Production status of Test Gaps for RE4 RPCs in Upscope

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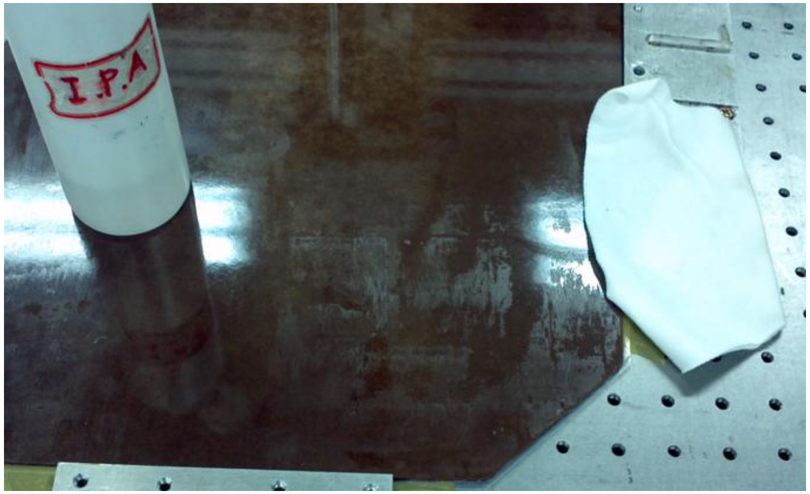
1. Oil dirt on HPL surfaces

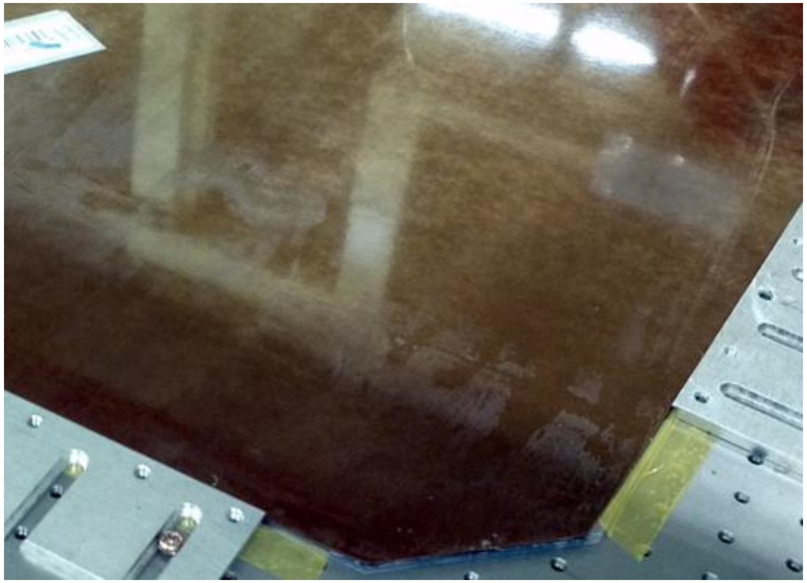
Checked that oil dirt remained on all the HPLs (all batches)

- Found that the stripe pattern created by the cleaning procedure was barely visible and just partially performed.
- At some places of the HPL sheets , the oil dirt still remained was thick.

After cleaning by IPA only



Before cleaning

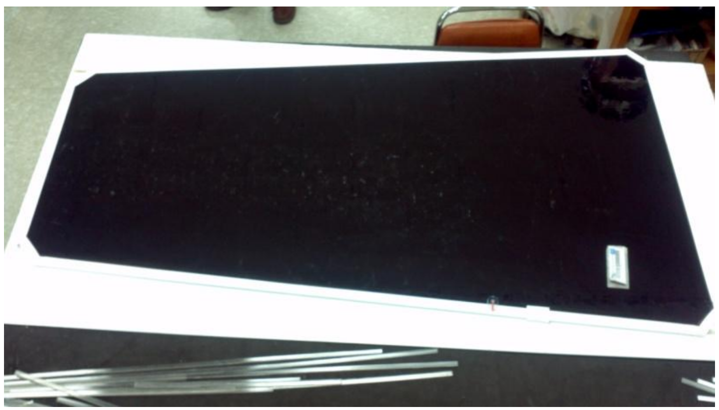


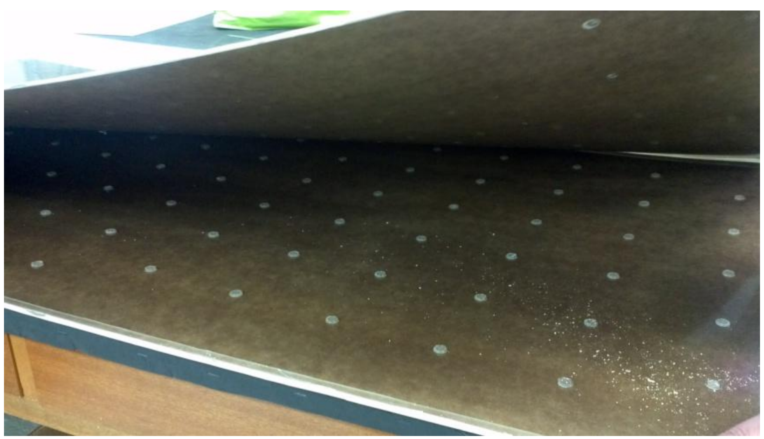
After cleaning by thinner

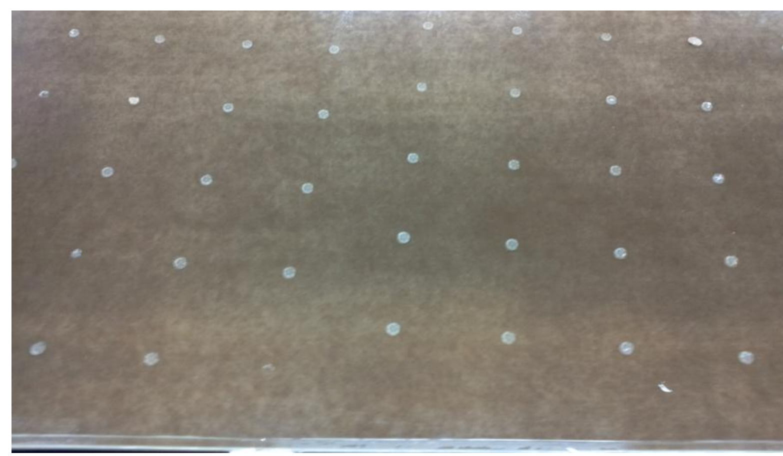
2. Oiled layers

- Opened a RE4/2 test bottom gap (HPLs from batch 12)

- The bonding strength seems to be good enough, but the surface layer of the HPLs were easy detached like a stacked paper layer. (HPLs are mechanically fragile !)
  -> Phenol resin seems to be very poorly smeared into the craft papers.
  Spacers were detached due to lack of the rigidity of the HPLs
- Places where the phenol resin was well smeared -> dark
  Otherwise -> bright and having microscopic bright spots



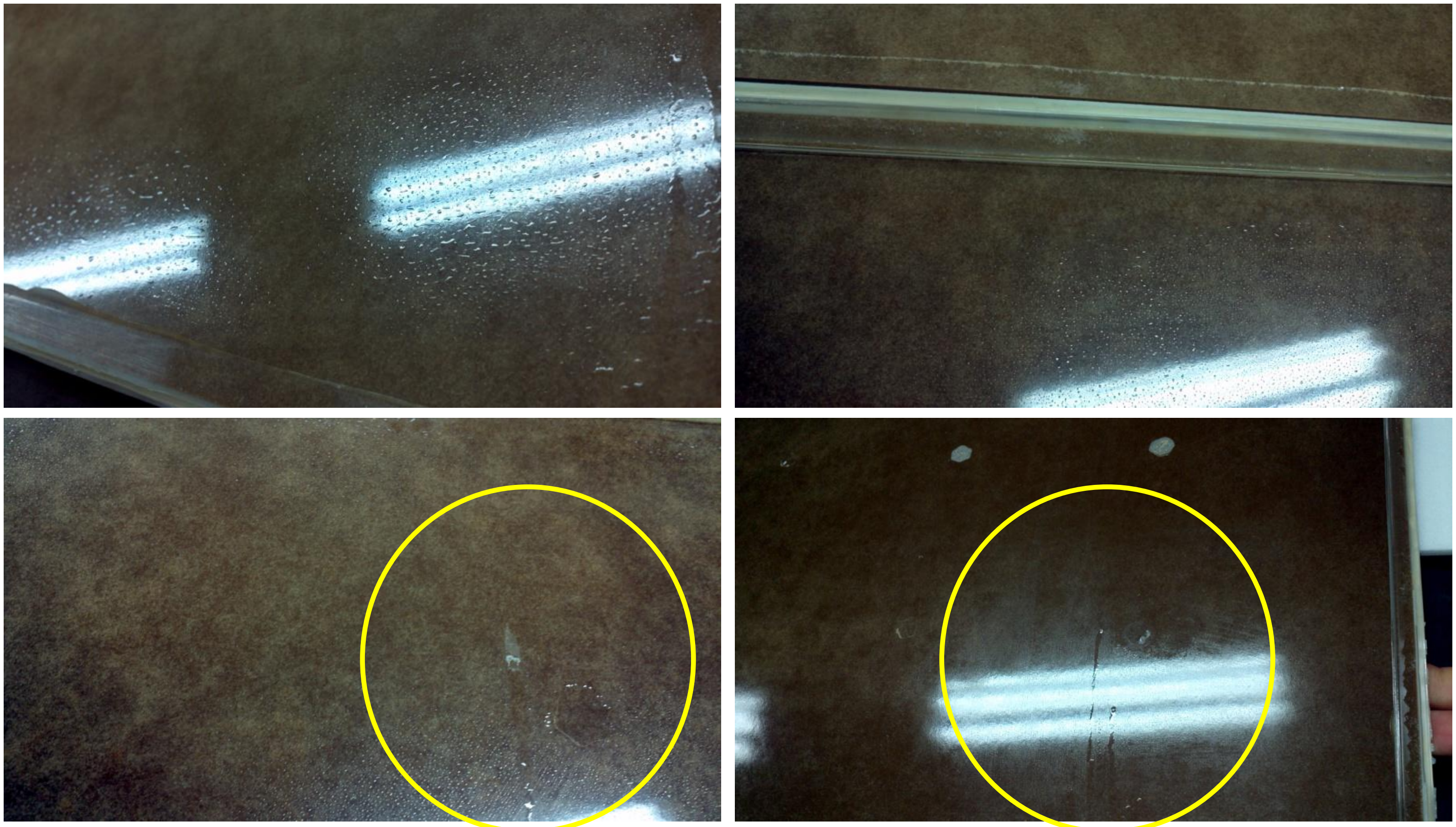




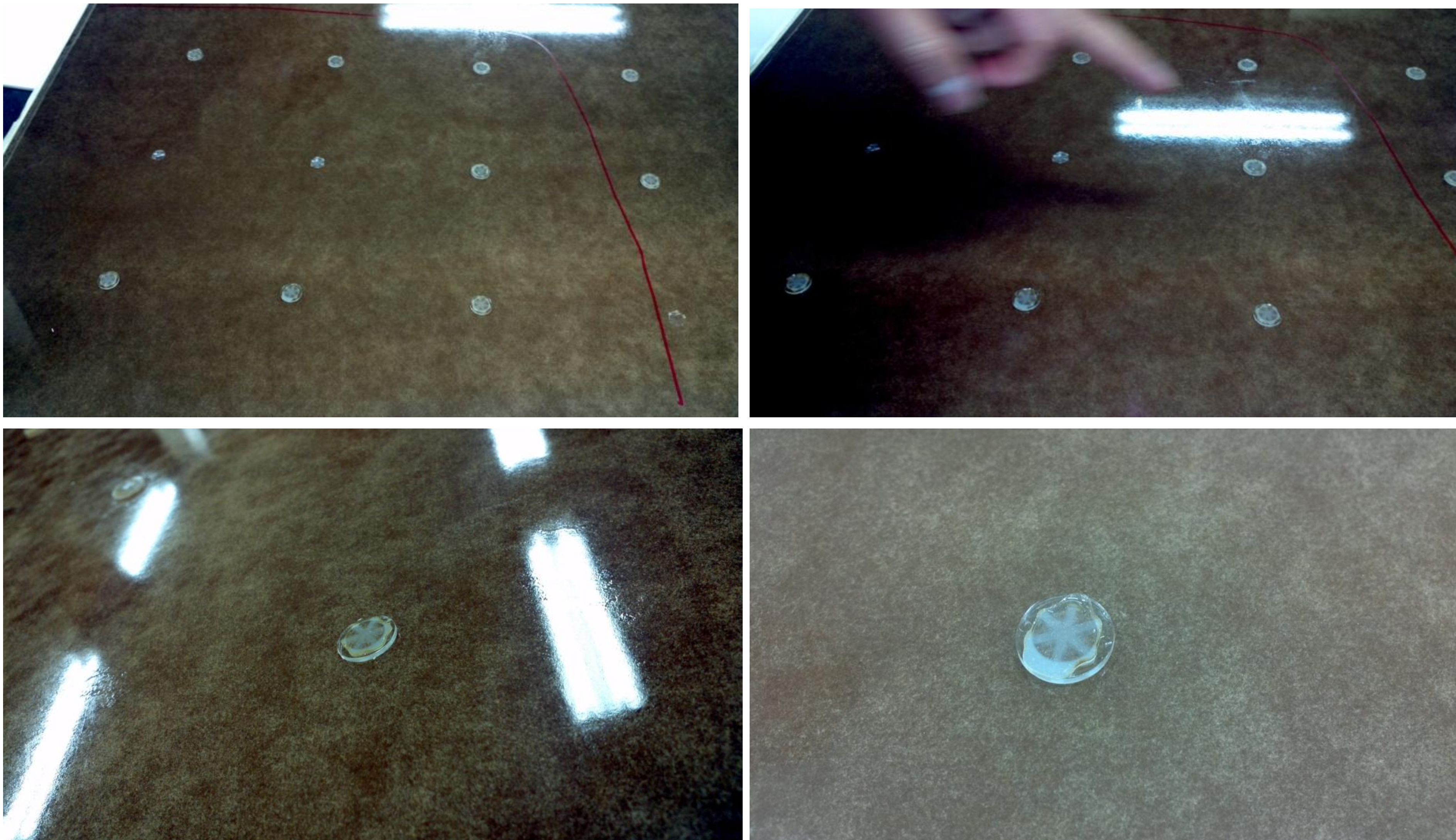
- We expect that the oil pattern could be nicely formed only when the oil/heptane is well attached on the phenol-covered surface of the HPL.

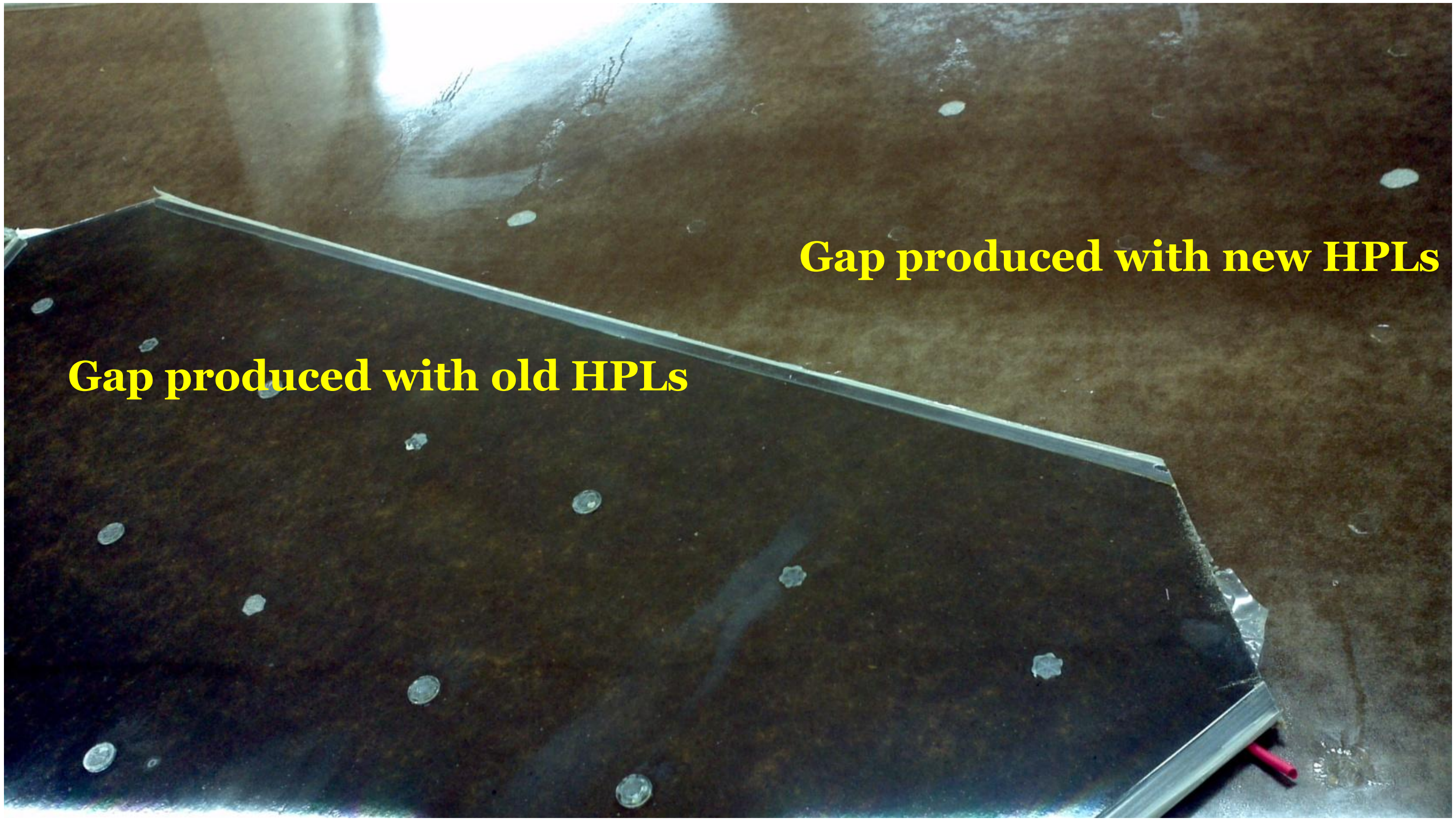
- Bad condensation of the oil could be due to two different factors
  1) Oil dirt (microscopically thin layer remained even after cleaned by IPA and thinner)
     (Still greasy even after cleaning by thinner & IPA)
  2) Poor condition of smeared phenol resin into the craft papers
     (The color is brighter and having white microscopic spots)

Bad oiled patterns especially on the places that the phenol was poorly smeared.



Good oiled patterns on the places that the phenol was relatively well smeared.



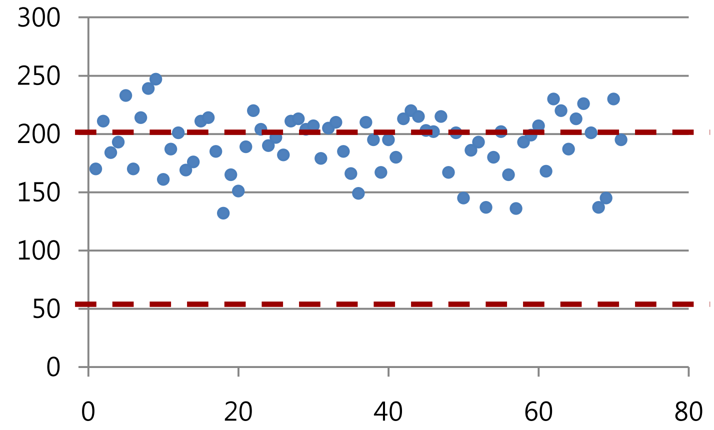

Gap produced with new HPLs
Gap produced with old HPLs


Gap produced with old HPLs


Gap produced with old HPLs

3. Silk data for RE4/2 test gaps

- Mean value of the graphite surface resistivity
  = 191.6 ± 26.0 (sigma) kΩ/square
  The desirable value lies bet. 50 ~ 200 kΩ/square
  The value seems to be ~ twice larger due to
  cold weather (the temperature ranged 10 ~ 15 °C)
  The temperature was NOT well controlled during
  the January shutdown period.



	A	B	C	D	E	F	G
1	Bakelite Code	Production Number	Production Batch		B	TN	TW
2	1A12E111019010399	399	12		170		
3	1B12E111019010400	400	12		211		
4	1C12E111019010401	401	12		184		
5	1D12E111019010402	402	12		193		
6	1E12E111019010403	403	12		233		
7	2A12E111019010404	404	12		170		
8	2B12E111019010405	405	12		214		
9	2C12E111019010406	406	12				
10	2D12E111019010407	407	12		239		
11	2E12E111019010408	408	12		247		
12	3A12E111019010409	409	12		161		
13	3B12E111019010410	410	12		187		
14	3C12E111019010411	411	12		201		
15	3D12E111019010412	412	12		169		
16	3E12E111019010413	413	12		176		
17	4A12E111019010414	414	12		211		
18	4B12E111019010415	415	12		214		
19	4C12E111019010416	416	12		185		
20	4D12E111019010417	417	12		132		
21	4E12E111019010418	418	12		165		
22	5A12E111019010419	419	12		151		
23	5B12E111019010420	420	12		189		
24	5C12E111019010421	421	12		220		
25	5D12E111019010422	422	12				
26	5E12E111019010423	423	12		204		

27	6A12E111019010424	424	12		190	167
28	6B12E111019010425	425	12		197	201
29	6C12E111019010426	426	12		182	145
30	6D12E111019010427	427	12		211	186
31	6E12E111019010428	428	12		213	
32	7A12E111019010429	429	12		204	193
33	7B12E111019010430	430	12		207	137
34	7C12E111019010431	431	12		179	180
35	7D12E111019010432	432	12		205	202
36	7E12E111019010433	433	12		210	165
37	8A12E111019010434	434	12		185	136
38	8B12E111019010435	435	12		166	193
39	8C12E111019010436	436	12		149	199
40	8D12E111019010437	437	12		210	207
41	8E12E111019010438	438	12		195	168
42	9A12E111019010439	439	12		167	230
43	9B12E111019010440	440	12		195	220
44	9C12E111019010441	441	12		180	187
45	9D12E111019010442	442	12		213	213
46	9E12E111019010443	443	12		220	226
47	0A12E111019010444	444	12		215	201
48	0B12E111019010445	445	12		203	137
49	0C12E111019010446	446	12		202	145
50	0D12E111019010447	447	12		215	230
51	0E12E111019010448	448	12			195

4. First HV data for RE4/2 test gaps

- The first HV test for 10 RE4/2 test bottom gaps was very successful.
- One gap was disconnected from HV cabling at somewhere -> drop it !
- All the rest 9 gaps were QC certified !
- At 6.0 kV, i ~ 0.2 μA for all the gaps
  At 10. 0kV, maximum i = 0.74 μA
  i(120h)/i(63h) < 1.0 for all the gap
- But we expected the currents of the test gaps should be much smaller than the normal gaps to be built with a right resistivity range ! (the resistivity of the HPLs in batch 12 is much higher)

4. HV tests

$$HV_0(293\,K, 1013\,hPa) = HV_{applied}\,\frac{1013\,hPa}{P}\,\frac{T}{293\,K}$$

Starting date of test		Feb. 07, 2012		Total gas rate = //h Circulation bfr HV = 26 h			Gas 0.95 Freon	Mixture 0.05 i-Bu
Time from test start	**Date/ Time**	***P* (hPa)**	***T* (°C)**	**$HV_{applied}$ (kV)**	**HV_0 (kV)**	**I_ini (μA)**	**I_final (μA)**	**H (%)**
0.0 h	Feb. 07, 2012 / 19:00	1021.5	18	1	0.98	0.01	0	23
0.5 h	19:30	1021.5	18	2	1.97	0.01	0.01	23
1.0 h	20:00	1021.5	18	3	2.95	0.01	0	23
1.5 h	20:30	1022.3	18	4	3.94	0.02	0.01	23
2.0 h	21:00	1023.3	18	5	4.92	0.02	0.02	23
2.5 h	21:30	1023.3	18	6.0 12 h test	5.9	0.02	0.02	23
14.5 h	Feb. 08, 2012 / 09:30	1022.8	17	7	6.86	0.02	0.02	24
15.0 h	10:00	1022.8	19	7.5	7.4	0.03	0.03	22
15.5 h	10:30	1022.8	20	8	7.92	0.03	0.03	21
16.0 h	11:00	1022.8	20	8.4	8.32	0.04	0.04	21
16.5 h	11:30	1022.9	20	8.6	8.52	0.04	0.04	21
17.0 h	12:00	1022.9	20	8.8	8.71	0.04	0.04	21
17.5 h	12:30	1022.4	20	9	8.92	0.05	0.05	21
18.0 h	13:00	1022.4	20	9.2	9.11	0.07	0.05	21
18.5 h	13:30	1021.4	20	9.4	9.32	0.08	0.07	21
19.0 h	14:00	1021.4	20	9.6	9.52	0.12	0.13	21
19.5 h	14:30	1020.8	20	9.8	9.72	0.18	0.22	21
20.0 h	15:00	1020.8	20	10	9.92	0.29	0.29	21
21.0 h	16:00	1020.8	20	9.6	9.53	0.13		21
24.0 h	19:00	1022.3	19		9.48	0.12		23
39.0 h	Feb. 09, 2012 / 10:00	1027.9	18		9.4	0.09		23
42.0 h	13:00	1026.1	20		9.48	0.09		21
45.0 h	16:00	1025.5	20		9.48	0.1		21
48.0 h	19:00	1024.9	19		9.46	0.09		22
63.0 h	Feb. 10, 2012 / 10:00	1027.5	18		9.4	0.08		24
			20		9.48	0.09		21
			20	96 h	9.49	0.09		23
			18	test	9.42	0.1	x	23
			17		9.34	0.08		24
			20		9.45	0.09		21
			20		9.46	0.07		21
			20		9.45	0.08		21
			17		9.32	0.07		24
			18		9.35	0.07		23
			18		9.37	0.07		23
			17		9.36	0.07		24
			18		9.35	0.06		23

QC decision								
Current Limits at 6.0 kV	RE4/2 TW	RE4/2 TN	RE4/2 BT	i(14.5h) at 6.0 kV		Final Decision	Certified	O
	1.5 μA	1.5 μA	1.5 μA	0.02				
	RE4/3 TW	RE4/3 TN	RE4/3 B					
	1.5 μA	1.5 μA	1.5 μA					
Current Limits at 10.0 kV	RE4/2 TW	RE4/2 TN	RE4/2 B	i(20h) at 10.0 kV				
	5.0 μA	5.0 μA	10.0 μA	0.29				
	RE4/3 TW	RE4/3 TN	RE4/3 B					
	5.0 μA	5.0 μA	10.0 μA					
Current Limits at 9.6 kV at t = 120 h	RE4/2 TW	RE4/2 TN	RE4/2 B	i(63h)	0.08		Not certified	
	2.0 μA	2.0 μA	3.5 μA	i(120h)	0.06			
	RE4/3 TW	RE4/3 TN	RE4/3 B	Criterion i(120h)/i(63h) < 1.5				
	2.0 μA	3.5 μA	5.0 μA	0.75				

Set at 10.0 kV at *t* = 20.0 h, and at 9.6 kV from 21 to 120 h for the long-term test.