COMPARISON TEST REPORT

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Content:

1. Problem description

The purpose of Test was a comparison of features and performances of two models of the convective cooling cells ***QualiCell*** and ***Apogee GTZ*** as competitors in PC processor cooling systems.

Specification for Comparison Test

1. Two Cooling cells should be compared: QualiCell and Apogee GTZ.
2. At comparison the starting conditions for each cell should be the same for any test.
3. The imitation of PC processor should be provided due to heated copper rectangular plate – the Thermal Plate (TP).
4. The following parameters have to be controlled:
   - Ambient temperature
   - Temperature of water in the entrance of cell

- Temperature of water in the exit of cell
- Temperature of Thermal Plate in the thermo-dynamical equilibrium (stationary values)
- Heat power that is transferring through Thermal Plate in the thermo-dynamical equilibrium
- Water discharge through cell in the thermo-dynamical equilibrium

5. All cells have to be clasped to Thermal Plate under the same pressure and the same greasing paste should be used
6. For each Cooling cell the following measurements should be done:
   - For ***given*** discharge of water and ***given*** Heating power the evolution of the temperature of Thermal Plate should be monitored during the period that is equal to 5 times of the
   - time, which is needed to reach of 95% of the temperature in the thermo-dynamical equilibrium
   - For ***given*** discharge of water the said evolutions of Thermal Plate's temperature should be obtained for, at least, **4 Heating powers** into the interval of values [100W, 400W] (preferably, equally distanced values)
   - For each tested cell said evolutions of Thermal Plate's temperature should be obtained for, at least, **5 discharges of water through tested cell** into the interval of values [0.5 Gallons/min, 3.5 Gallons/min] (preferably, equally distanced values)

2. Testing Stand

The main element of Testing Stand is a 5”x5” pure (99.9%) copper cube that is shown in Fig. 1.

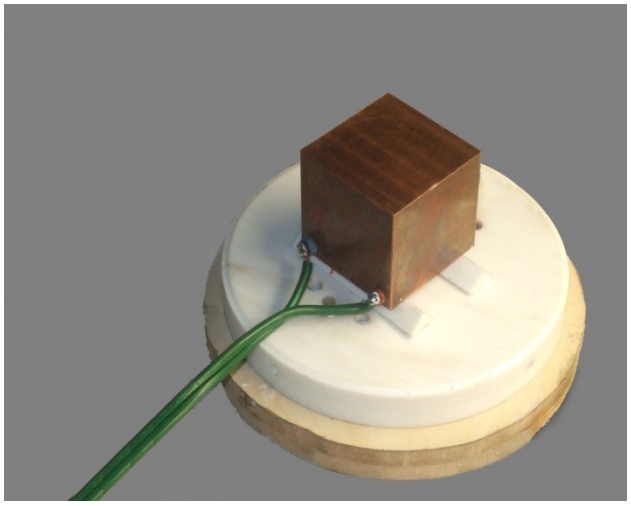

Fig. 1. Copper cube with hitting spiral inside its bottom part.

The heating element (see Fig. 2) is pressed and sealed on the bottom of this cube so that heating spiral can be connected with source of an electric current.

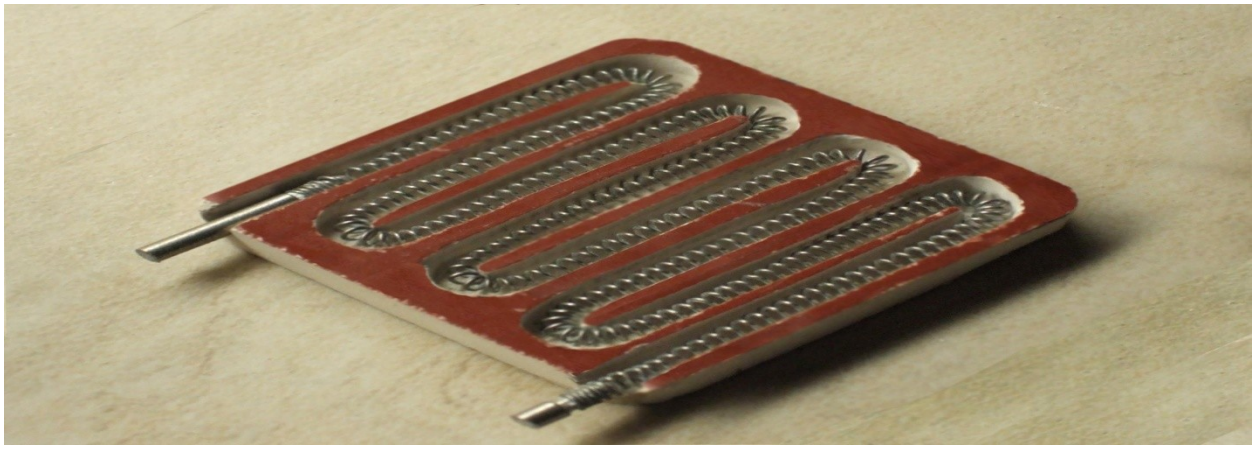

Fig. 2. Heating element before pressing (with fulfilling with a quartz sand) and sealing it into a sleet into the copper cube)

After sealing heater inside the copper cube, it was covered with thermo-insulating materials together with four attachment bolts or holes, as it is shown in Fig. 3a and 3b, correspondingly.
This made imitator of heating PC processor accomplished with well-fixed polished Thermal Plate (TP) ready to be covered by the tested Cooling Cell.

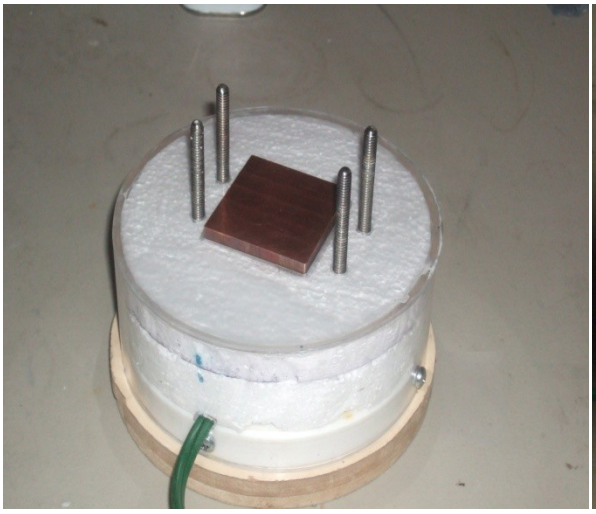

Fig. 3a. PC processor imitator with attachment bolts.

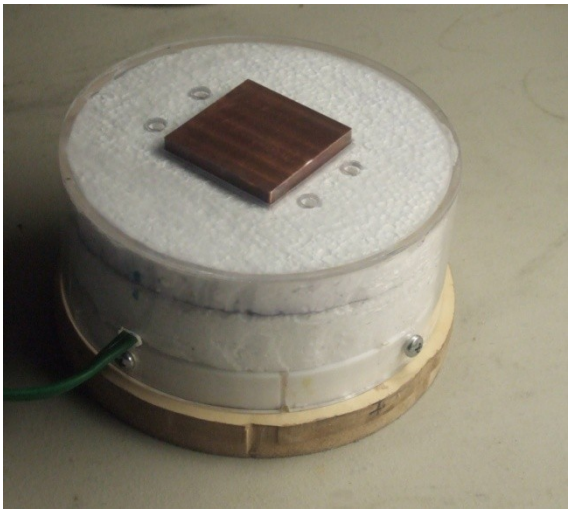

Fig. 3b. PC processor imitator with attachment holes.

3. Testing Procedure

The Thermal Plate (TP) – the top surface of the copper cube seen in Fig. 1-3 – was covered by the tested Cooling Cell and reliably was pressed to the TP due to four attachment screws. The same standard greasing paste was used in each test.

Such set was incorporated in the standard water flowing opened circle and all procedures, which are mentioned in *Specification for Comparison Test*, were applied.

The typical evolution of temperature on TP is shown in Fig. 5.

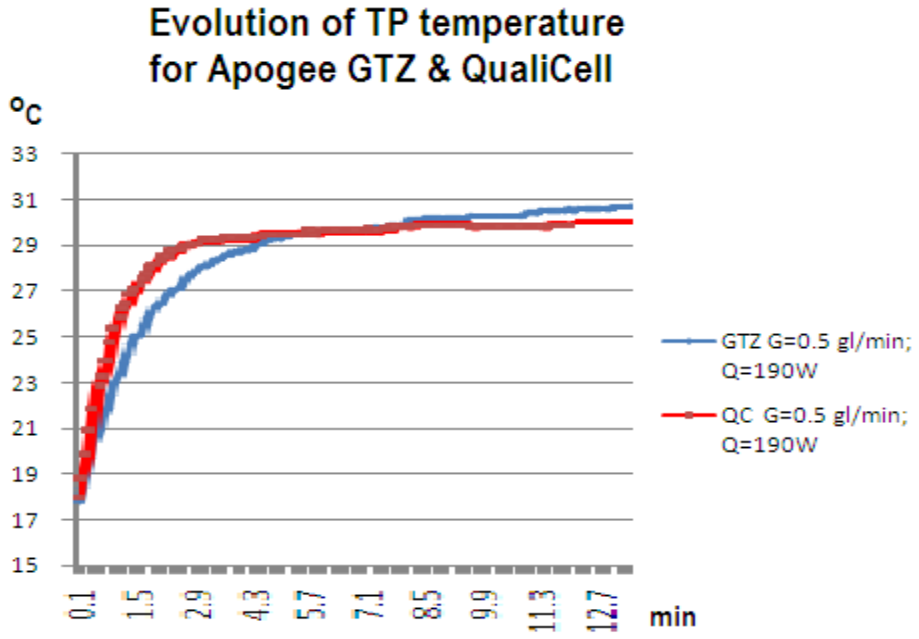

Fig. 5. Development of temperature of TP after instant turning on of heater for a given electric power.

4. Test results

The major results of the conducted test are the following.

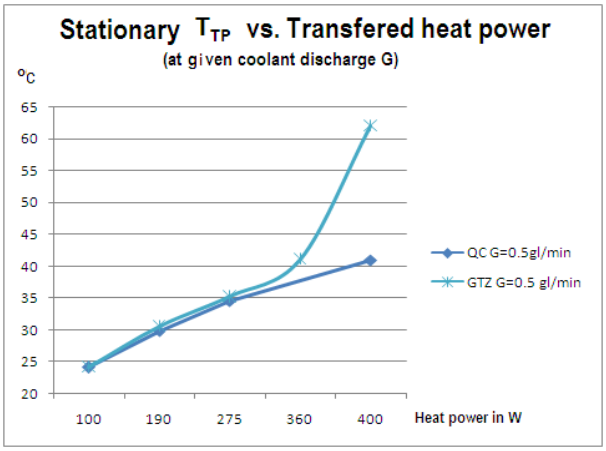

Fig. 6a.

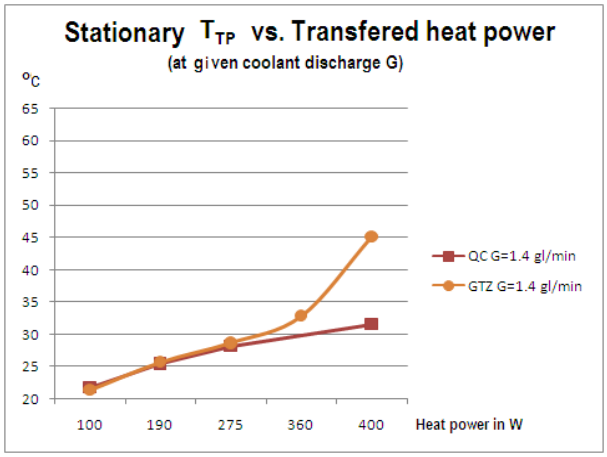

Fig. 6b.

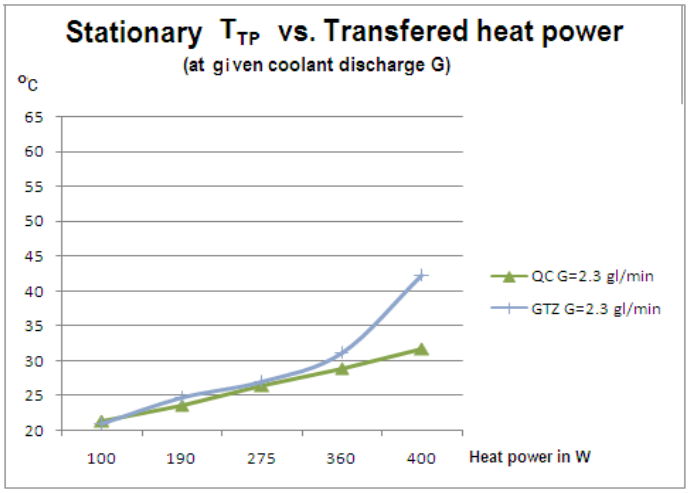

Fig. 6c.

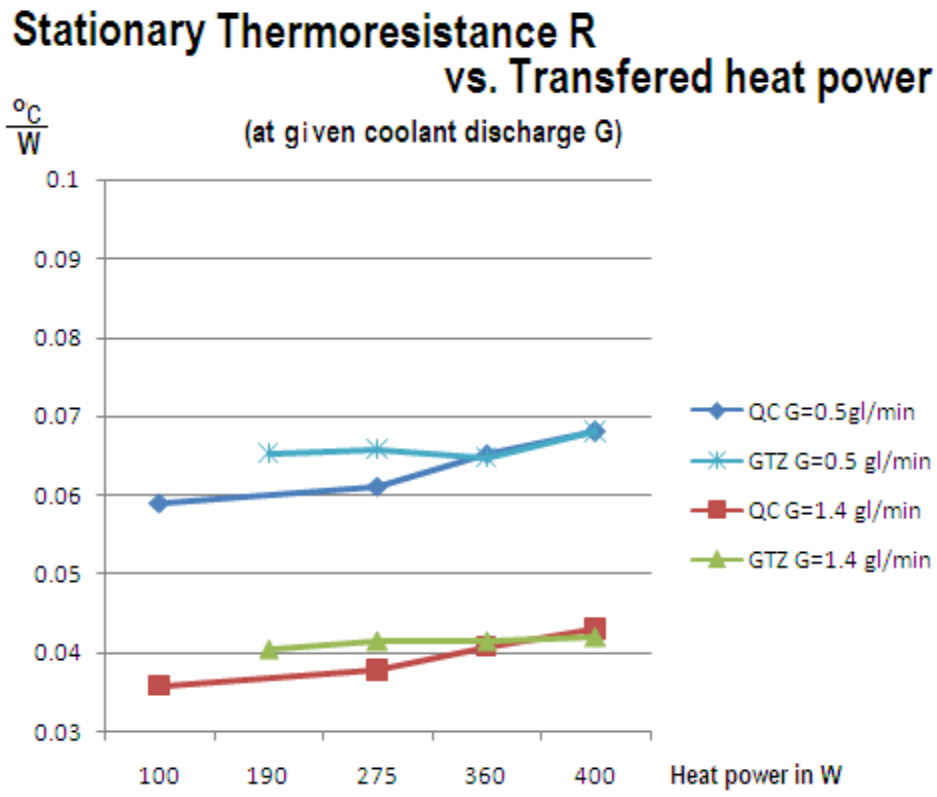
Stationary Thermoresistance R
vs. Transfered heat power
°C/W
(at given coolant discharge G)
0.1
0.09
0.08
0.07
0.06
0.05
0.04
0.03
100
190
275
360
400
Heat power in W
QC G=0.5gl/min
GTZ G=0.5 gl/min
QC G=1.4 gl/min
GTZ G=1.4 gl/min

Fig. 7.

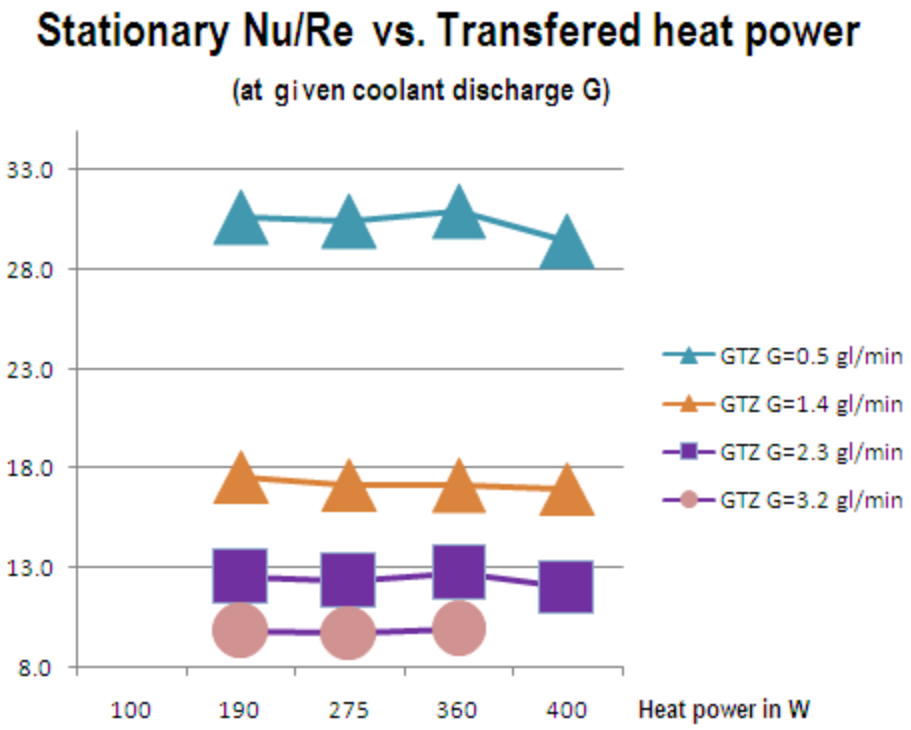
Stationary Nu/Re vs. Transfered heat power
(at given coolant discharge G)
33.0
28.0
23.0
18.0
13.0
8.0
100
190
275
360
400
Heat power in W
GTZ G=0.5 gl/min
GTZ G=1.4 gl/min
GTZ G=2.3 gl/min
GTZ G=3.2 gl/min

Fig. 8a.

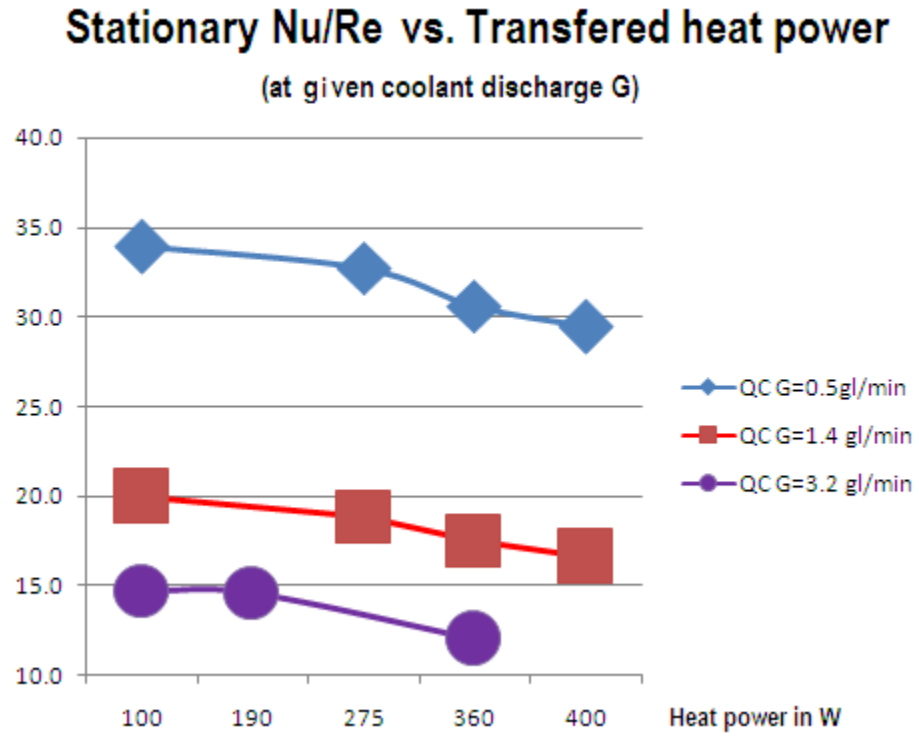
Stationary Nu/Re vs. Transfered heat power
(at given coolant discharge G)
40.0
35.0
30.0
25.0
20.0
15.0
10.0
100
190
275
360
400
Heat power in W
QC G=0.5gl/min
QC G=1.4 gl/min
QC G=3.2 gl/min

Fig. 8b.

5. Conclusions

- As Figures 6 shown, *QualiCell* reveals better cooling effect than *Apogee GTZ*, and advantage of *QualiCell* becomes more significant at larger heating powers.
- As Figure 7 shows, *QualiCell* reveals lesser thermal resistance than *Apogee GTZ* does, but this advantage of *QualiCell* disappears at larger heating powers.
- As Figure 8a shows, important for heat exchange technique ratio Nu/Ra (i. e. Nusselt number/Reynolds number) for *Apogee GTZ* does not depend on heat power. The same ratio for *QualiCell* reveals meaningful dependence on heat power.
- The relaxation time for *QualiCell* twice lesser than relaxation time for *Apogee GTZ*.

THE SAME DATA FOR OTHER COMPITING COOLING CELS WILL BE PRESENTED LATER, TOGETHER WITH DATA ON HYDRO-RESISTANCES OF ALL CELLS.