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DESY SUMMER SCHOOL

2007 REPORT

A Research Study About Temperature Calibrations On Desy-Hasylab

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Purpose of the Experiment

HAAKE F8 system has been tuning of detectors and lots of system temperature. At this study, calibration of HAAKE F8 termination will have done using homogeneity and stability of pure water temperature, with together Mercury-in-glass thermometer and ALMEMO 2690-8 Electronic Thermometer. Different points of temperature will be measured using these thermometers inside of the water bath.

A) The pure water will be revolutioned in the cylinder cup at Haake F8 system by using C25 which is temperature control bath and this water temperature will be measured every half an hour from 20^0C to 26^0C increasing of one celcius degree with Haake F8 system. (mercury-in-glass thermometers with a temperature range of 20...25°C and an accuracy of 0.01K). Beside the same measurements will have been made with reference mercury-in-glass thermometer to measure weather temperature at outside of cylinder cup.

B) At first step, the measurement have been made using by a mercury thermometer. At the second step the values of temperature will be measured between 20^0C- 26^0C soaking the deep using by two mercury thermometers.

C) **1-a)** At this part, a cubic cup will be used instead of cylinder cup and between 20^0C- 26^0C temperature values. The measurement will be in the pure water bath where is entering water using by ALMEMO 2690-8 electronic thermometer instead of mercury thermometer.

1-b) The same measurements will be taken center of the pure water inside of the cubic cup.

1-c) The same measurements will be taken in front of the outlet of the pure water inside of the cubic cup.

2) The same measurements will be taken in front of the outlet of the pure water, center of the pure water and in front of the inlet of the pure water inside of the cubic cup at the same time.

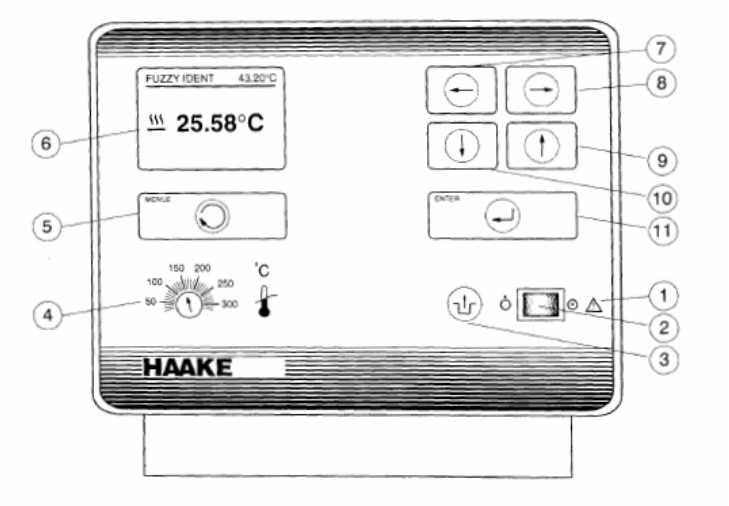
3) The same measurements will be taken using ALMEMO 2690-8 electronic thermometer pure water bath inside of the cubic cup, inlet and outlet of water points without linearity parts.

D) The same measurements will be taken with ALMEMO 2690-8 electronic thermometer and mercury thermometer at center of the pure water inside of the cubic cup.

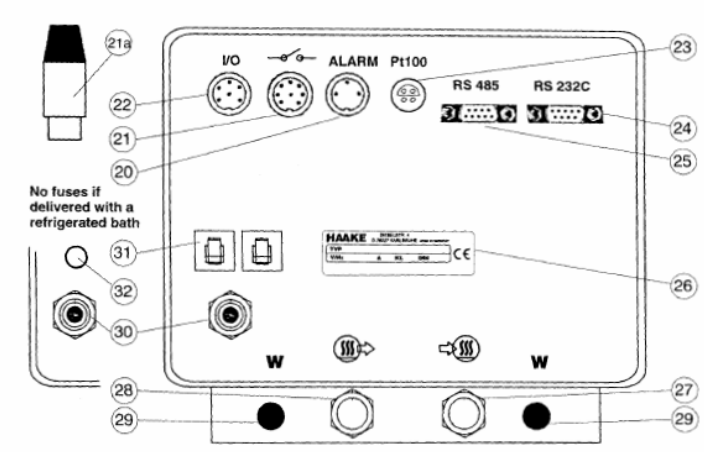
How is the Experiment System Working ? [1]

HAAKE F8

Functional Elements of HAAKE F8

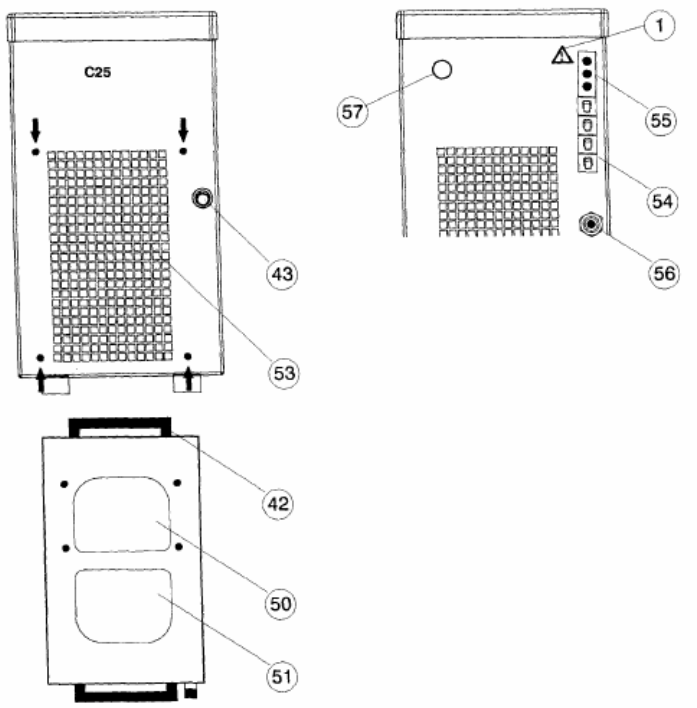


1) Symbol: Read the user manual!
2) Mains switch
3) Reset button
4) Excess temperature setting
5) Menu selection key
6) LCD display
7) Value selection (←) left
8) Value selection (→) right
9) Value alteration (↑) higher
10) Value alteration (↓) lower
11) Enter key



20) Socket for external alarm device
21) Socket for ON/OFF and low liquid level alarm
21a) Short circuit plug for socket 21
22) Socket for analog control signals **(option)**
23) Socket for external Pt100 sensor
24) RS 2326 interface
25) RS 485 interface
26) Name plate
27) Pump inlet: back flow from the external object
28) Pump outlet: pressure to the external object.
29) Cooling coil fittings for tap water cooling (not for N8: the cooling coil is delivered with the bath vessel); not in conjunction with refrigerated baths
30) Mains cable (or cable to the refrigerated bath)
31) Fuses (not in conjunction with refrigerated baths)
32) Control cable to the refrigerated bath

Functional Elements of Refrigerated bath C25



1) Symbol: Read the user manual!
42) Handle
43) Drainage nozzle
50) Opening for temperature control module
51) Bath opening with bath cover (standard feature)
53) Ventilation grid (removable, four mounting points: ↓)
54) Fuses
55) Socket for cable 30 from temp. control unit FIN
56) Mains cable
57) Socket for control cable 32 from FIN

Caution: Read the instruction manual before operating.

Instrument in "off" position.

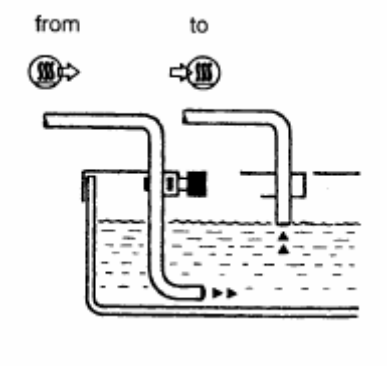
Instrument in "on" position.

Adjustment for setting the cut-off point for excess temperature protection.

Reset after fault of the instrument.

Selection of the basic menu or return from any sub menu after settings have been made.

Filling with Bath Liquid



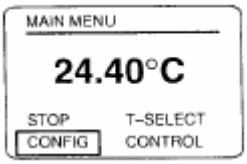
5* to *95°C *Distilled Water*

Normal tap water leads to calcareous deposits necessitating frequent unit decalcification.

Water, of course, can be employed up to 95"C, however above **80°C** water vaporization reaches a level which necessitates the liquid to be constantly replenished.

Configuration

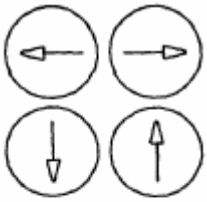
Especially when putting into operation for the first time it is necessary to adjust some parameters.



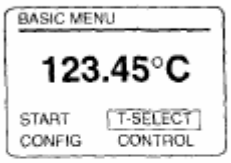
CONFIG in the main menu.

Read the user manual for CONFIG

Operating



Any single menu point in a menu display (monitor contents) can be selected by using the arrow keys.

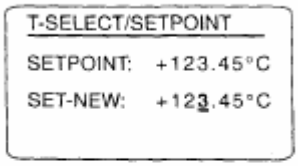


The selected menu point will be marked.
e.g. T-SELECT

ENTER key to confirm a selection and to change to the next menu.

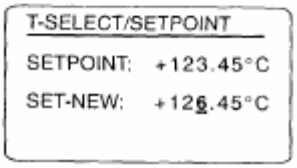
The next menu appears
e.g. SETPOINT

Selection of the digit which needs to be altered in any temperature or time displays. Can be made left or right.



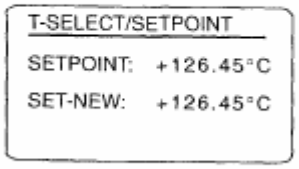
The selected digit is underlined,
e.g. change of set value:
The one-degree digit has to be changed

Change of the selected digit between 0 and 9,



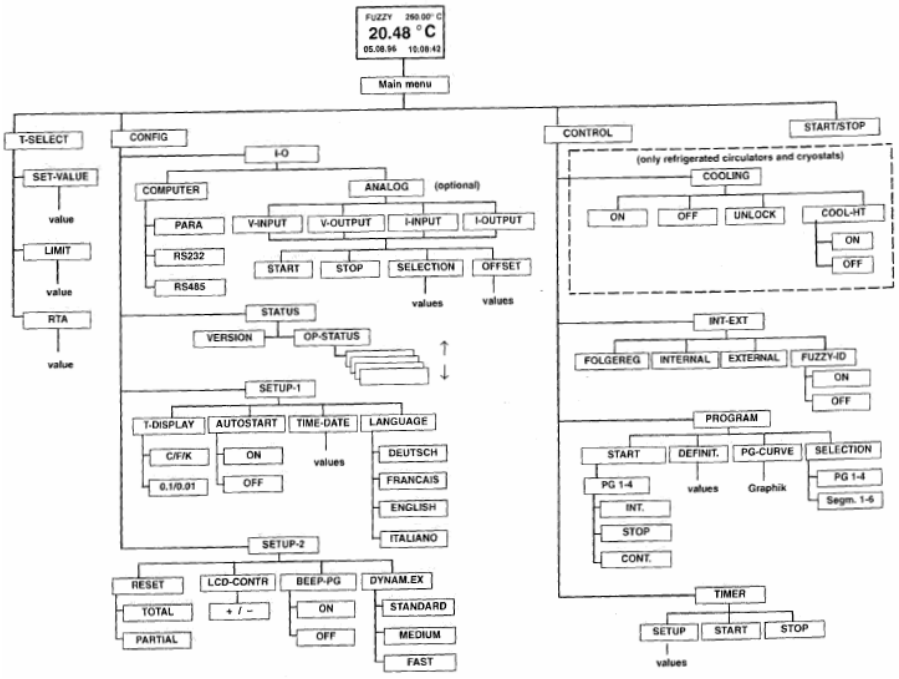
e.g. change of set value:
The temperature has been altered by 3°C.

ENTER key to confirm a selection,



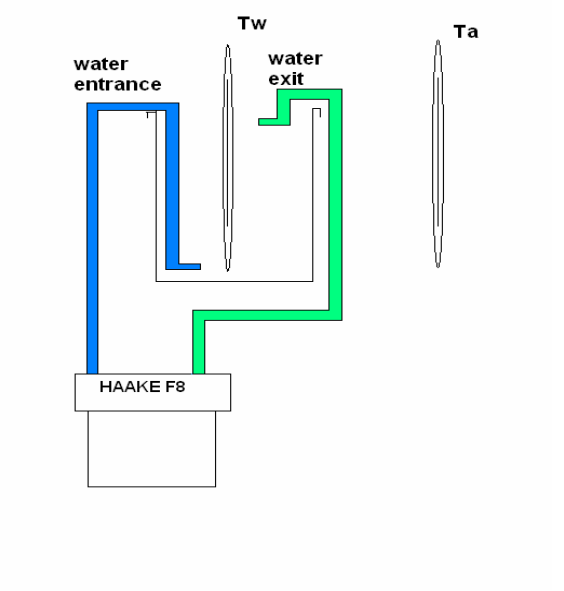
e.g. change of set value:
The set value alteration of plus 3°C
has been confirmed and is in action.

Tree of Menu



Experimental Verities

A) The Temperature Calibration of Haake F8 Bath with a Mercury-in-glass Thermometer ;



T_s **:** Set Temperature of Haake F8

T_r **:** Actual Temperature of Haake F8

T_w **:** Temperature of in Pure Water a Mercury Thermometer

T_a **:** Temperature of in Weather a Mercury Thermometer

Values are taken carefully per every half an hour.

i)

T_s	20.00 ^{0}C
T_r	20.00 ^{0}C
T_w	~18.00 ^{0}C
T_a	~26.00 ^{0}C

ii)

T_s	21.00 ^{0}C
T_r	21.01 ^{0}C
T_w	20.60 ^{0}C
T_a	~26.00 ^{0}C

iii)

T_s	22.00 ^{0}C
T_r	22.01 ^{0}C
T_w	21.62 ^{0}C
T_a	~26.00 ^{0}C

iv)

T_s	23.00 ^{0}C
T_r	22.99 ^{0}C
T_w	22.50 ^{0}C
T_a	~26.00 ^{0}C

v)

T_s	24.00 ^{0}C
T_r	24.00 ^{0}C
T_w	23.45 ^{0}C
T_a	~26.00 ^{0}C

vi)

T_s	25.00 ^{0}C
T_r	25.00 ^{0}C
T_w	24.36 ^{0}C
T_a	~26.00 ^{0}C

vii)

T_s	26.00 ^{0}C
T_r	26.00 ^{0}C
T_w	25.40 ^{0}C
T_a	~26.00 ^{0}C

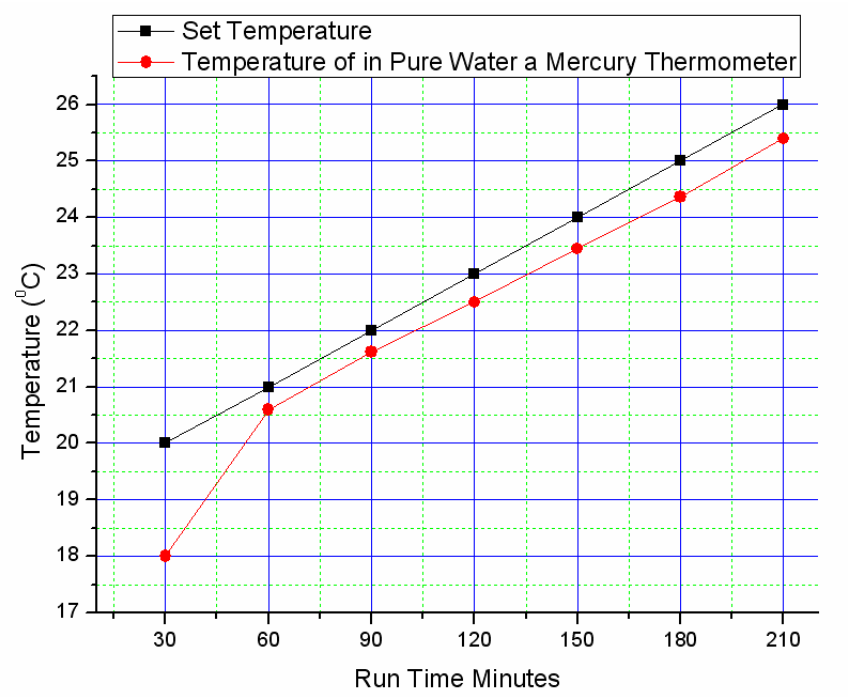
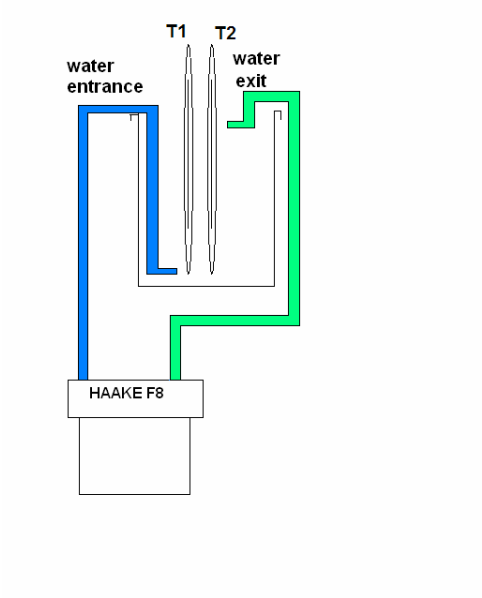


Figure-1

B) The Temperature Calibration of Haake F8 Bath with Two Mercury-in-glass Thermometers ;



T_s : Set Temperature of Haake F8

T_r : Actual Temperature of Haake F8

T_1 : Temperature of in Pure Water First Thermometer

T_2 : Temperature of in Pure Water Second Thermometer

Values are taken carefully per every half an hour.

i)

T_s	20.00 ^{0}C
T_r	20.00 ^{0}C
T_1	~19.70 ^{0}C
T_2	~19.70 ^{0}C

ii)

T_s	21.00 ^{0}C
T_r	21.00 ^{0}C
T_1	20.61 ^{0}C
T_2	20.62 ^{0}C

iii)

T_s	22.00 ^{0}C
T_r	21.99 ^{0}C
T_1	21.54 ^{0}C
T_2	21.55 ^{0}C

iv)

T_s	23.00 ^{0}C
T_r	23.00 ^{0}C
T_1	22.48 ^{0}C
T_2	22.50 ^{0}C

v)

T_s	24.00 ^{0}C
T_r	23.98 ^{0}C
T_1	23.39 ^{0}C
T_2	23.40 ^{0}C

vi)

T_s	25.00 ^{0}C
T_r	25.00 ^{0}C
T_1	24.61 ^{0}C
T_2	24.62 ^{0}C

vii)

T_s	26.00 ^{0}C
T_r	26.00 ^{0}C
T_1	~25.30 ^{0}C
T_2	~25.35 ^{0}C

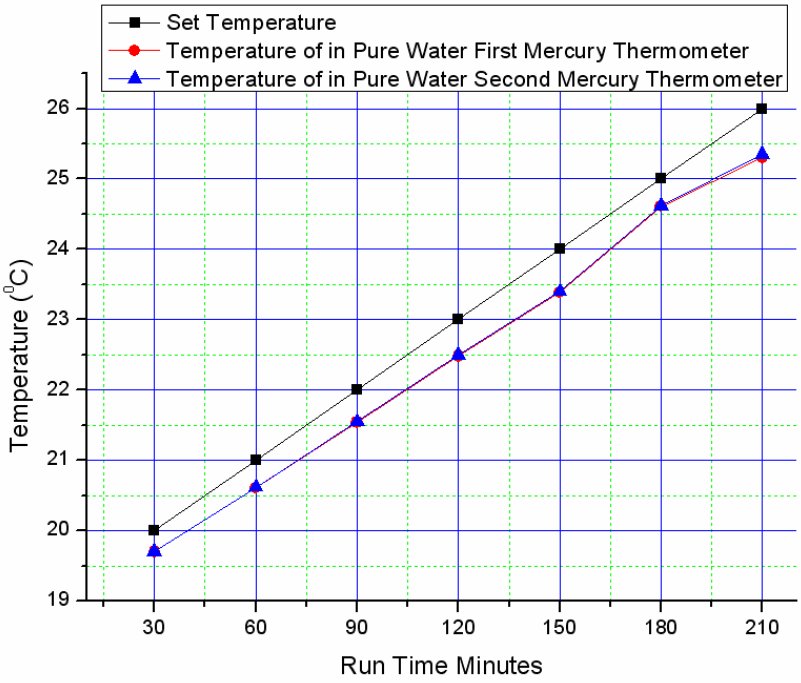
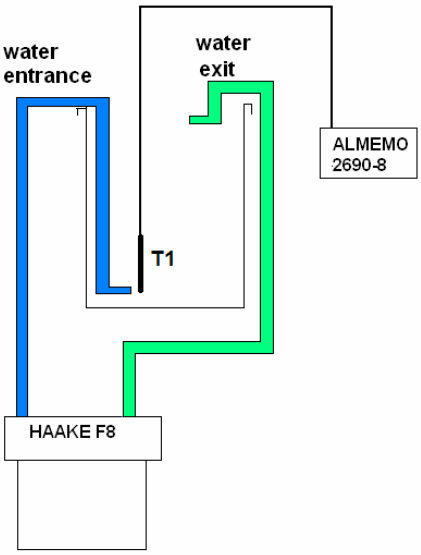


Figure-2

C-1-a) The Temperature Calibration of Haake F8 Bath with ALMEMO 2690-8 Electronic Thermometer ;



ALMEMO 2690-8
Electronic Thermometer

T_s : Set Temperature of Haake F8

T_r : Actual Temperature of Haake F8

T_1 : Temperature of in Pure Water an Electronic Thermometer

Values are taken carefully per every half an hour.

i)

T_s	20.00 ^{0}C
T_r	20.00 ^{0}C
T_1	19.564 ^{0}C

ii)

T_s	21.00 ^{0}C
T_r	21.01 ^{0}C
T_1	20.406 ^{0}C

iii)

T_s	22.00 ^{0}C
T_r	22.00 ^{0}C
T_1	21.342 ^{0}C

iv)

T_s	23.00 ^{0}C
T_r	23.00 ^{0}C
T_1	22.258 ^{0}C

v)

T_s	24.00 ^{0}C
T_r	24.00 ^{0}C
T_1	23.365 ^{0}C

vi)

T_s	25.00 ^{0}C
T_r	25.00 ^{0}C
T_1	24.246 ^{0}C

vii)

T_s	26.00 ^{0}C
T_r	25.99 ^{0}C
T_1	25.031 ^{0}C

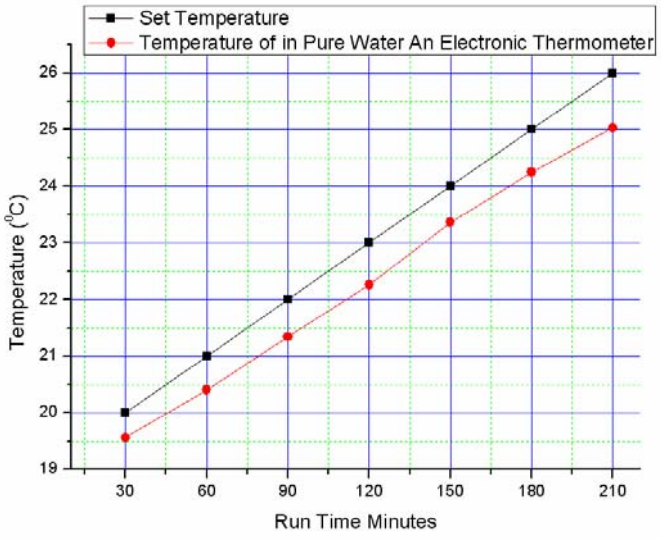
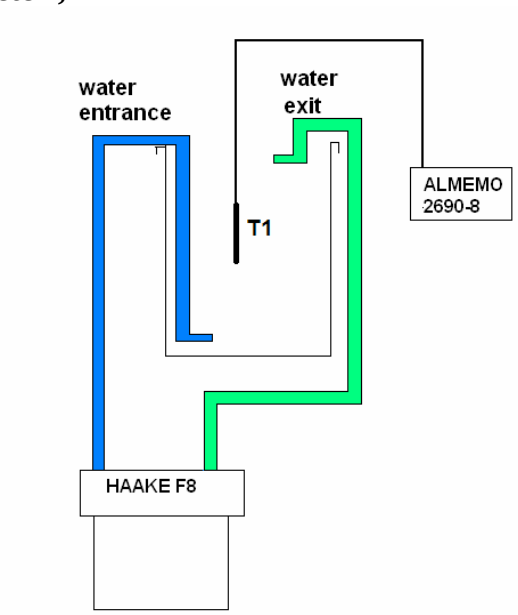


Figure-3

C-1-b) The Temperature Calibration of Haake F8 Bath with ALMEMO 2690-8 Electronic Thermometer ;



T_s : Set Temperature of Haake F8

T_r : Actual Temperature of Haake F8

T_1 : Temperature of in Pure Water an Electronic Thermometer

Values are taken carefully per every half an hour.

i)

T_s	20.00 ^{0}C
T_r	20.00 ^{0}C
T_1	19.661 ^{0}C

ii)

T_s	21.00 ^{0}C
T_r	21.00 ^{0}C
T_1	20.461 ^{0}C

iii)

T_s	22.00 ^{0}C
T_r	21.99 ^{0}C
T_1	21.335 ^{0}C

iv)

T_s	23.00 ^{0}C
T_r	23.00 ^{0}C
T_1	22.194 ^{0}C

v)

T_s	24.00 ^{0}C
T_r	24.00 ^{0}C
T_1	23.337 ^{0}C

vi)

T_s	25.00 ^{0}C
T_r	25.00 ^{0}C
T_1	24.178 ^{0}C

vii)

T_s	26.00 ^{0}C
T_r	26.00 ^{0}C
T_1	25.005 ^{0}C

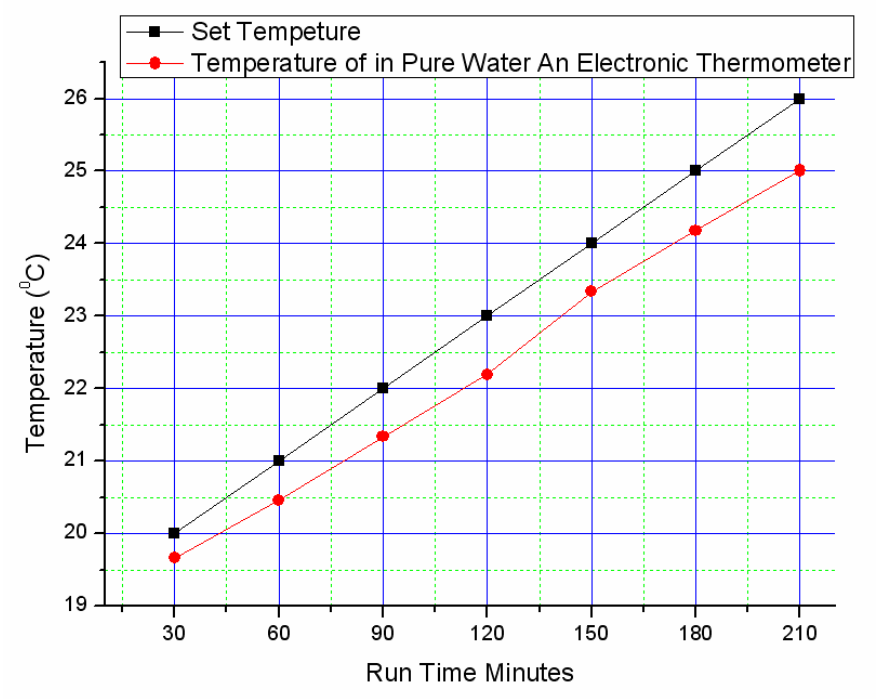
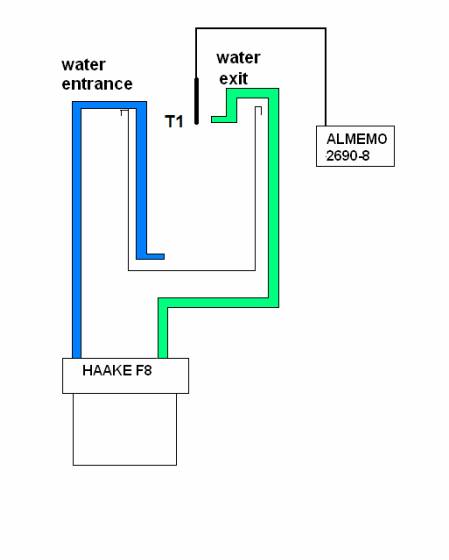


Figure-4

C-1-c) The Temperature Calibration of Haake F8 Bath with ALMEMO 2690-8 Electronic Thermometer ;



T_s : Set Temperature of Haake F8

T_r : Actual Temperature of Haake F8

T_1 : Temperature of in Pure Water an Electronic Thermometer

Values are taken carefully per every half an hour.

i)

T_s	20.00 ^{0}C
T_r	20.00 ^{0}C
T_1	19.670 ^{0}C

ii)

T_s	21.00 ^{0}C
T_r	21.00 ^{0}C
T_1	20.468 ^{0}C

iii)

T_s	22.00 ^{0}C
T_r	22.00 ^{0}C
T_1	21.336 ^{0}C

iv)

T_s	23.00 ^{0}C
T_r	23.00 ^{0}C
T_1	22.189 ^{0}C

v)

T_s	24.00 ^{0}C
T_r	24.00 ^{0}C
T_1	23.336 ^{0}C

vi)

T_s	25.00 ^{0}C
T_r	24.99 ^{0}C
T_1	24.165 ^{0}C

vii)

T_s	26.00 ^{0}C
T_r	26.00 ^{0}C
T_1	25.992 ^{0}C

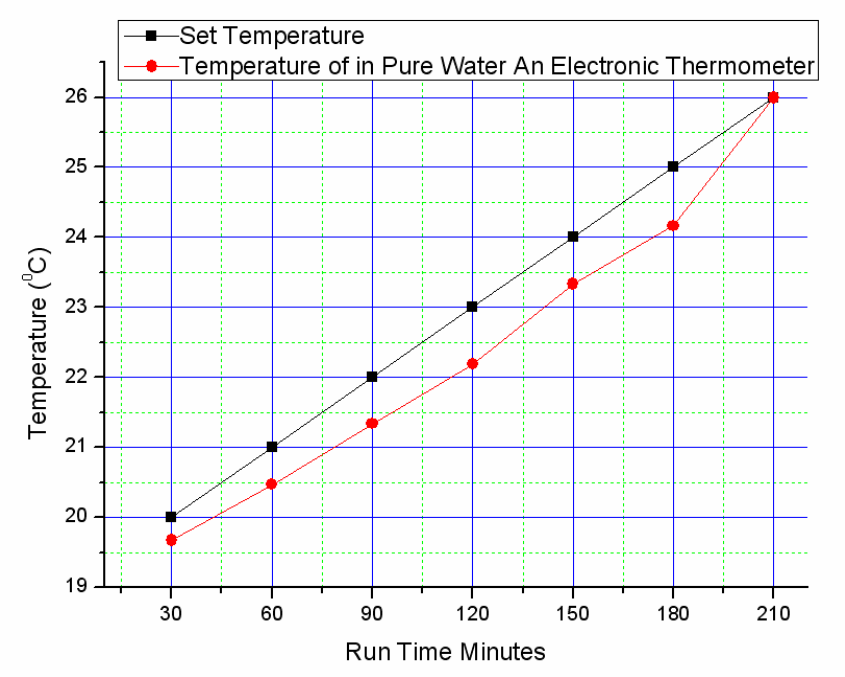
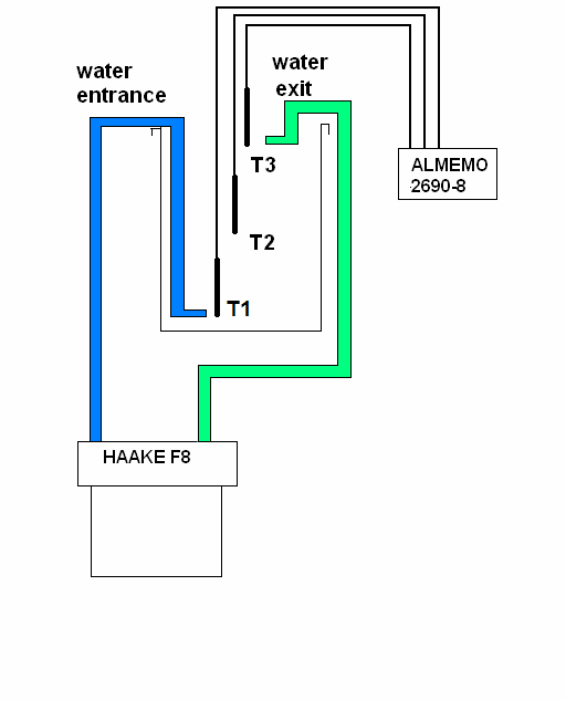


Figure-5

C-2) The Temperature Calibration of Haake F8 Bath with ALMEMO 2690-8 Electronic Thermometer ;



T_s : Set Temperature of Haake F8

T_r : Actual Temperature of Haake F8

T_1 : Temperature of in Pure Water an Electronic Thermometer

T_2 : Temperature of in Pure Water an Electronic Thermometer

T_3 : Temperature of in Pure Water an Electronic Thermometer

Values are taken carefully per every half an hour.

i)

T_s	20.00 ^{0}C
T_r	20.00 ^{0}C
T_1	19.522 ^{0}C
T_2	19.585 ^{0}C
T_3	19.570 ^{0}C

ii)

T_s	21.00 ^{0}C
T_r	21.00 ^{0}C
T_1	20.403 ^{0}C
T_2	20.414 ^{0}C
T_3	20.415 ^{0}C

iii)

T_s	22.00 ^{0}C
T_r	22.00 ^{0}C
T_1	21.307 ^{0}C
T_2	21.304 ^{0}C
T_3	21.305 ^{0}C

iv)

T_s	23.00 ^{0}C
T_r	23.00 ^{0}C
T_1	22.292 ^{0}C
T_2	22.305 ^{0}C
T_3	22.296 ^{0}C

v)

T_s	24.00 ^{0}C
T_r	24.00 ^{0}C
T_1	23.215 ^{0}C
T_2	23.212 ^{0}C
T_3	23.208 ^{0}C

vi)

T_s	25.00 ^{0}C
T_r	25.00 ^{0}C
T_1	24.145 ^{0}C
T_2	24.117 ^{0}C
T_3	24.112 ^{0}C

vii)

T_s	26.00 ^{0}C
T_r	26.00 ^{0}C
T_1	25.050 ^{0}C
T_2	25.973 ^{0}C
T_3	25.994 ^{0}C

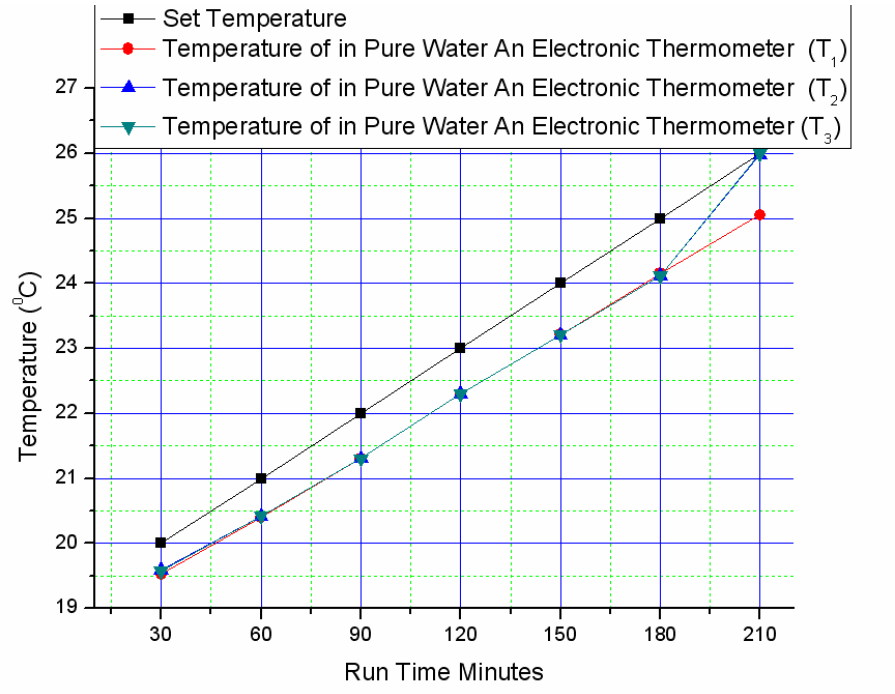
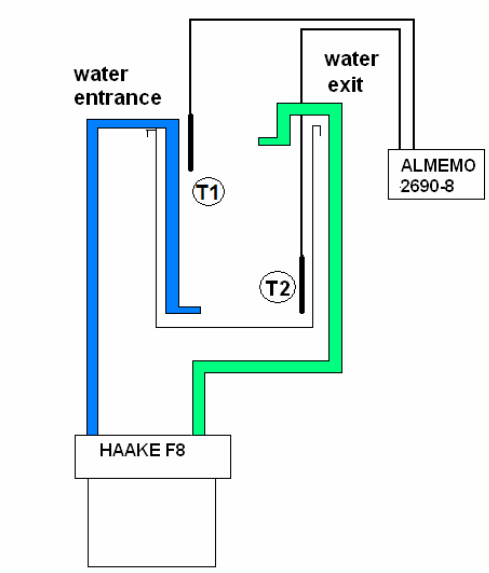


Figure-6

C-3) The Temperature Calibration of Haake F8 Bath with ALMEMO 2690-8 Electronic Thermometer ;



T_s **:** Set Temperature of Haake F8

T_r **:** Actual Temperature of Haake F8

T_1 **:** Temperature of in Pure Water First Electronic Thermometer

T_2 **:** Temperature of in Pure Water Second Electronic Thermometer

Values are taken carefully per every half an hour.

i)

T_s	20.00 ^{0}C
T_r	20.00 ^{0}C
T_1	19.646 ^{0}C
T_2	19.639 ^{0}C

ii)

T_s	21.00 ^{0}C
T_r	21.00 ^{0}C
T_1	20.505 ^{0}C
T_2	20.514 ^{0}C

iii)

T_s	22.00 ^{0}C
T_r	22.00 ^{0}C
T_1	21.449 ^{0}C
T_2	21.459 ^{0}C

iv)

T_s	23.00 ^{0}C
T_r	23.00 ^{0}C
T_1	22.376 ^{0}C
T_2	22.383 ^{0}C

v)

T_s	24.00 ^{0}C
T_r	24.00 ^{0}C
T_1	23.219 ^{0}C
T_2	23.223 ^{0}C

vi)

T_s	25.00 ^{0}C
T_r	25.00 ^{0}C
T_1	24.281 ^{0}C
T_2	24.298 ^{0}C

vii)

T_s	26.00 ^{0}C
T_r	26.00 ^{0}C
T_1	25.110 ^{0}C
T_2	25.113 ^{0}C

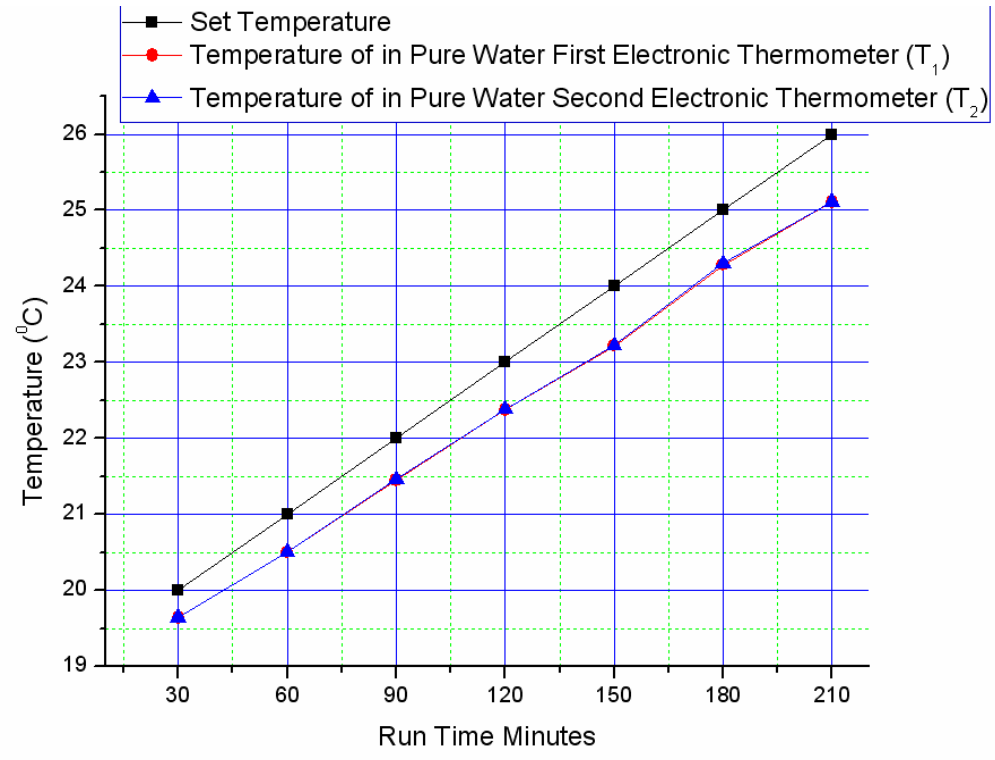
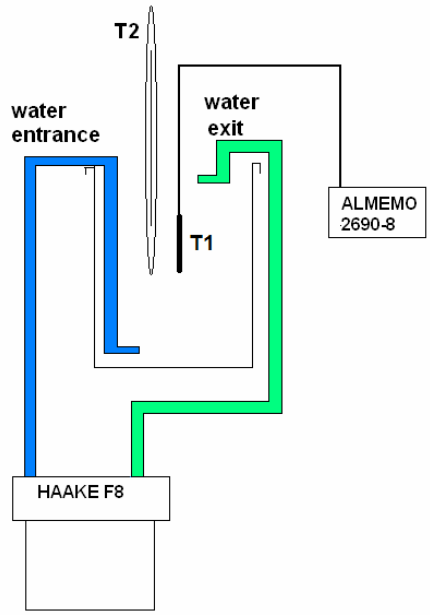


Figure-7

D) The Temperature Calibration of Haake F8 Bath with ALMEMO 2690-8 Electronic Thermometer and Mercury Thermometer ;

ALMEMO 2690-8 Electronic Thermometer's and mercury thermometer's probes dipped submerged in middle of pure water bath at sametime.



T_s : Set Temperature of Haake F8

T_r : Actual Temperature of Haake F8

T_1 : Temperature of in pure water an electronic thermometer

T_2 : Temperature of in pure water a mercury thermometer

Values are taken carefully per every half an hour.

i)

T_s	20.00 ^{0}C
T_r	20.00 ^{0}C
T_1	19.571 ^{0}C
T_2	~19.5 ^{0}C

ii)

T_s	21.00 ^{0}C
T_r	21.00 ^{0}C
T_1	20.417 ^{0}C
T_2	20.42 ^{0}C

iii)

T_s	22.00 ^{0}C
T_r	22.00 ^{0}C
T_1	21.341 ^{0}C
T_2	21.35 ^{0}C

iv)

T_s	23.00 ^{0}C
T_r	23.00 ^{0}C
T_1	22.252 ^{0}C
T_2	22.26 ^{0}C

v)

T_s	24.00 ^{0}C
T_r	24.00 ^{0}C
T_1	23.258 ^{0}C
T_2	23.29 ^{0}C

vi)

T_s	25.00 ^{0}C
T_r	25.00 ^{0}C
T_1	24.223 ^{0}C
T_2	24.31 ^{0}C

vii)

T_s	26.00 ^{0}C
T_r	26.00 ^{0}C
T_1	25.241 ^{0}C
T_2	~25.26 ^{0}C

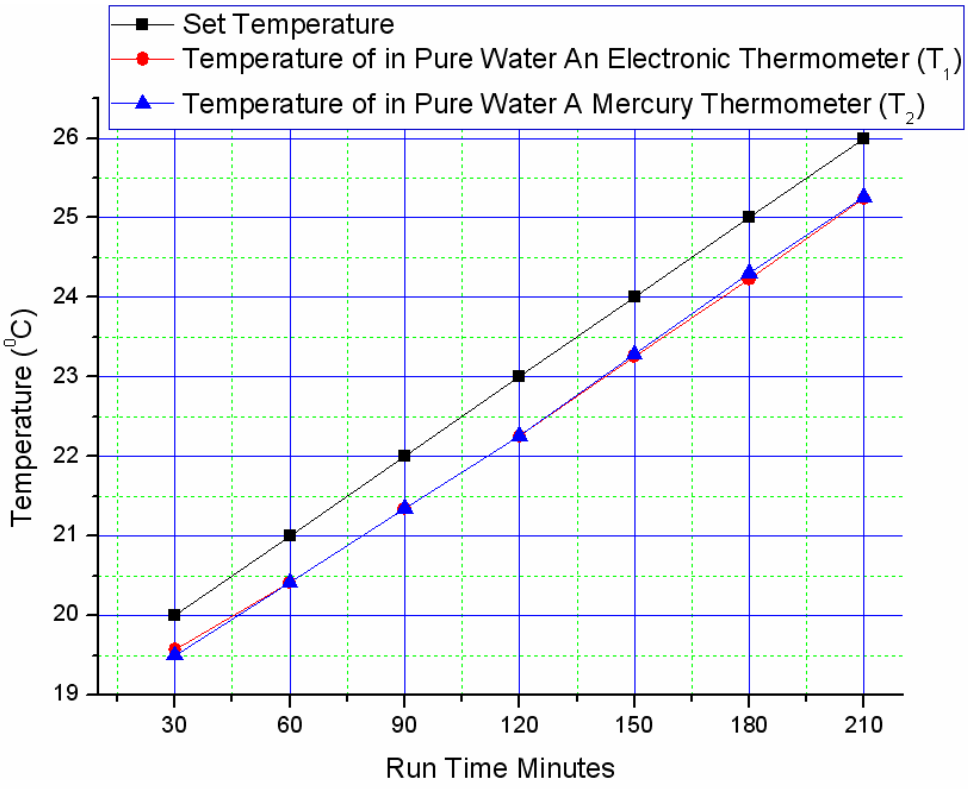


Figure-8

Results and Discussion

A) The Temperature Calibration of Haake F8 Bath with a Mercury-in-glass Thermometer ;

The pure water by using C25 which is temperature control bath and this water temperature values were measured every half an hour from 20^0C to 26^0C increasing of one celcius degree with Haake F8 system. Also, the same measurements were made for weather temperature with reference mercury thermometer at the room temperature. The weather temperature invariable was observed. A mercury thermometer and temperature-depending on time of tuning graph which had interval inside of measurements of pure water was shown in figure 1. According to figure 1, values of temperature measuring from mercury thermometer was observed average different of half ^{0}C without interval temperature of 20 ^{0}C. This measurement must be count good measurement.

B) The Temperature Calibration of Haake F8 Bath with Two Mercury-in-glass Thermometers ;

At the second step; the values of temperature were measured between 20^0C- 26^0C soaking the deep using by two mercury thermometers. Two mercury thermometers and temperature-depending on time of tuning graph which had interval inside of measurements of pure water was shown in figure 2. According to figure 2 this graph, measuring values of mercury thermometers were observed coherent with together and had very little difference adjustable temperature values.

C) The Temperature Calibration of Haake F8 Bath with ALMEMO 2690-8 Electronic Thermometer ;

1-a) For a cubic cup was made same measurements between 20^0C- 26^0C temperature values. The measurement would be in the pure water bath where was entering water using by ALMEMO 2690-8 electronic thermometer instead of mercury thermometer. The measurement of ALMEMO 2690-8 electronic thermometer in the pure water and temperature-time graph of tuning interval was shown in figure 3. According to this graph, at first step; temperature values of measurement from mercury thermometers were observed different from adjustable temperature values. This difference can be confided correlated to using different cups. Cubic cup larger than cylinder cup. Also the cubic cup has more excess contacting surface than the cylinder cup with weather.

1-b) The same measurements were taken center of the pure water inside of the cubic cup. The measurement of ALMEMO 2690-8 electronic thermometer in the pure water and temperature-time graph of tuning interval was shown in figure 4. According to this graph, entrance of the pure water and center of the pure water inside of the cubic cup values are nearly together and for an adjustable temperature value is approximately the same.

1-c) The same measurements were taken outlet of the pure water . The measurement of ALMEMO 2690-8 electronic thermometer in the pure water and temperature-time graph of tuning interval was shown in figure 5. According to this graph, entrance of the pure water and center of the pure water inside of the cubic cup values are nearly together without 26^0C and for an adjustable temperature value is approximately the same.

2) The same measurements were taken in front of the outlet of the pure water, center of the pure water and in front of the inlet of the pure water inside of the cubic cup at the same time. The measurement of ALMEMO 2690-8 electronic thermometer in the pure water and temperature-time graph of tuning interval was shown in figure 6. According to this graph, entrance of the pure water ,center of the pure water and outlet of the pure water inside of the cubic cup values are compatible with together without 26^0C and for an adjustable temperature values are observed different average half ^{0}C.

3) The same measurements were taken using ALMEMO 2690-8 electronic thermometer pure water bath inside of the cubic cup, inlet and outlet of water points without linearity parts. The measurement of ALMEMO 2690-8 electronic thermometer in the pure water and temperature-time graph of tuning interval was shown in figure 7. According to this graph, measuring temperature values of inlet and outlet of water points without linearity parts are observed compatible with together and had very little difference with adjustable temperature values.

D) The Temperature Calibration of Haake F8 Bath with ALMEMO 2690-8 Electronic Thermometer and Mercury Thermometer ;

The same measurements were taken center of the pure water using by ALMEMO 2690-8 electronic thermometer and mercury thermometer. The measurement of ALMEMO 2690-8 electronic thermometer and mercury thermometer in the pure water and temperature-time graph of tuning interval was shown in figure 8. According to this graph, measuring values of center of cubic cup were observed coherent with together and had very little difference adjustable temperature values. Temperature values of ALMEMO 2690-8 electronic thermometer and mercury thermometer were observed the same with together.

Reference

[1] Instruction Manual F8 and N8 Cirulator including all Baths (V 1.56)
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