General Guide to the Linkam Stages

APS Detector/Equipment Pool

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Safety and Handling

- All Linkam stages have **EXTREMELY** fragile platinum leads connecting the heating element to the stage. AT NO TIME should these leads be touched or moved!!!
- If using LN2 sample cooling, please follow all APS procedures for safe handling of LN2.
- The black capillary tube on the LN2 dewar lid is fragile. Please handle carefully.
- Disconnect the LN2 dewar from the stage before heating above 300^{o}C. Leaving the tubing connected can damage the tubing and/or heater.
- Use as little sample as possible to reduce thermal load and avoid damaging the heating element.

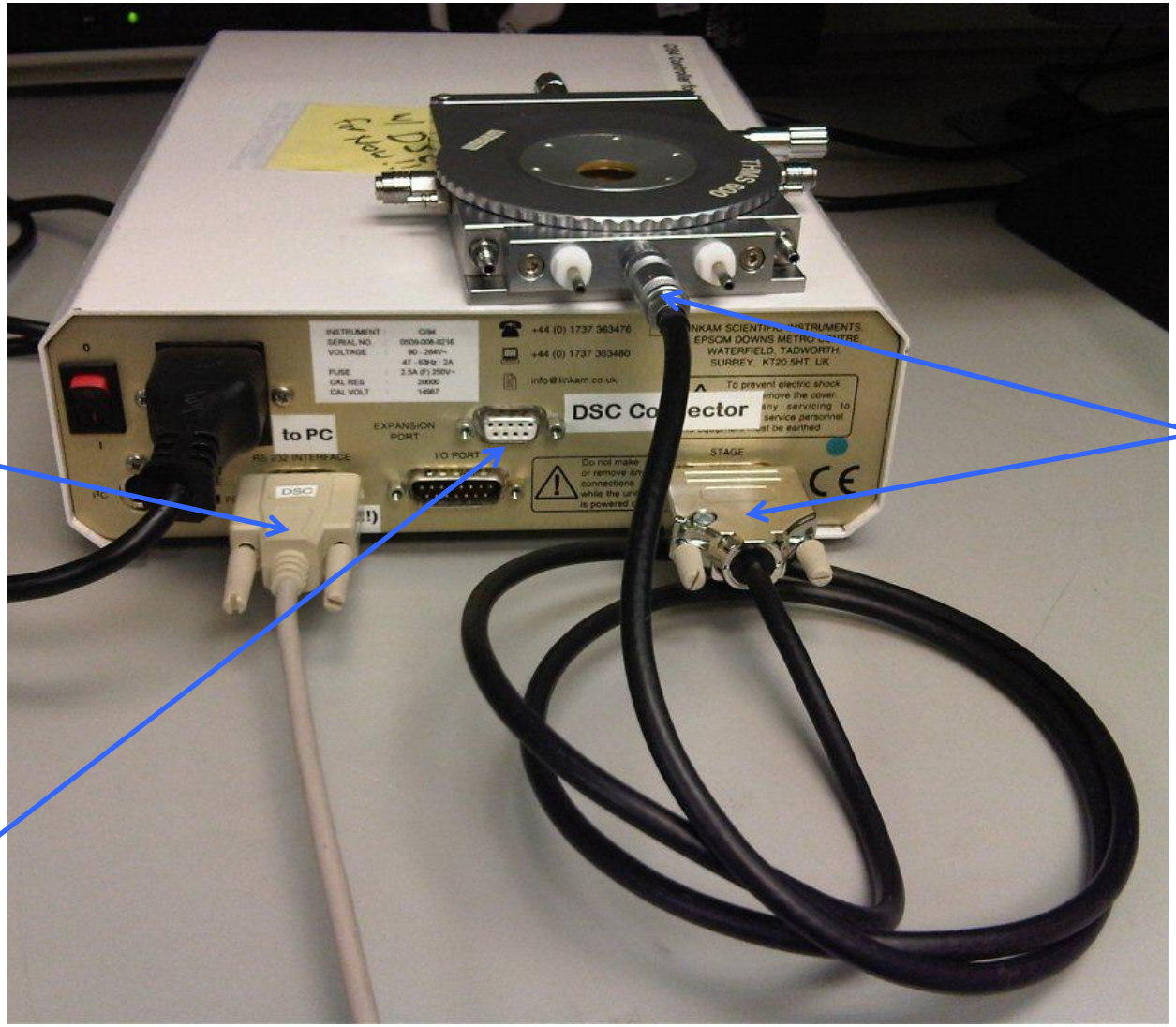
THMS600 and DSC600 Stages

THMS600/DSC600

- The Linkam THMS600 and DSC600 can be used to heat or cool a sample from

  -196^{o}C to 600^{o}C at speeds of 1-100^{o}C per minute.
- The following slides show connections for using either stage with or without cooling.

Connections for THMS600 & DSC600 without cooling

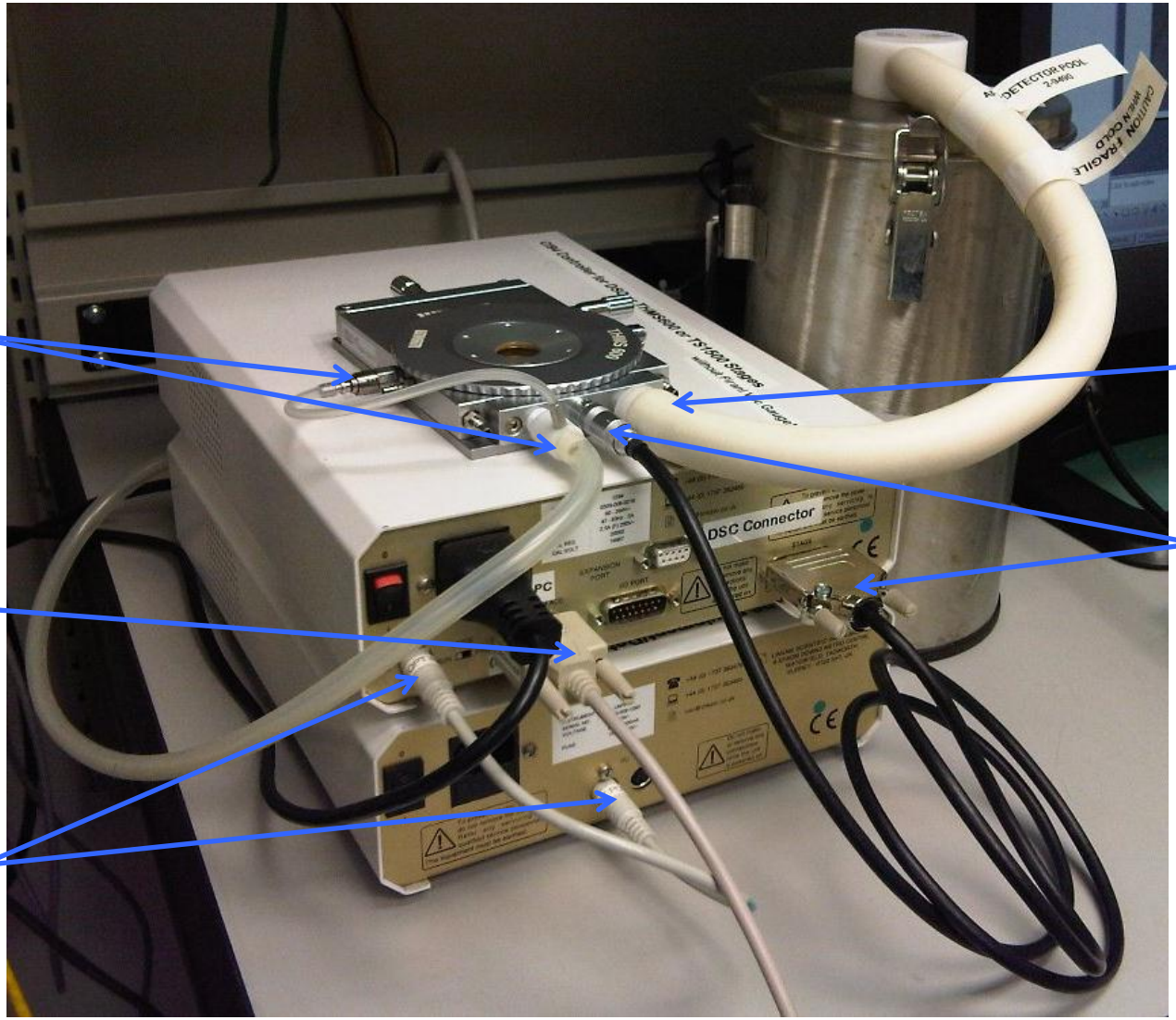


Crossover cable (or serial cable with null modem adapter) connects CI94 to computer serial port.

Lemo connector connects to stage. D-type connector connects to CI94.

If you are using the DSC600, there is an additional cable connection to make.

Connections for THMS600 & DSC600 with Cooling Pump (LNP), rear view



Tube connects stage to front of LNP. Make sure tube is secure; connect inner tube first. {Optional, if cooling is desired.}

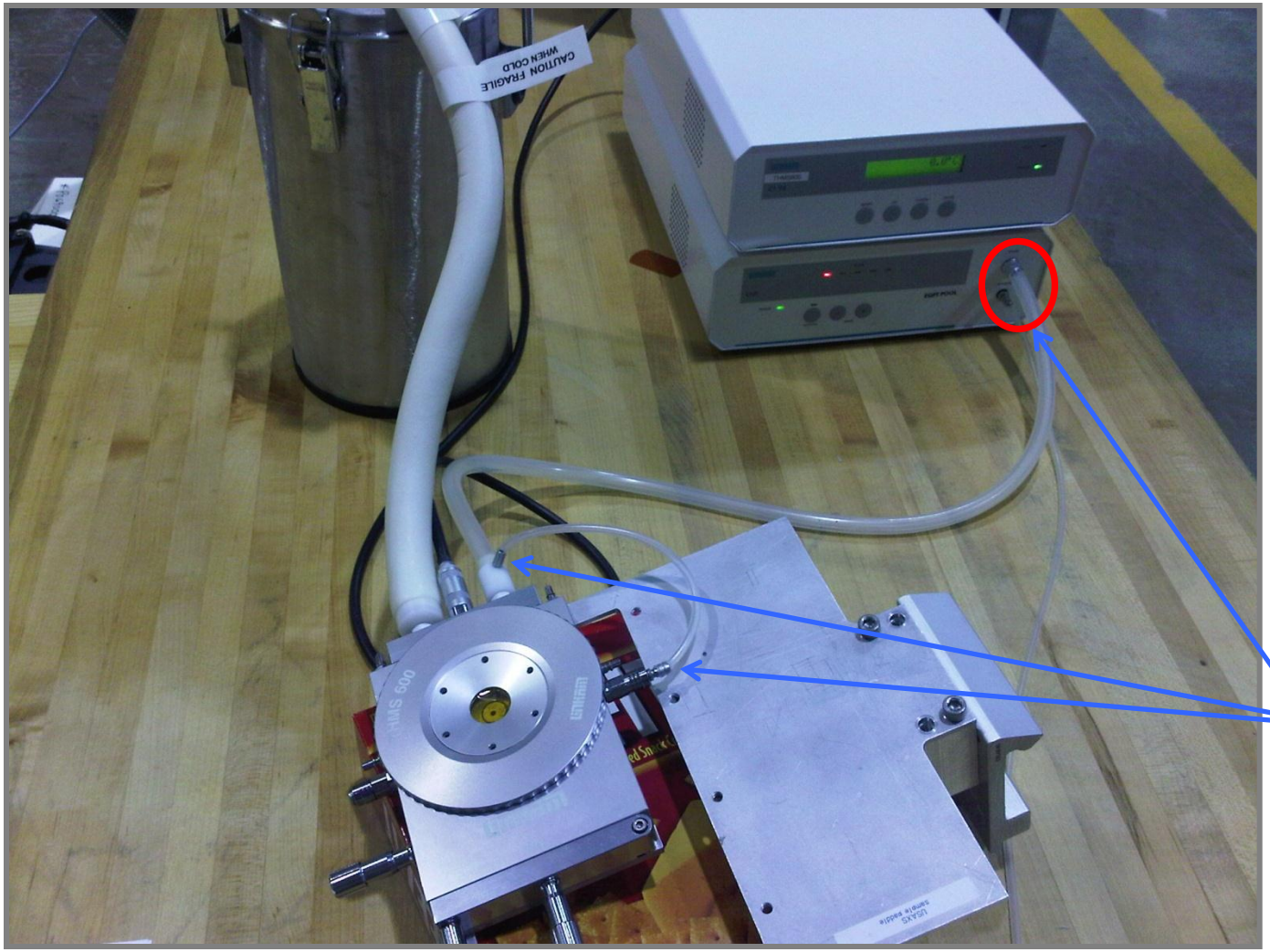
Crossover cable (or serial cable with null modem adapter) connects CI94 to computer serial port.

I²C cable connects CI94 to LNP. {Optional, if cooling is desired.}

LN2 dewar connects to stage. {Optional, if cooling is desired.}

Lemo connector connects to stage. D-type connector connects to CI94.

Connections for THMS600 with Cooling Pump (LNP), front view

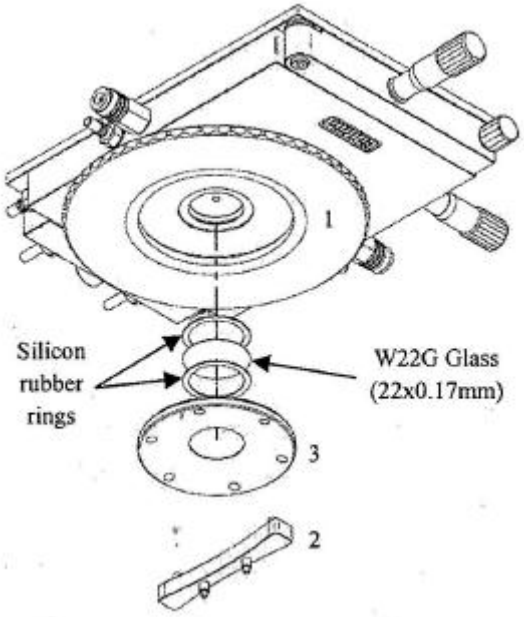


Tube connects stage to front of LNP. Make sure tube is secure; connect inner tube first. {Optional, if cooling is desired.}

THMS600 Parts

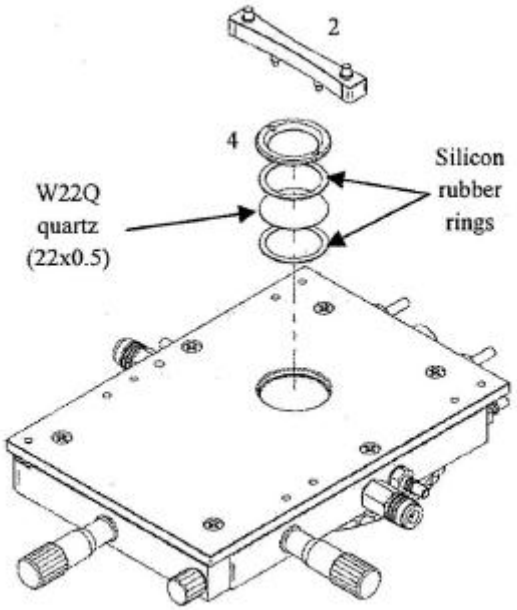
Lid Window Assembly

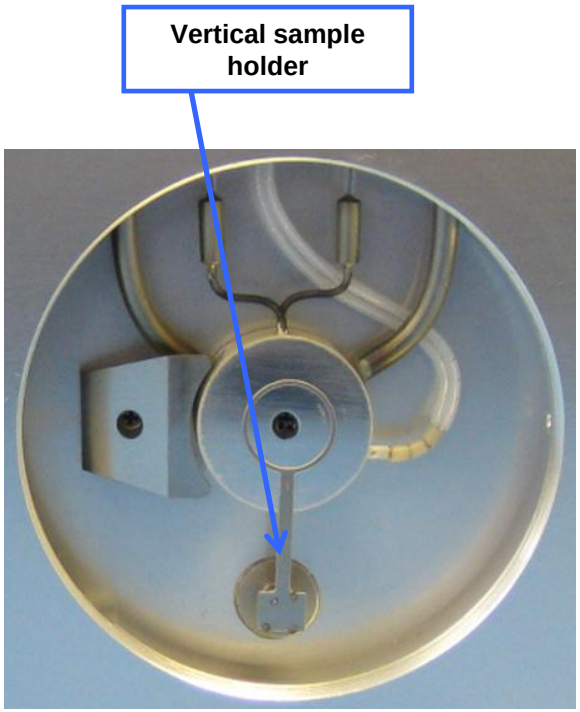
To replace the windows in the Stage Lid (1) use the Window Tool (2) and align the two wide spacing pins to the Tube Clip Holder holes and unscrew the Lid Insert (3).
The Stage Lid and Lid Insert should be turned upside down as shown in the diagram opposite and reassembled in the order indicated.
The Lid Insert should be screwed down until the cover slips are held firmly, then turn the assembly over and screw down the Lid Insert until it is felt to come to a stop.



Bottom Window Assembly

Use two narrow spacing pins of Window Tool (2) to align it to the two holes of Window Locking Ring (4) and unscrew.
Reassemble the bottom window as shown in the opposite diagram





Photos/graphics courtesy of linkam.co.uk

Cooling with LNP95

Cooling with LNP95: Reminders

- If using LN2 cooling, please follow all APS procedures for safe handling of LN2.

- Disconnect the LN2 dewar from the stage before heating above 300^{o}C. Leaving the tubing connected can damage the tube and/or heater.

- The black capillary tube on the dewar lid is fragile. Please handle carefully.

Cooling with LNP95

- Fill the dewar approximately 2/3 full.
- The LNP95 must be switched on before the T95/CI95 system controller.
- The stage chamber needs to be purged of air before starting a cooling experiment.
  - See procedure on next page.

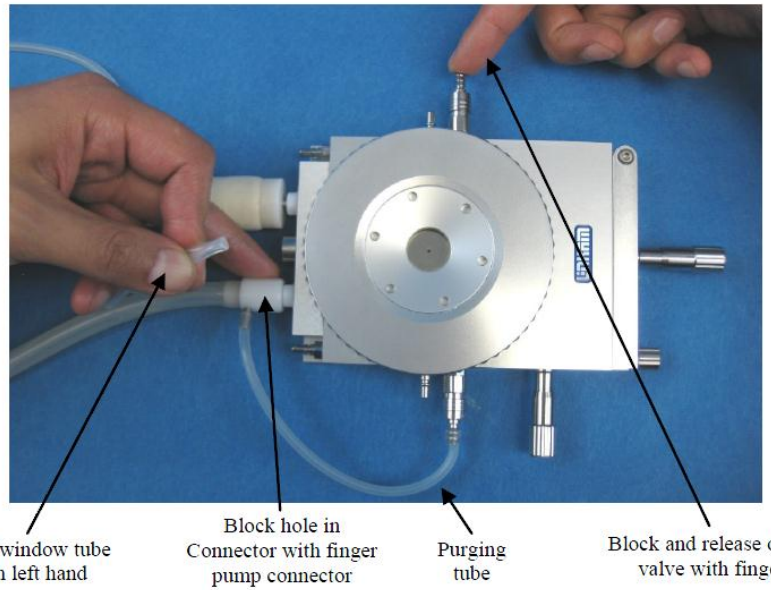


Photo courtesy of linkam.co.uk

Purging Procedure

- For full details, please see the THMS600 User Guide from Linkam, available on the Detector Pool website.
- To purge using recycled nitrogen gas produced from the Dewar:
  - Make all connections, make sure that the stage lid and gas inserts are secure, turn on the LNP95, then turn on the T95/CI95.
  - Set the LNP95 to “Manual” mode.
  - Set the T95/CI95 to hold at 40^{o}C
  - Set the LNP95 to a speed of 100.
  - Block the hole in the white plastic pump connector, and pinch the narrow window tube to block it.
  - Block the gas outlet for a few seconds to allow pressure to build, then release. Repeat for a few minutes.
  - When finished, unblock the pump connector, window, tube, and gas outlets.
  - Change the LNP95 to “Automatic” mode.

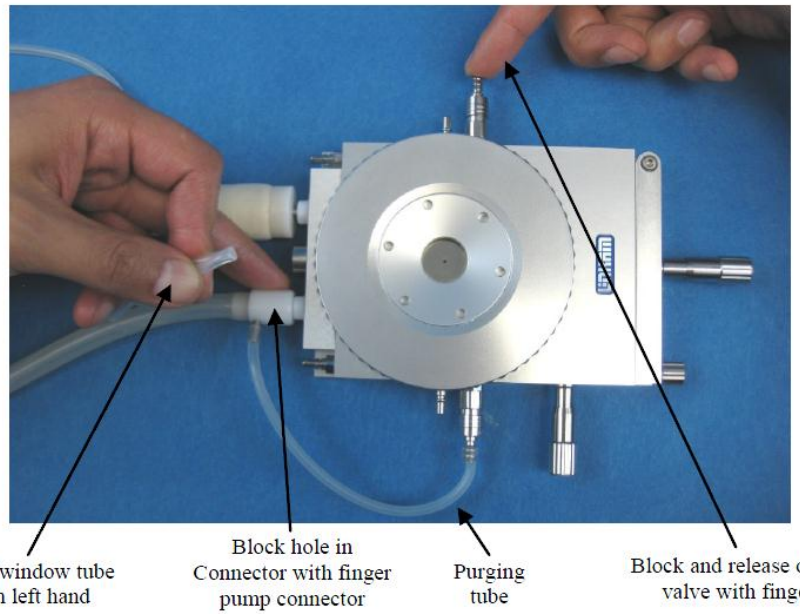


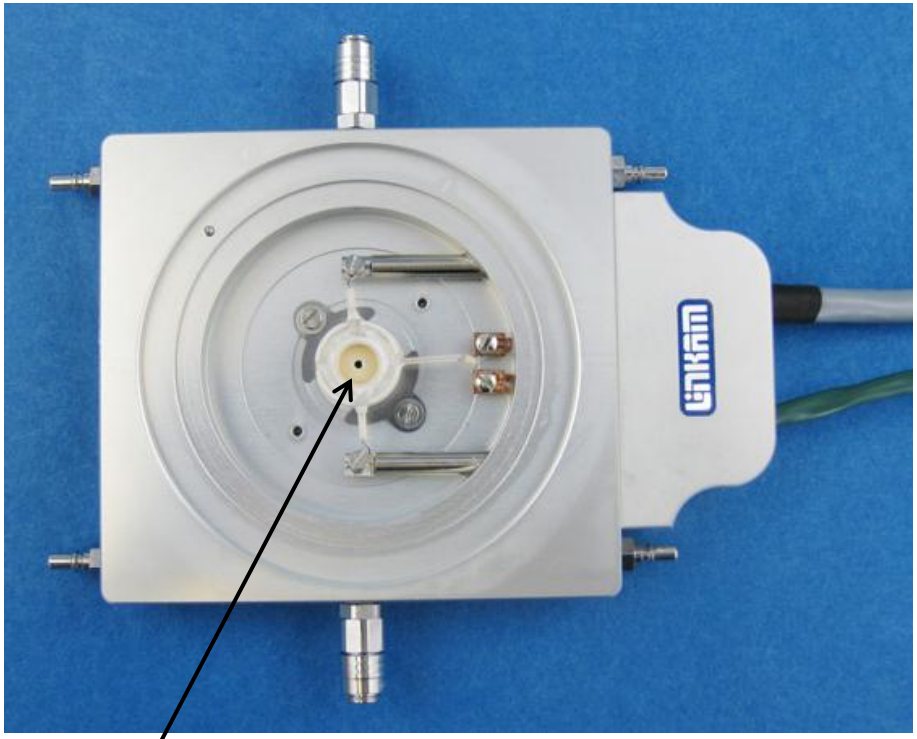
Photo courtesy of linkam.co.uk

TS1500 Stage

TS1500 Stage

- The TS1500 stage can be used to heat a sample from room temperature to 1500^{o}C at speeds of 1-100^{o}C per minute.
- Use as little sample as possible to reduce thermal load and avoid damaging the heating element.
- Samples must be placed on either the W7S sapphire disk or a Pt crucible; otherwise, the sample will fuse to the ceramic cup and/or damage the thermocouple.
- To prolong the life of the heating element, try to avoid consistently high heating rates and temperatures.
- All Linkam stages have **EXTREMELY** fragile platinum leads connecting the heating element to the stage. AT NO TIME should these leads be touched or moved!!!

TS1500 Stage

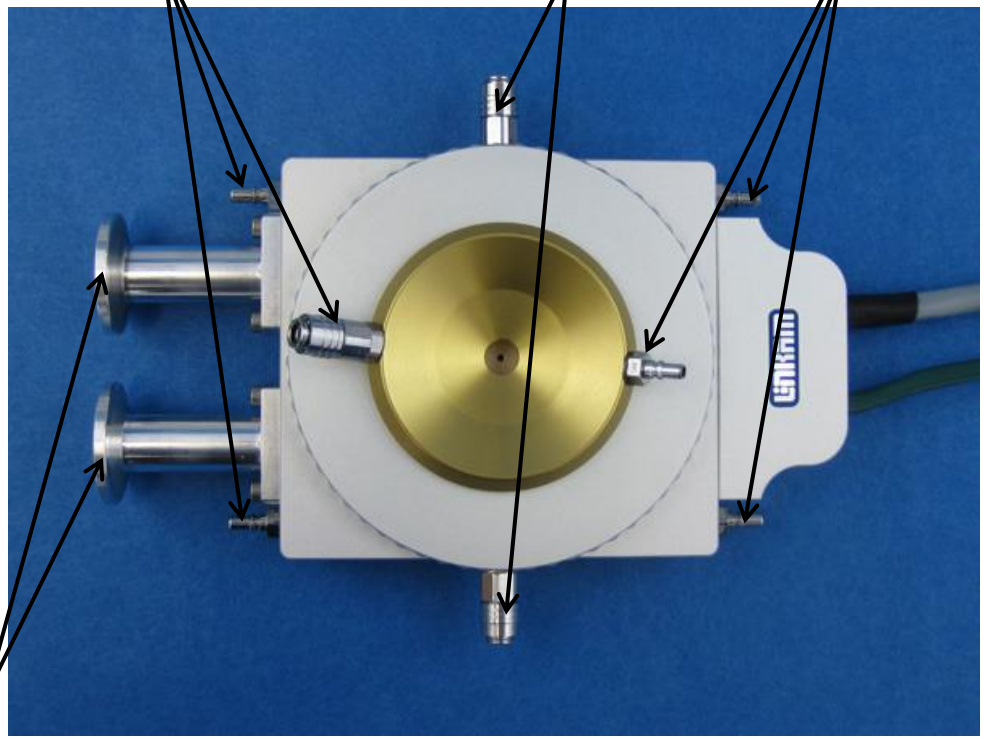


Heating element with ceramic heating crucible

Water cooling connections

Optional Gas connections

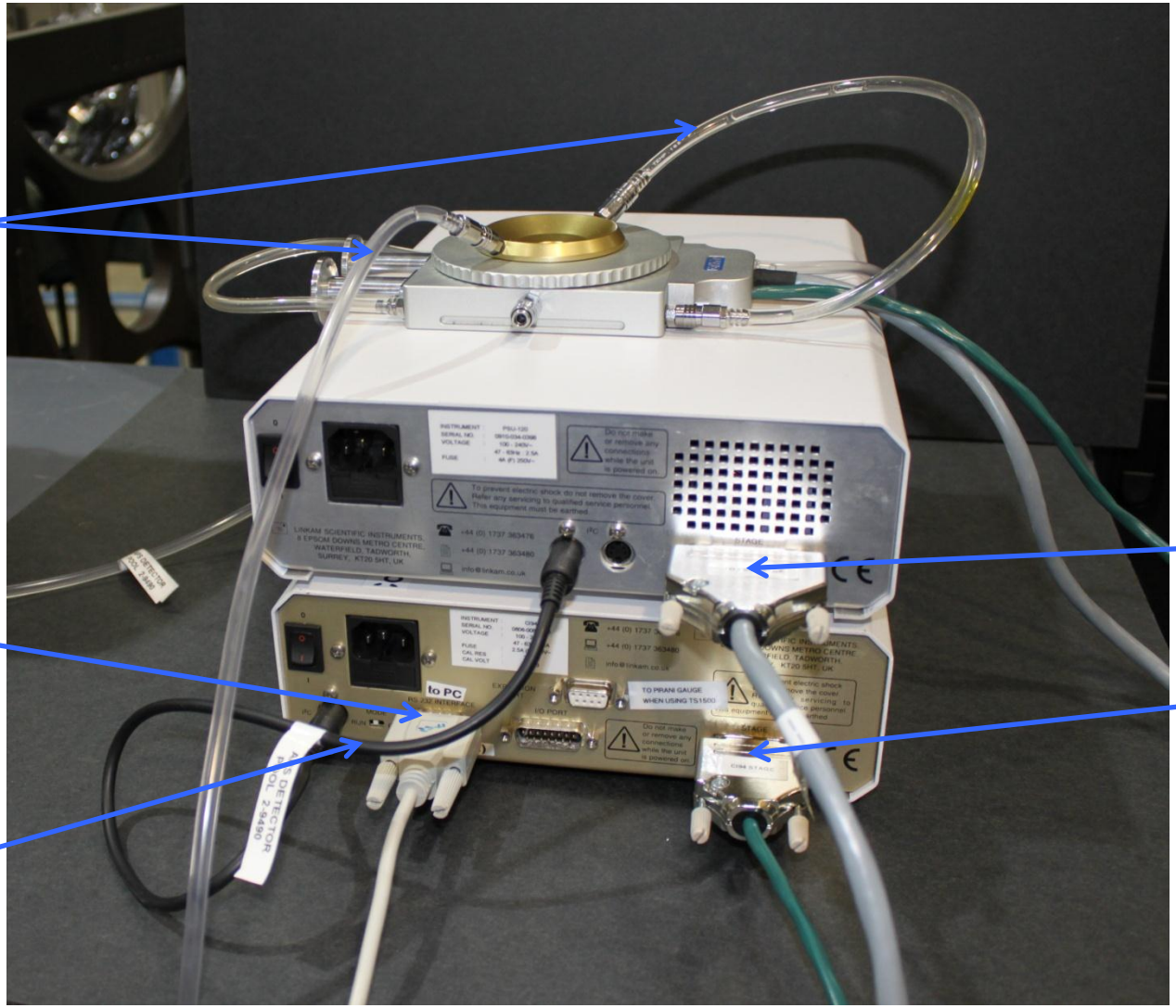
Water cooling connections



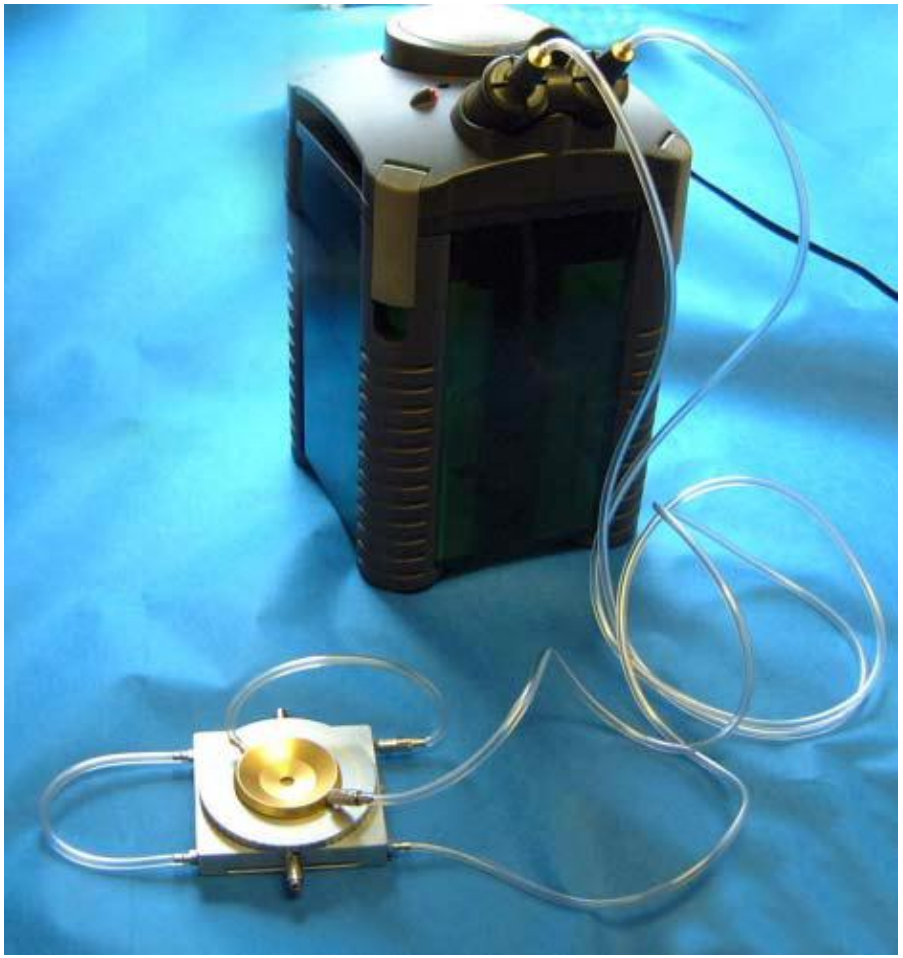
Optional vacuum ports

Photos courtesy of linkam.co.uk

Connections for TS1500



Water Connections for TS1500



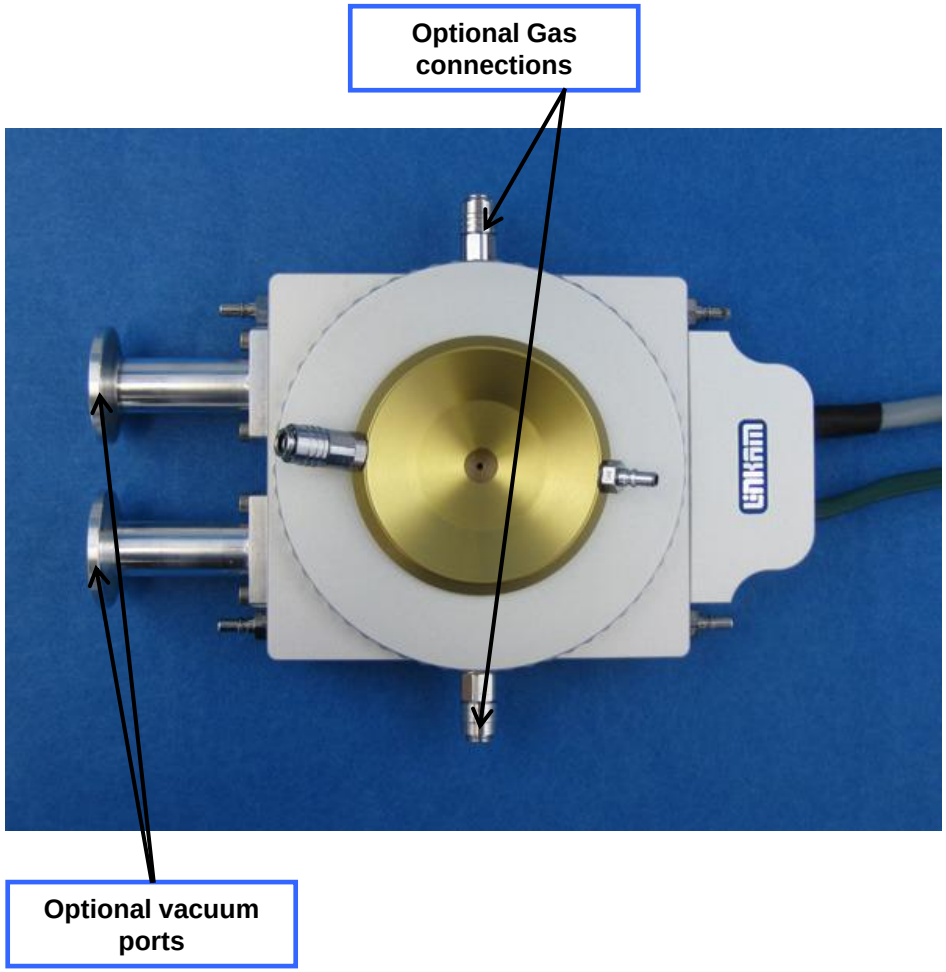
- The TS1500 requires water cooling to keep the stage body and lid window cool during sample heating.
- It may be necessary to prime the ECP water circulator if the water connectors have been removed.

Water Connections for TS1500

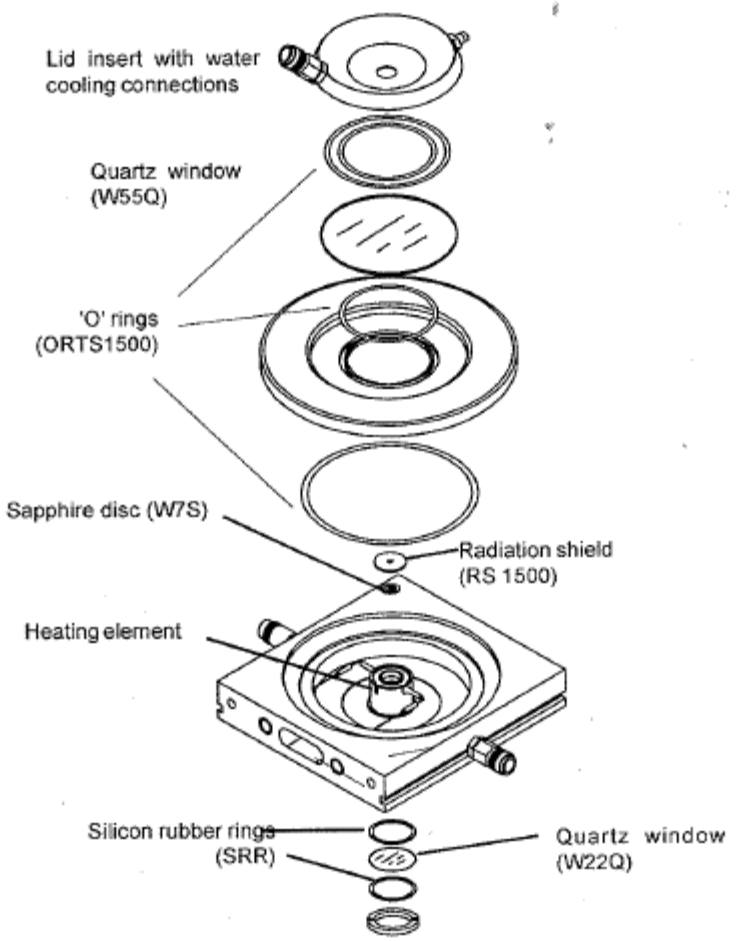
- Alternatively, a small recirculating chiller can be used.

Vacuum Connections for TS 1500 (optional)

- The vacuum connections should be used if the sample outgases significantly. This will help prevent the deposition of the sample on the interior of the stage.
- Inert gas may also be supplied to aid in purging the sample chamber.
  - Helium is not recommended because of its high thermal conductivity.



TS 1500 Parts



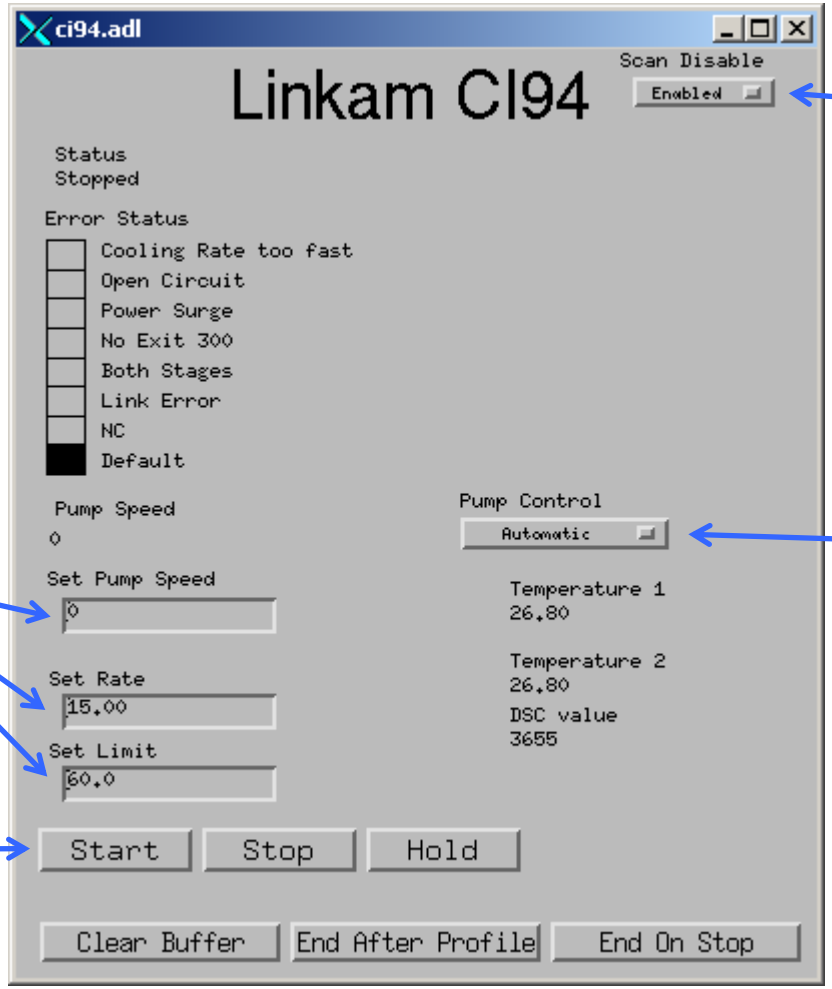
Software Controls

Software Controls: EPICS

- The Linkam equipment can be controlled either with EPICS or with the Linkam software, but not both. To use EPICS, make sure the Linksys32 software is not running.
- From the desktop, click the “Start Linkam epics IOC” icon:

- From the desktop click “Start Linkam MEDM” to start MEDM windows:

Software Controls: EPICS



Scan Disable: tells VME (EPICS sscan) to stop communicating with controller (e.g. if software is loaded but CI94 is not in use). "Enable" restarts communication.

Toggles LNP control from automatic to manual

Set pump speed (upper limit = 30), temperature rate of change (ºC per min), and desired temp

Start: start heating/cooling. Stage will go to "Set Limit" temp and hold

Stop: return to room temp

Hold: while heating or cooling, hold current temp

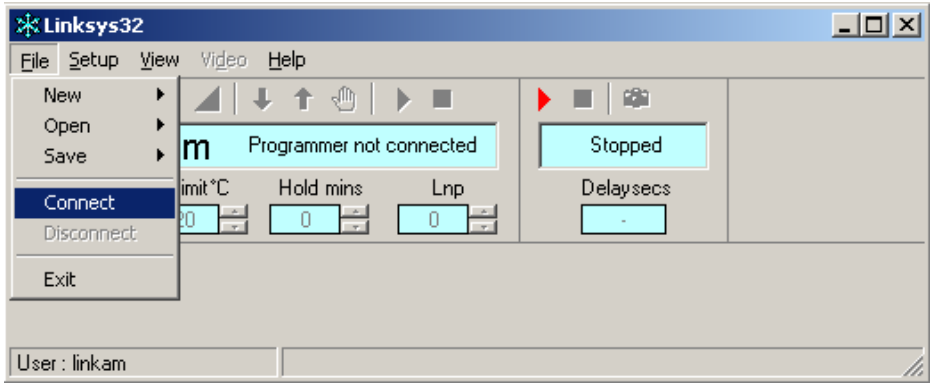
Thanks to John Hammonds for the EPICS interface!

Software Controls: Linkam

- The Linkam equipment can be controlled either with EPICS or with the Linkam software, but not both. To use the Linkam software, make sure that the EPICS IOC is not running.

- From the desktop, click Linksys32 icon:

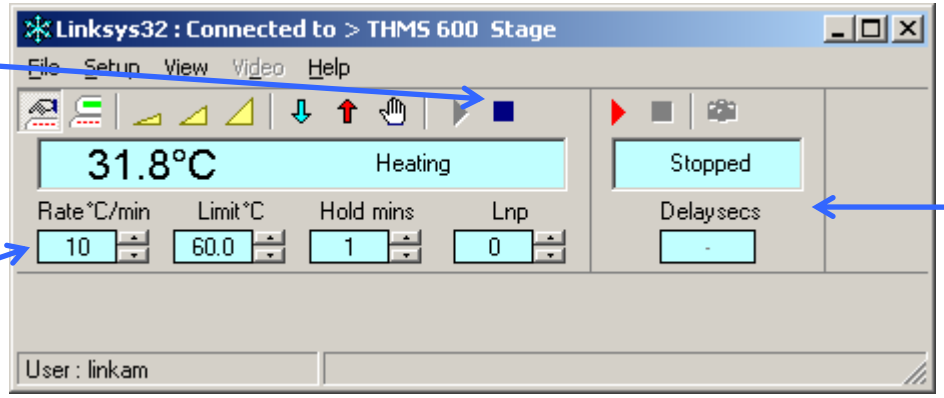
- Select “File: Connect”



Software Controls: Linkam

- The Linksys32 window can be used to control heating and cooling of the stage.

Start and stop temperature ramps



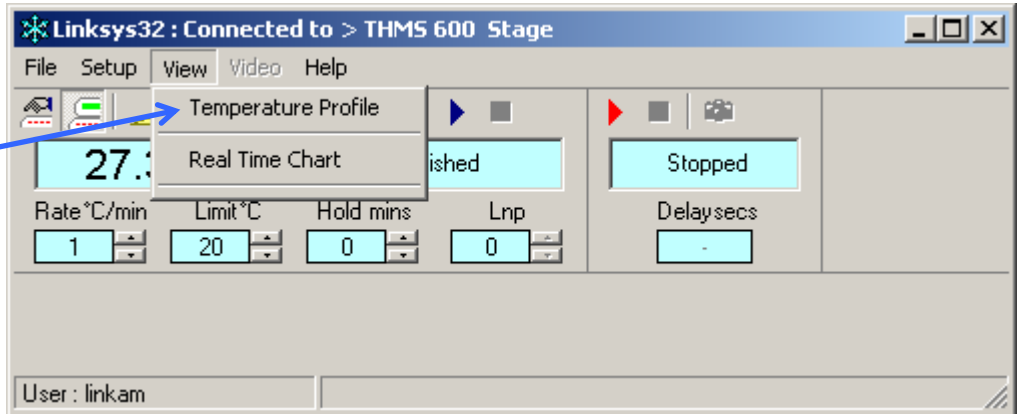
Set the rate, max/min temperature, and hold time here

Data capture controls

If you are using the DSC, you may be required to use a Temperature Profile!!! See next page….

Software Controls: Linkam

Select “View Temperature Profile” to setup multiple-step temperature ramps



A previously-set temperature profile may affect your ability to control the stage. If control difficulties occur, check the temperature profile settings.

Profile

Profile - Cycle mode off

Ramp	Rate	Limit	Time	Delay
1	1	20.0	30	-
2	0	0.0	0	-
3	0	0.0	0	-
4	0	0.0	0	-
5	0	0.0	0	-
6	0	0.0	0	-
7	0	0.0	0	-
8	0	0.0	0	-
9	0	0.0	0	-
10	0	0.0	0	-

If you are using the DSC, you may be required to use a Temperature Profile!!!