Thermal Test of Prototype Electromagnetic Calorimeter for Gep5 Experiment Completed

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Outline

Test run of ECal 16 channels in 2015

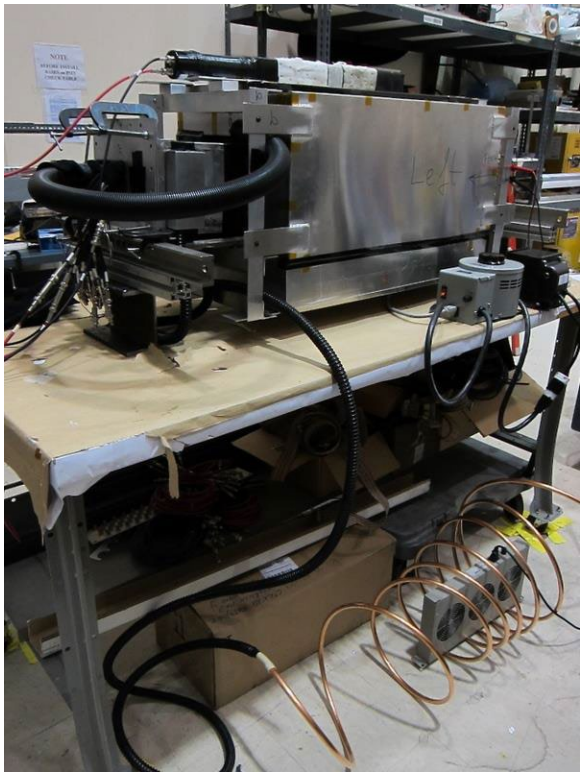
First thermal test of ECal prototype

Second thermal test of ECal prototype

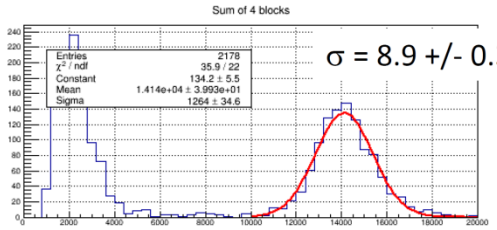
Test of cooling system of prototype

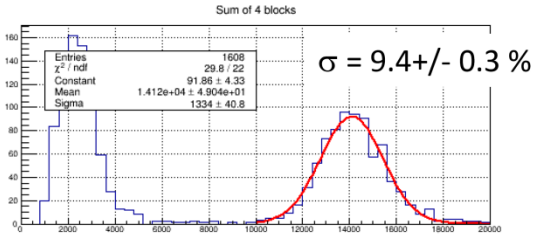
16 Channel Test Run

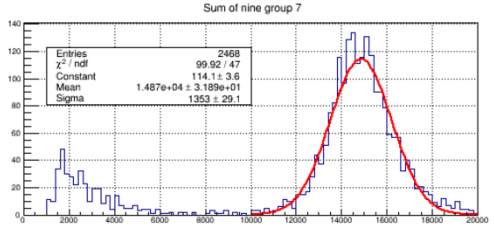
- Test run done in 2015.
- Required temperature setting at the front and back of lead glass blocks were determined (225℃ at the front, 185℃ at the back).
- Annealing at these temperatures keeps resolution nearly constant.

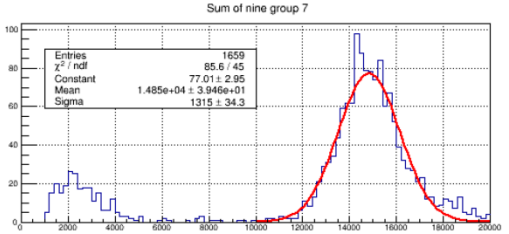


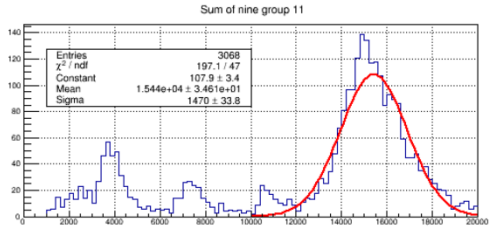
Cool air blows in back to cool PMT

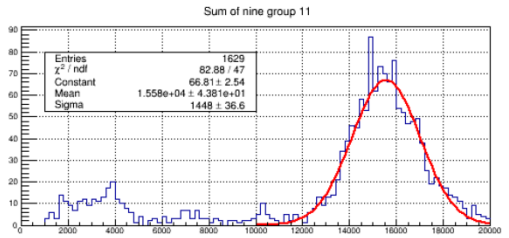










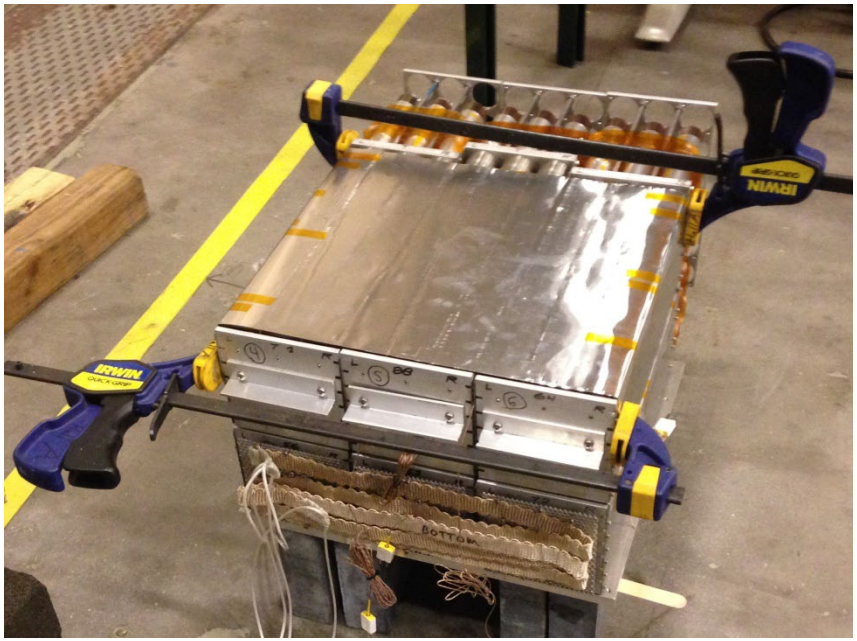


First ECal prototype test

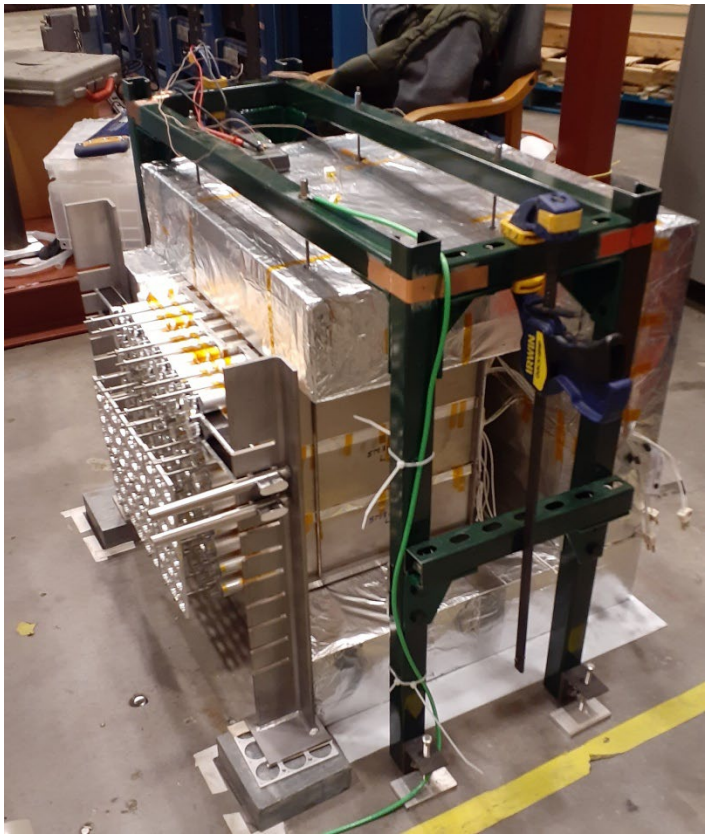
Prototype consists of 9 SM-s

1 heating tape attached to 3 SM-s

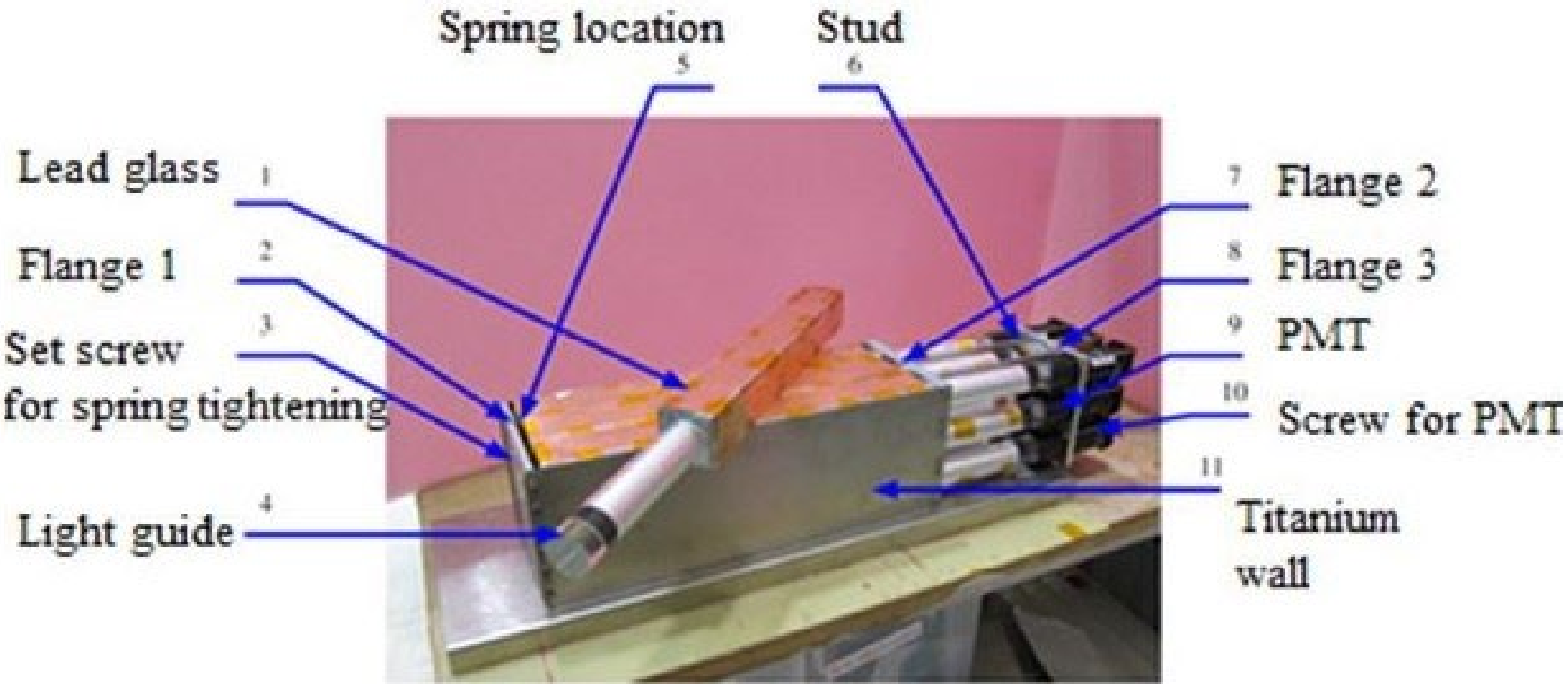
Heater power 830 W at 120 V



Prototype with foam-glass

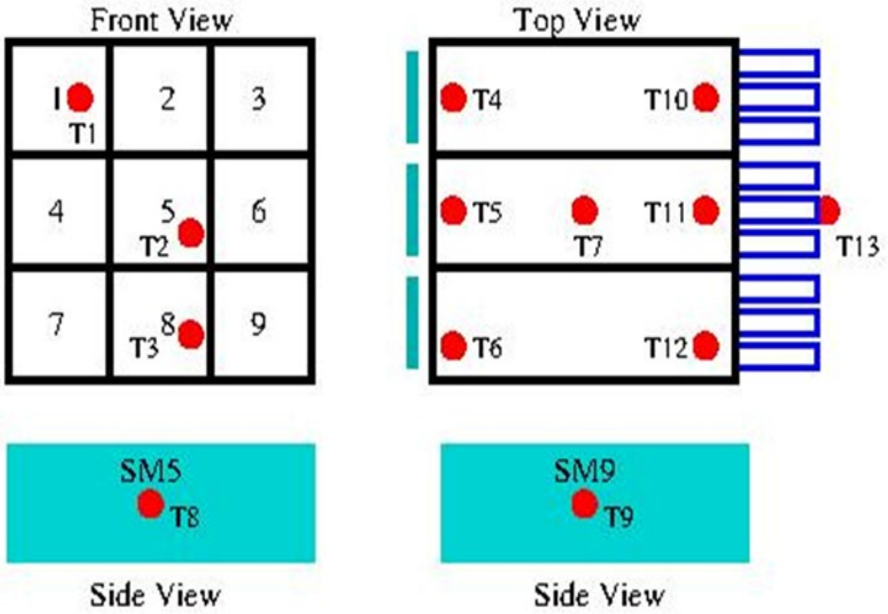


ECal SuperModule



ECal prototype test setup
Schematic view

Front and side view



Thermocouple position

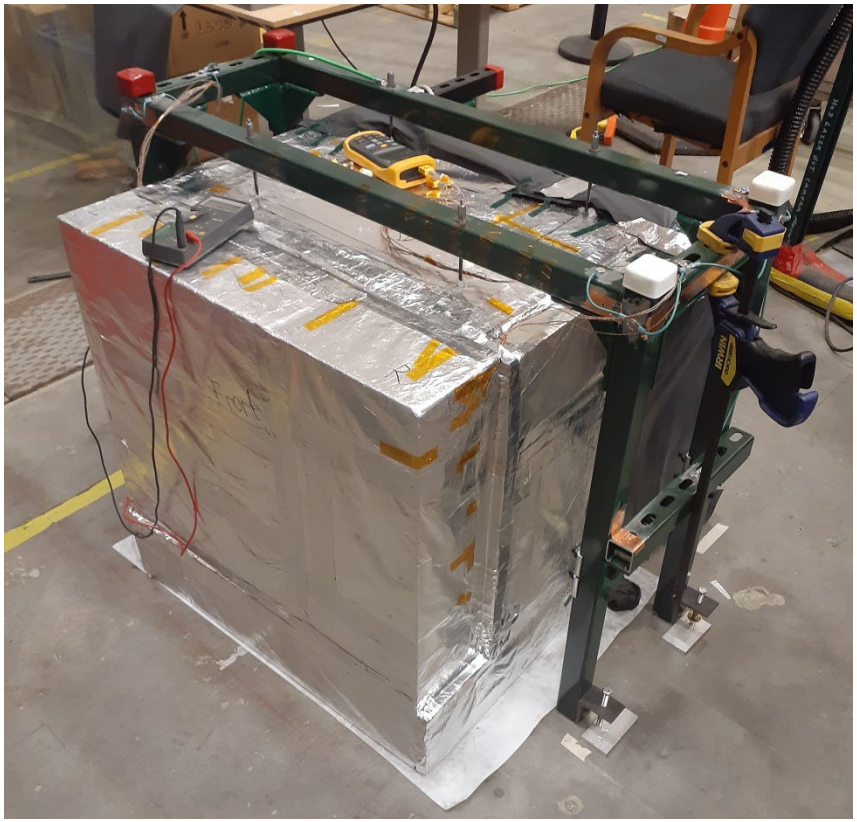
- ***T1 – on flange 1***
- ***T2 – on flange 5***
- ***T3 – on flange 8***
- ***T4,5,6 – on LG front***
- ***T7,8,9 – on LG middle***
- ***T10,11,12 - on LG back***
- ***T13-on Light guide***

First test results

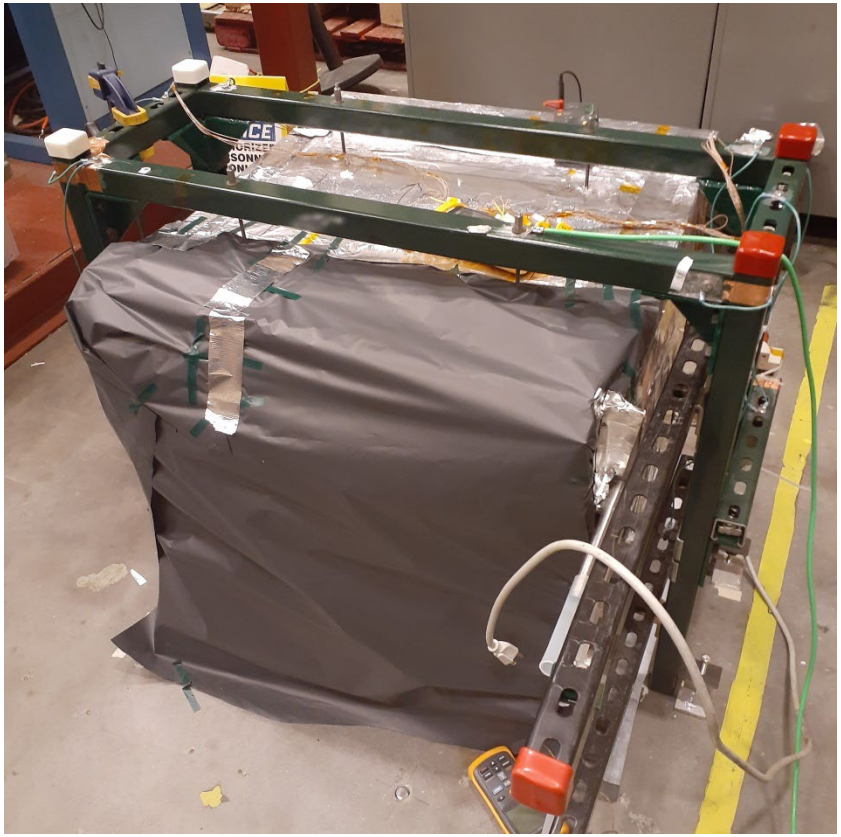
- All heaters were fed from variable transformers
- Heaters were attached to the front of SM-s, via perforated Al
- The perforated Al was attached to the front flange via ¼” thick Al bar
- At ~185 ℃ on the back of the lead glass block, temp. at the front of the lead glass block reached 250 ℃.
- At these conditions, temp. of the front flange was 360 ℃.
- Voltage at heaters was 57 V (total power 560 W).
- Temp-s of light guides reached 70 ℃.
- Results are not satisfactory, decided to conduct another test.

ECal Prototype

Prototype covered with foam-glass
Front view



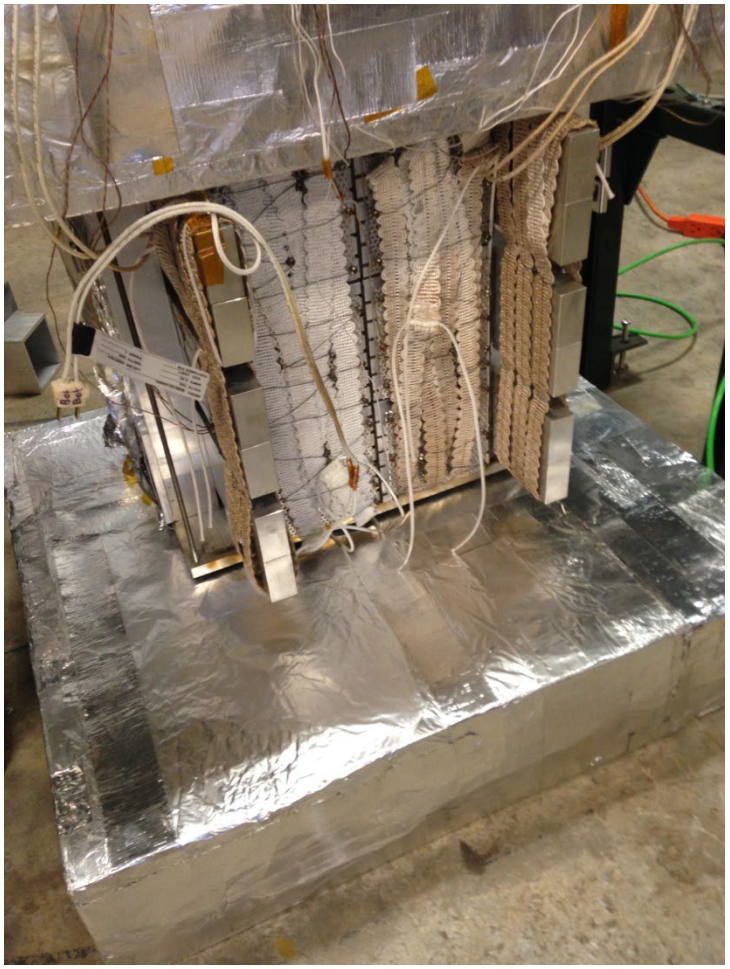
Prototype covered with foam-glass
Back view

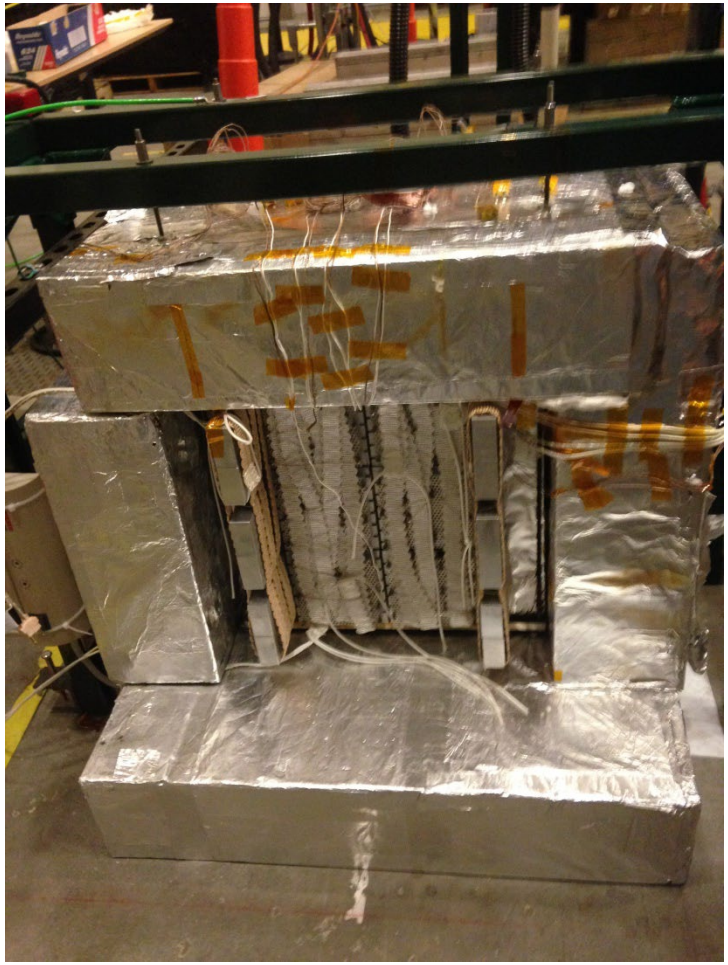


Objectives of the 2-nd test

- After data analysis of the 1-st test, in order to achieve boundary temp-s 225℃ and 185 ℃ it was decided to heat blocks from sides as well.
- For the side heating, bars of high thermo-conductivity Al of 6063 type, of 1”x2” cross section, of lead glass block + 4” length were used.
- 2-nd prototype consisted of 6 SM-s.
- Against sides of SM-s 2 Al bars and 1” spacer was pressed.

ECal prototype second test setup

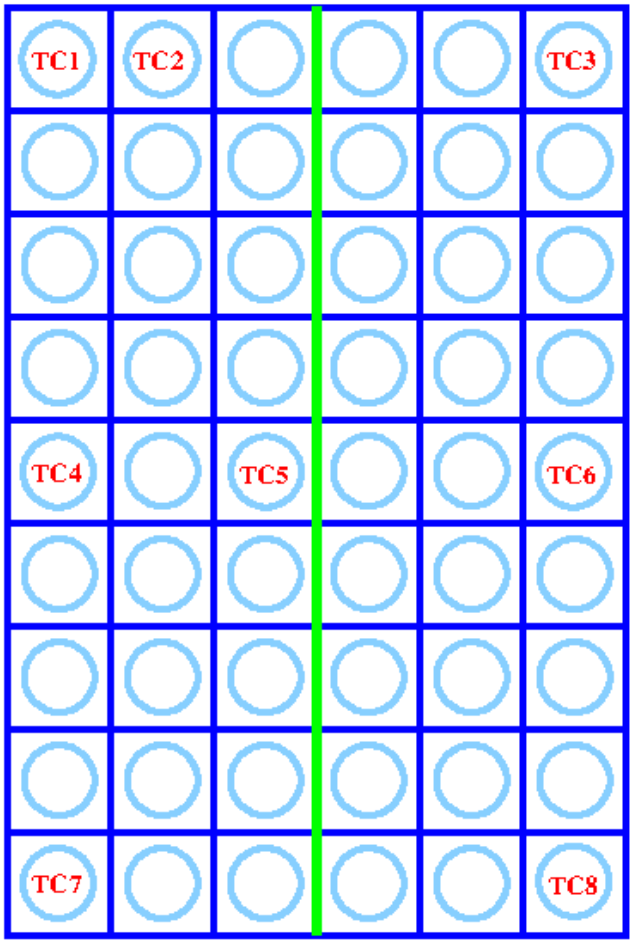




2-nd Test Results

- Achieved 250 ℃ at the front flange of SM
- At the front of lead glass block ~225 ℃
- At the back of lead glass block ~185 ℃
- At the end tip of the light guide ~70 ℃
- Heater voltage was 45 V, total power output 465 W
- Light guide cooling is needed.

Prototype Cooling System

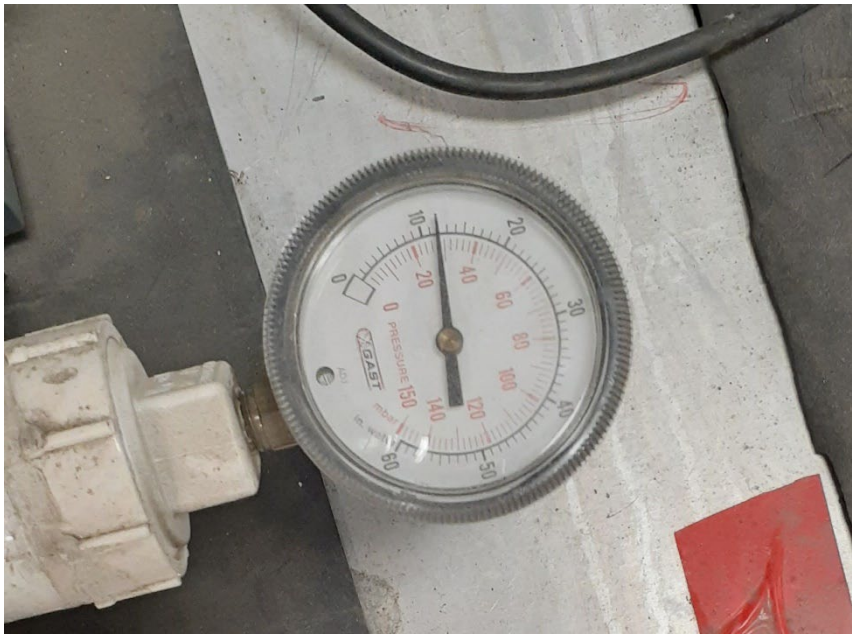


- Install 8 thermocouples
- Blower off max temperature was 70 degree C
- Blower off transformer output 45 V
- Blower on max temperature was 35 degree C
- Blower on transformer output 48 V

Thermocouple position on the light guide

Cooling system setup

Pressure of the blower 12” water



Conclusion

First Test

- Front flange temperature 360 degree C
- Front lead glass block temperature 250 degree C
- Back lead glass block temperature 180 degree C
- Light guide temperature 70 degree C
- Transformer output 57 V

Second test

- Front flange temperature 250 degree C
- Front lead glass block temperature 220 degree C
- Back lead glass block temperature 187 degree C
- Light guide max temperature 35 degree C with blower on
- Transformer output 48 V
- Necessary power for 1 SM is 90 W

Thanks Iuliia