Manual
TV7000LT

Tamson Instruments bv

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1 SAFETY AND WARNINGS

Make sure before installing or operating the equipment to read and understand all instructions and safety precautions listed in this manual. If there are any questions concerning the operation of the equipment or about the information given in this manual, please contact your local dealer or our sales department first.

Performance of installation, operation, or maintenance other than those described in this manual may result in a hazardous situation and may void the manufacturer's warranty.

Never operate equipment that is not correctly installed. Unqualified personnel must not operate the equipment. Avoid damage to the equipment, or its accessories, caused by incorrect operation.

Important:

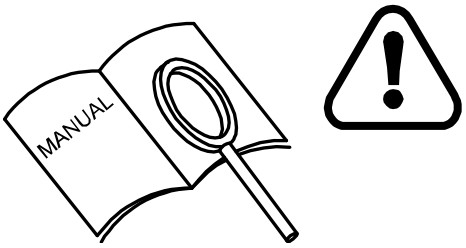
- When performing service, maintenance or moving the apparatus, always disconnect at the mains socket of the apparatus.
- Proper skilled and trained personnel are only allowed to operate this equipment.
- Take notice of warning labels and never remove them.
- Refer service and repairs to a qualified technician.
- If a problem persists, call your supplier or Tamson Instruments b.v.

2 WARRANTY

Tamson Instruments b.v. warrants that all their manufactured equipment is free from defects in material and workmanship preventing the machine from normal operation. Tamson Instruments bv does not warranty that the equipment is fit for any other use than stated in this manual. The manufacturer can only be held responsible for the security, reliability and performance of the equipment when operated in accordance with the operating instructions, extensions, adjustments, changes and/or if repair is performed by Tamson Instruments b.v. or authorized persons only. This warranty is limited to one year from the date of invoicing. All equipment and materials are subject to standard production tolerances and variations.

3 PRECAUTIONS AND HAZARDS

Before attempting to operate the bath read all parts of this manual carefully to ensure proper operation and avoid damage to the equipment or its accessories.



If a malfunction occurs consult the section trouble shooting found on page 24 of this manual. If the problem persists, call your supplier or Tamson Instruments b.v.

Never operate the equipment if not correctly installed. The equipment must be operated only by qualified personnel. Avoid damage to the equipment or its accessories through incorrect operation.

Use temperature and chemical resistant protection material when operating the bath.

Preventing overflow. Use chemical and temperature resistant materials.

Prevent dangerous fumes or vapour and use appropriate ventilation. Methanol vapour can cause explosion hazard.

Do not move apparatus when filled.

Do not place apparatus and waste container in walking area when operating.

Use appropriate bath liquid.

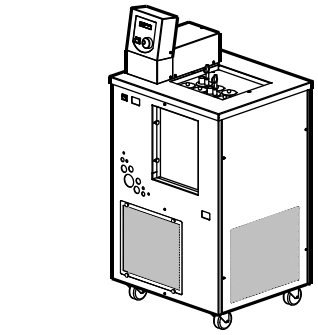
4 INSTALLATION

4.1 Important

Tamson Instruments b.v. is not responsible for any consequential damage or harm caused by using this bath. Repairs on the electrical system of the bath may only be carried out by well trained and authorized persons.

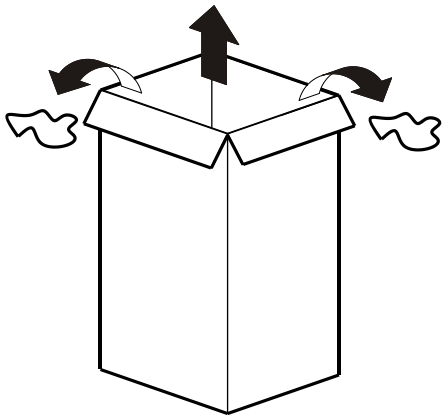
4.2 Tilting

Before unpacking inspect the tilt watch located on the outside of the packing. When the tilt watch indicates a red color contact Tamson instruments and the forwarder before continuing with unpacking.



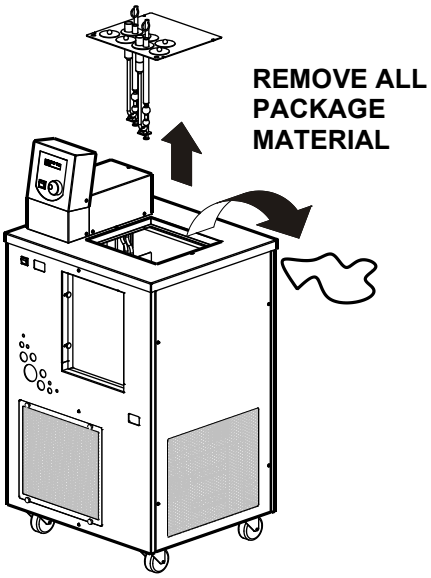
4.3 Unpacking

Before leaving the factory Tamson baths are adequately packed to prevent damage during normal transportation. Check the packing for external damage and make a note on the shipping documents if any damage is found. Always retain the cartons and packing material until the bath has been tested and found in good condition. (Transport companies generally will not honor a claim for damage if the respective packaging material is not available for examination).

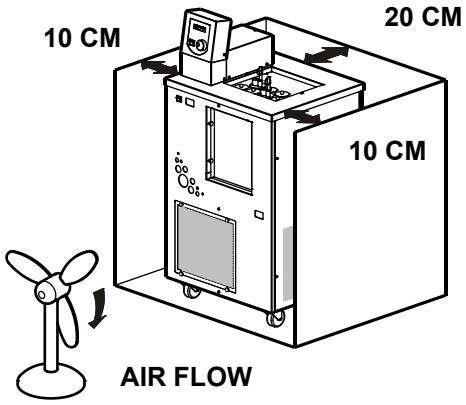


The shipment contains at least the bath as mentioned in the delivery checklist. Further the consignment might contain one or more viscometers which should be individually packed in small boxes with the calibration certificate included in the box, as well as ASTM thermometers, thermometer holders, etc. Please see the packing list for details concerning total contents of consignment.

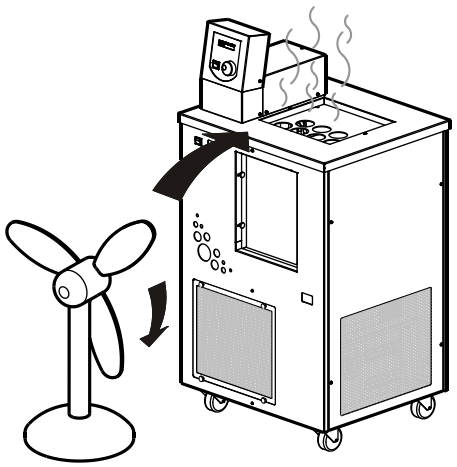
Before filling the bath remove any remaining packing material from its interior. The interior of the bath can be accessed by taking off the lid on the top of the bath.



4.4 Placement and ventilation

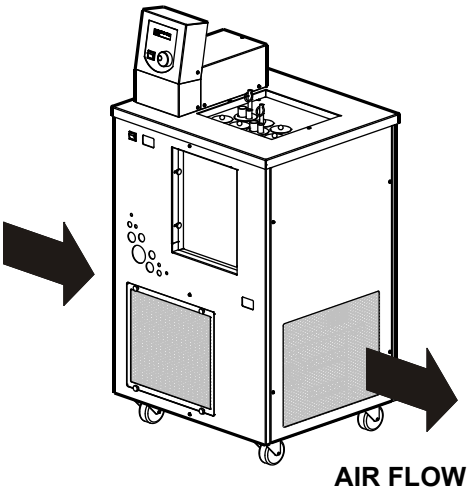


Air circulation has to be enabled by 10 cm of free space at both sides and 15 to 20 cm at the rear of the bath.



The bath has to be placed in a well ventilated area.

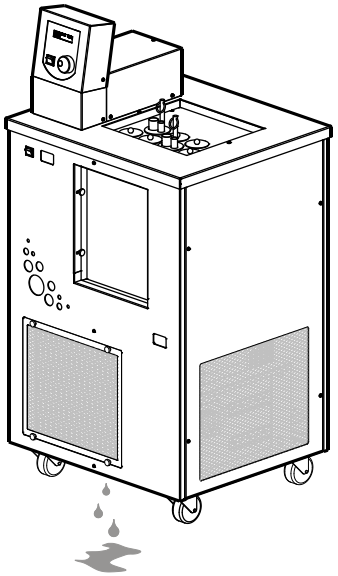
Airflow
Air must pass the apparatus freely. The air transports the heat from inside the apparatus to the environment. When airflow is blocked the apparatus will not perform to its specifications and it may harm the equipment or even cause mechanical damage.



AIR FLOW

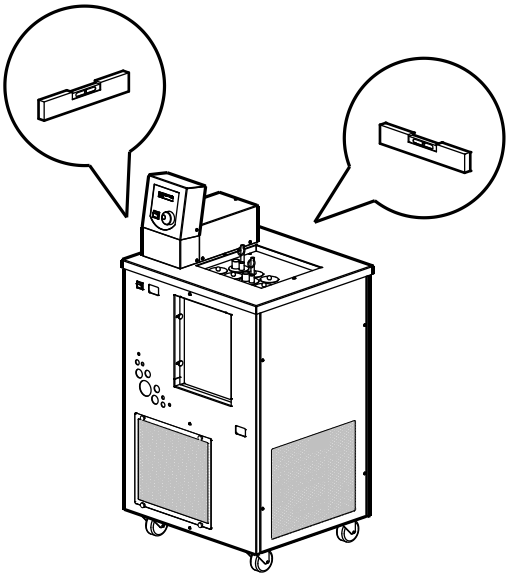
Dust
Do not place the bath in a dusty environment. Dust will block the condenser unit inside the apparatus which will lead to severe mechanical damage.

Regularly check the apparatus and condenser unit for dust. Remove dust with a vacuum cleaner. Do NOT remove dust with compressed air.



Leaking
Inside the bath the cold parts condensate and ice can be build. When the apparatus is switched-off this melt water may leak onto the floor. Do not place the apparatus on a floor which can be damaged by this melt water. The amount of water is limited to a few mL/hr.

4.5 Initial use

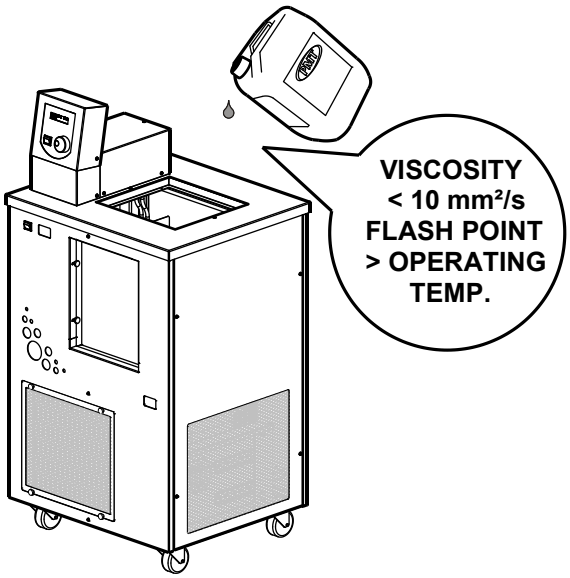


Due to transportation allow the bath a 24 hour period for stabilization. This applies also when the apparatus has been tilted or fallen.

Do not switch on power, because lubrication-oil inside the compressor system has to run into the capillary.
It will take several hours before the oil has flown back into the compressor unit. When the apparatus is immediately turned on after it has been tilted, severe damage may occur to the compressor unit due to insufficient lubrication.

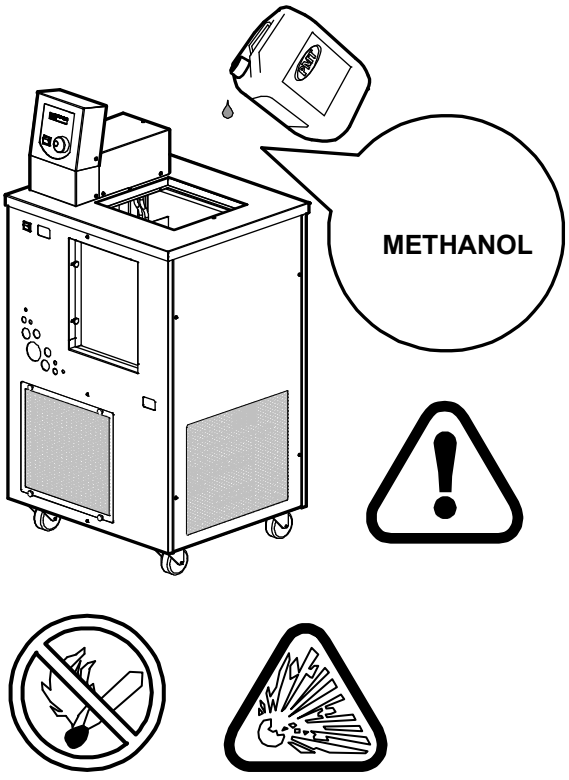
4.6 Bath liquids

The bath must be filled with a liquid suitable for the minimum operating temperature.



It is very important to select a liquid with a viscosity preferably less (e.g. 3 mm²/s) at the operating temperature and a flash point which is well above the operating temperature.

The best bath liquid to be used is methanol, enabling circulation at very low temperatures.



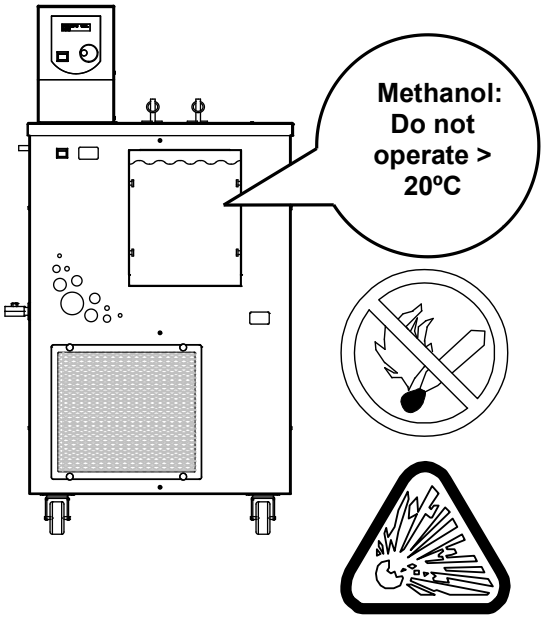
Methanol is extremely flammable and can cause fire hazard. Take all necessary precautions to reduce fire hazard.
When using methanol all vapors must be removed by using appropriate air ventilation.

Methanol is toxic and can cause health risks. Use appropriate ventilation and other precautions to prevent inhaling toxic vapors. If ventilation is insufficient the risk of explosion hazards can occur!

The supplier of the bath liquid (methanol) will be able to hand over all chemical details and safety precautions related to the use of methanol. These precautions must be followed when operating the bath.

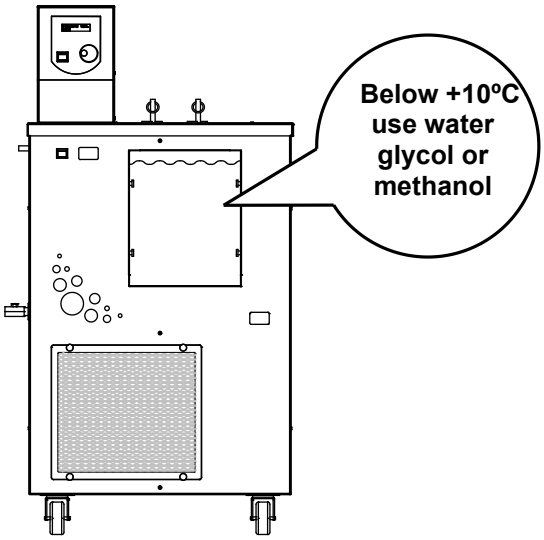
Extreme HAZARD
Do not use methanol at temperatures above 20°C. The methanol will vaporise and cause toxic and flammable vapours. Explosion hazard can build up in or around the bath

When working at temperatures above 20°C, oil or water can be used as an alternative.



Water, water-glycol, mineral or silicone oil also are liquids applicable to use in this bath.

Do not use distilled water. Distilled water can cause corrosion to the stainless steel inner bath and its parts. Filtered water from reversed osmoses apparatus can be used without problem.

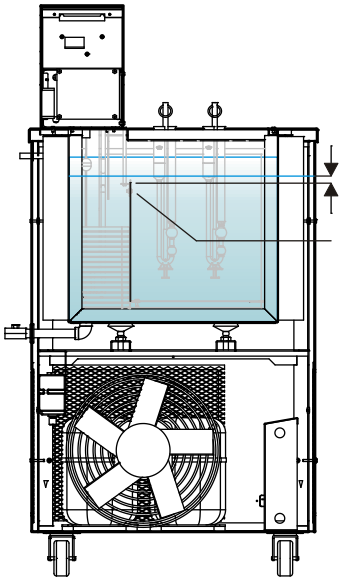


4.7 Bath fluid level

4.7.1 Minimum level

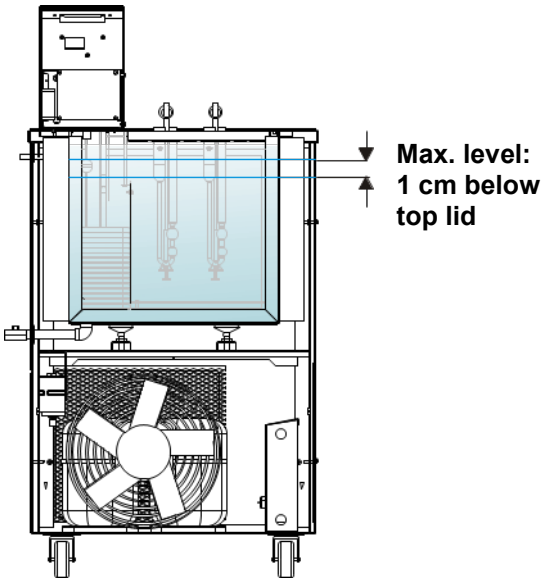
The minimum fluid level is just above the baffle plate. When fluid level is lower than the baffle plate circulation will be insufficient causing instability and non homogeneousness of the fluid temperature .

The level indicator on the front panel will start to blink (blue light) when the fluid level is too low.



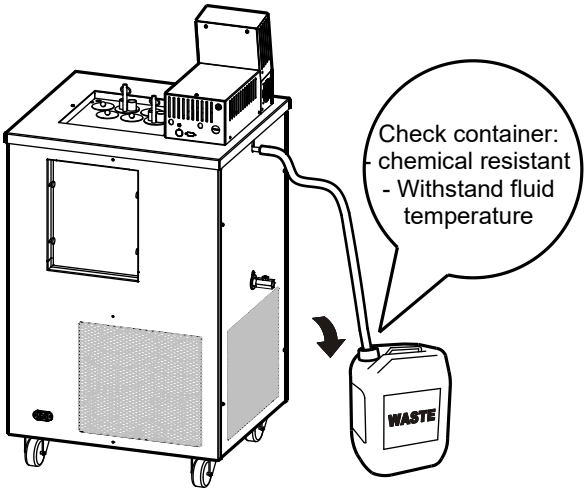
4.7.2 Maximum level

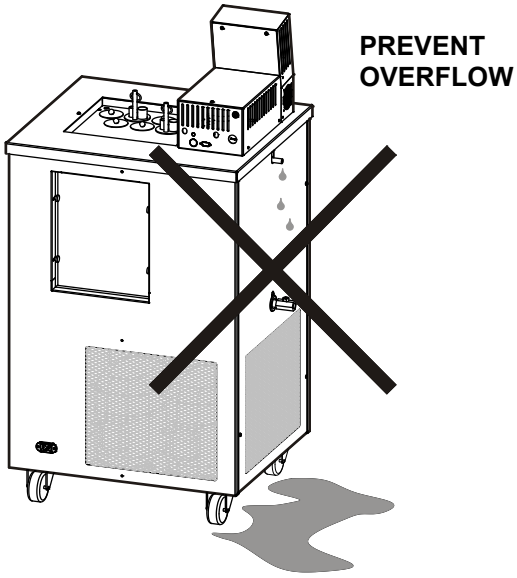
Caution:
When using methanol one must be worn that the fluid shrinks dramatically when cooled down. If the bath is filled at these low temperatures up to its maximum level the bath will overflow when heating up.



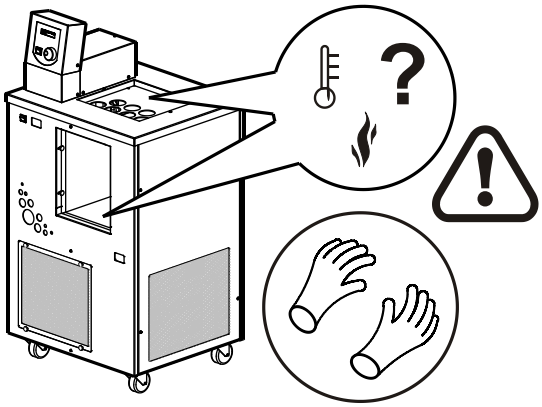
If the fluid level is too high, it will leave the bath via the overflow outlet (10mm outer diameter pipe) placed on top on the left hand side of the bath. When a hose is connected to this overflow drain, the expanded methanol can flow back into the connected waste container or jerry can.

Pay attention to following:
- Use chemical resistant materials (hose and container (jerry can),
- Use appropriate indication on jerry can,
- When working at higher temperatures use temperature resistant materials,
- Prevent fumes from escaping,
- Do not place the container in the walking area but storage space next to the apparatus.





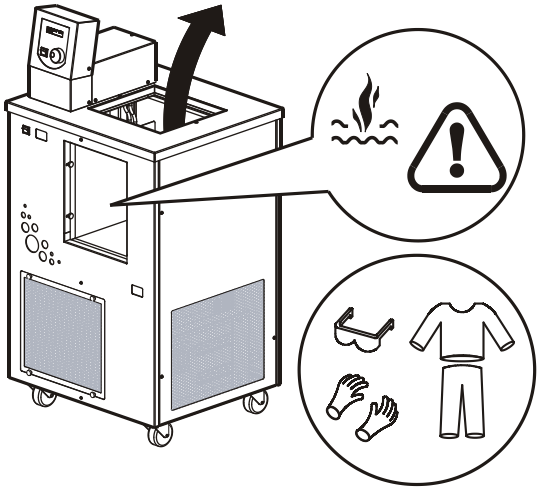
When operating at high temperatures the lid (of the bath), top plate and the window section of the bath become very hot. Always use heat protective gloves. Care must be taken when placing or removing material from the bath.



WEAR HEAT PROTECTIVE GLOVES

Pay attention when removing hot fluid:

Use heat protective clothing and wear gloves and safety glasses.

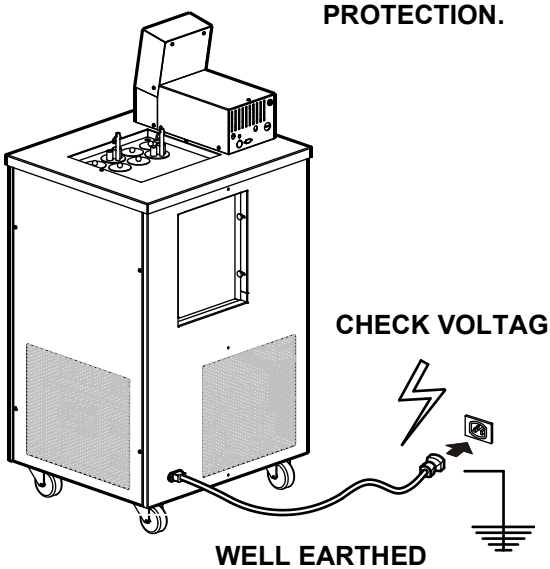


WEAR PROTECTIVE GLOVES , CLOTHING AND EYE PROTECTION.

4.8 Connecting

Before plugging TV bath into mains socket, make sure the voltage of the bath corresponds to the local voltage and frequency.

Use a mains supply that is well earthed, clean of interference and suitable for the acquired electrical load of the bath.



CHECK VOLTAGE

WELL EARTHED

5 INTRODUCTION

5.1 General

The TV7000LT apparatus basically consists of a combination of a cooling system and microprocessor controlled heating element. The design ensures a high degree of accuracy and reproducibility of temperature control.

5.2 Construction

The TAMSON baths are constructed entirely from corrosion-resistant materials such as stainless steel and brass. The bath is effectively insulated against heat loss by a layer of Armaflex® rubber between the inner tank and outer casing and the use of two multilayer thermo-pane windows.

5.3 Circulator

The stirrer is built-in to guarantee an uniform temperature distribution within the bath (see “Technical specifications” page 28)

5.4 Temperature control and setting

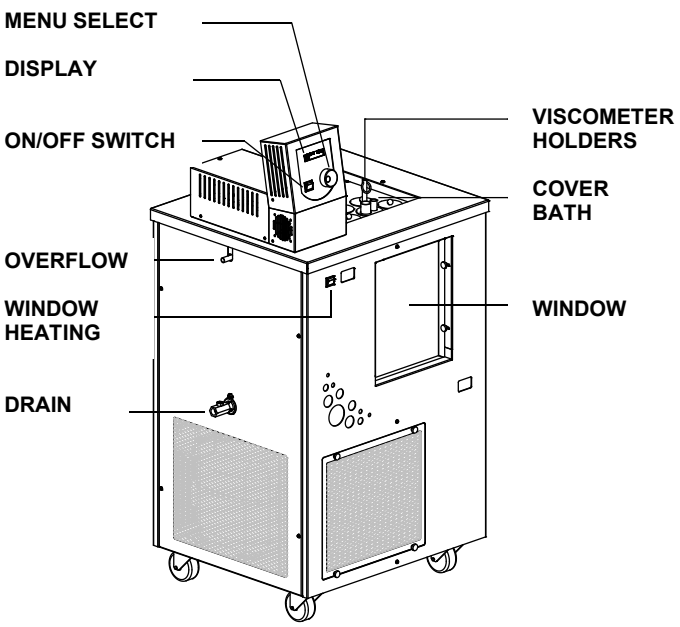
The bath temperature is regulated using a PT-100 temperature probe Class A connected to a microprocessor module. The advanced electronic control system continually computes the energy input required for optimal temperature accuracy and stability. Temperature read-out is on a LCD display. The actual set point is computed within the controller with a relative accuracy of 0.001°C. For further details about accuracy and range see "Technical specifications" page 28.

The heat removal (cooling) is automatically selected from the set-point temperature setting.
The set-point temperature in the selected range than can be set on the controller with it’s blue front, see “Menu item "Setpoint"” page 17.

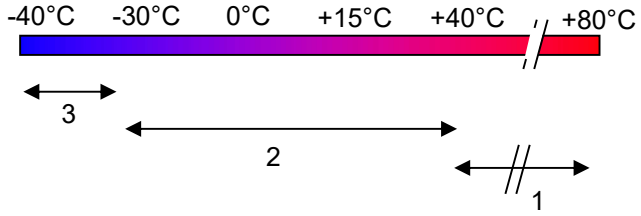
To obtain an energy friendly control of the temperature the cooling has been split in four stages:

1 Heating only, no cooling,
2 Energy saving cooling capacity (compressor running, TEV used to cool down, Capillary used when tuning and controlling),
3 Full cooling capacity (compressor running and TEV - long),

As the set point temperature is controlled by heating against the heat removal, it is obvious that by limiting the cooling capacity this way of control is more energy friendly than conventional systems. If full heat removal capacity is used at 0°C over up to 3 kW of heating should be applied, instead of the current 300 Watt.

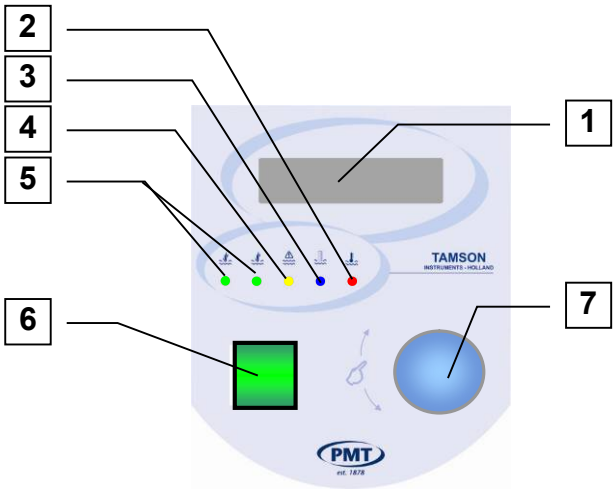


Automatic selection of heat removal



5.5 Front panel layout

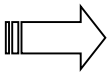
Item	Description	Function
1	LCD Display	Shows bath parameters
2	LED (red)	Over temperature indicator
3	LED (blue)	Level indicator
4	LED (yellow)	Error
5	LED (green)	Heater indicator
6	Switch	Mains switch
7	Button	Turn-push button



The front panel layout shows the turn-push button:

Next / increase: Turn right 

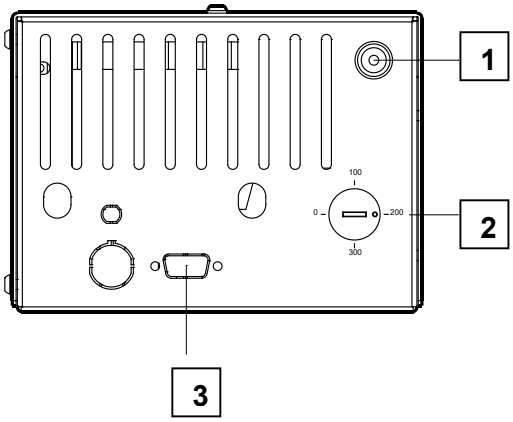
Previous / decrease: Turn left 

Select: Press 

5.6 Backside apparatus

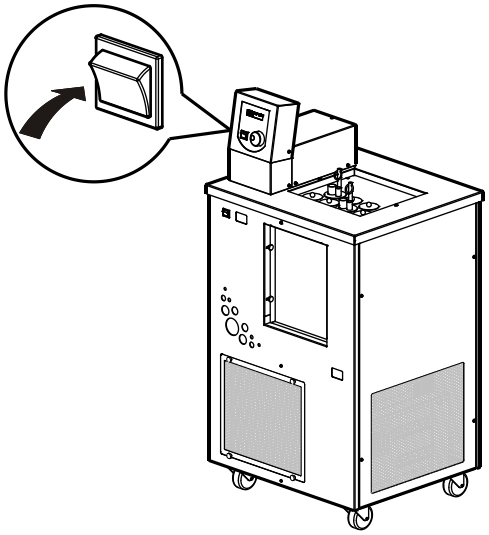
On the top - backside of the bath following can be indicated:

1: Motor fuse
2: Safety thermostat (overtemperature protection)
3: RS232, female



6 OPERATING THE BATH

When the bath is ready for use it can be switched on by pressing the mains switch. The bath will initialise and calibrate itself.



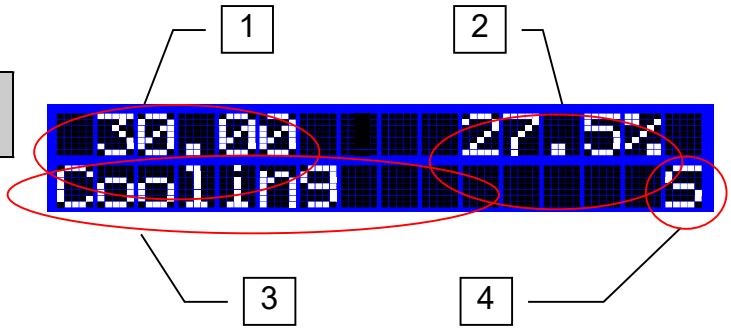
6.1 Overview menu items

Setpoint
- Offset (press: <-5.00 .. +5.00°C resolution 0.01°C)
- Max Power (press: low 25, med, hi, max)
- Boost heater (press on / off)
- Time const (press: fast, medium slow, precise)
- Stirrer
- Low alarm
- High alarm
- PID parameter (PID set 1, PID set 2. PID set 3, PID set 4)
  - Proportional band
  - (Pb=1/P where P is proportional value)
  - Integral
  - differential
- Backlight
- Temp units
- Baudrate
- Restart

6.2 Safety thermostat

When the bath temperature becomes higher than the set point temperature of the safety thermostat. The heating electronics and controller are switched-off. The red LED on the display will light. When the temperature of the bath has been lowered with approximately 20°K, the thermostat re-sets itself automatically, however to continue normal operation the bath has to be switched off and on again.

When switching off wait 5 seconds before switching on again.



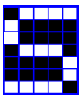
6.3 Display

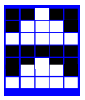
1 Temperature readout
2 Applied percentage of power
3 Operating mode
4 Indicator, alarm high, alarm low, control stable

Ad 1: When the controller starts or is restarted, the displayed value increases to a stable readout appears after a few seconds.
Ad 2: The controller calculates every second the amount of power which should be applied for stable control. The value is displayed with a resolution of 0.1% and ranges from 0% to 99.9%.

Ad 3:	Boost	Bath is heating to set point using boost heater
	Heating	Bath is heating to set point, boost heater is off
	Cooling	Bath is cooling down to set point
	Tuning Ratio	Bath is tuning for power needed at set point, first step
	Tuning SA	Bath is tuning, second step
	PID SP=25.00	Bath is controlling, set point is 25.00°C (example)

Ad 4:

- Bath control is stable 

- Alarm high, press button to reset 

- Alarm low, press button to reset 

6.4 Window heating

The TV7000LT has heated windows to prevent build up of condensate. The heating is thermostat driven and kept around 50-49°C. If heating is off and the inner bath cooled down, the outside window also will drop in temperature forming a cold surface. This surface quickly will be covered with condensate blocking the visibility.

Window heating can be switched on or off separately from the TV-LT system. When the window heating is on, the green lamp of the switch will light.

6.5 QUICK START

To start operating the bath in a quick way do the following:

Fill the bath with liquid as indicated, place the power plug, connect to mains socket, switch-on the bath, using the mains switch, select appropriate set point.

PID settings
All measuring results have been acquired using following PID settings:

Pb := 25
I := 16
D := 0

Under different settings its possible to achieve even better values by trimming the PID settings.

7 Menu items

Use the turn-push button to select a menu item and select the item by pressing the button. After pressing a sign appears next to the value indicating the value can now be changed. Pressing the button again activates the value immediately. When the value is altered but the button is not pressed the value will be accepted and stored after 5 seconds automatically. The menu returns back to normal operating mode.

7.1.1 Menu item "Set point"

Select the set point temperature. Resolution is 0.01°C +/- the system accuracy.

There bath can be cooled down more rapidly by entering the minimum set point of -40°C. Both compressors are than switched-on and the systems cools down fastest. When the bath has reached a temperature just below the desired SP, set the new SP. For example if the bath is running at 40°C and the operator wants to lower the temperature to 5°C. Set the SP to -40°C. When the unit has reached 4°C set the new SP to 5°C. The unit will than heat and get stabilised around 5°C.

Care must be taken when using water as bath fluid as there is a risk of freezing.

The reason for following this procedure is technical and is caused by the way the cooling capacity is adapted over the temperature span of the bath.

If the unit does not get stable, please have a look at the PID parameters. These settings are explained in the manual. Standard values are 25, 16 0. If the unit fluctuates too much try to increase the P to 50 or 100 and the I to 50.

To get stable temperature control with small variations is a secure procedure and may take effort to realise.

7.1.2 Menu item "Offset"

The temperature displayed can be increased or decreased with an offset ranging from +5.00 down to -5.00 in steps of 0.01°C.

The offset will synchronise the bath temperature readout with an independent separate thermometer.

If there remains an offset try to decrease the P down to 2 (instead of 25). The offset is due to the PID setting and depends on the applied power percentage. When the power percentage is below 15% the P value must be lower than 25, i.e. 10.

7.1.3 Menu item "Max Power"

(press: low, med, hi, max)
Limits the applied power by a maximum value:

Low	Maximum of 25% applied
Medium	Maximum of 50% applied
High	Maximum of 75% applied
Maximum	100% power is applied

Limiting the power can be used to lower overshoot temperature..

7.1.4 Menu item "Boost heater"

A secondary heater is used to quickly heat up the bath. This menu item enables or disables the boost heater.
Standard value: On

7.1.5 Menu item "Time const"

Used to select time to tune. The option precise has to be used to reach maximum temperature accuracy. Options are:

- Fast	60 seconds
- Medium	120 seconds
- Slow	180 seconds
- Precise	240 seconds
Standard value:	Precise

7.1.6 Menu item "Stirrer" (optional)

Optional: Stirrer 0 .. 100% (step 6%). Inactive

7.1.7 Menu item "Low alarm" (optional)

Optional: min SP to max SP. resolution 0.1°C.
No hardware connected, display function only.

7.1.8 Menu item "High alarm" (optional)

Optional: min SP to max SP. resolution 0.1°C.
No hardware connected, display function only.

7.1.9 Menu item "PID parameter"

PID set 1	-	
PID set 2	-	deactivated
PID set 3	-	deactivated
PID set 4	-	Activated when communication via RS232

Each set offers individual PID settings for:
- Proportional band value
- Integrating value
- Differentiating value

Default settings

Pb*	:=	25
I	:=	16
D	:=	0

*Pb= proportional band. Proportional value P is found to be 100/Pb.

If there remains an offset in the temperature readout try to increase the I to 25 or 50. The offset is due to the PID setting and depends on the applied power percentage. An offset of 0.1°C can be adjusted with the offset value available in the menu or when increasing the PID integrator value to 25 or 50.

7.1.10 Menu item "Backlight"

On
Off
Standard value: On

7.1.11 Menu item "Temp units"

°C
°F
Standard value: °C

7.1.12 Menu item "Baudrate"

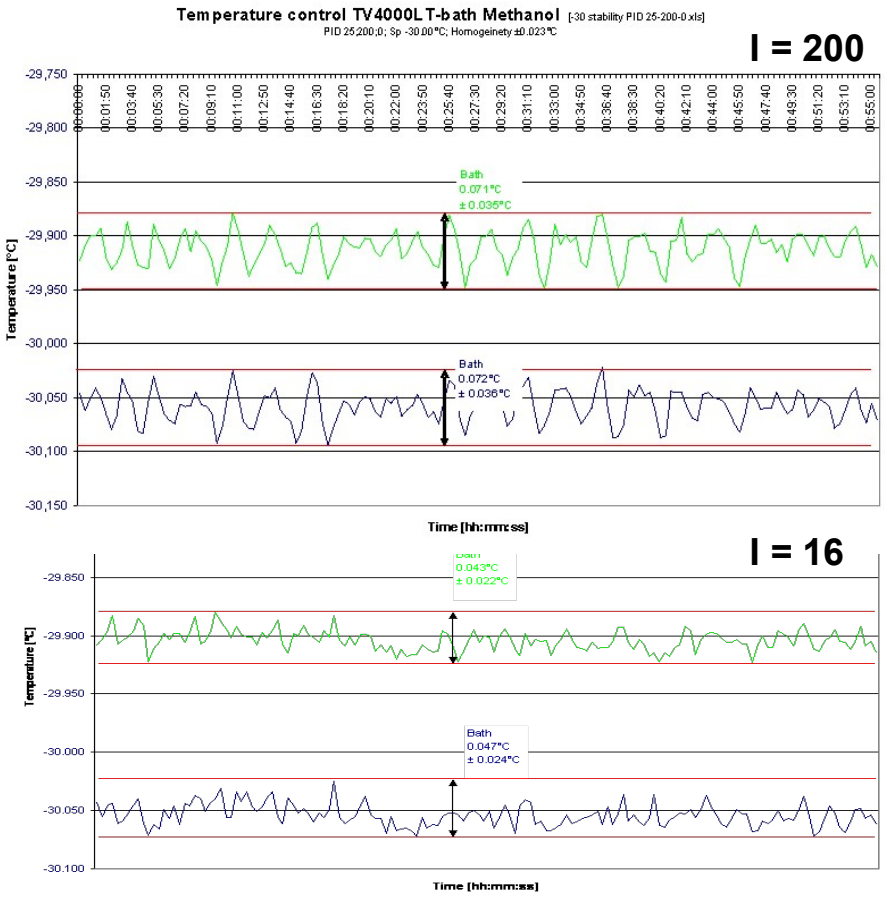
300
600
1200
2400
4800
9600
19200
38400
Standard value: 9600

7.1.13 Menu item "Restart"

Restarts system and activates tuning

7.2 PID configuration

The two graphs below show the influence of the integral setting. The graph on top has a setting of 200 for the integral parameter. The bottom graph has a setting of 16. The value of 200 causes less stable control.



7.3 Manual tuning

The temperature control of the bath is based on a digital PID system. When using different fluids in the bath each with their own heat capacity, the use of external cooling and external connected processes(circulation), or working at different set point temperatures requires new settings of the PID parameters. These parameters have to be optimised after changes to the system when optimal and accurate temperature control of the bath liquid is required.

Tuning of the bath results in:

- Stable temperature control of the bath,
- No over- or undershoot of the temperature set point,
- Quick response to deviations from the set point caused by external disturbances.

Tuning can be done automatically or manually.

Parameter	Description	Display
Proportional band	The bandwidth in display-units over which the output power is proportional between minimum and maximum	Prop
Integration time	Determines the time taken by the controller to remove steady state error signals	Integ
Derivative time	Determines the time taken by the controller to react on error signals.	Diff

Table 1 Parameters influencing the temperature control

8 MAINTENANCE

8.1 Drain bath liquid

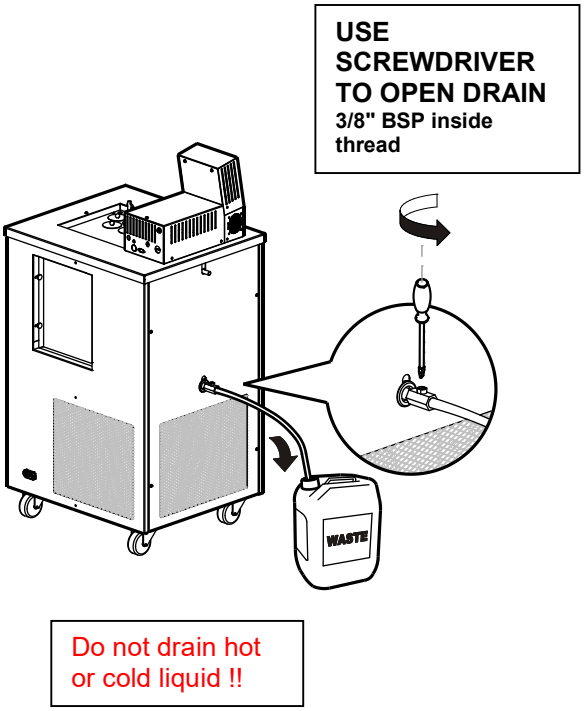
The bath can be emptied via the drain tap located at the left side of the apparatus. For safety reasons the tap can only be opened by using a screwdriver. The thread inside the tap is 3/8".

Take necessary precautions against fire hazard when removing flamable bath fluid.

When removing bath fluid do not inhale toxic vapor. Always use appropriate ventilation.

Handle old bath fluid as toxic waste.

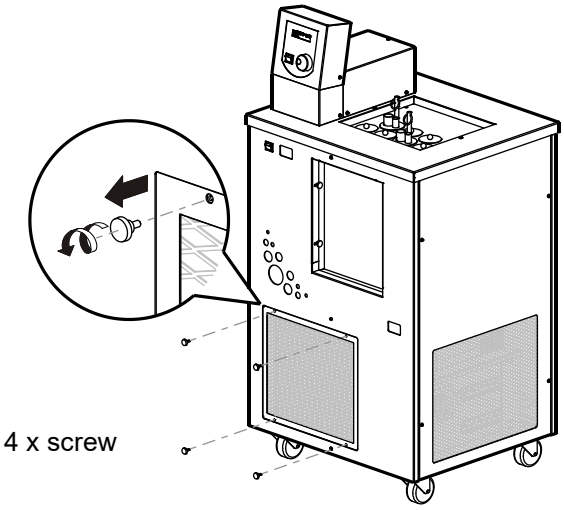
Cool down or heat bath fluid to ambient before removing.

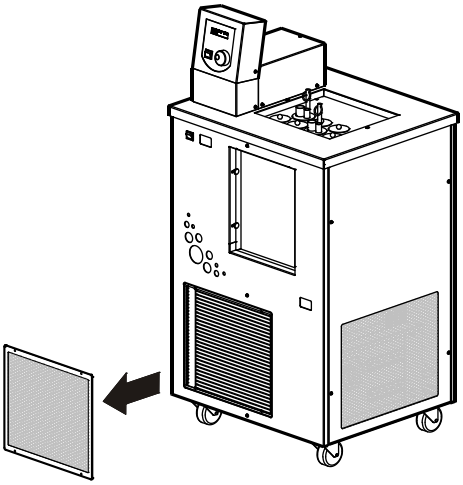


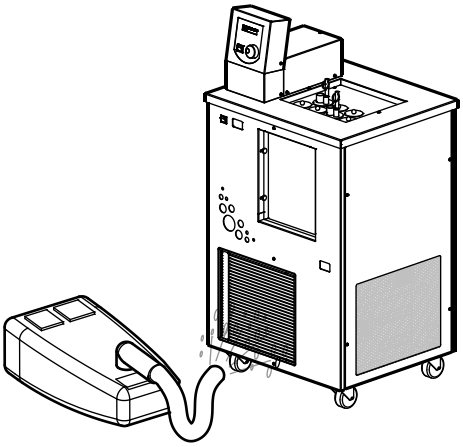
8.2 Cleaning

Regularly check the apparatus and condenser unit for dust. Remove dust with a vacuum cleaner.
Do NOT remove dust with compressed air.

Remove the front panel. Use a vacuum cleaner to remove dust.







9 TROUBLE SHOOTING

9.1 The motor, compressor and lamps are dead.

-Check the main voltage and all electrical connections, including switches.

-Check fuse in wall socket of mains supply.

-Check the safety thermostat. See “Safety thermostat” page 15.

9.2 Motor is not running, lamps and electronics operate (the motor turns freely by hand).

-Motor overloaded. The motor protection may trip because of mechanical overload. Reset the fuse by pushing button on rear side of the motor housing.

-The motor capacitor is defective. Replace motor capacitor inside the system.

-Malfunctioning wiring. Check wiring.

9.3 Compressor makes “clicking” noise

-Bath has been switched on and off to quickly. Wait approximately 10 minutes before switching on again. The clicking noise is a temperature fuse inside the compressor preventing it from overheating.

-Clean the condenser unit and make free from dust. Air must pass the inside of the unit freely.

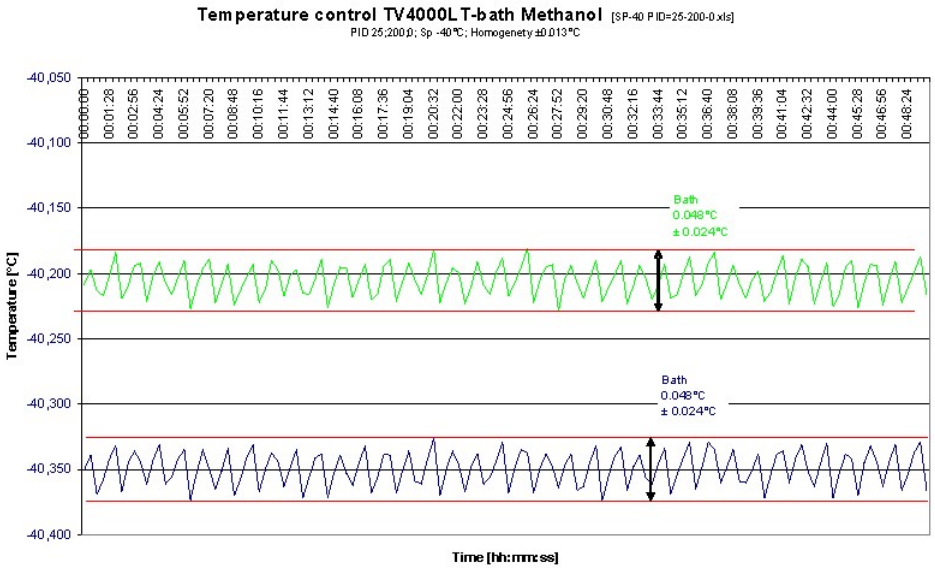
9.4 Compressor will not start

When the machine has been switched off the pressure in the cooling circuit can rise to a high level. For this reason the apparatus has to settle the pressure of the cooling liquid for a few minutes before it can be restarted.

When this problem occurs more often it will indicate that dust is blocking the condenser circuit. Clean the inside of the TV7000LT and remove all dust from the condenser unit and fan with a vacuum cleaner. Do not use pressurized air to remove dust. The flying dust particles can damage the fan bearings, are very unhealthy when breathed in and can lead to severe eye problems.

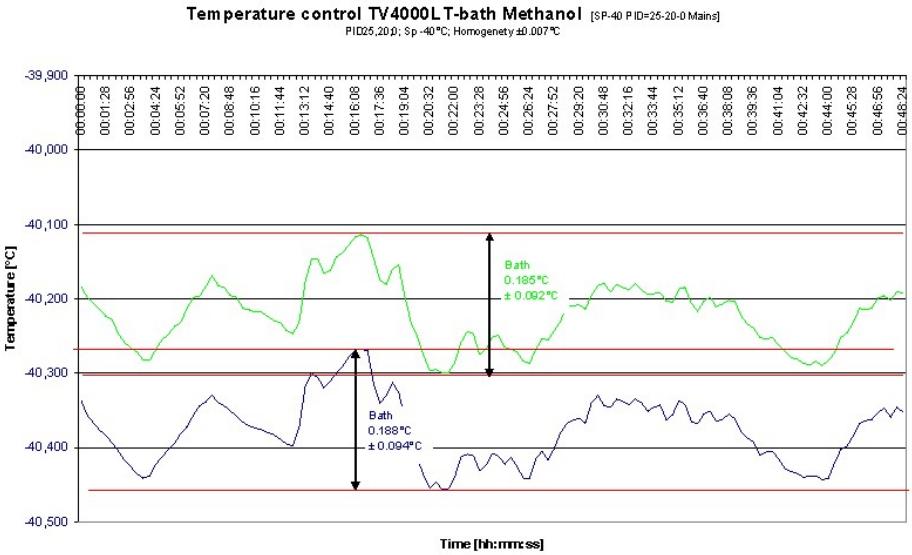
9.5 Temperature not stable

- Restart system (option from menu, see menu item "Restart" page 19)
- Place top lid on the bath.
- Check PID settings. When PID settings are incorrect the system can start to be unstable. Graph (SP-40 PID25-200-0) shows unstable control at -40°C due to a high setting of I=200. Lowering this value to 20 results into control of better than ±0.02°C



Standard PID setting:
Pb*=25
I=16
D=0
*Pb= proportional band. Proportional value P is found to be 100/Pb)

- System connected to RS232. PID settings “4” are used. Change settings with Tamcom to Pb=25, I=16, D=0.
- Check mains supply for stable power. Graph below shows heavy disturbance due to fluctuations in mains supply. Temperature accuracy is heavily disturbed by voltage fluctuations due to switching on and off heavy apparatus at mains supply. Previous graph(SP-40 PID=25-200-0) and graph below (SP-40 PID=25-20-0) are same apparatus.



9.6 Bath temperature does not drop

- Check set point setting (option from menu, see menu item "Setpoint" page 17)
- Restart system (option from menu, see menu item "Restart" page 19)

9.7 Faulty temperature reading / temperature offset

The temperature read out on the display does not correspond to the temperature measured.
-When the controller starts or is restarted, the displayed value increases to a stable readout appears after a few seconds.

- PT100 is defective
- PT100 has aged.
- Check offset in menu

9.8 Condensate building up on window

- Fuse window heating defective. Check fuse inside the system. Replace when defective
- Measure shortcut caused by condensate in heating elements.

9.9 Unit is leaking water

- Inside the bath the cold parts condensate and ice can be build. When the apparatus is switched off this leak onto the floor. Do not place the apparatus on a floor which can be damaged by this leakage. The amount of condensate water is limited to a few mL/hr

9.10 It takes long to reach the new bath temperature

- There is a possibility to cool down rapidly by entering the minimum set point of -40°C. Both compressors are switched on and the systems cools down fastest. When the compressor reached a temperature just 1 degree below the desired SP, set the new SP. For example if the bath is running at 40'C and the operator wants to lower the temperature to 5°C. Set the SP to -40°C. When the unit has reached 4°C set the new SP to 5°C. The unit will heat and stabilize around 5°C.

- When using water as bath medium care must be taken to prevent freezing.

- If the unit does not get stable have a look at the PID parameters. These settings are explained in the manual. Standard values are 25, 16 0. If the unit fluctuates too much try to increase the P to 50 or 100 and the I to 50.

9.11 Bath temperature doesn't equal set point temperature

- If there remains an offset on the display relative to the set point temperature, lower the proportional "P- value" down to 10 or 2. A relative large offset (0.1°C) can occur when applied power is below 15% and the proportional value too high (>2).
- Viscosity bath fluid to high. Viscosity should be lower that 3mm²/s at set point temperature. Using water and methanol have no problems concerning viscosity.

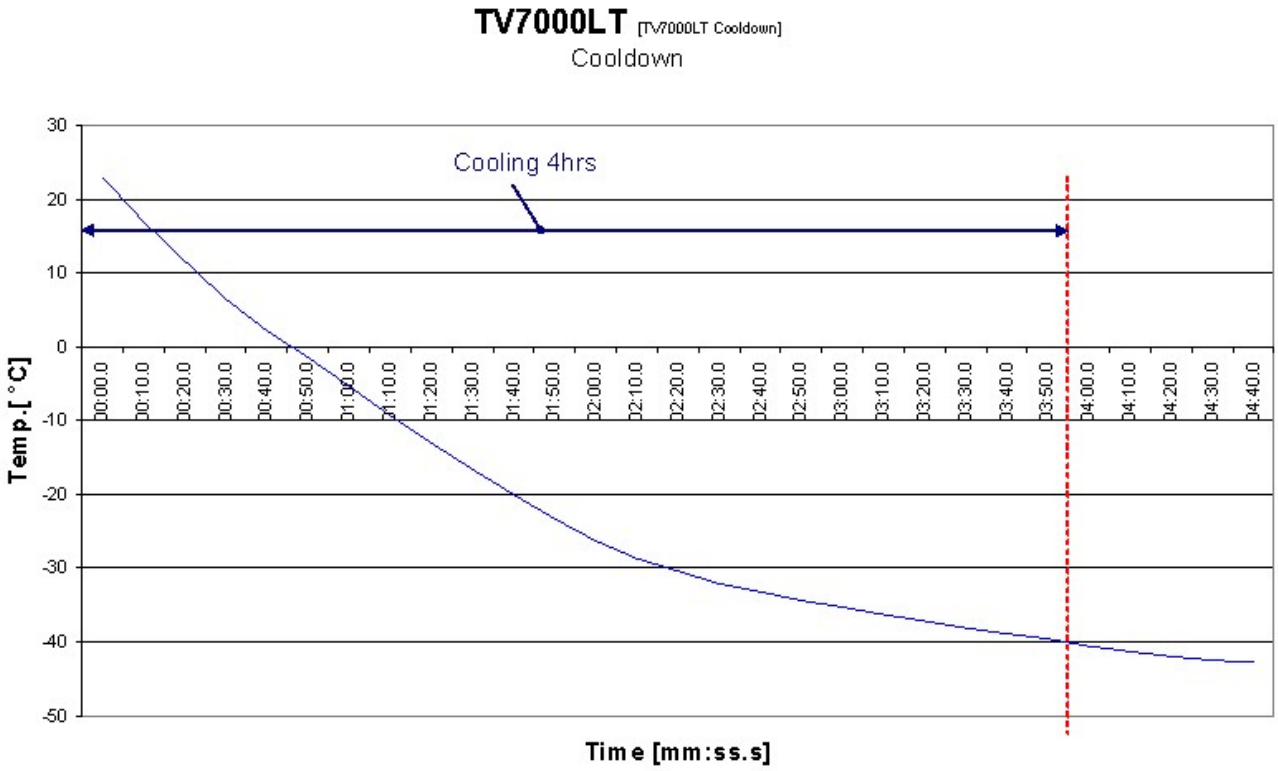
10 TECHNICAL SPECIFICATIONS

Item	Unit	TV7000LT
Temperature range	[°C]	-40 .. 100
Setting ±	[°C]	0,01
Stability* ±	[°C]	0,02
Uniformity* ±	[°C]	0,02
Temperature linearity full range	[°C]	0,2°C
Heating	[W]	1500W + 500
Heaters (combined)		2
Bath volume	[L]	70
Opening	[mm]	260 x 240
Depth	[mm]	600
Length	[mm]	500
Width	[mm]	680
Height	[mm]	1450
Weight	[kg]	120
Power	[Watt]	3500 Max
Voltage	[Volt]	230-50HZ
Noise (1mtr, average)	[dB]	61

* **Absolute** min/max value measured **over 1hrs** in methanol

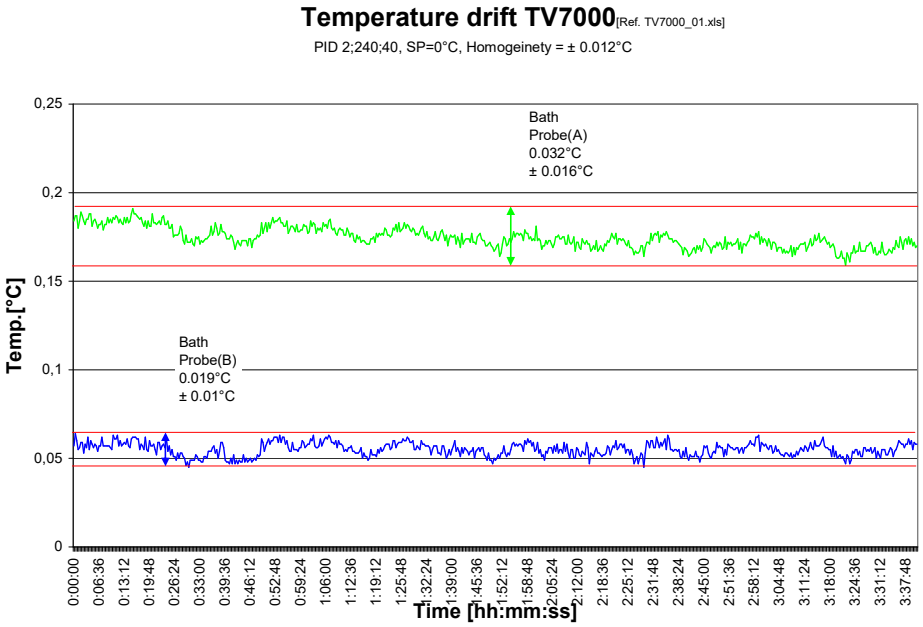
11 STABILITY TESTS TV7000LT

11.1 Cool down



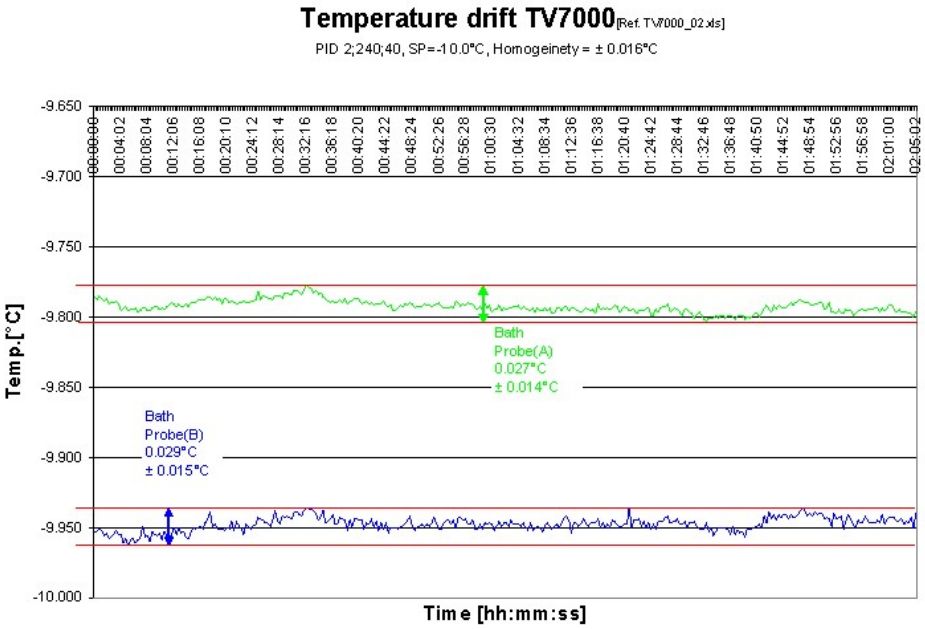
11.2 Stability at 0°C

Bath liquid used is methanol



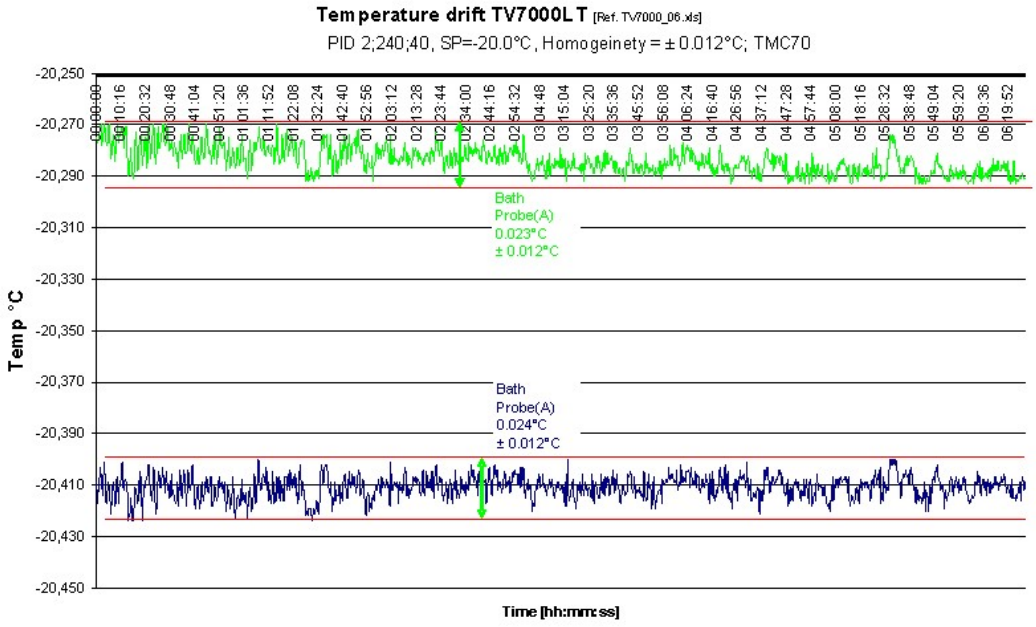
11.3 Stability at -10°C

Bath liquid used is methanol



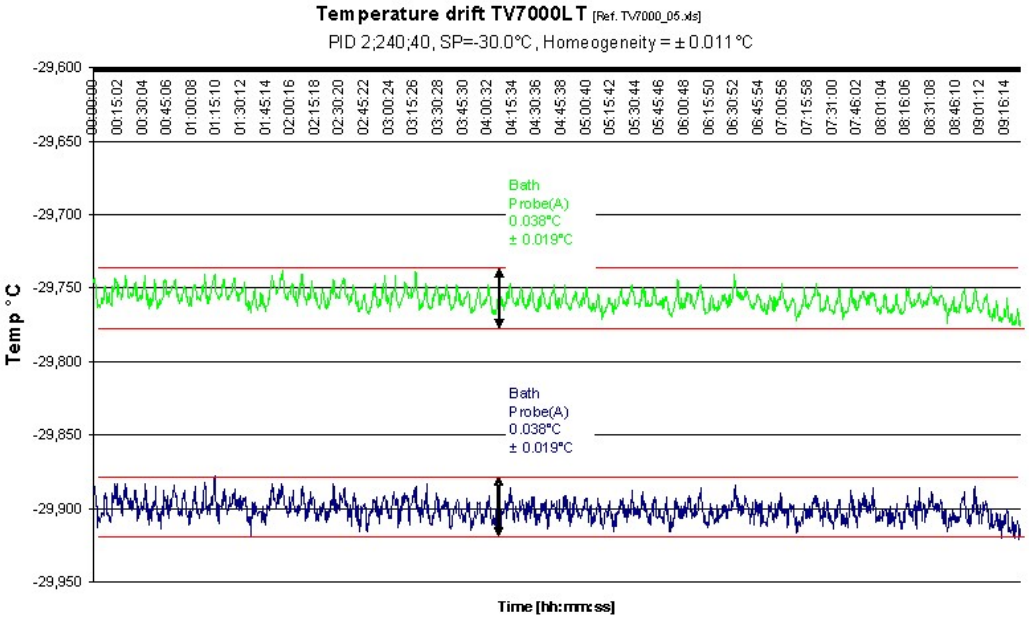
11.4 Stability at -20°

Bath liquid used is methanol



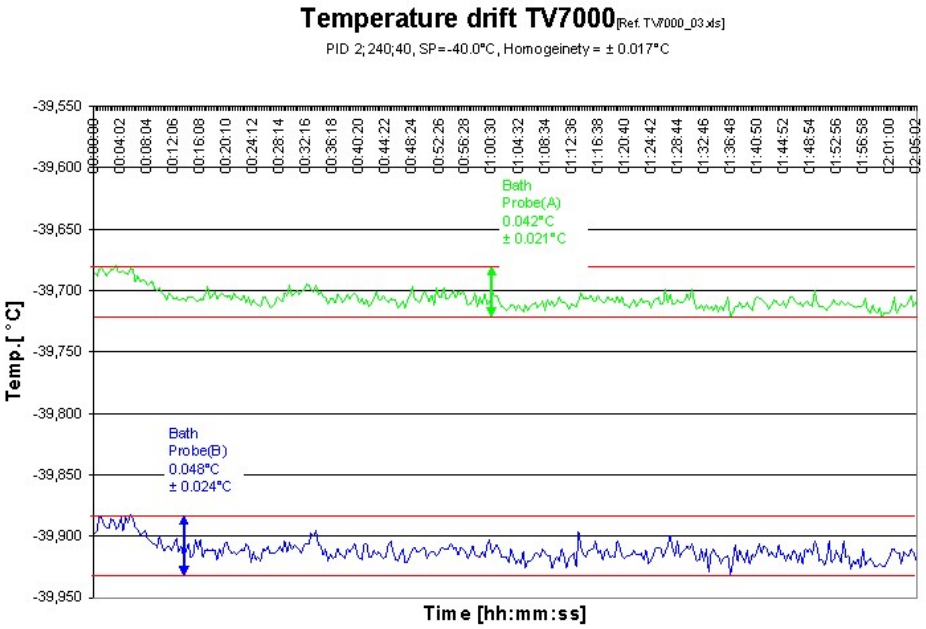
11.5 Stability at -30°

Bath liquid used is methanol



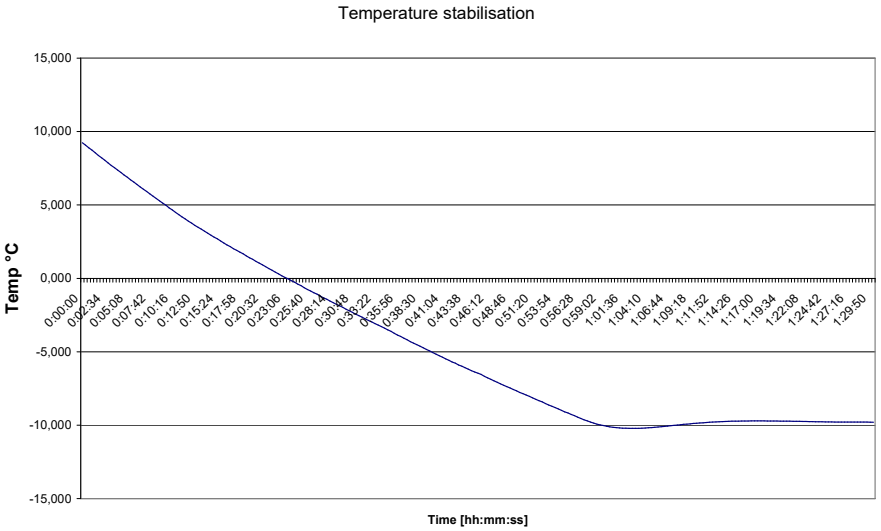
11.6 Stability at -40°C

Bath liquid used is methanol



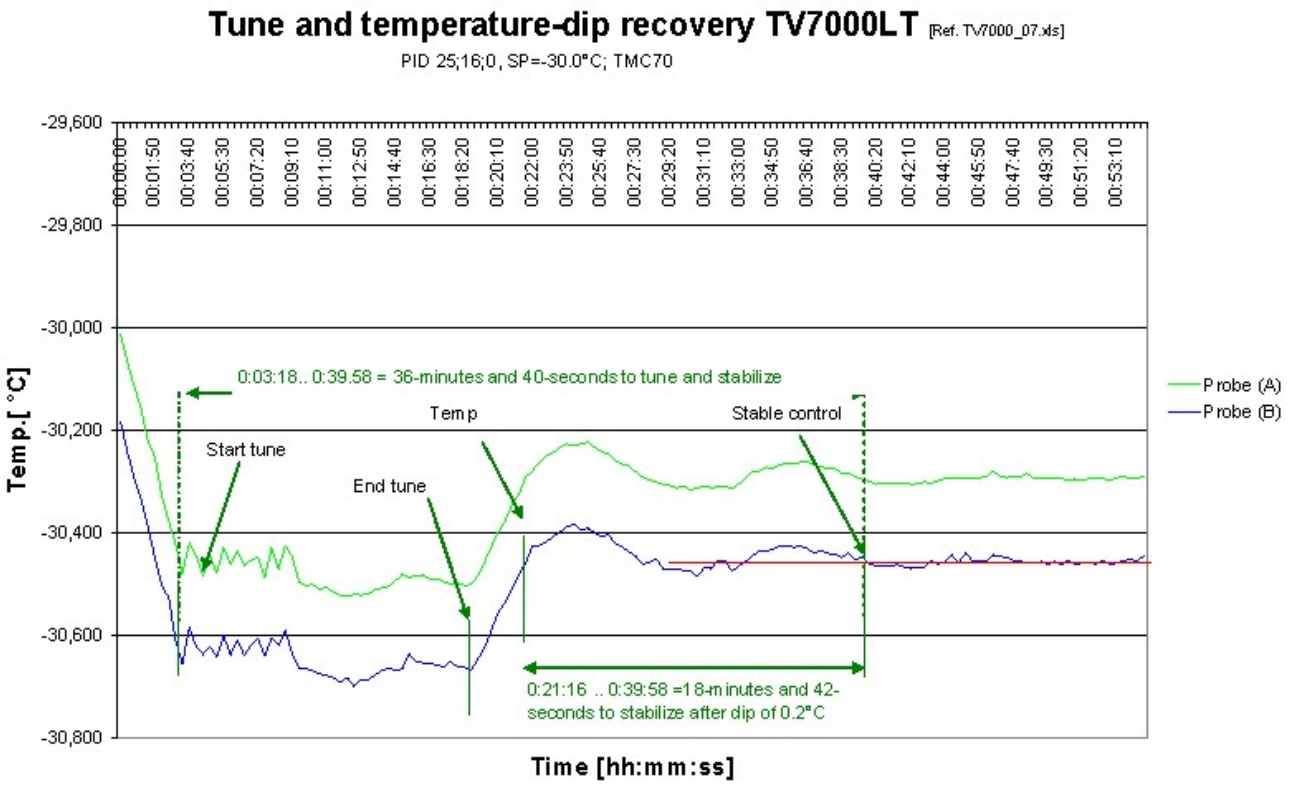
11.7 Settling time (at -10°C)

Bath liquid used is methanol



11.8 Settling time (at -30°C)

Bath liquid used is methanol



12 RS 232 C Interface

The bath is equipped with a RS 232 C interface which allows the communication with a computer.

Please see our separate manual "communication. PDF" and Tamson software to use the bath remotely or use the software as datatlogger.

12.1 General settings

Baudrate can be selected using the menu option "Baudrate". In example
4800

Data setting parameters are fixed (can not be altered):
8 data bits
1 stop bit
parity none

12.2 Commands overview

Notation
commands are place between brackets "[ ]"
values are placed between "< >" signs
(Do not use these brackets when sending commands.)

[ST] returns whether bath is stable or not. State 1 = stable, 0 not stable. Limits are set with parameters StableLimitHigh and StableLimitLow defined by ASTM D445. So when PV is in the region of 100°C>PV<0°C StableLimitHigh is defined as 0.05. When the average PV deviation (calculated from a sliding window of 255 seconds) is smaller than StableLimitHigh, the ST command will return stable(1).

When PV is 0°<=PV<=100°C and the average PV (calculated from a sliding window of 255 seconds) is smaller than StableLimitLow, the ST command will return stable(1)

[RS] Restarts (same as power off-on)
[RA] Reads raw ADC value, returns 3 bytes binary data, LSB first. This returns the last raw ADC reading. Note that this is updated every 200mS, so reading at a faster rate may return duplicate values. Maximum reading is 0x7FFFFF. This command is used for factory calibration/test.
[CT] **<enter>** Returns the offset value.
[CT] **<value> <enter>** Sets the offset value.

[TC] Sets/displays time constant in seconds
[PL] Power limit in seconds.
[BH] Returns boost heater on/off state, 0 or 1
[BH<n>] sets boost heater state 0/1
[CS] Control state – returns state of control algorithm
bits 4..7 represent the main control stages, bits 0..3 are sub-states within each main state
$00 : control algorithm disabled – allows external PC to take control of heaters
$10 : startup hold-off started
$11 : startup holdoff in progress
$12 : startup delay finished, decide to boost or cool
$20 : boosting
$30 : Waiting for cool-down
$40 : Start of ratio process
$41 : Ratio process in progress
$42 : waiting for PV<SP-tuneoffset after ratio
$50 : Start of successive approximation process
$51 : Sucessive approximation stabilize delay

$52 : Successive approximation in progress
$53 : end of sucessive approximation stage
$60 : Proportional mode (subject to change - other values to be defined)

[CS<n>] Sets state of control algorithm

[HP] Returns current heater power percentage
HP<nn> : sets heater percentage to <nn> - this command is only useful if control algorithm suspended with CS command.
[AC] Returns 1 when a new temperature value is available, 0 if no new has been measured since the last PV or PVH command. Cleared by PV or PVH command. Used for external PC control synchronization.
PV Returns Process Value with unit, no decimals. 23C or 74F
[PVF] returns temp as follows :
Use PVF to return a decimal value with 7 decimal digits, e.g.
12.345342C, works for degrees Centigrade, and degrees Fahrenheit. Only first three are significant. When reading is in degree Fahrenheit character F indicates the unit i.e. 73.3961328F

When temperature is negative, minus sign appears i.e. -1.6955468F

[PP] returns proportional band value. Proportional band is 100/gain
[PI] returns integrating value
[PD] returns derivative value

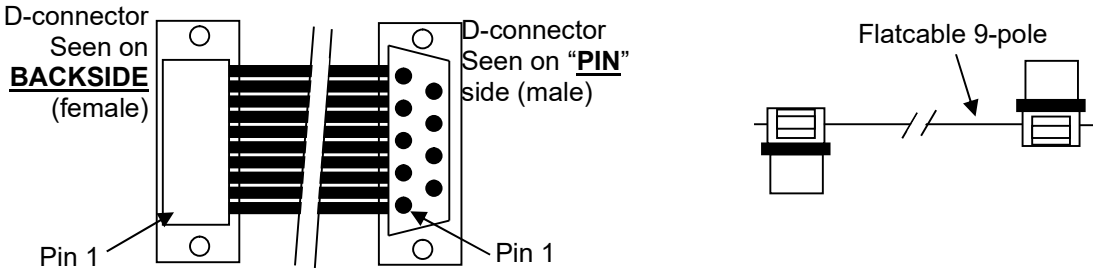
PID range and set:

Pb = setting 1..999
I = 0..999
D = 0..999

[PP] Followed by value, or space and value, will set proportional band. I.E. PP25 will set Proportional band to 25.
[PI] Followed by value, or space and value, will set integrating value. I.E. PI16 will set Integration value to 16.
[PD] Followed by value , or space and value, will set integrating value. I.E. PD2 will set Derivative value to 2.
The TMC70 contains 4 independent PID sets. Each set can be enabled using the TMC70.EXE program and can have its own name i.e “water”, “silicone oil” or “methanol”. However when the command PP, PI, or PD is used to set a value, automatically set 4 is used. **So PID set4 is reserved for RS232 operation and is activated when approached from RS232.**

[SP] Set point temperature
SP, Set point temperature is returned i.e. 20.22
SP22.50 sets set point temperature to 20.50°C
When controller displays temperature in °F, SP20.50 sets the set point to 20.50°F
SP22.555 results in error code "10"

12.3 RS 232 Cable



13 ORDERING CODE

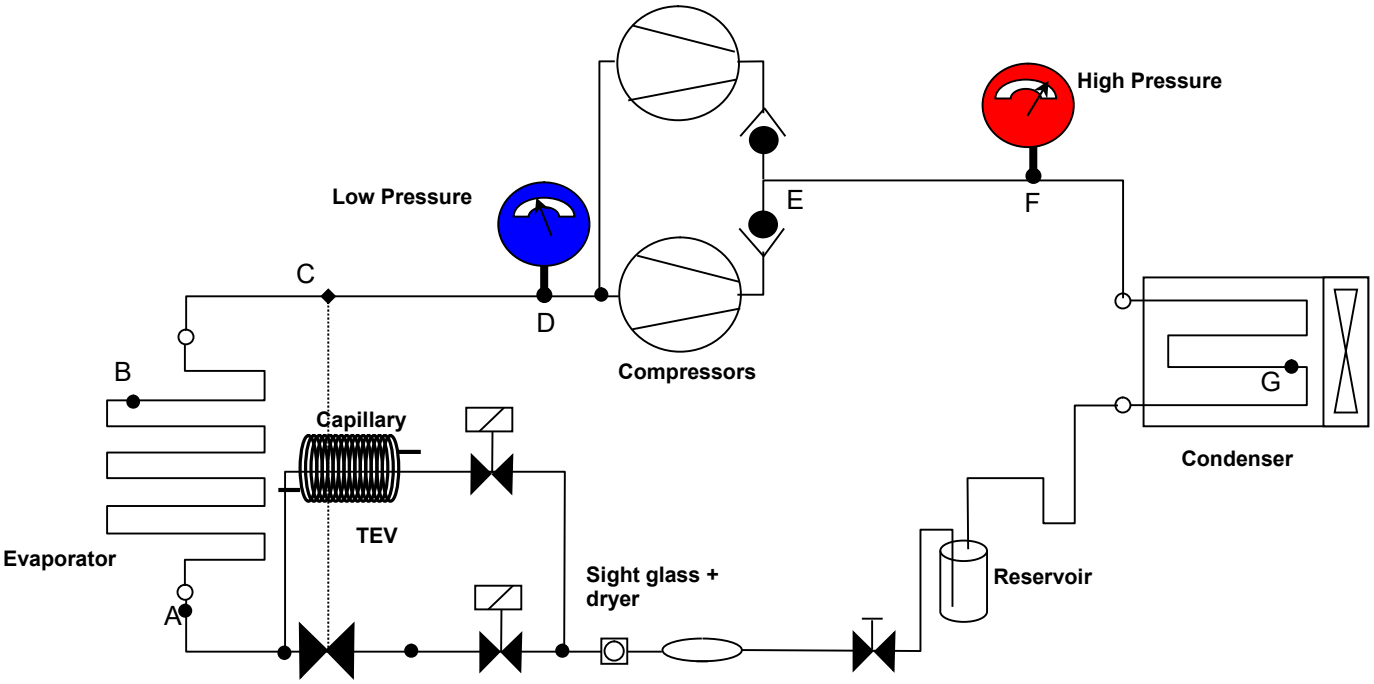
Item	voltage	ordering code
TV7000LT	230V/50Hz	00T0450

14 SPARE PARTS LIST

Voltage 230V(50/60hz)	Item
04T0062	Stirrer complete TV7000LT
24T8081	Motorfuse 0.3 Amp. (23ov) 0.6 Amp. (115V)
24T3300	
25T0215	Heater 500W/1500W
06T0512	Power TMC70
28T4009	Front foil
28T3904	Indicator safety thermostat
24T8545	Mains switch
24T8581	Safety cut-out thermostat
24T7580	Knob safety thermostat
27T3056	Solid State Relay 16A S216S02
25T2311	PT-100 sensor
06T0500	PCB micro controller TMC70
06T0502	PCB display TMC70
06T0517	PCB IO/cooler TMC70
06T0511	PCB power TMC70
24T7089	Wheel 80mm, no break
24T7090	Wheel 80mm, with break
10T2200	Knob insert light-blue turn-push button
10T2205	Knob light grey turn-push button

15 ADDENDUM: TECHNICAL REFERENCE

15.1 Technical Drawing



16 EC declaration of conformity thermostatic bath TV7000LT

Manufacturer: Tamson Instruments BV
van 't Hoffstraat 12
2665 JL Bleiswijk
The Netherlands

Product: **Thermostatic bath**

Model: **TV7000LT**

We declare that the product mentioned above conforms to the essential's exigency of the directive 2006/42/EC relative to machinery, directives 2004/108/EC relatives to electromagnetic compatibility and directive 2006/95/EC relative to low voltage.

The products are in conformity with the following specifications:
EMC (2004/108/EG)

Conducted emission	- EN55016-2-1 + EN61326+A1
Radiated emission	- EN55016-2-3 + EN61326+A1+A2+A3
Harmonics	- EN61000-3-2
ESD	- EN61326 +A1+A2+A3 and EN61000-4-2 +A1+A2
Radiated immunity	- EN61000-4-3 +A1
Electrical Fast Transients	- EN61000-4-4+A1+A2
Surges	- EN61000-4-5+A1
Conducted immunity	- EN 61000-4-6+A1
Voltage dips and Voltage variations	- EN61000-4-11 +A1

Low voltage (2006/95/EC):
Safety requirements for electrical equipment for measurement, control, and laboratory use Part 1, General requirements,
EN 61010-1-2010
Safety requirements for electrical equipment for measurement, control, and laboratory use Part 2, Particular requirements for laboratory equipment for the heating of material,
EN 61010-2-010-2003
Machinery directive (2006/42/EC)
2006-42-ec-2nd-2010
NEN 3140
Due to the type of netfilter used for the TV7000LT-DC version a higher than the standard allowed 2mA eaurth leackage can occur. Values are still within the standard NEN 3140.

June 2010, Tamson Instruments bv, The Netherlands

Ing. R.C. van Hall
Director

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