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THERMOGRAPHIC ACTIVITIES IN THERMOLAB

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THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Introduction

Thermolab as a part of the Laboratory for applied thermodynamic deals with thermographic measurements designated to research activities, industry, energetic certification of buildings, medicine etc. This presentation gives the review of some activities done in the last year.

- The first activity is related to the problem that occur in the glass industry
- The second one presents the application of thermography in the inspection of building envelope
- The third one is related to testing the convector unit
- The fourth one shows testing the new design of driver seat

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Glass industry

Introduction

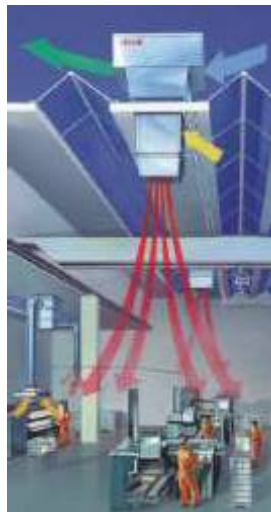
The first activity is related to the problem that occur in one glass factory and is concerned to the so called „cold zone” of the production line. The new standard for glass industry which produce packaging glass products (BRC- British Retail Consortium - Global Standard for Packaging and Packaging Materials) demands the defined microclimatic parameters for areas such as cold zone and packaging.

To be able to satisfy requirements of the standard the complex study of all influencing parameters has to be done. Among different measuring methods thermography can help a lot for temperature distribution measurement on different surfaces like walls, ceiling etc. which indirectly gives the information about efficiency of HVAC system applied and informations useful for analysis.

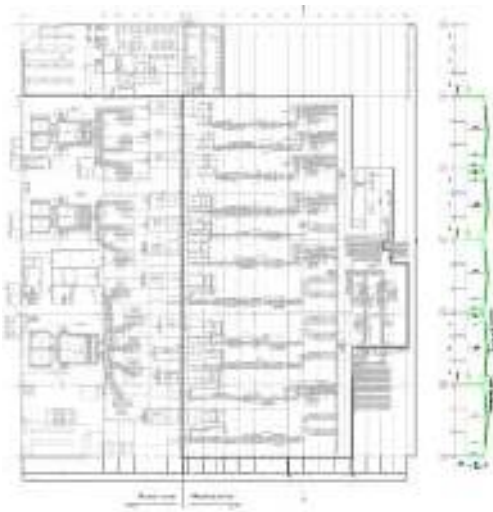
THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Introduction

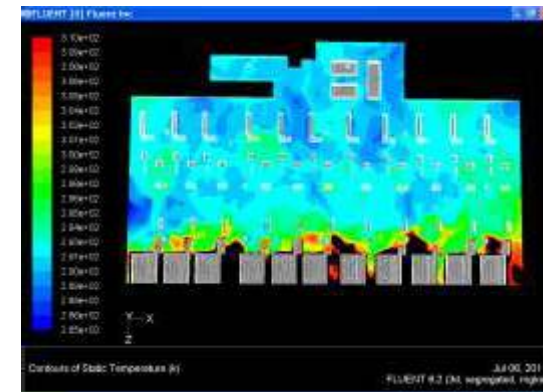
After simulation of various HVAC systems which possibly could be applied a solution with Hoval RoofVent units was selected. The fig. 1 gives the principle of air distributor, fig.2 shows the lay out of production and cold zone and fig. 3 the temperature distribution in one plane of the cold zone obtained by simulation.



1. RoofVent



2. Lay out of the production area



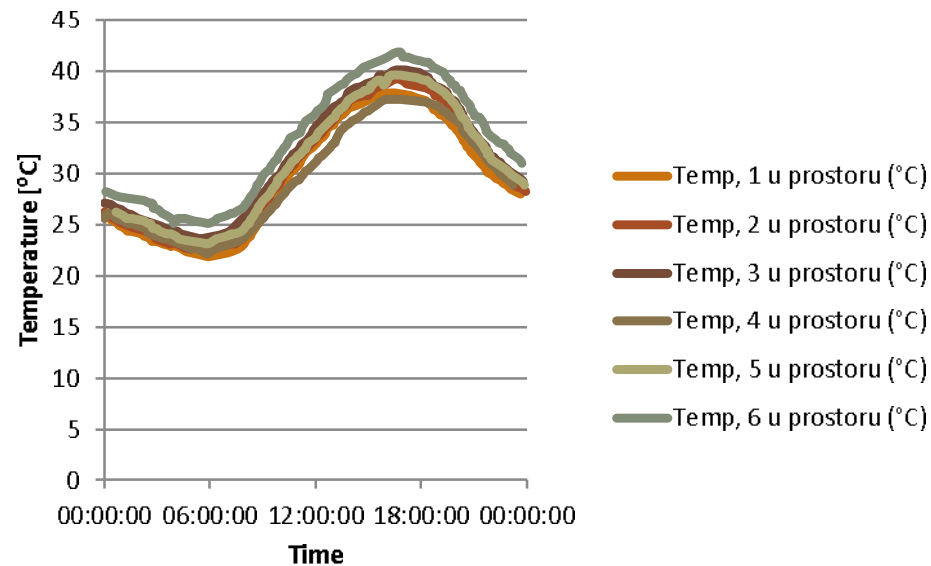
3. Result of simulation the temperature distribution in Cold zone

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements

To be able to verify the new HVAC system the measurements of air flow, air temperatures and temperatures of walls, roof and other surfaces as well as production line was measured before the reconstruction. They will be compared with results obtained after the reconstruction.

Temperatures in the cold zone, summer



| H, m | t, °C | w, m/s |
|------|-------|--------|
| 1 | 32,5 | 0,2 |
| 3 | 32 | 0,3 |
| 5 | 35,5 | 0,35 |
| 8 | 39 | 0,5 |

Temperatures and air velocities at measuring point 6 (time 12:00)

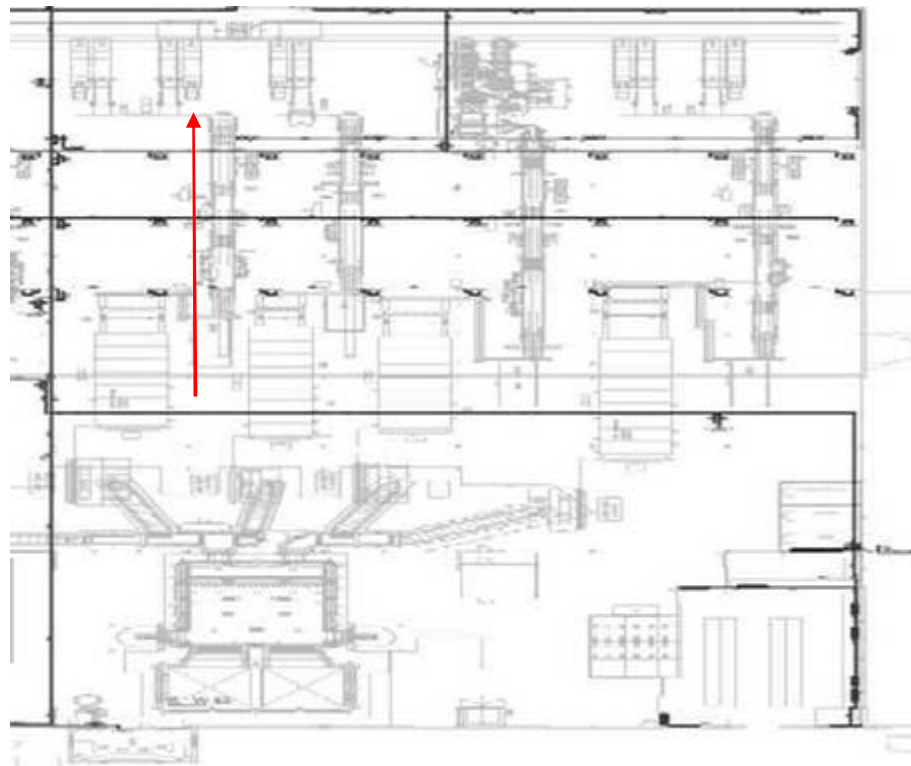
Air flow visualization



THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements

Thermographic measurements of the temperature distribution on surfaces (roof, walls, production equipment, products). Thermographic camera FLUKE Ti 32



Direction of thermographic measurements in one line



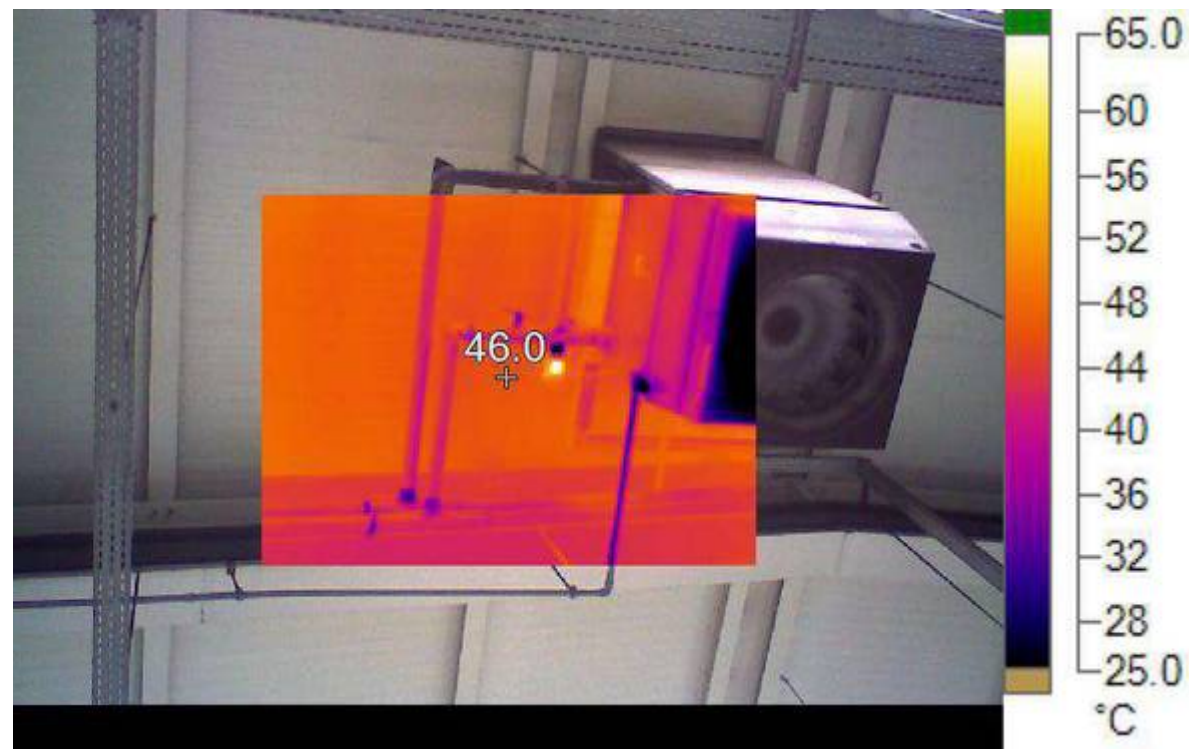
THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements



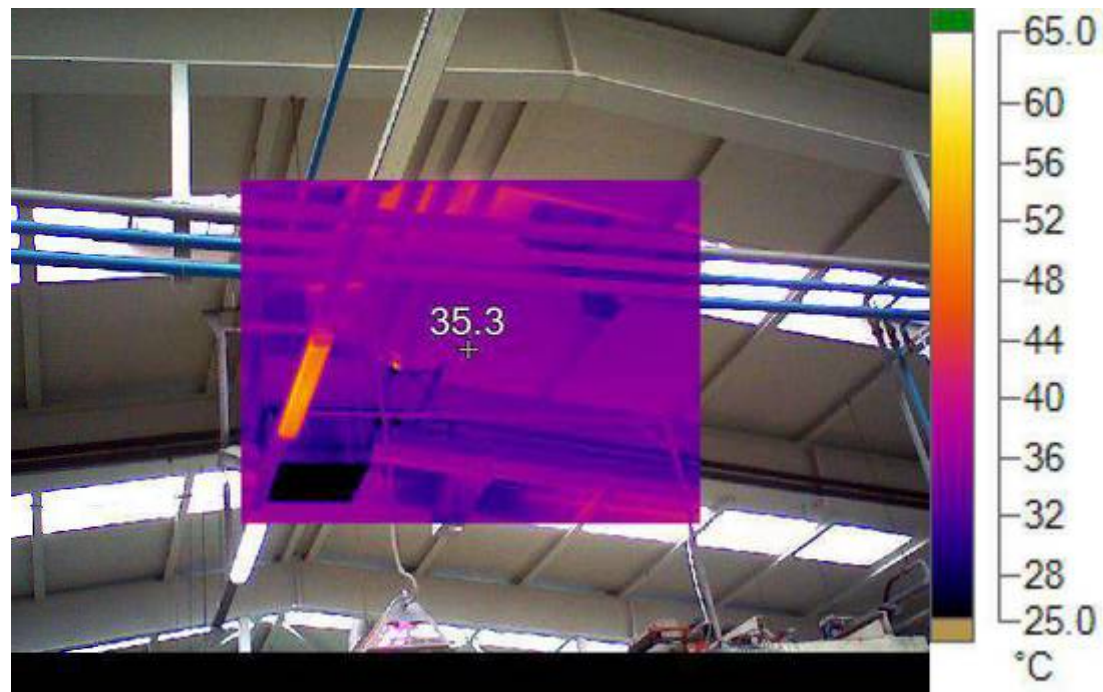
THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements



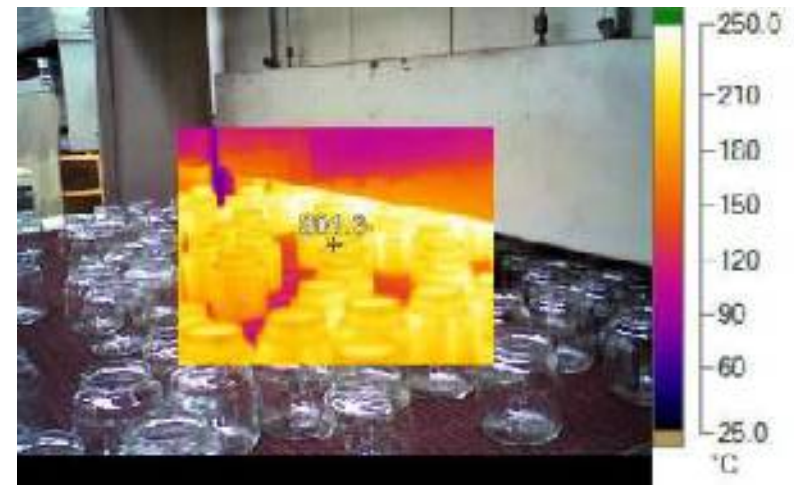
THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements



THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements



Thermograms obtained on the production line surfaces

This thermograms will be compared with those which will be taken after reconstruction.

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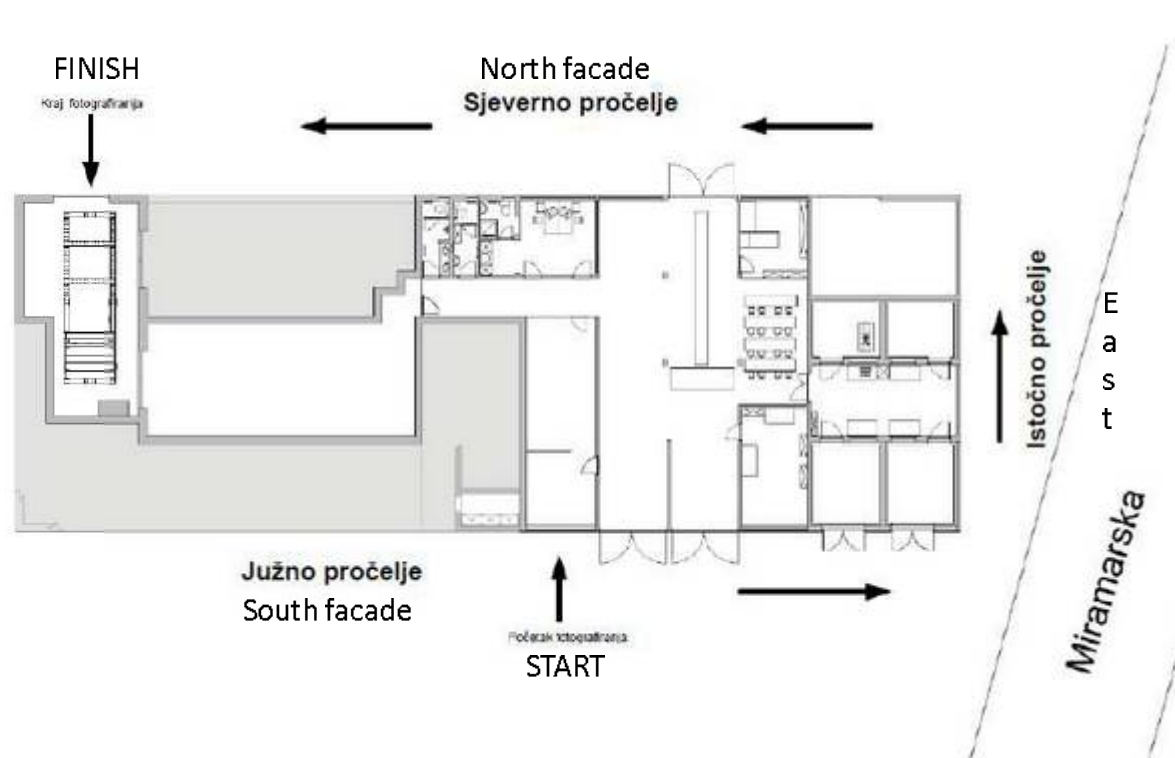
Inspection of building envelope

Introduction

During the reconstruction of building envelope it is important to control the quality of works done. Thermography could be successfully applied for such control. It is recommended to record thermograms before and after reconstruction and if possible during the work. In the second part of presentation the measurements done during the reconstruction of one faculty building is presented.

on

THERMOGRAPHIC ACTIVITIES IN THERMOLAB



Ground plan of the faculty building

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements

Basic parameters

| | |
|-------------------------------------------------------------------------------------------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| Objekt mjerenja/object: | Laboratorij za motore i vozila, FSB |
| Vrijeme i datum mjerenja/time and date: | 4.2.2014.; 11 h i 30 min |
| Koordinate objekta/coordinates: | +45° 47' 44.19", +15° 58' 23.97" |
| Adresa objekta/adress: | Miramarska cesta, 10000 Zagreb, Hrvatska |
| Predmet mjerenja/subject: | Vanjska ovojnica zgrade/envelope |
| Ovojnica prije radova/envelope before reconstruction: | Betonski zidovi bez toplinske izolacije te staklenim vratima i prozorima s pripadajućim metalnim okvirima (bez toplinske izolacije)/concrete walls , glass windows and doors in metal frames |
| Ovojnica nakon radova/envelope after reconstruction: | Betonski zidovi s toplinskom izolacijom te staklenim vratima i prozorima s pripadajućim metalnim okvirima (bez toplinske izolacije)/concrete walls with glass wool insulation, glass windows and doors in metal frames |
| Emisijski faktor armirano betonske ovojnice/emissivity of concrete walls: | e = 0,90 |
| Emisijski faktor emajliranih metalnih okvira bez sjaja/emissivity of metal frames: | e = 0,88 |
| Vanjska temperatura/average ambient temperature: | |
| Temperatura ambijenta južnog pročelja/soth side: | T _{amb} = - 2,2 °C |
| Temperatura ambijenta istočnog pročelja/east side: | T _{amb} = - 1,7 °C |
| Temperatura ambijenta sjevernog pročelja/north side: | T _{amb} = -0,6 °C |

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements



South facade



East facade

Faculty building in the reconstruction



THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements



North facade



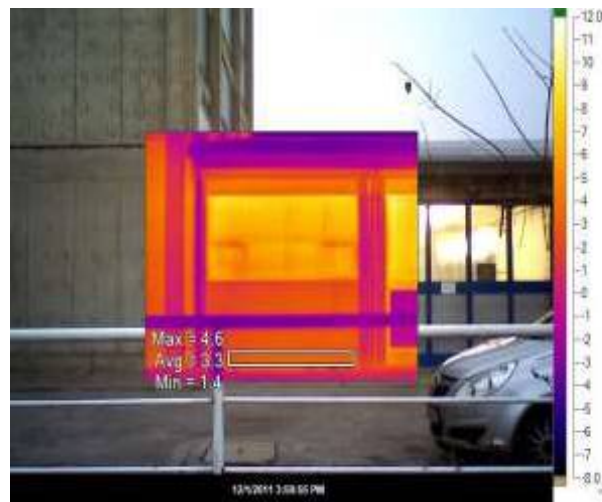
THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements

Thermographic camera FLUKE Ti32.

All thermograms, before and after reconstruction, were recorded in the nearly same conditions. Winter, ambient temperature between 1°C and -2°C . Cloudy day, late afternoon. Inside temperatures between 18°C and 22°C .

South facade



Before



After

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements

South facade

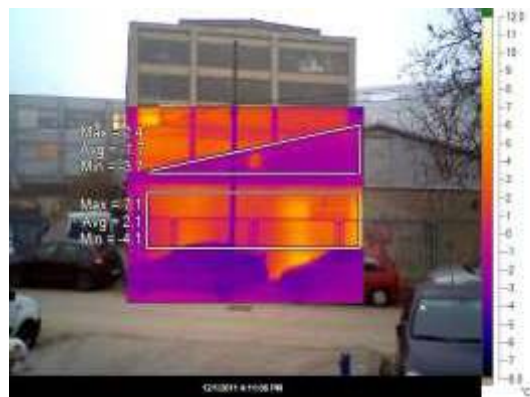


Before



After

East facade



Before



After



THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements

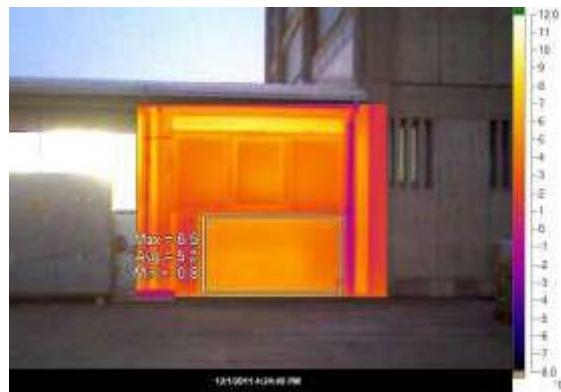
North facade



Before



After



THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements

Conclusion

It can be seen from the thermograms the quality of works and advantages of insulation which ensure the better energy efficiency of building.

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Testing the ventilo-convector prototype

Introduction

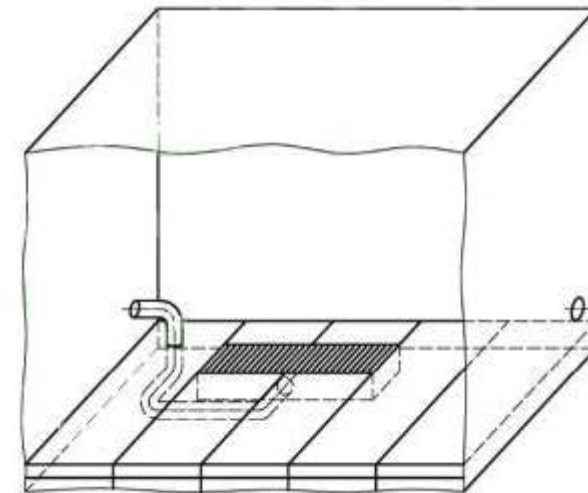
Laboratory for applied thermodynamic deals with testing of the heating and cooling equipment in the development phase.

The goal of the measurements:

- Determination of the thermal characteristic
- Determination of flow parameters
- Pressure drop on air/water side



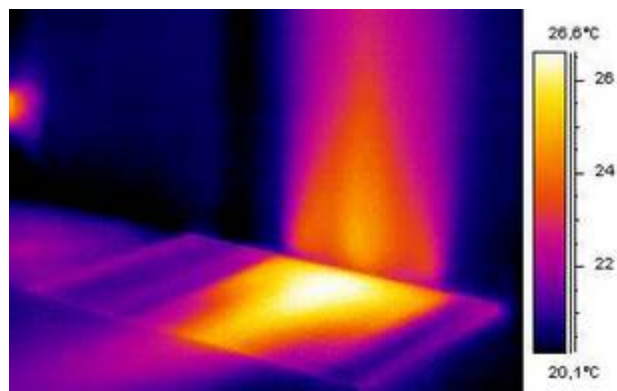
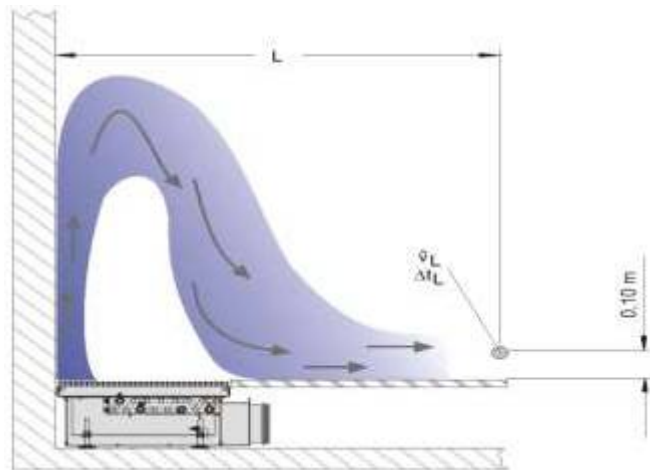
Ventilo-convector



Testing chamber

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements with primary air included (primary air is prepared separately)

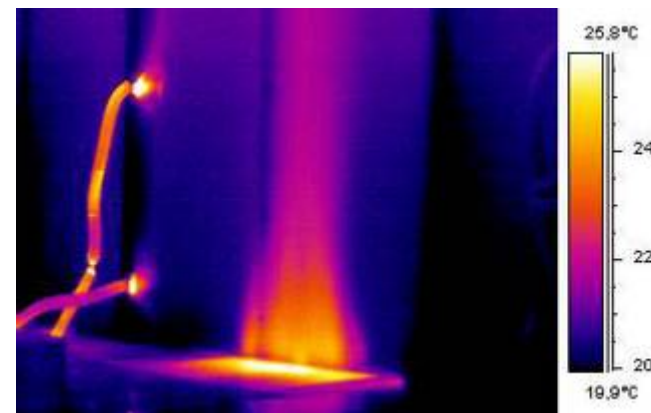
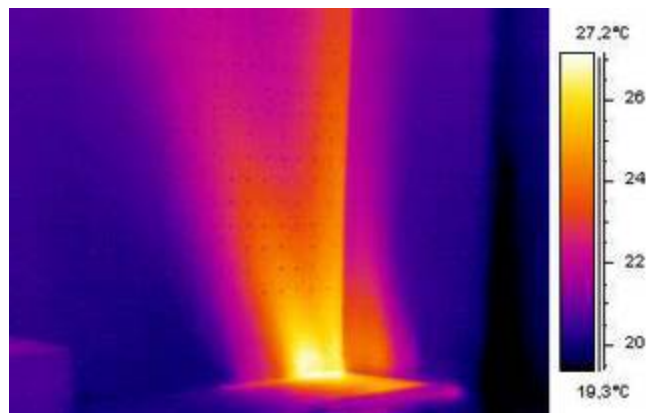


Heating mode
Average chamber air temperature 21,3°C
Water temperatures 40/35°C
Temperature of inlet air 22°C
Water flow 50 kg/h
Air flow 35 m³/h
Heating capacity 268 W

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

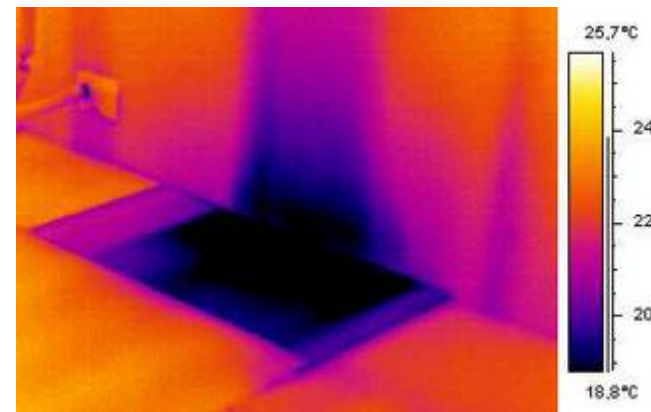
Measurements with primary air included

Heating mode



Cooling mode

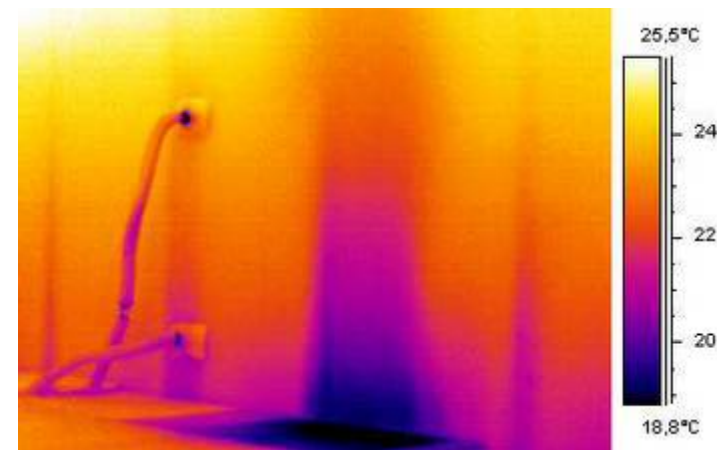
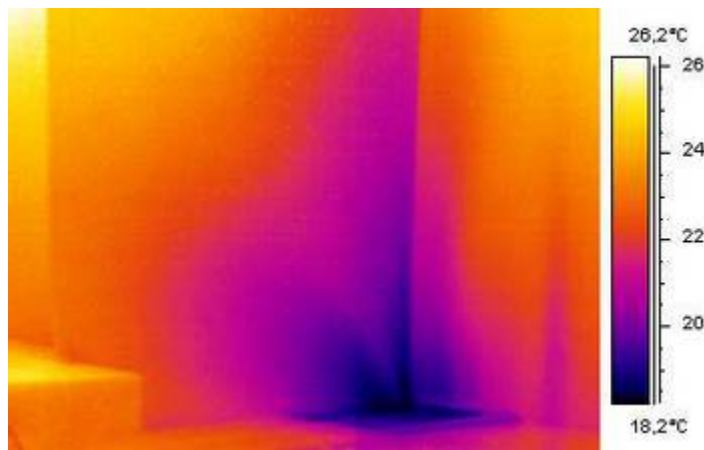
Average chamber air temperature 26,9 °C
Water temperatures 16,2/17,9°C
Inlet air temperature 18°C
Water flow 42,6 kg/h
Air flow 35 m³/h
Cooling capacity 210 W



THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements with primary air included

Cooling mode

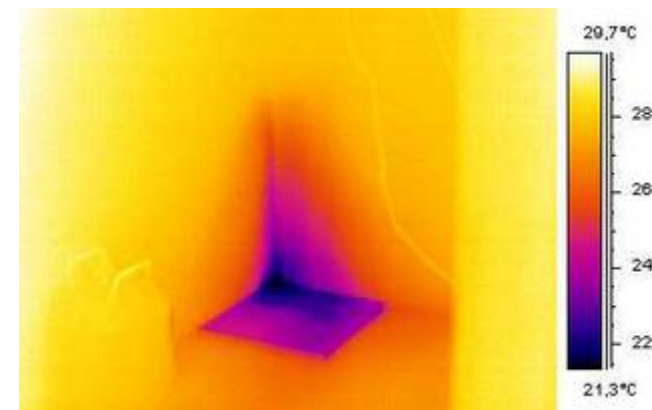
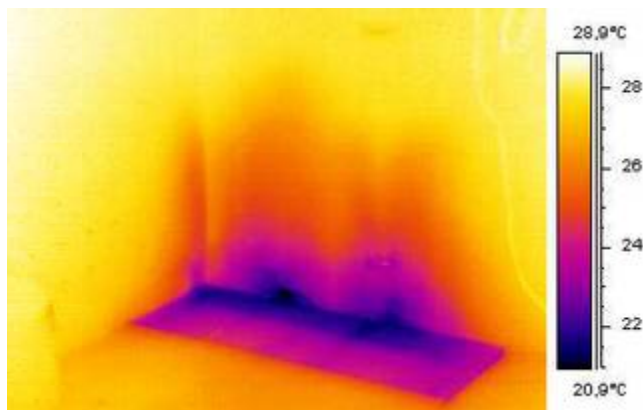
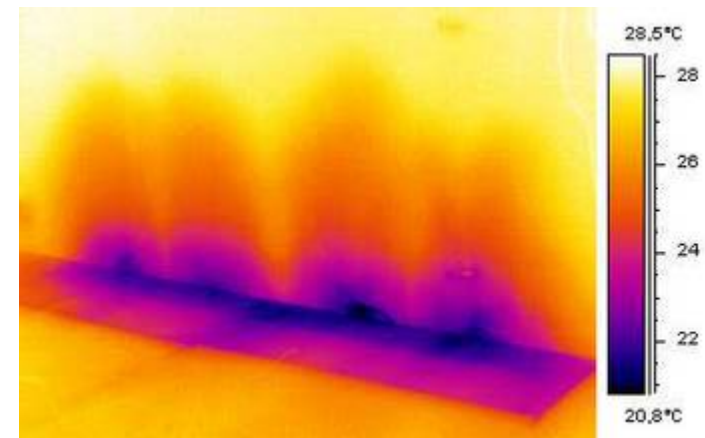


THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements without primary air

Cooling mode

Average air temperature 27,6 °C
Water temperatures 16/18 °C
Water flow 99,6 kg/h
Fan velocity number 1
Cooling capacity 228 W



THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements without primary air

Cooling mode

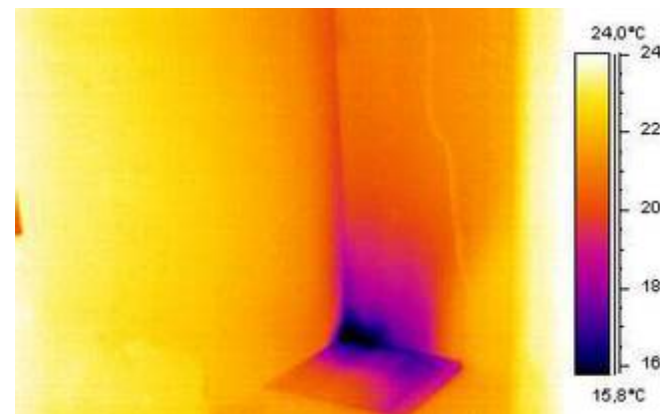
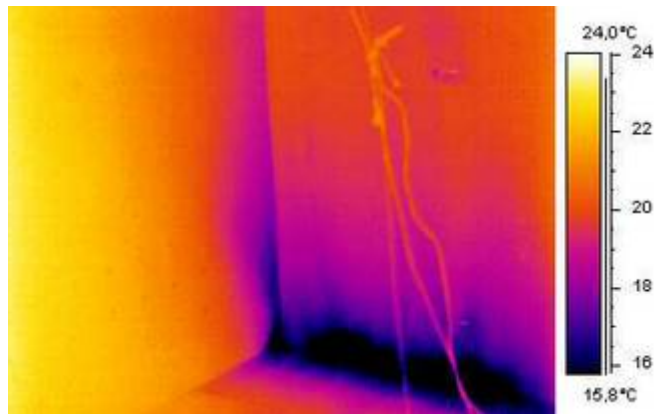
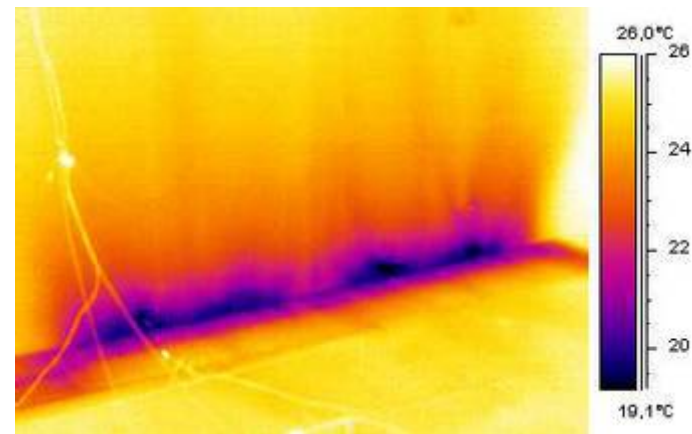
Average chamber air temperature 26,5 °C

Water temperatures 15,6/17,75 °C

Water flow 395,7 kg/h

Fan velocity number 3

Cooling capacity 990 W



THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements of ventilo-convector

Conclusion

According to the measurement results the conclusion for ventilo-convector prototype was given:

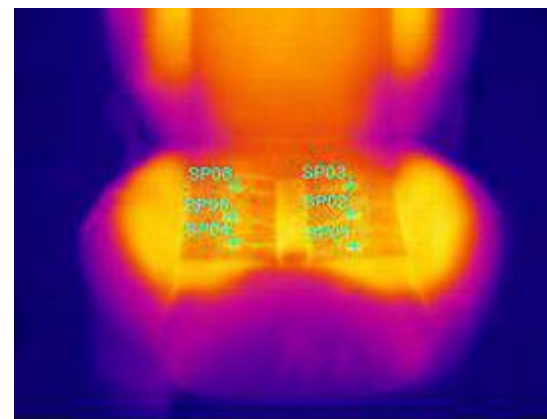
- unequal flow through convector
- unsatisfactory air profile in heating mode
- unsatisfactory air profile in cooling mode (acceptable at fan velocity number 3)

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

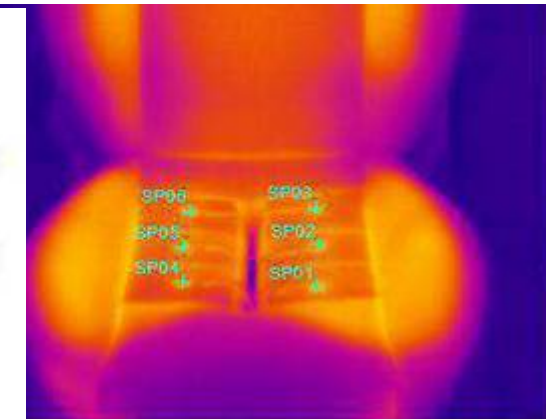
Testing the driver seat

Introduction

Sometimes in the laboratory we get very strange prototypes for which authors want to get different data. One of them is the prototype of driver seat which will reduce the heating of the body on particular location.



Temperature distribution on driver seat with insert set in



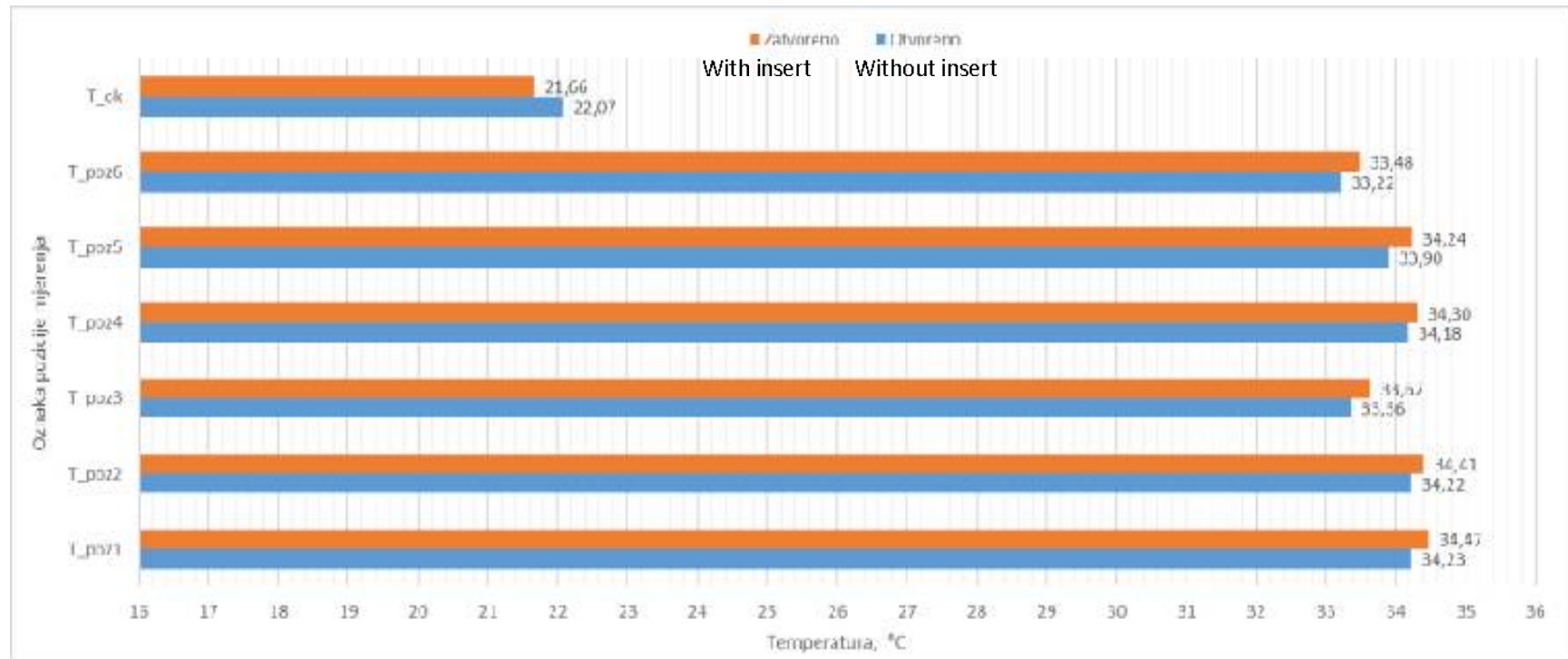
Temperature distribution on driver seat without insert

THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements

Results

Position



Temperature

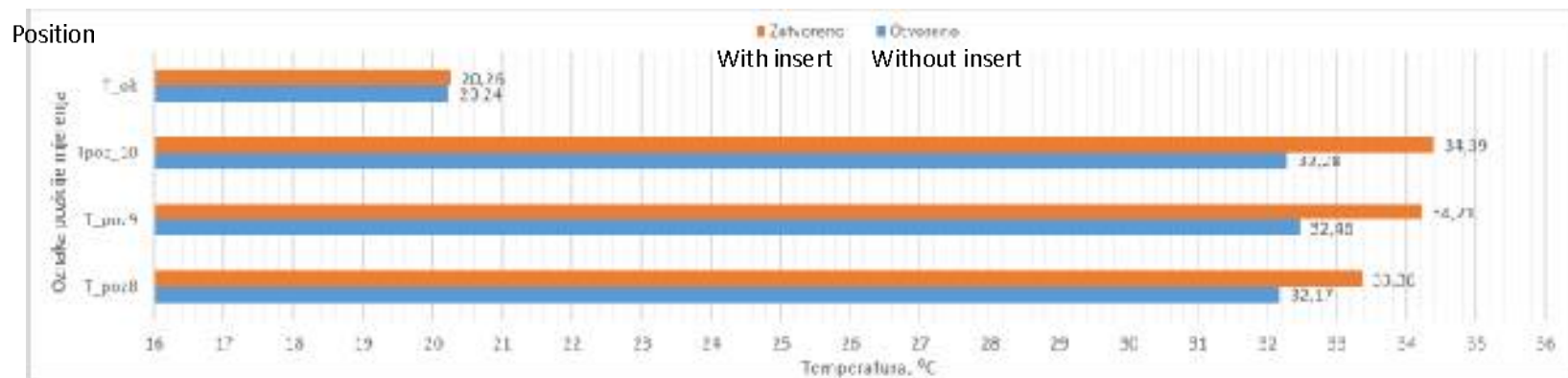


THERMOGRAPHIC ACTIVITIES IN THERMOLAB

Measurements

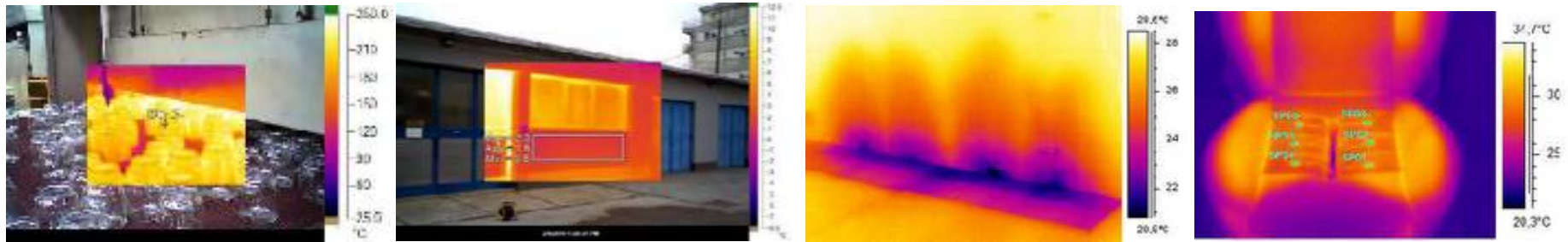
Conclusion

The temperatures on the seat remains more or less the same, with and without the insert, after seating duration of one hour. Such result was expected in the temperature domaine. The temperatures were recorded by thermographic camera FLIR 2000 SC and thermocouples.



Temperatures on the insert versus temperatures in the hole

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Thank you for your
attention

