USER-MANUAL
TLC40 / TLC80
TLC80DP
TLC90

Tamson Instruments B.V.

P.M. Tamson Instruments bv
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THE NETHERLANDS

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IBAN Code: NL95 RABO 0160100046

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 manufactures 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 the line cord 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 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 B.V. 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 EC DECLARATION OF CONFORMITY

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

Product: Thermostatic bath and circulator

Model: TLC40/TLC80/TLC90/TLC80DP

The products to which this statement relates, is manufactured and dully carried out in compliance with the provisions of directive 73/23/EEC on the approximation of the laws of the member states relating to low voltage.

The products are in conformity with the following specifications:

Item	Reference	Description	Test result
1	**EN55016-2-1**	Conducted emission	p
2	**EN61326+A1**	Conducted discontinuous emission	p
3	**EN55016-2-3**	Radiated emission	p (anechoic room)
4	**EN61326+A1+A2+A3**	Radiated emission	p (anechoic room)
5	**EN61000-3-2**	Harmonics	p
6	**EN61326 +A1+A2+A3**	Flicker	p^3
7	**EN61000-4-2 +A1+A2**	ESD	p
8	**EN61000-4-3 +A1**	Radiated immunity	p
9	**EN61000-4-4+A1+A2**	Electrical Fast Transients	Minimum requirements pass
10	**EN61000-4-5+A1**	Surges	Minimum requirements pass
10	**EN61000-4-6+A1**	Conducted immunity	p
11	**EN61000-4-11 +A1**	Voltage dips and Voltage variations	p

p = Pass
p^3 = Pass, condition of operating during Pst measurement: Operational with heating element 1500W. P_{st} and P_{lt} are not evaluated in accordance with A.5 of Annex A of EN 61000-3-3(1995) + A1(2001).

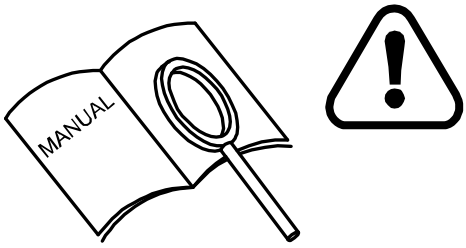
not applicable were:
Conducted discontinuous emissions (Clicks)
Radiated emission (OATS)
Power Frequency Magnetic Field*

2007, Tamson Instruments bv, The Netherlands,

Name : R.C. van Hall
Function : Director

4 PRECAUTIONS AND HAZARDS

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



READ CAREFULLY

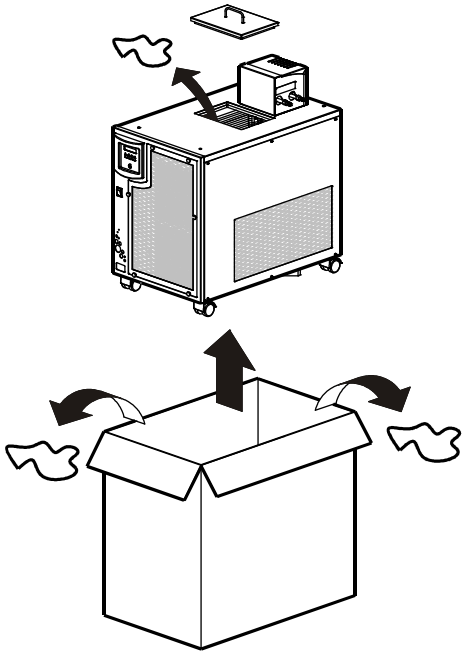
If a malfunction occurs, consult section "TROUBLE SHOOTING ", page 19
If problem persists, call your supplier or Tamson Instruments B.V. Never operate the equipment if not correctly installed. The equipment must be operated only by qualified personnel. Avoid damage to the equipment or its accessories through incorrect operation.

5 INSTALLATION

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.

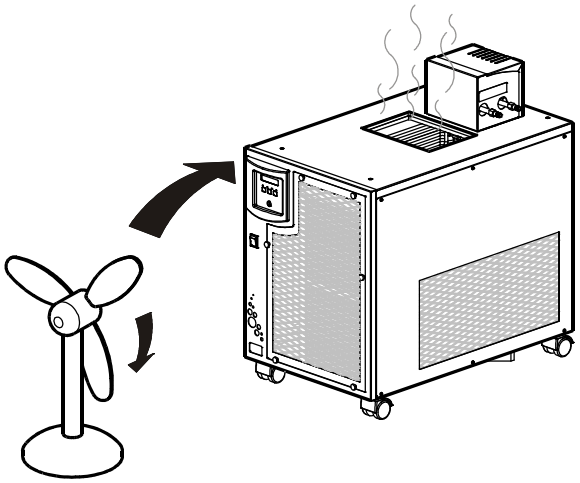
5.1 Unpacking

To avoid damage during transport all Tamson baths are carefully packed for shipment. Check the packaging 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 damages if the respective box is not available for examination. The shipment contains at least the bath/circulator. The consignment may contain other parts, individually packed in small boxes. Please see packing list for details concerning total contents of consignment.



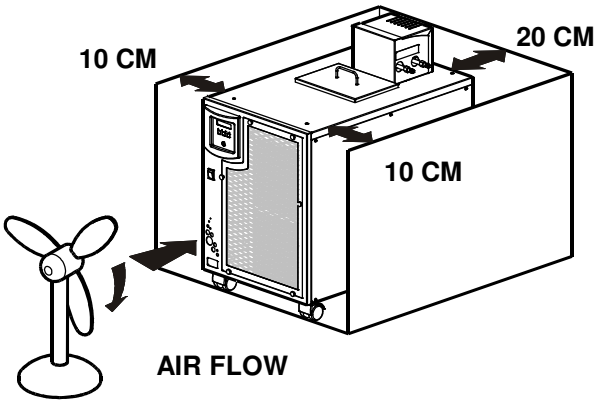
Before filling the bath remove any remaining packing material from its interior. The interior of the bath can be accessed by taking off the lid on the top of the bath.

5.2 Placement and ventilation



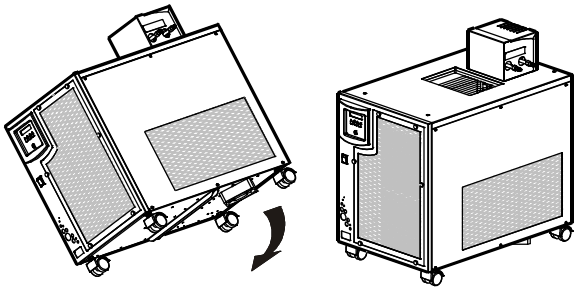
The bath has to be placed in a well ventilated area.

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.



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.

5.3 Initial use

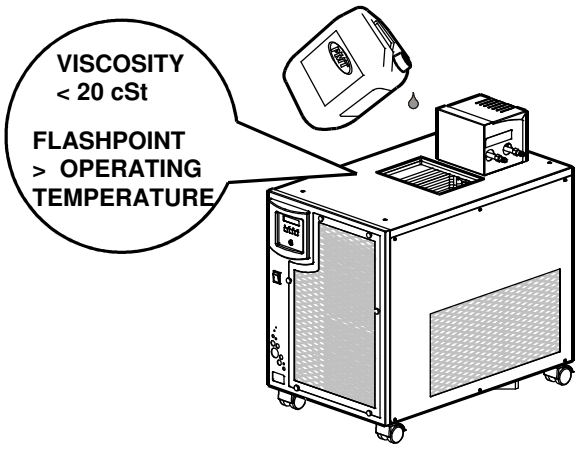


Due to transportation allow the bath a 24 hour period for stabilization. This applies also when the apparatus has been tilted or fallen.

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.

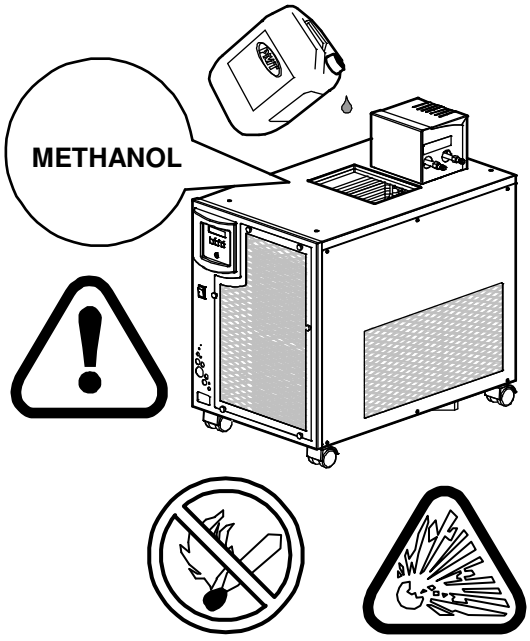
5.4 Bath liquids

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 of less than 20 cSt 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.



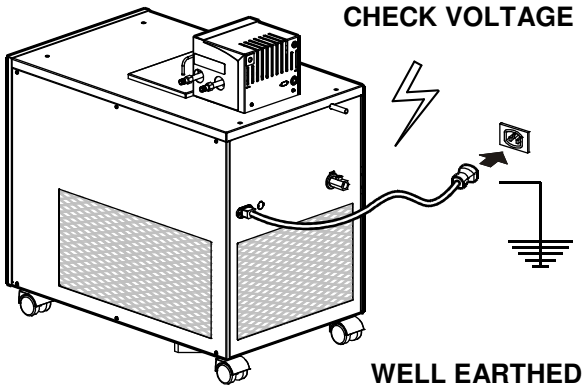
Methanol is extremely flammable and can cause fire hazard. Take all necessary precautions to reduce fire hazard. When using methanol all vapors must be removed by using appropriate air ventilation.

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.

6 CONNECTING

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



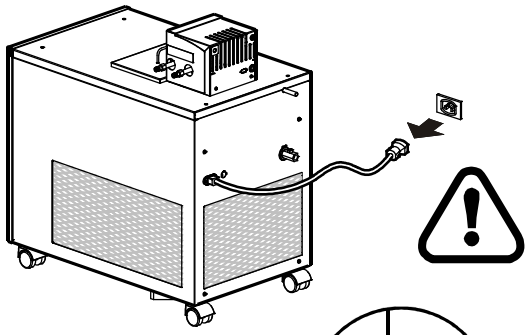
Use a mains supply that is well earthed, clean of interference and suitable for the acquired electrical load of the bath.

6.1 Cleaning

Regularly check the apparatus and condenser unit for dust. Follow steps 1 to 6 to remove the dust.

Disconnect the main supply !

1.



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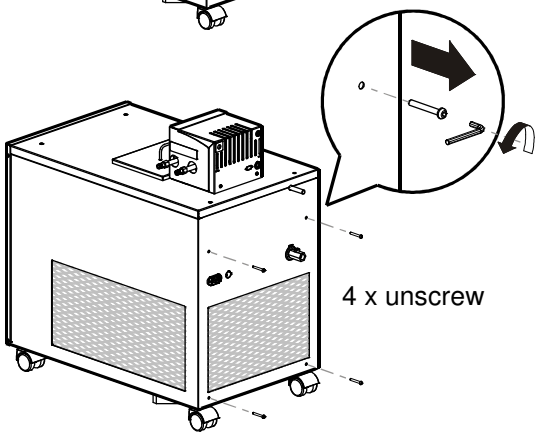

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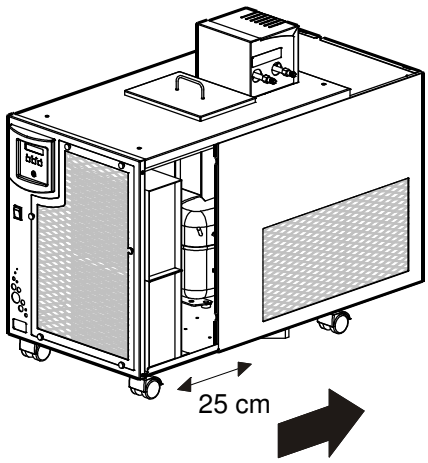

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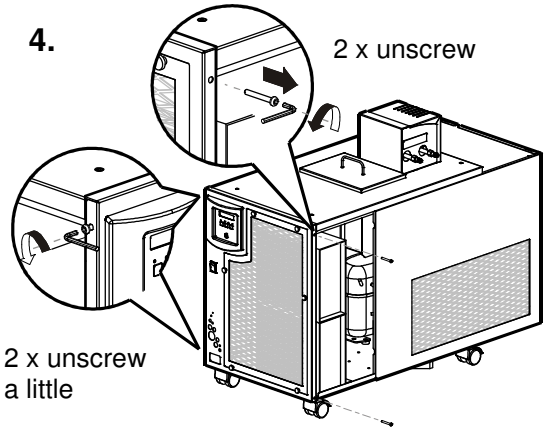

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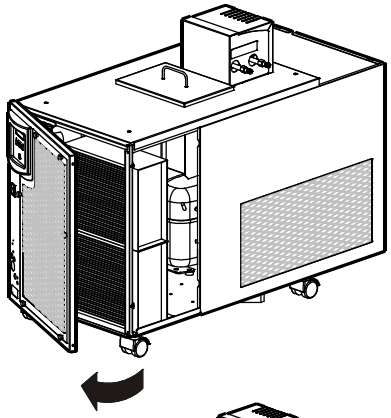

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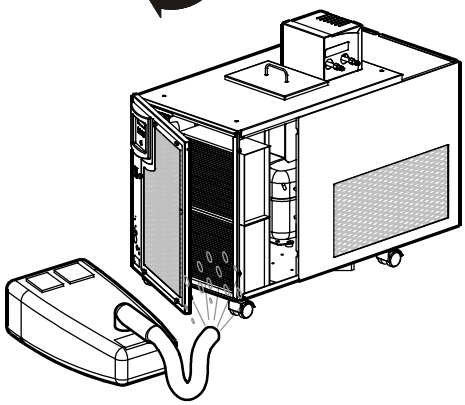
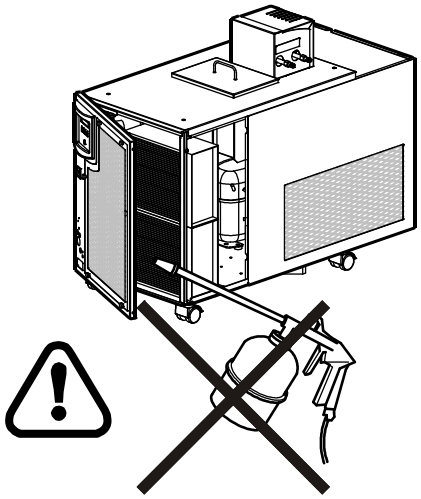


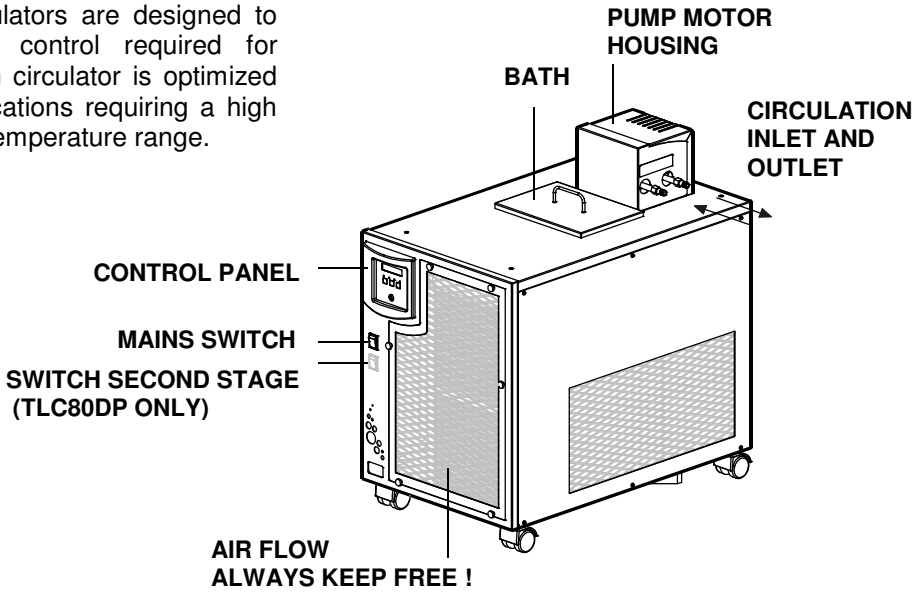
Remove dust with a vacuum cleaner.

Don't remove dust with a compressed air gun !



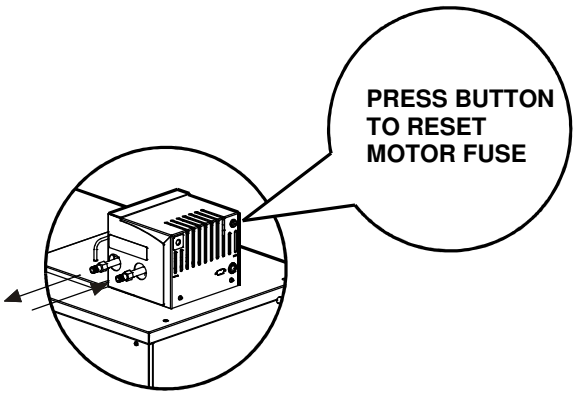
7 INTRODUCTION TO THE TLC SERIES

The TAMSON model TLC circulators are designed to perform accurate temperature control required for general laboratory. The Tamson circulator is optimized for temperature control of applications requiring a high degree of stability over a broad temperature range.



7.1 General

The TLC apparatus consists of a combination of a cooling system and a microprocessor controlled heating element. This design ensures a high degree of accuracy and reproducibility of temperature controls.



The TAMSON baths are constructed throughout from corrosion-resistant – stainless steel and Teflon – materials. The bath is effectively insulated against heat loss by a layer of Armaflex® rubber between the inner tank and outer casing.

7.2 Pump

A circulation pump is built-in to guarantee an uniform temperature distribution within the bath and providing the possibility to circulate through a closed external system.

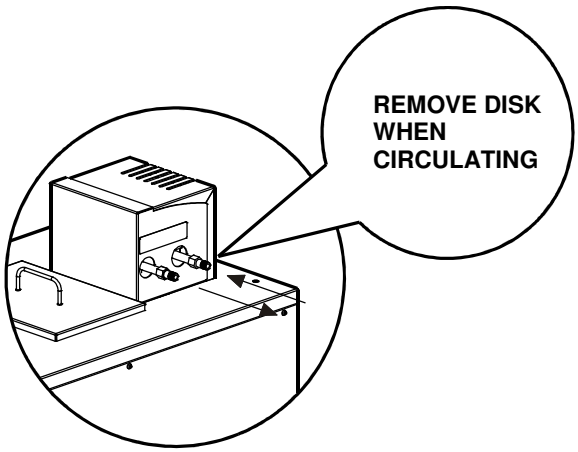
The TLC40, TLC80, 80DP and TLC90 can be provided with two pumps.

Standard pump: a circulation pump is provided with a circulation pump with a capacity of 10 liters / min and a max pressure of 3 m head of water [3mtr H2O].

A performance pump: can be ordered under item 24T0392. This pump is not interchangeable and has to be specified when ordering as an optional item.

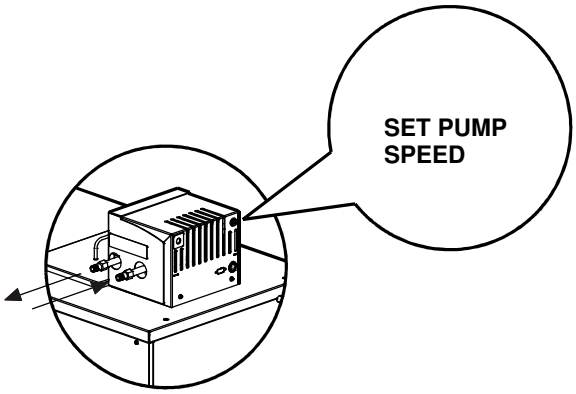
The standard pump offers a motor protection (small thermal fuse) which is placed on the back panel of the motor compartment. This protects the motor from excessive loads.

When pumping viscous liquids the thermal fuse can be activated. The motor fuse can be reset by pressing the knob.



The inlet and outlet of the pump are fitted with 10 mm hose connections and 3/8" threaded fittings for metal tubing. The outlet (most near to the backside of the apparatus) is provided with a small disc, stopping the circulation action.

Before the fluid can begin circulating through external systems this disc must be removed by unscrewing the fitting and hose connection removing the disc.



Optional available is a stronger pump with adjustable flow. Part number is 24T0392. Flows of up to 15 liters per minute can be realized. This pump is for circulating purposes where a constant external flow with higher pressure up to 0.8 bar is required. Please check our specification sheet for all pump performance details.

7.3 Temperature control

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 4 digit, 7 segments LED-display with 0.1°C reading. The actual set point is computed within the controller with an accuracy of 0.01°C.

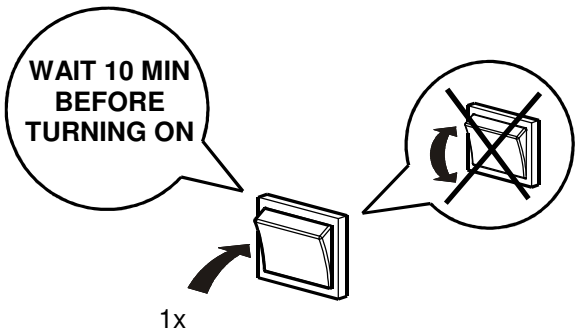
8 OPERATION

8.1 Switching on

If the bath has been properly filled with fluid it can be switched with the mains switch located on the front panel. Choose a working temperature (set point) with ▲ and ▼ keys. For an optimal performance the bath is best tuned at the set point temperature.

8.2 Caution with powering on/off

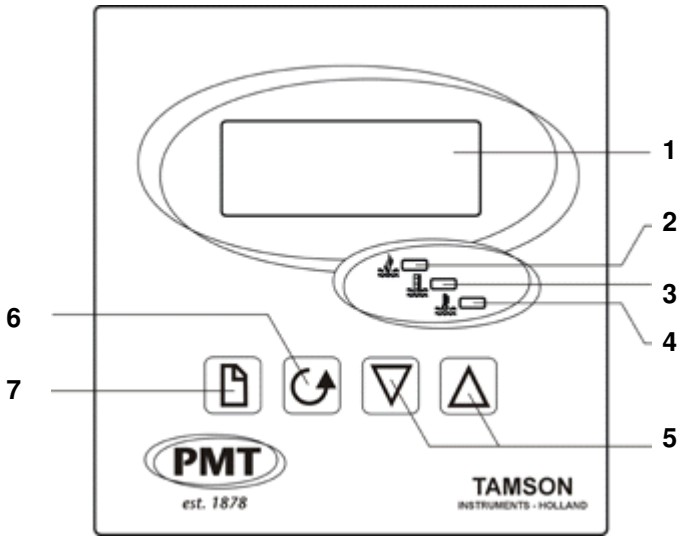
Be careful and do not toggle with the on/off switch. To start the cooling compressor high currents are needed which will heat the compressor motor internally. Switching off and on the compressor several times will lead to mechanical damage.



When switching off the apparatus, wait for 10 minutes before switching the system back on again.

8.3 Control panel

1 LED display
2 Heater indicators (Green)
3 Level indicators (Blue)
4 Over temperature indicator (Red)
5 Up and down buttons
6 List – key
7 Page - key



8.4 Selecting parameters

The front panel layout shows the following 4 operating keys:

PAGE

LIST

DOWN

UP

Press shortly and following is displayed

Sequence

SP.1	- Temperature set point in °C,
tU.n	- Tuning the bath (“Atune”),
Pb	- Changing the tuning (PID) parameters "P"value
ti	- Changing the tuning (PID) parameters "I"value
td	- Changing the tuning (PID) parameters "D"value
OFSt	- Change temperature readout offset (± 5°C)

Each time is pressed another option is displayed.

Up and Down keys allow changing the listed value. All changed values, like set point and PID parameters, will be kept in memory when pressing the page key to leave the menu. After switching off the power supply, changed values are kept in memory.

SP.1 - Set point adjust. Press page key to confirm setting when altered.
tU.n - Auto tuning PID parameters, set on or off.

Off is default value here.
On, when selecting parameter 2nd time, On.A is played. This indicates adaptive tune. Bath is adapting PID setting in background operation. When in On.A mode PID values can not be set manually anymore.

pb - Changing the tuning (PID) parameters. 'Proportional band value. Default value is 2, range 1 .. 100. (Proportional band equals 1/proportional value). Press page key to confirm setting when altered.

ti - Changing the tuning (PID) parameters 'Integrator' value. Default value is 200. Range 1 .. 1200. Default value is 200. Press page key to confirm setting when altered.

td - Changing the tuning (PID) parameters 'Differentiator' value. Default value is 10. Range 1 .. 600. Default value is 40. Press page key to confirm setting when altered.

OFST - Set offset. The offset value is added to the displayed bath temperature. I.e. when the displayed bath temperature is 20.0°C, an offset of 0.2 displays a value of 20.2°C. An offset of -0.2°C will display 19.8°C. Range is -5°C .. +5°C. Press page key to confirm setting when altered.

note:

☞ When tune is set to on, PID values can not be set. Change tune to off en alter PID values.

☞ Press page key to confirm setting when altered.

8.5 Quick start

To quickly start operating the bath:

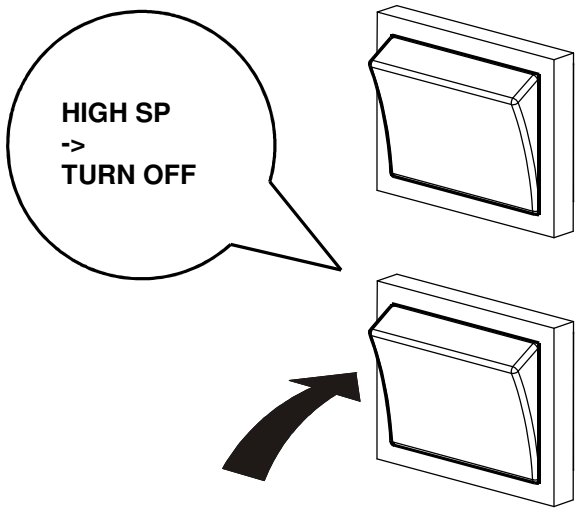
- Fill the bath with sufficient fluid* to flood the cooling coil, However do not fill the bath fully to the maximum.
- Place the power plug,
- Switch the bath on using the mains switch,
- Choose a working temperature (set point):

Press [ ] once. Display will indicate "SP.1". Alter set point temperature by using up [▲] and down [▼] key to select the desired bath temperature.
Press [ ] to display bath temperature again (or wait 10 seconds).

8.6 Selecting capacity (TLC80DP only)

The TLC80DP system is constructed around 2 x 2 compressors. The system contains a first and second stage and each stage has two compressors.
In some cases the full heat removal power is not required(idle or overnight use). In these circumstances each second compressor in both stages can be switched off. The purpose for this is to conserve energy and when heating up the bath prevent high pressure in the cooling circuit.

When the bath is working at low temperatures and a new much higher temperature is entered as SP, always switch back the TLC80DP to half capacity.



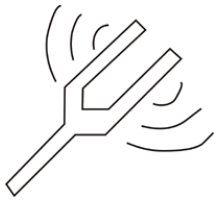
8.7 Tuning the bath

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 optimized 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. The parameters mentioned in Table 1 will influence the control of the bath.



IN-TUNE

Parameter	Description	Display	Default value
Proportional band	The bandwidth in display-units over which the output power is proportional between minimum and maximum	Pb	2
Integral time	Determines the time taken by the controller to remove steady state error signals	Ti	40 .. 200
Derivative time	Determines the time taken by the controller to react on error signals	Td	0

8.8 Tune PID values

Choose desired set point,
Wait until the bath has reached the set point temperature,
Highest temperature accuracy can be achieved when tuning the bath. Select tU.n by pressing twice.

Press ▲ to choose “ON”,

Press 5 times to return to displayed PV
(PID values can no longer be adjusted unless the "tU.n" value is set to off)

8.9 Deselect tuning

- Pressing twice,
- Display shows ”tU.n”,
- Press ▼ to choose “Off”,
- Press 5 times to return to displayed PV.

8.10 Manual tuning

The parameters for the PID control can also be changed manually. The method described below provides fast finding of the PID settings and is refereed to as the method of "Ziegler Nichols"

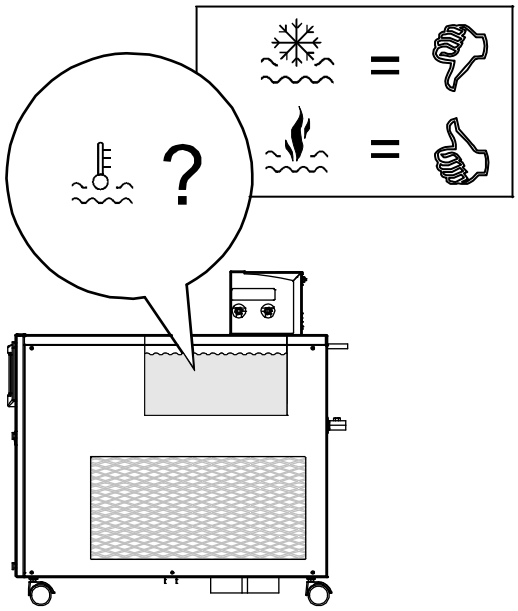
This procedure is only to be followed when automatic tuning is not functioning.

This method provides fast manual findings of the PID values. Start the bath at its required running temperature:

1. Set the integral time “Ti” and the derivative Time “Td” to off
2. Check if the Lcb and Hcb are set to auto
3. Ignore the fact that the temperature may not settle precisely at the set point
4. If the temperature is stable, reduce the proportional band Pb so that the temperature just starts to oscillate. If the temperature is already oscillating, increase the proportional band until it begins oscillating. Allow enough time between each adjustment for the loop to stabilize. Make a note of the proportional band value “B” and the period of oscillation “T” Set the Pb, Ti and Td parameter values according to the calculations given in the next table.

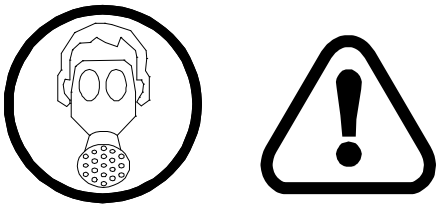
Type of control	Proportional band “Pb”	Integral time “Ti”	Derivative time “Td”
Proportional only	2*B	Off	Off
P + I control	2,2*B	0,8*T	Off
P + I + D control	1,7*B	0,5*T	0,12*T

8.11 Draining bath fluid



Before removing flammable bath liquids take the appropriate fire hazard precautions against these liquids.

Do not remove cold bath liquid. Cold liquid can cause severe burning when spilled. Preheat the bath liquid back to ambient temperature before removing.

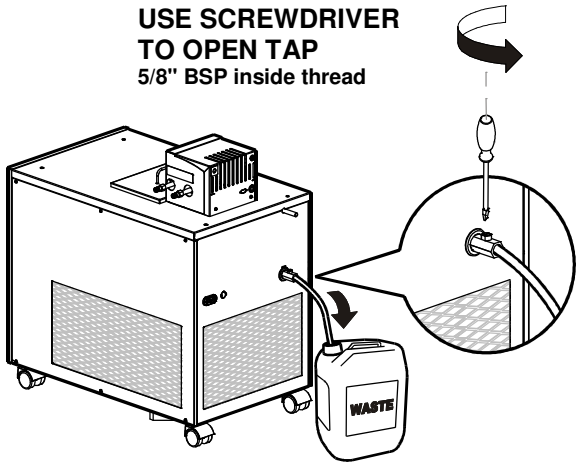


When removing bath fluid do not inhale toxic vapor. Always use appropriate ventilation.

8.11.1 Using the drain tap

The TLC baths can be drained via the drain tap located at the backside of the apparatus.

For safety reasons the tap can only be opened by using a screwdriver. The thread inside the tap is 5/8".

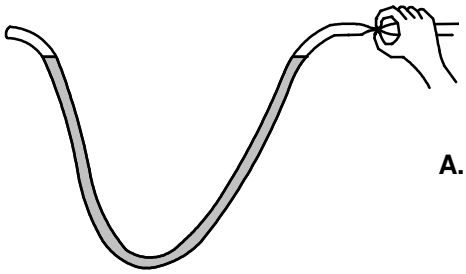


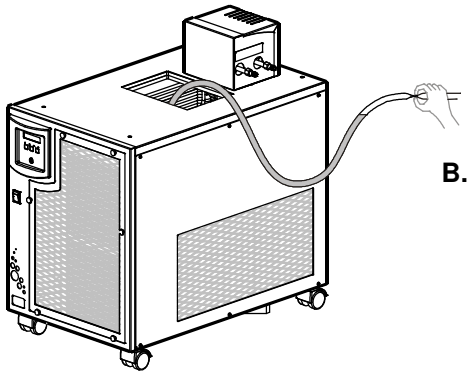
8.11.2 Fast method: drain by hand

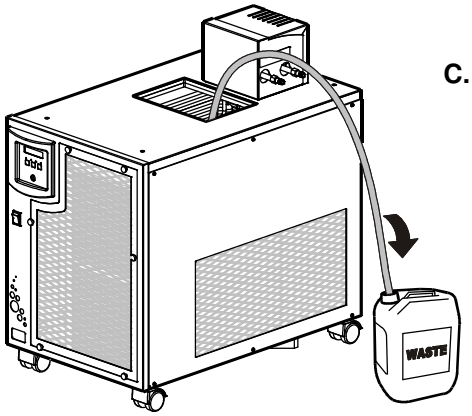
The bath fluid can easily be removed by using a length of hose. Length of approximately 1.5 mtrs and 10mm inner diameter.

Handle as follows:
Fill the hose with fluid (“A”),

- Close one side of the hose and immerse the other end in the bath (“B”),
- Lower the closed end into a waste bucket and let the bath fluid flow (“C”),
- Remove the last pieces with a sponge or tissue,
- Refill the bath approximately 1 cm below the lid.







8.12 Maintenance

Keep the apparatus free from dust. Regularly check the cooling openings and remove dust with vacuum cleaner. If necessary remove cover and clean internally. Use appropriate protection when cleaning, dust can be very unhealthy.

9 TROUBLE SHOOTING

9.1 General

The motor is not running and the lamps are not on.	Check the main voltage and all electrical connections, including switches. Check fuse in wall socket of mains supply.
Motor is not running, lamps and electronics operate (the motor turns freely by hand).	Motor overloaded. The motor protection may trip because of mechanical overloading of the pump. Reset fuse by pushing button on rear side of blue motor housing. The motor capacitor has a defect. Replace motor capacitor inside the system.
Bath is not heating, Red error led on front panel blinks on and off	Malfunctioning wiring. Check wiring. Over temperature protection has been activated. Bath temperature reached > 30'C. Switch off the unit, Let the bath fluid cool down Restart.
Compressor is making “clicking” noise	Bath has been switched on and off too quickly. Wait approximately 10 minutes before switching on again. The clicking noise is a temperature fuse inside the compressor preventing it from overheating. Bath liquid temperature is rising too fast. When the bath is working at low temperatures and a new much higher temperature is entered as SP, always switch back the TLC80DP to half capacity. This will speed up the heating of the bath liquid but more important it will prevent excessive high pressures in the cooling circuit.
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 several minutes (5 ... 10) 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 TLC80 and remove all dust from the condenser unit and fans with a vacuum cleaner. Do not use pressurised air remove dust. The flying dust particles can damage the fan bearings, are very unhealthy when breathed in and can lead to severe eye problems.
Can not set PID values	Check if ATUN has been set to on. PID values can no longer be adjusted unless the ATUN value is set to off. See 8.7 page 15.
Temperature not stable	Tune the TLC80 at the set point temperature. Place top lid on the bath.
Temperature does not drop	Bath is not properly insulated. Place top lid on the bath.
	Insulate circulation circuit.
	Circulation load exceeds heat removal capacity.
	Use appropriate bath fluid preferably methanol. If the bath contains a high percentage of water, this will freeze and prevent the fluid from cooling, as can bee seen from the picture on the left.

9.2 Error messages on display

Code	What does it mean	What action to take
xx	Error on configuration parameter	The 2 digits show the wrong parameter.
101	Error on RTD	Replace PT100
102	Error on voltage input calibration	Defective controller, replace
130	Error on operative mode parameter	Contact Tamson or local dealer
150	Error during data storing	Fault resets itself
Display “dead”	Probably over-temperature protection is active	Turn bath off and on
Red LED	Blinking	Over temperature protection has been activated. Bath temperature reached > 30'C. Switch off the unit, Let the bath fluid cool down Restart.

9.3 Faulty temperature readings

The temperature read out on the display does not correspond to the temperature measured.

PT100 is defective,

Offset value is set to a wrong value. See Selecting parameters page 13, parameter "OFST".

10 SPECIFICATION

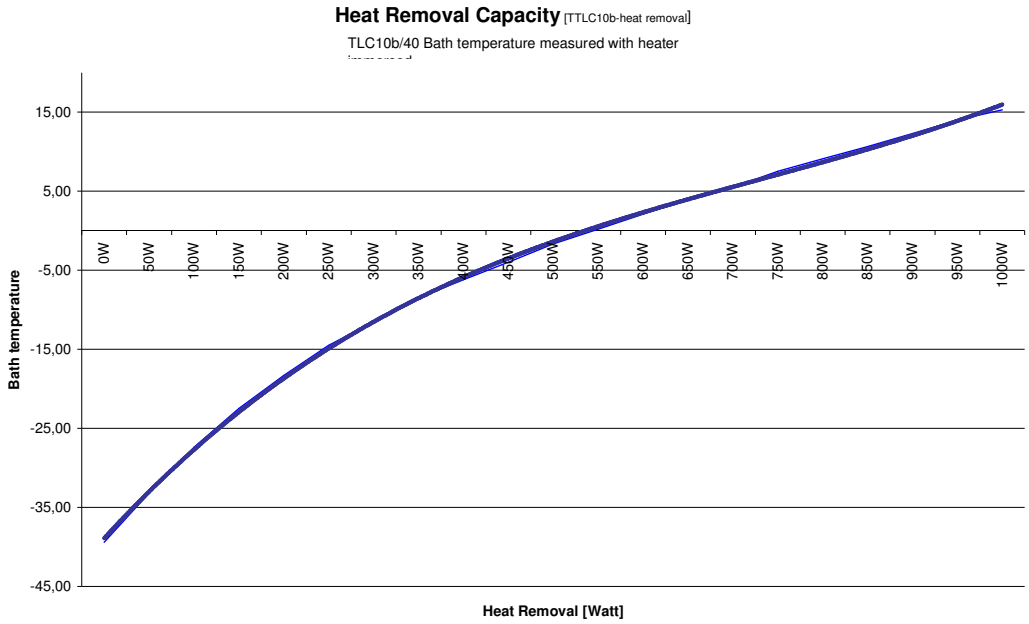
10.1 Technical specifications overview

Item	Unit	TLC15	TLC30	TLC40	TLC80	TLC80DP	TLC90
Temperature							
Range	[°C]	+60..-15	+60..-30	+20..-40	+20..-80	+20..-80	+20..-90
Setting ±	[°C]	0,1	0,1	0,1	0,1	0,1	0,1
Stability* ±	[°C]	0,05	0,05	0,05	>0,05	>0,05	>0,05
Uniformity* ±	[°C]	0,05	0,05	0,05	>0,05	>0,05	>0,05
Specified at		-5°C)	-5°C)	-5°C)	-5°C)	-5°C)	-5°C)
Heating							
Rate heating	[°C/min]			2,3	2,3	2,3	
Heater	[W]			1100	1500	1500	1500
Pump							
Pressure	[mbar]			300 max	300 max	300 max	300 max
Capacity	[L/min]			10	10	10	10
Pump high pressure							
Pressure				>800	>800	>800	>800
Capacity				15	15	15	15
Dimensions							
Bath volume	[L]			14..15	14..15	14..15	14..15
Bath Opening	[mm]			240 x 170	240 x 170	240 x 170	240 x 170

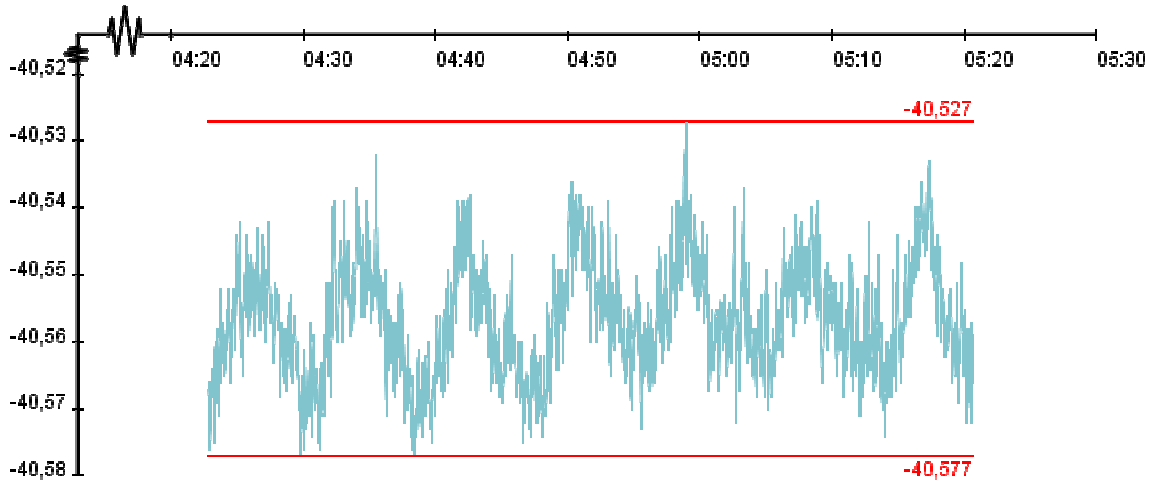
Opening effective				240 x 160	240 x 160	240 x 160	240 x 160
Depth	[mm]			150	150	150	150
Length	[mm]			810	810	789	810
Width	[mm]			460	460	496	460
Height	[mm]			770 (710 no wheels)	770 (710 no wheels)	1175	770 (710 no wheels)
Weight	[kg]			80	80	140	80
Power (max)**	[kW]			2.0 max	2.8 max.	3.6 max	2.8 max.
Voltage	[Volt]			230 or 115	230 or 115	230	230 or 115

* **Absolute** min/max value measured **over 1hrs** in methanol
** Depends on bath temperature and cooling or heating cycle

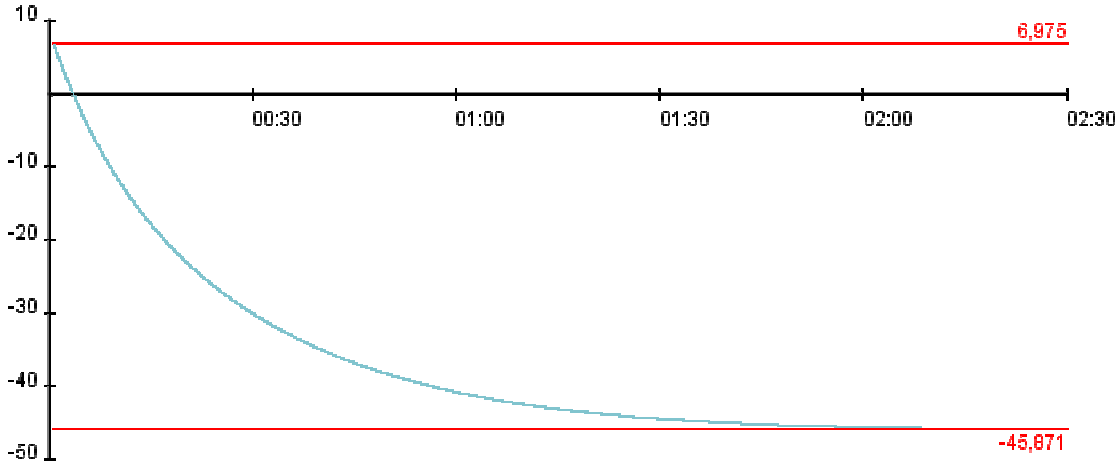
10.2 TLC40 performance



10.2.1 Stability TLC40

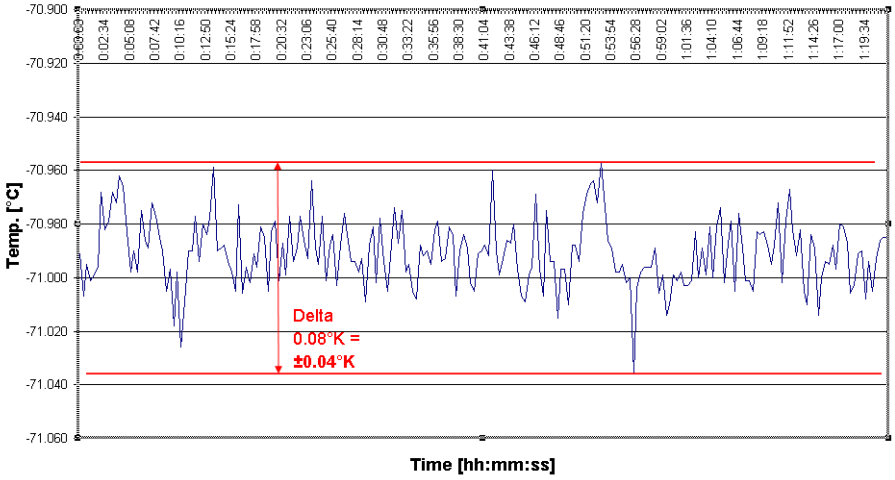


10.3 Cool down TLC40

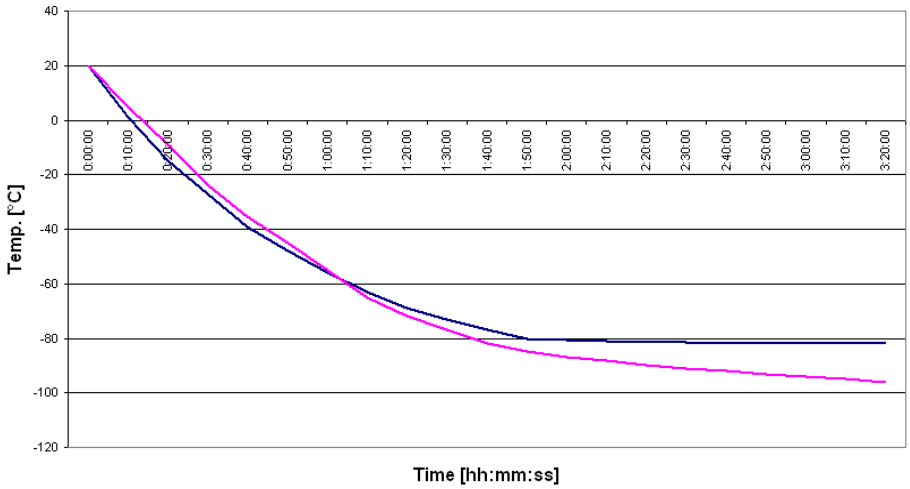


10.4 TLC80 - TLC90 performance

10.4.1 Stability TLC80 - TLC90



10.4.2 Cool down TLC80 - TLC90



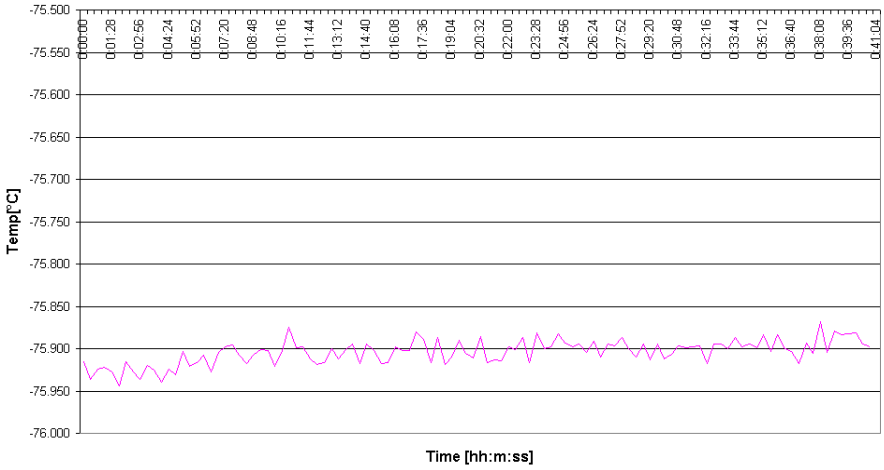
10.4.3 Heat removal TLC80 - TLC90

Temperature [°C]	TLC80	TLC90	
20*	500	500	[watt]
0*	450	450	[watt]
-20*	350	350	[watt]
-50*	250	250	[watt]
-60*	225	225	[watt]
-70	175	175	[watt]
-80	125	125	[watt]
-90	-	20	[watt]

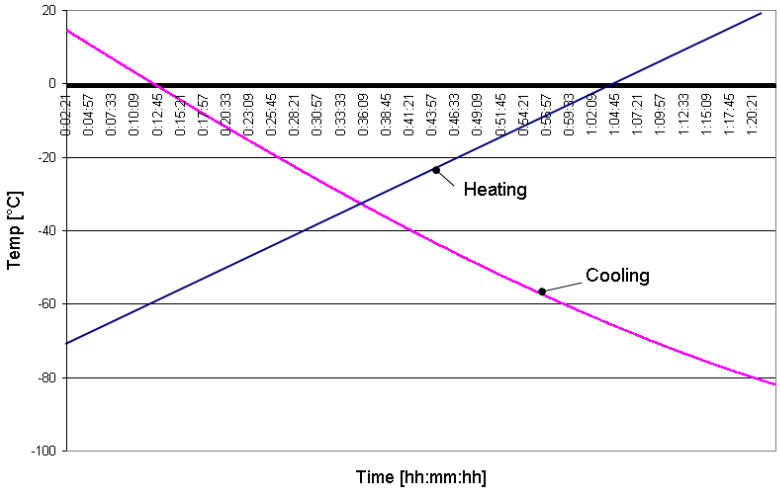
* During cool down. Do not operate bath continuously at this temperature

10.5 TLC80DP performance

10.5.1 Stability TLC80DP



10.5.2 Cooldown TLC80DP



10.5.3 Heat removal capacity TLC80DP

Temperature [°C]	TLC80DP	
20*	550	[watt]
0*	500	[watt]
-20*	450	[watt]
-50*	400	[watt]
-60	400	[watt]
-70	325	[watt]
-80	200	[watt]

* During cool down. Do not operate bath continuously at this temperature

11 SPARE PARTS

11.1 TLC80 and TLC90

230 Volt 50HZ	230V 60HZ	115 Volt 60Hz	Description
25T1290		25T1300	Motor for pump
24T3300		n. a.	Capacitor 7uF
n. a.		24T3330	Capacitor 25uF
25T0253		25T0254	Heater 1100 Watts
24T8081		n. a.	Motor fuse 0.3 Amp.
n. a.		24T8080	Motor fuse 0, 6 Amp.
24T8581			Mechanical safety thermostat
04T2070			Bearing cover with bearing
04T2135			Bearing PTFE
22T3520			Fill valve
24T8545			Mains switch
28T4015			Front foil
25T2310			PT-100 sensor
06T0475			Mains board with filter and relay
28T3015			Controller

11.2 TLC80 DP

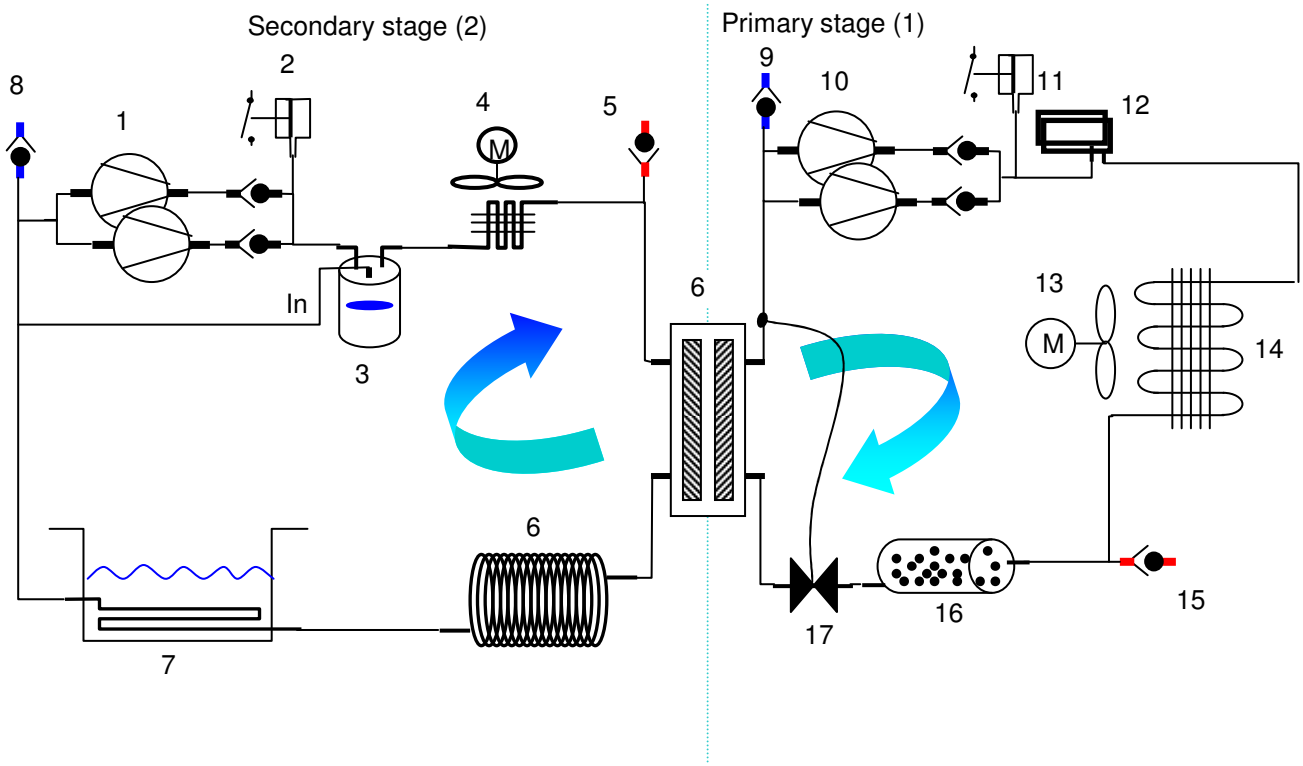
230 Volt 50HZ	Description
25T1295	Motor for pump
25T1343	Capacitor 2uF
25T0251	Heater 1100 Watts
24T8081	Motor fuse 0.3 Amp.
24T8581	Mechanical safety thermostat
04T2070	Bearing cover with bearing
04T2135	Bearing PTFE
24T8545	Mains switch
28T4015	Front foil
25T2310	PT-100 sensor
06T0475	Mains board with filter and relay
28T3015	Controller

TLC40

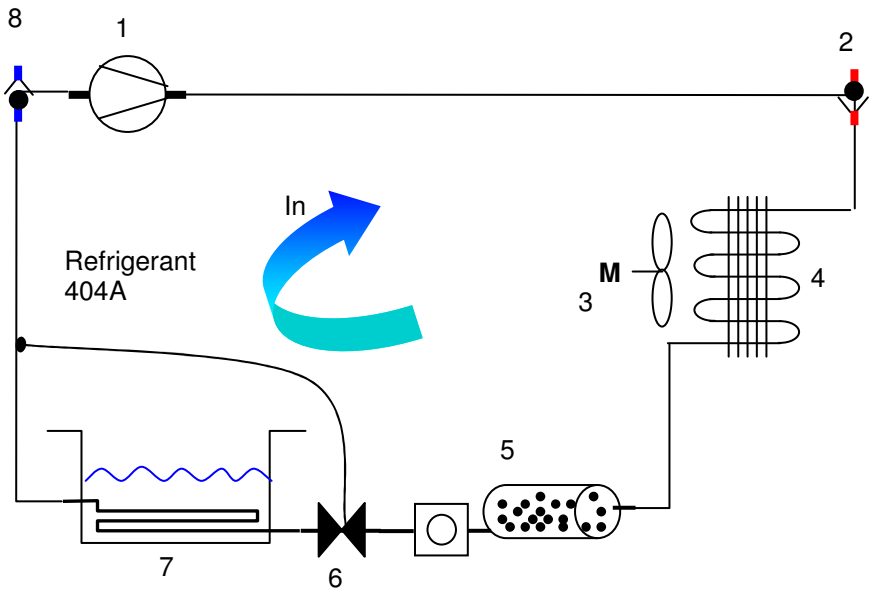
230 Volt 50HZ	230V 60HZ	115 Volt 60Hz	Description
25T1290		25T1300	Motor for pump
24T3300		n.a.	Capacitor 7uF
n.a.		24T3330	Capacitor 25uF
25T0251		25T0252	Heater 1100 Watts
24T8081		n.a.	Motor fuse 0.3 Amp.
n.a.		24T8080	Motor fuse 0,6 Amp.
06T0465		06T0470	PCB with relay and mains
24T8581			Mechanical safety thermostat
04T2070			Bearing cover with bearing
04T2135			Bearing PTFE
22T3520			Filling valve
24T8545			Mains switch
28T4015			Front foil
25T2310			PT-100 sensor
28T3014			Controller

12 PRINCIPLE OF OPERATION

TLC80, TLC80DP and TLC90: principle of operation			
1	Compressor(s) 2nd stage	10	Compressor(s) 1st stage
2	Safety overpressure switch 2nd stage	11	Safety overpressure switch 1st stage
3	Oil separation (DP only)	12	Heating top plate
4	Inter cooler (DP only)	13	Fan condenser
5	High pressure	14	Condenser
6	Heat exchanger	15	High pressure side
7	Throttle second stage	16	Dryer
8	Low pressure side 2nd stage	17	Throttle 1st stage
9	Low pressure side 1st stage		



TLC40			
1	Compressor	5	Filter / dryer
2	High pressure side	6	Thermostatic Expansion Valve
3	Fan condensor	7	Evaporation (Bath)
4	Condensor	8	Low presure side (suction)



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