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Tracker Thermal Control System

AMS-TTCS Status Report

AMS-TIM meeting, CERN, Feb 4th, 2009

ZH He

On behalf of **SYSU** team:

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Outline

- TTCS Accumulator Status
- Preheater Status
- QM condenser test
- Documents finished



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Accumulator Status

- FM1 & QM arrived AIDC
- FM2 is at Thermocoax for heater connector replacement, to be finished this tomorrow, and brought back by Johannes to AIDC
- Pressure Test report and weld certificate signed by CAST are needed



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Preheater Status

- Preheaters for FM1 and FM2 are ready at AIDC
- Preheaters for QM still under resoldering. (by the end of Feb.)



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TTCS QM Condenser Test

the first test of condenser with Inconel tubes

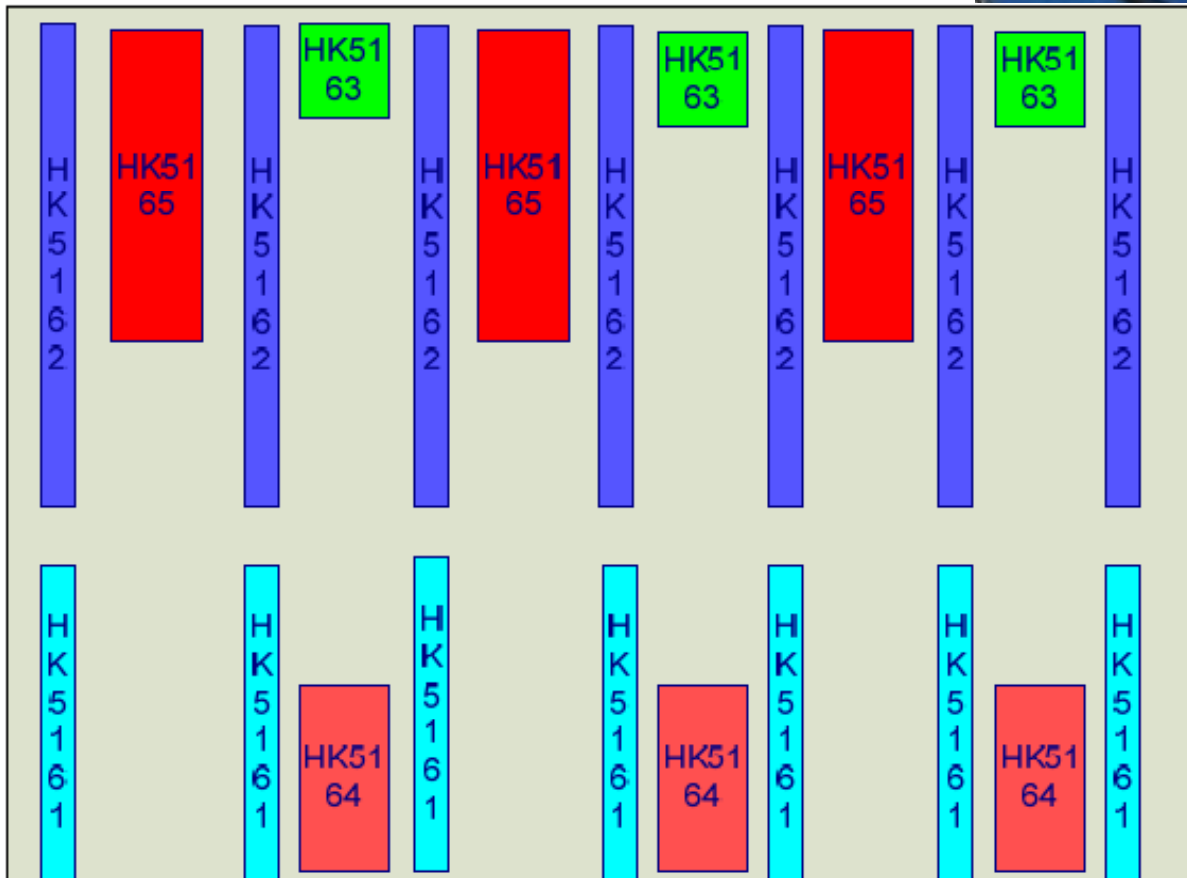
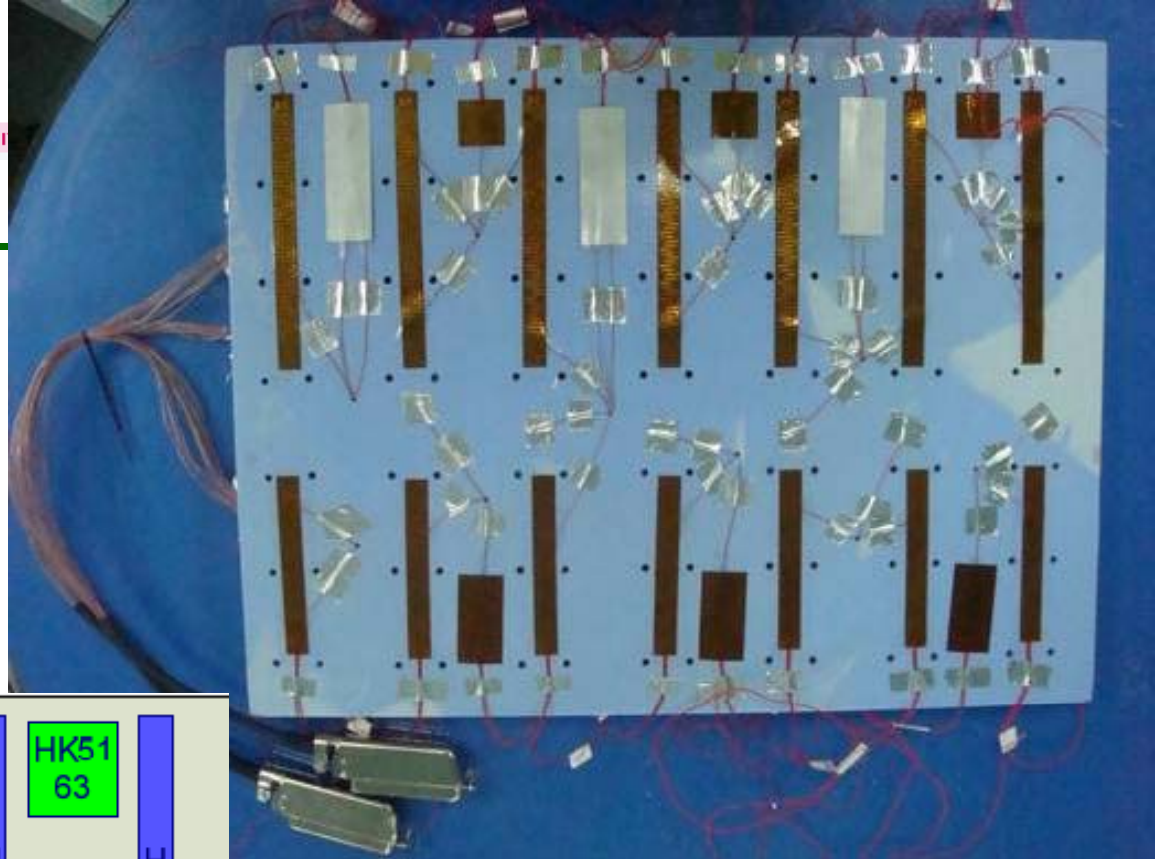
- QM condenser acceptance test
- Preparation for the QM condenser functional test
- QM condenser Functional tests
 - Phase I: conductance test with heaters on a silicon gel plate
 - Phase II: conductance test with cold plate
 - Phase III: thermal cycling with cold plate
 - Phase IV: conductance test again with cold plate
 - Phase V: conductance test again with silicon gel plate
 - Phase VI: defreezing test



**Functional Test Preparation:
Thermally insulated**



Heater and thermal couple distribution



Corresponding delta T Before thermal cycling	Corresponding delta T after thermal cycling	Difference	Corresponding delta T Before thermal cycling	Corresponding delta T after thermal cycling	Difference
2.3	2.1	-0.2	3.4	3.1	-0.3
1.5	1.3	-0.3	2.6	2.0	-0.6
1.5	1.4	-0.1	2.7	2.1	-0.6
-0.1	-0.2	-0.1	-0.2	-0.3	-0.1
4.2	3.6	-0.6	7.3	5.8	-1.5
9.1	8.4	-0.7	13.7	12.3	-1.4
1.4	1.6	0.3	2.2	2.6	0.4
1.4	1.5	0.0	3.0	2.7	-0.3
-0.1	-0.1	0.0	0.0	0.0	0.0
4.1	3.8	-0.3	8.0	6.7	-1.3
3.3	3.4	0.1	4.9	5.2	0.3
1.6	1.7	0.1	3.7	3.7	0.0
1.3	1.2	-0.1	2.6	2.4	-0.2
0.0	0.0	0.0	0.1	0.1	0.0
3.5	2.9	-0.6	6.0	4.5	-1.5
8.6	8.4	-0.3	14.1	12.6	-1.5
1.6	1.2	-0.4	3.7	2.3	-1.5
1.4	1.5	0.1	2.8	2.7	-0.1
-0.1	-0.1	0.1	-0.3	-0.2	0.2
4.5	4.0	-0.5	6.6	5.9	-0.7
3.9	3.4	-0.5	5.7	4.9	-0.8
1.6	1.3	-0.2	3.7	3.2	-0.6
1.4	1.0	-0.4	2.2	1.5	-0.7
0.0	0.0	0.0	0.1	0.1	0.1
4.6	4.5	0.0	7.7	6.7	-1.0
9.1	9.1	0.0	14.8	13.6	-1.2

Temperature differences are small before and after thermal cycling



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Summary

- No glue rupture happened during the thermal cycling
 - 1% of glue rapture (glue torn off) will lead to 2K temperature difference increase; which is not observed in the test
 - the difference of delta T between the bottom and the top plate is rather unobvious and even negative in many districts



Thermal conductance before and after thermal cycling

Thermal conductance before thermal cycling

Case	Tset/C	T2f/C	T_cold-plate/C	P	K
Case1	15	15.8	19.0	204.2	63.8
Case2	15	15.7	18.1	153.8	64.1
Case3	-20	-18.3	-14.7	204.2	56.7
Case4	-20	-18.4	-15.8	153.5	59.0

Thermal conductance after thermal cycling

Case	Tset/C	T2f/C	T_cold-plate/C	P	K
Case1	15	15.8	18.7	203.9	69.0
Case2	15	15.7	17.8	152.7	70.7
Case3	-20	-18.3	-14.9	204.2	59.6
Case4	-20	-18.5	-15.9	152.2	59.9



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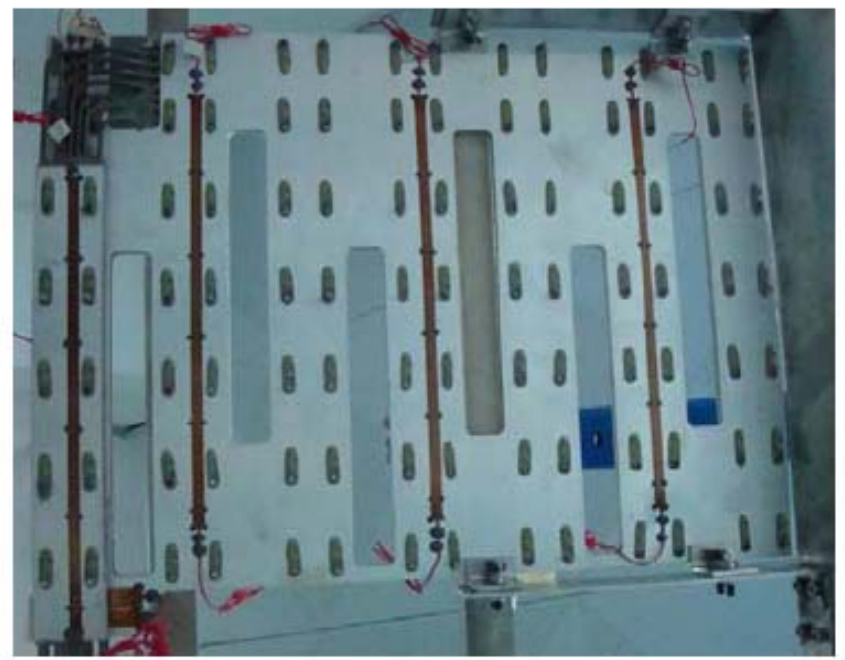
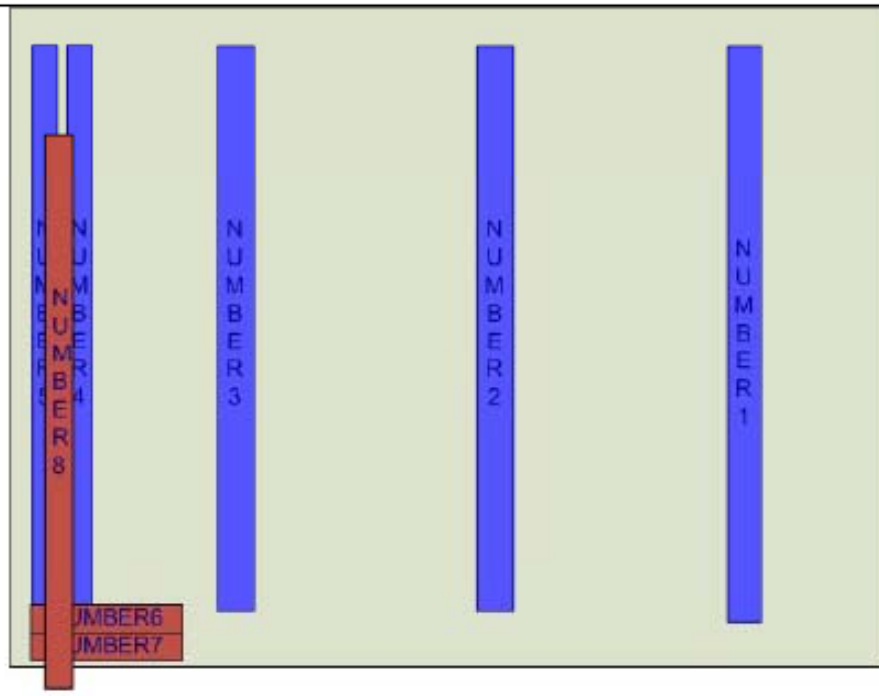
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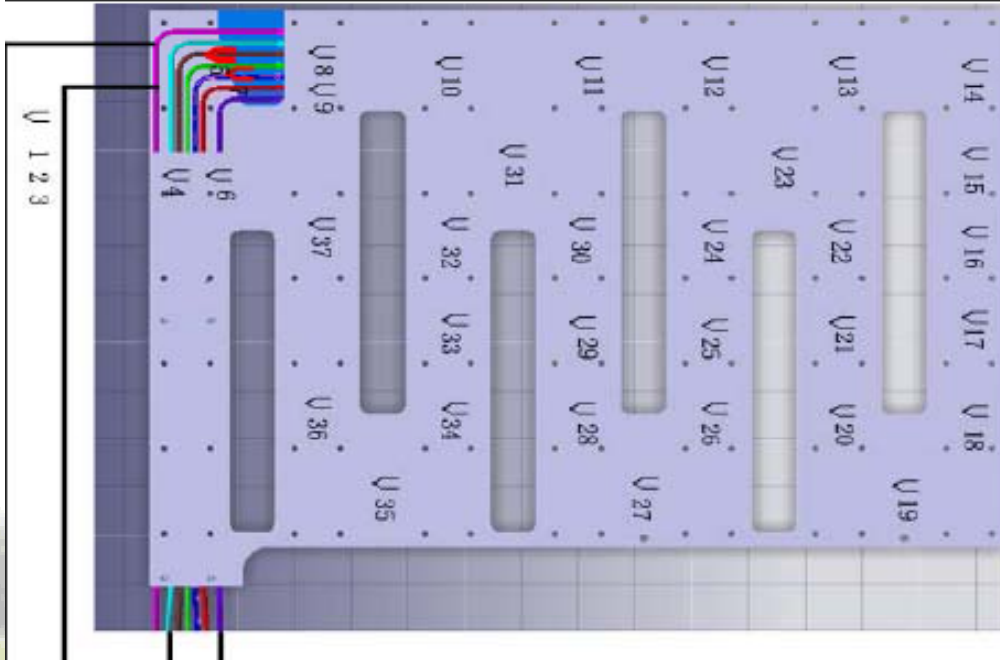
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Summary

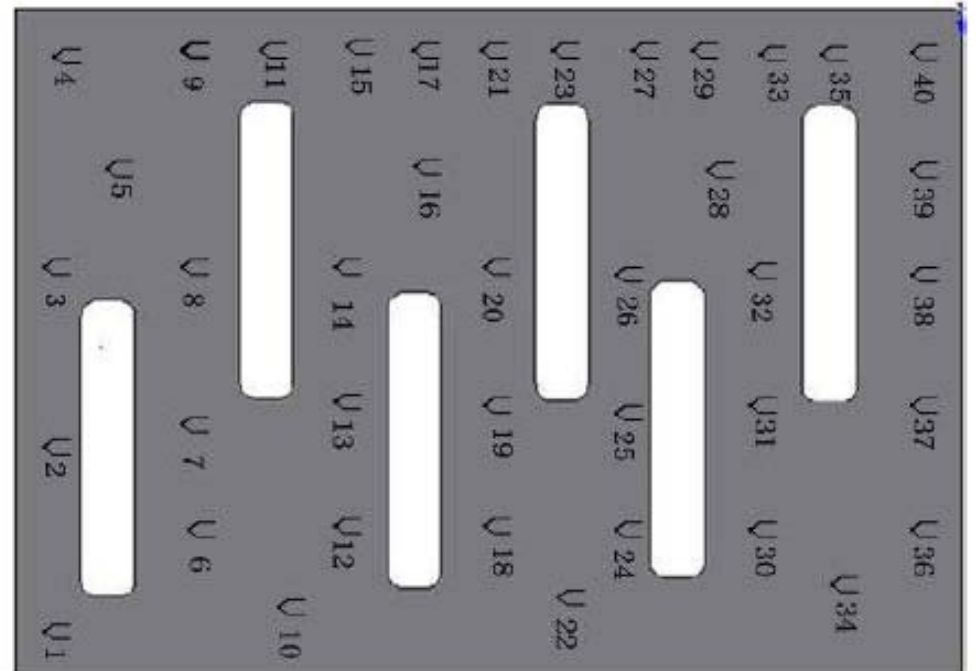
- Glue performance is sustained after thermal cycling
 - The thermal conductance after thermal cycling doesn't change notably, and even a little higher than that before cycling.



Foil heater on QM condenser top-plate



Thermal couples distribution on QM condenser top-plate and silicongel





top-plate heater test

Temperatures of The top-plate and The Silcongel

Total power: 100W
FR: 2g/s
(for one condenser)

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Condenser	T condenser	Silicongel T	T silicongel	Delta T
top-plate T number	(°C)	number	(°C)	
4	-18.0	3	-17.0	-1.0
8	-17.2	9	-17.2	0.0
9	-16.3			0.9
10	-17.7	15	-18.2	0.5
11	-17.1	21	-18.2	1.1
12	-17.9	27	-18.5	0.6
13	-17.2	33	-18.4	1.2
14	-18.2	40	-18.8	0.6
15	-18.4	39	-18.8	0.4
16	-18.5	38	-18.9	0.4
17	-18.5	37	-18.9	0.4
18	-18.3	36	-18.7	0.4
19	-17.2	34	-18.3	1.1
20	-13.7	30	-17.6	3.9
21	-13.4	31	-17.4	4.0
22	-13.5	32	-17.5	4.0
23	-17	28	-18.2	1.2
24	-18	26	-18.6	0.6
25	-18.6	25	-18.7	0.1
26	-18.4	24	-18.6	0.2
27	-17.4	22	-18.1	0.5
28	-13.9	18	-17.7	3.8
29	-13.2	19	-17.4	4.2
30	-13.6	20	-17.4	3.8
31	-16.9	16	-18.1	1.2



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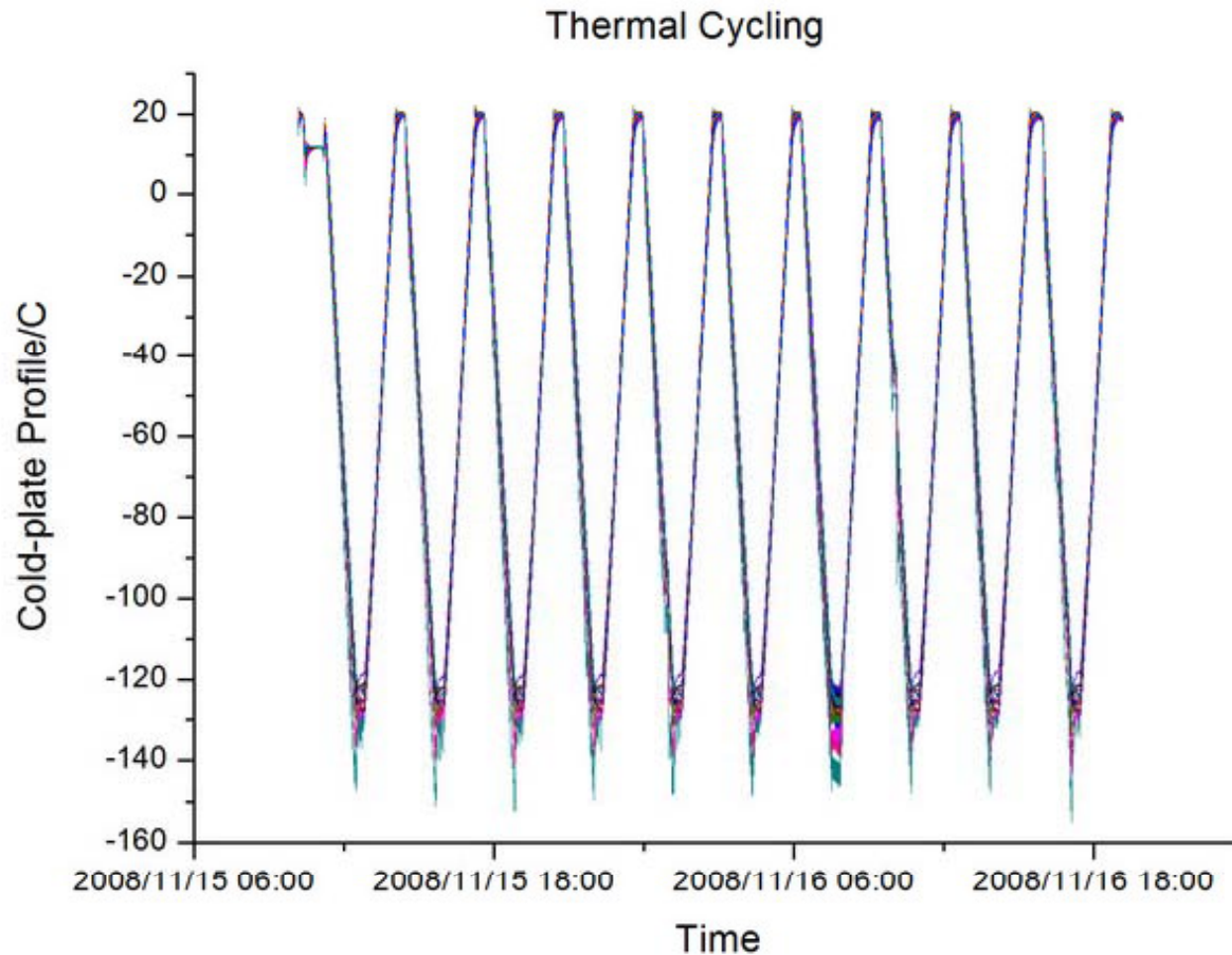
Top-plate heater test Summary

- Glue between the tubes and the QM condenser top-plate exhibit a good thermal performance
 - the temperature difference between condenser the top-plate and the bottom-plate is small and the temperature on silicongel corresponding to the heater position is much higher than the flowing two-phase CO₂



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Thermal Cycling and Defreezing Test

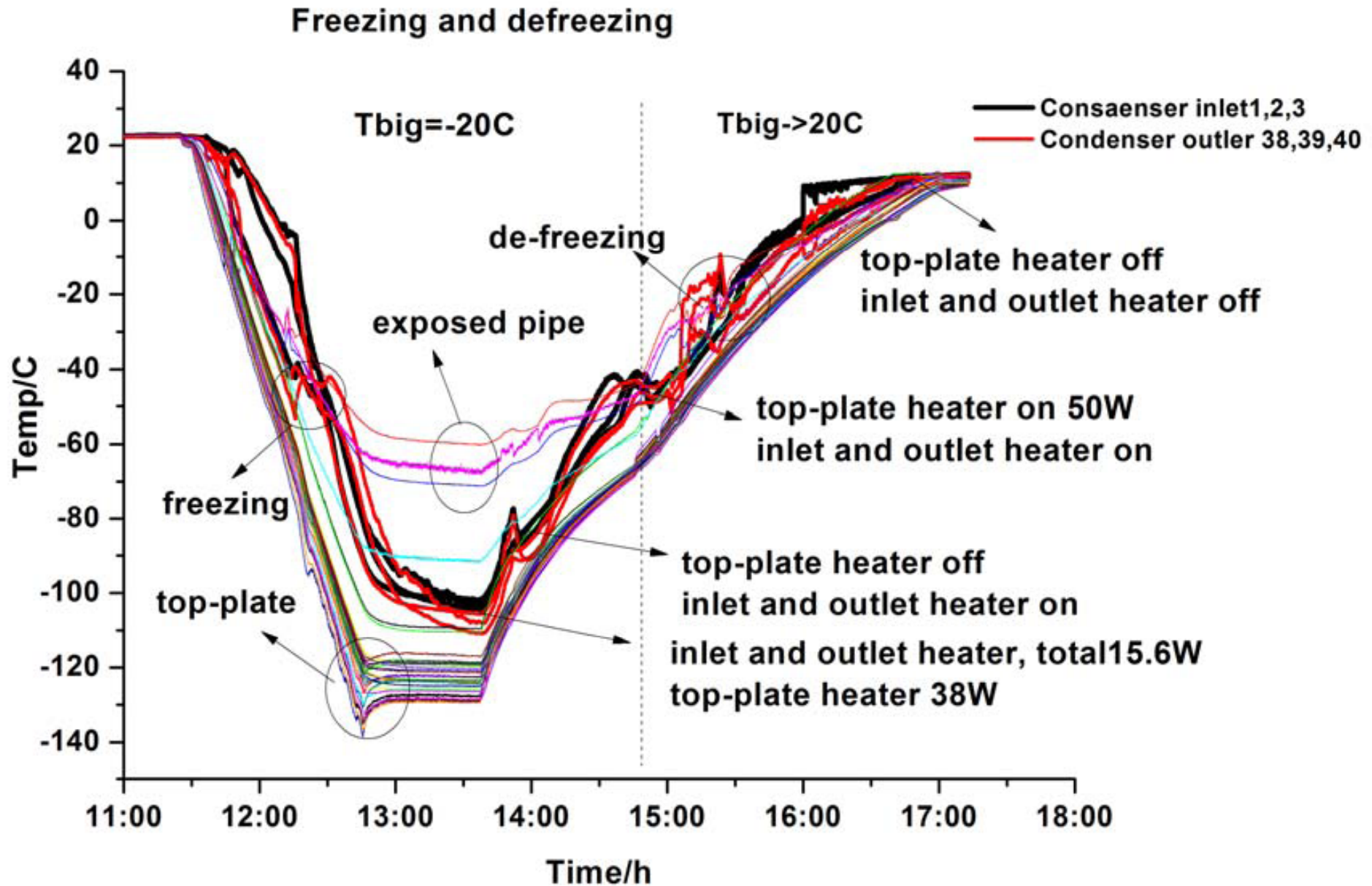




Successful De-freezing Test

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Freezing and de-freezing temperature profile





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De-freezing Test Summary

- The condenser survive after freezing and de-freezing process.
 - the CO₂ melts in the inlet and outlet tubes well before it does inside the condenser tubes.
 - the expansion of the melted CO₂ does not encounter obstacles and the pressure inside the condenser tube is under the safety threshold



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Documents Finished since last TIM

Title	DOC.#	Date	Prepared by
TTCS EM INTEGRATION DESCRIPTION	TTCS-SYSU-TEST-TN-002-1.0	2009-1-4	W.J.Xiao / Z.H. He
TTCS EM primary and secondary 3D integration description	TTCS-SYSU-TEST-TN-005-1.0	2009-1-4	Xihui.Sun
TTCS QM CONDENSER PERFORMANCE TEST REPORT	TTCS-SYSU-TEST-TRP-011-1.0	2008-12-10	Z.Zhang/ZL.Weng
ACCUMULATOR STRUCTURE ANALYSIS	TTCS-SYSU-MECH-AN-004-3.0	2008-12-17	Y.Y.Zhang Y.Chen Y.C.Zhang
TTCB-Structural-Analysis	TTCS-SYSU-MECH-AN-009-3.0	2008-10-27	Y.Y.Zhang Y.C.Zhang Y.Chen
TTCB-Structural-Analysis	TTCS-SYSU-MECH-AN-009-4.0	2008-12-12	Y.Y.Zhang Y.C.Zhang



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Thank you!