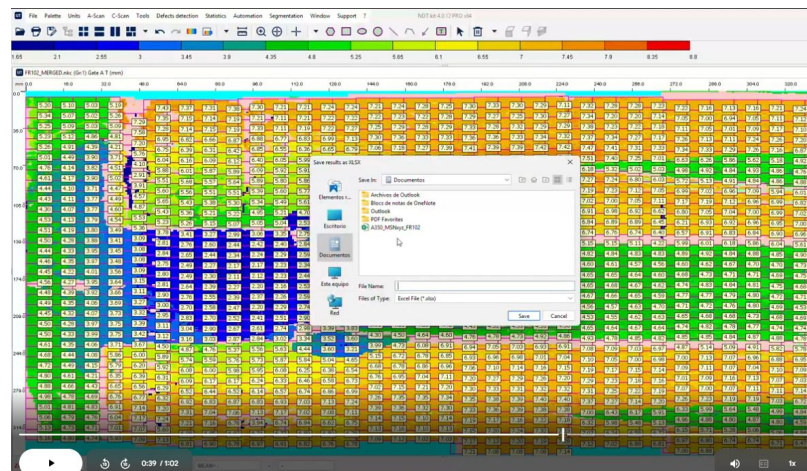
C-Scan Rotation



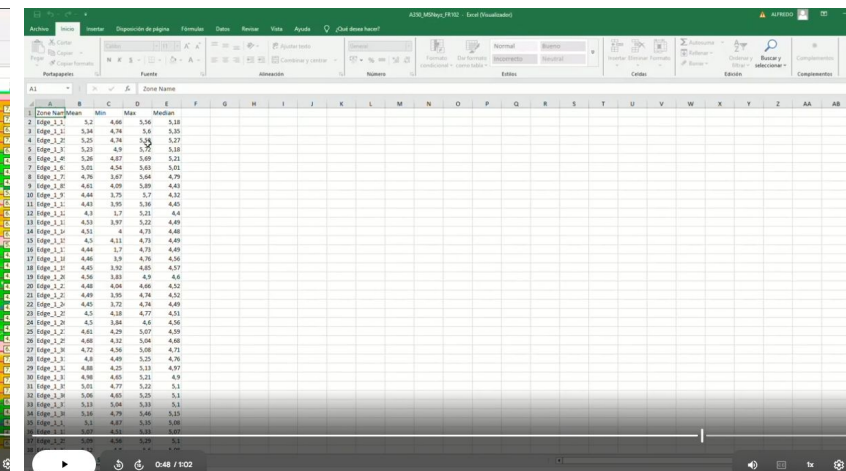
C-Scan Fit to width



Script launching

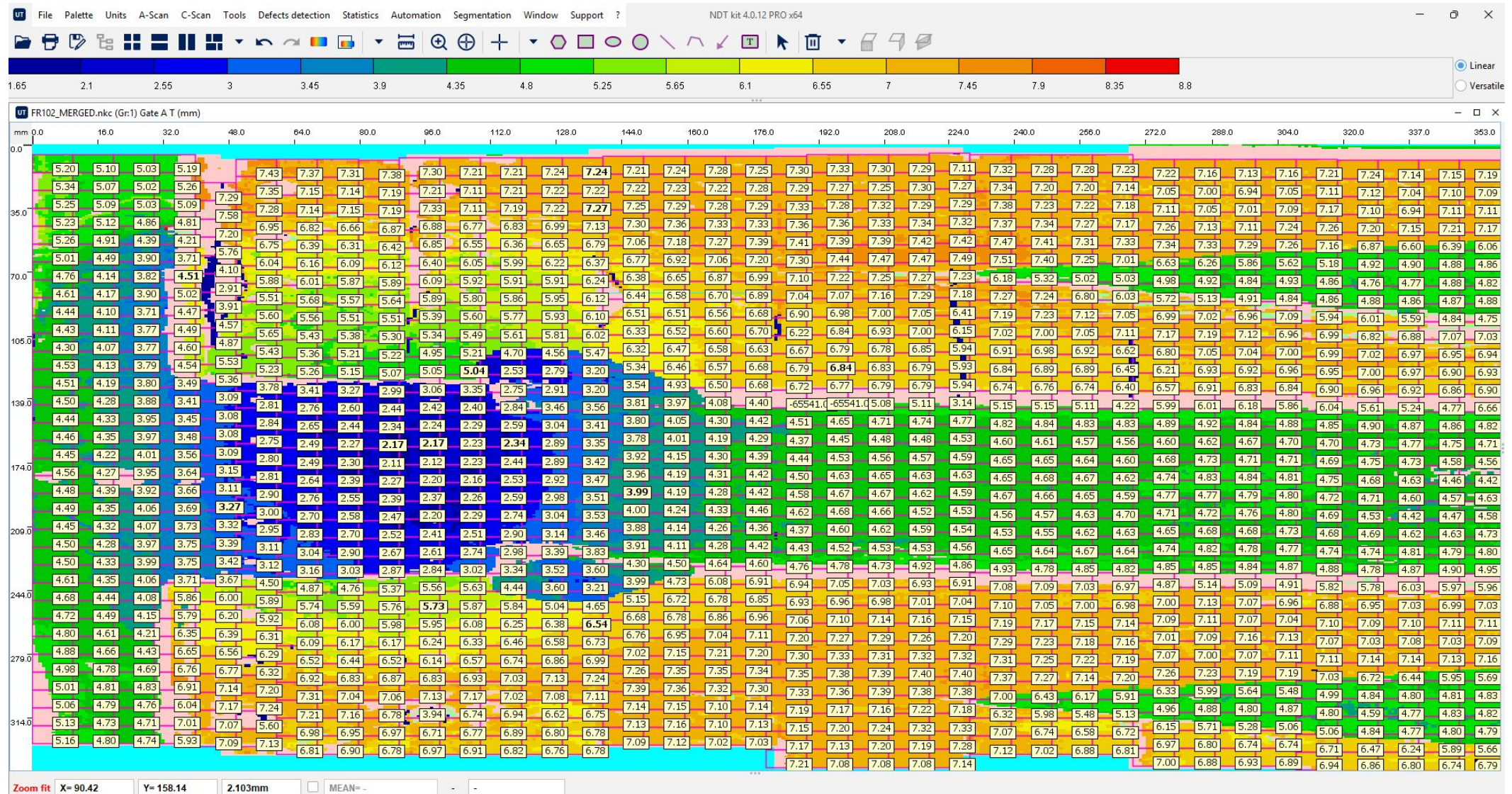


10 mm x 10 mm Grid created + MRT visualization



Export to Excel (not really needed for reporting)

Solution 3 - Development of a fit-for-purpose software



Conclusions

- CFRP is not Aluminum
- More and more Full-body CFRP aircraft up in the skies.
- Need to be prepared to react quickly and precisely on such events.
 - First time right (reporting) and avoid Ping-Pong
- PAUT Inspection is a MUST for large areas.
- Post treatment software saves valuable time and improves efficiency during inspection and repair

Thank you for your attention!



Do you have any question?

Thank you

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