

**Linkam Scientific  
Instruments Ltd**

**TS1500  
Stage Manual**

**User's Guide**

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## Important Notice

Please check that your Linkam equipment has not been damaged during transport. If there is any evidence of external damage **DO NOT SWITCH ON ANY ELECTRICAL ITEMS**.

Contact LINKAM SCIENTIFIC or their appointed distributor immediately. Your warranty may be impaired if Linkam is not informed of any transport damage within 7 working days of delivery.

NO attempt should be made to repair or modify the equipment in any way, as there are **no user replaceable parts**.

No attempt should be made to open the case except by qualified personnel as hazardous voltages are present.

Please contact Linkam for custom modifications for specific applications.

In order to use this equipment successfully, please take time to read this manual all the way through before starting to work.

## Warranty

This equipment has a warranty against defects in material and workmanship for a period of 12 months. Linkam will either repair or replace products that prove to be defective. For warranty service or repair, this product must be returned to Linkam or a designated service facility.

The warranty shall not apply to defects resulting from interfacing, unauthorized modification or misuse, operation outside of the environmental specifications for the product, or improper site preparation or maintenance.

## Technical Support

Any technical questions or queries should be addressed to the Technical Support Department at the address shown on the back of this manual.

## Equipment Maintenance

The programmer does not require any regular maintenance. If for any reason it is necessary to check the electronic calibration then a set of standard resistances can be supplied, which simply plug into the programmer in place of the stage, and indicate known temperature values. The standards are traceable to NAMAS (National Accreditation of Measuring and Sampling)

Before cleaning the case or front panel of the programmer, remove the mains lead from the wall outlet. Use a small quantity of isopropyl alcohol with a soft cloth and gently wipe the surface.

## Safety Precautions

- 1) Read this guide before using the equipment. Save these instructions for later use.
- 2) Follow all warnings and instructions which may be placed on the programmer or stage.
- 3) If for any reason the mains fuse needs to be replaced then it must be replaced by one of the same type and rating as shown in the equipment ratings.
- 4) To prevent electric shock, do not remove the cover of the controller or associated electronics.
- 5) Never use the equipment if a power cable has been damaged. Do not allow any heavy objects to rest on the power cables. Never lay the power cables on the floor.
- 6) Do not obstruct any ventilation holes. Do not attempt to insert anything into these openings. Provide adequate ventilation of at least 75mm all around the equipment.
- 7) Do not expose the equipment to water. If for any reason it gets wet then unplug it from the mains and contact Linkam Scientific Technical Support.  
The equipment is not intended to be used outdoors.
- 8) Each product is equipped with a 3-wire grounded (earth) mains plug or a free-end 3 wire mains lead. The plug only fits into a grounded-type outlet. The free-end mains lead should be connected to a correctly grounded 3-wire mains outlet.

Free - end mains leads are colour coded as follows :

Colour	Function
Brown	Live
Blue	Neutral
Green/Yellow	Earth (Ground)

- 9) If any problems occur then unplug the equipment from the mains outlet and contact Linkam Scientific Technical Support.
- 10) Do not remove the cover from the equipment unless the mains inlet has been removed. Any servicing should be carried out by qualified service personnel.

## Symbol Reference



**Caution -**  
This safety symbol is on the backpanel of the equipment and warns:-  
The user must not make or remove any connections while the unit is powered on.  
To avoid electric shock do not remove the cover. Refer servicing to qualified service personnel.



**Caution -**  
This warning symbol indicates that the surface labelled with this symbol may be hot.

## Optical Information

It cannot be stressed enough, how important it is to have the microscope set up correctly, especially when working at high magnifications.

The following few paragraphs detail the setting up of the most important features of the microscope such as the light source and condenser lens.

To help explain the set up procedures for the microscope, a simple line drawing showing the essential parts of the microscope's optical path is shown below.

If the condenser working distance is less than 12.5 mm, we can supply a condenser extension lens for most reasonably new microscopes.

### Phase Contrast

Please contact Linkam for further details if you are using the stage with phase contrast.

### Light source centring and focus

The adjustment of the light source is only necessary when the microscope is first installed or when the bulb is replaced, provided that the adjustments made are not disturbed.

1. Open the field diaphragm on the base of the microscope to it's largest extent and place a flat, thin piece of paper over it.
2. Turn the light source to maximum output.
3. Slide the lamp housing backwards and forwards until the image of the bulb filament is visible on the paper.
4. To centre the filament, adjust both the lamp vertical centring ring and the lateral centring screw on the lamp housing.
5. Pull the lamp housing slightly forward until the filament image is diffused, or alternatively fit a diffusing filter.

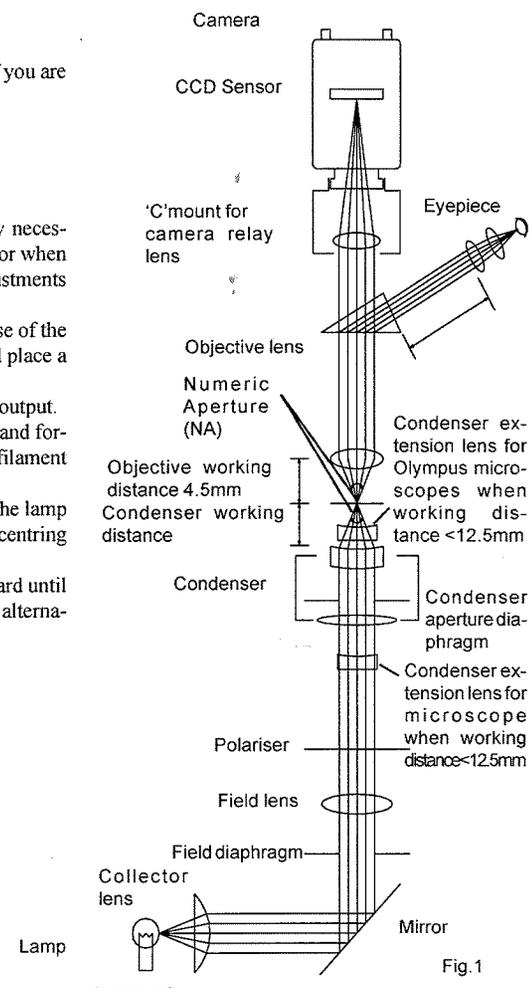


Fig. 1

### Centring the condenser lens

It is extremely important to have a focused, centred and condensed light beam at all times and to ensure that the field diaphragm and condenser aperture diaphragm are set correctly.

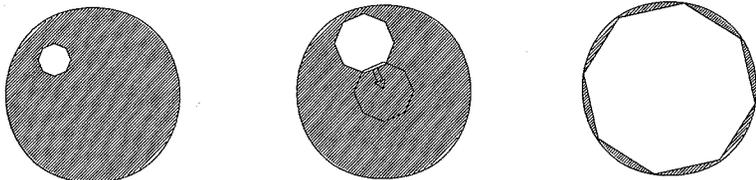


Fig.2

- 1) Select the 10X lens and close the field diaphragm on the microscope base to its smallest size. Rotate the condenser focus knob, moving the condenser up and down until a sharp image of the field diaphragm is seen clearly in the eyepiece.
2. Using the two condenser centring screws bring the field diaphragm image into the centre of the field of view.
3. Adjust the field diaphragm so that the image of the diaphragm is about the same size as that of the field of view. If it is still not centred use the condenser centring screws again.

### Use of field diaphragm

The field diaphragm controls the diameter of the illuminated area on the specimen surface in relation to the field of view of the microscope. By stopping down the field diaphragm until it is slightly larger than the field of view, will reduce stray light, and in turn will increase image definition and contrast.

### Use of condenser aperture diaphragm

This adjusts the numerical aperture (N.A) of the illuminating system of the microscope and determines the resolution, contrast and depth of focus.

In general it should be stopped down to 70~80% of the numerical aperture of the objective lens for best overall results.

After completing focus adjustment, remove one of the eyepieces and look into the empty eyepiece tube. Adjust the size of the diaphragm, observing the image of the diaphragm which is visible on the bright circle of the objective exit pupil.

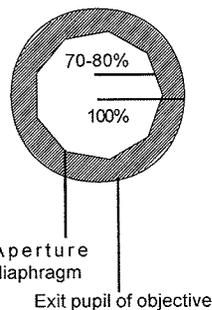
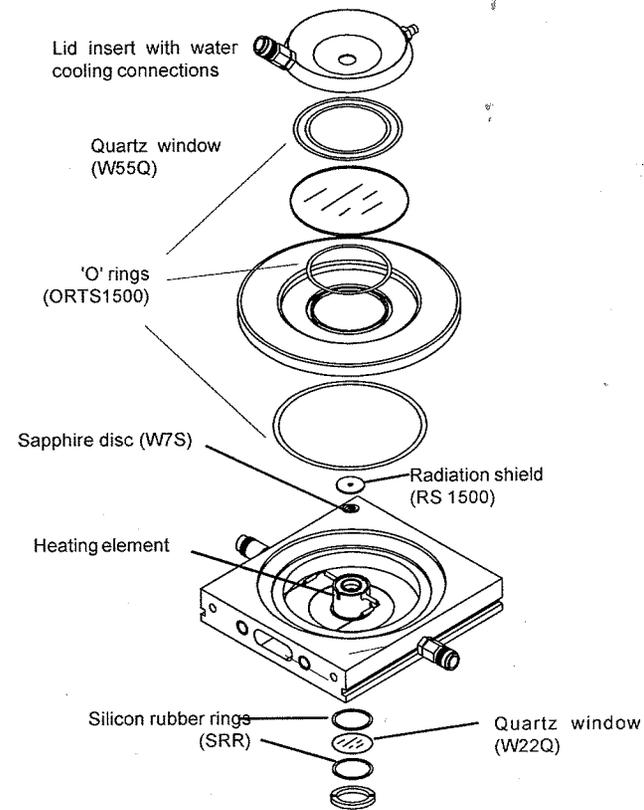
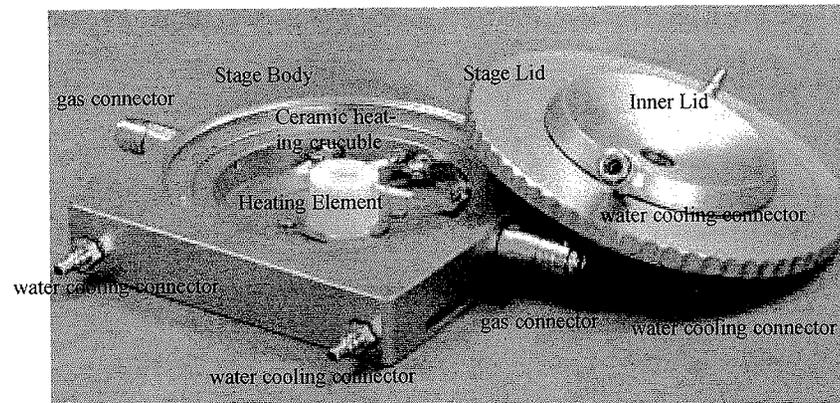


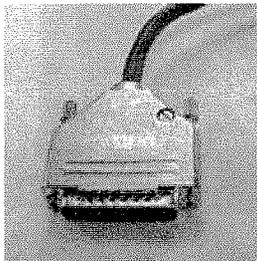
Fig.3

### Stage Anatomy

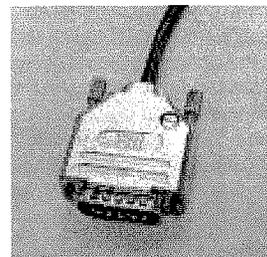
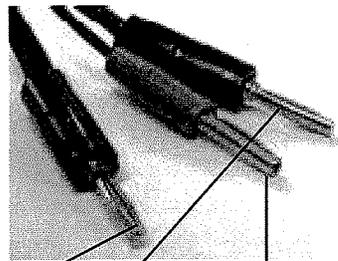


## Stage Electrical Connections

This connector plugs into the PSU (power supply unit)



The black leads are for the power and green is the earth



This connector goes into the temperature programmer(TMS94)



This end of the cable goes into the stage. Ensure that the Wider copper pin goes into the wider slot in the green connector

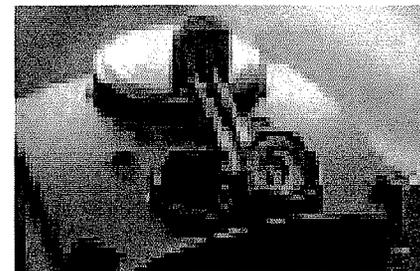
## Connecting the ECP Water Circulator

The water circulator is necessary to keep the stage body and Lid window cool during heating experiments. Make sure the water is running before you start heating experiments.

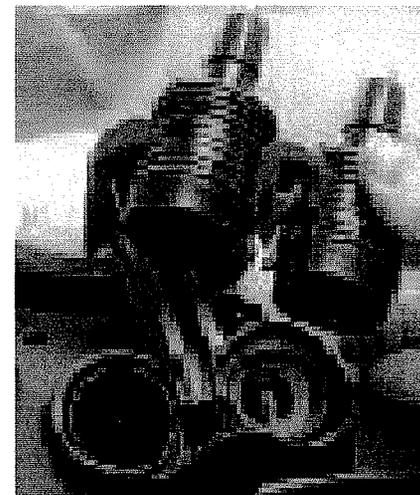
There are different types of water circulation pump depending on voltage in your country.

### Connecting 110V ECP

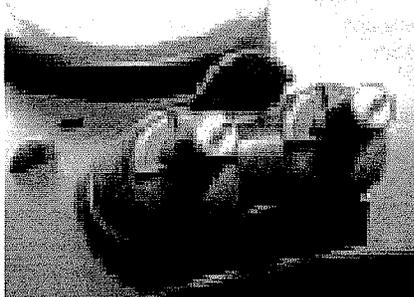
The ECP is shipped without the water connectors in place. The top of the ECP will appear as in the picture on the right. If the grey catch in between the two openings is not in the furthest back position, (as seen in the picture) you will need to press the red button to the left of the catch to release it and push it further back.



Place the part with the two brass water connectors into the corresponding inlet/outlet holes on the top of the ECP. Two small triangles indicate the flow. Match the triangle symbols on the pump with those on the connector.

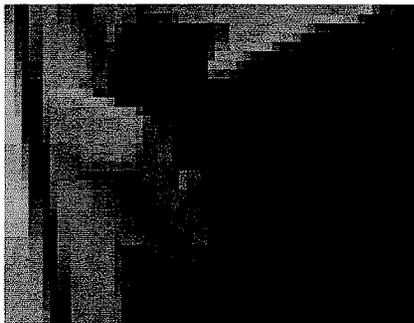


Push the grey lever down. To fasten the water connectors in place



### *Filling the ECP*

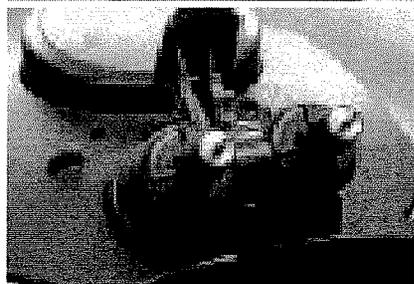
Remove the top part of the ECP by unclipping the four grey plastic catches. The catches are released by pulling the grey piece outward from the bottom



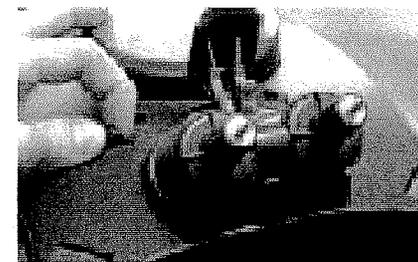
Lift off the lid and fill the green reservoir so that it is completely full. Then fasten the catches.



You now need to top up the reservoir. Lift the catch at the top of the water connectors as shown in the picture.



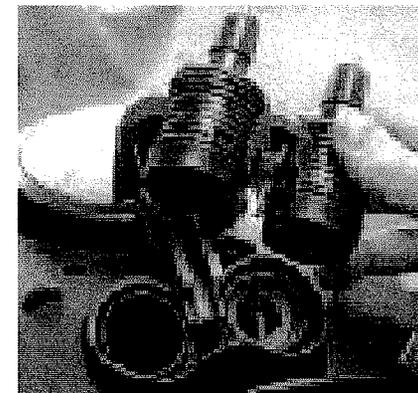
Press the red button to the left of the water connectors and lift the catch further back to completely release the water connectors. The red button may be quite stiff, so ensure that it is pushed as far as it will go.



This picture shows how far back you need to lift the catch in order to release the water connectors.

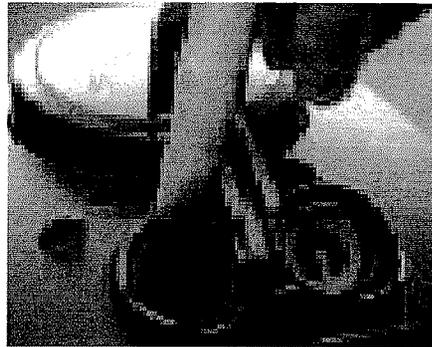


Completely remove the connectors.



Add water until you can just see it through the inlet hole.

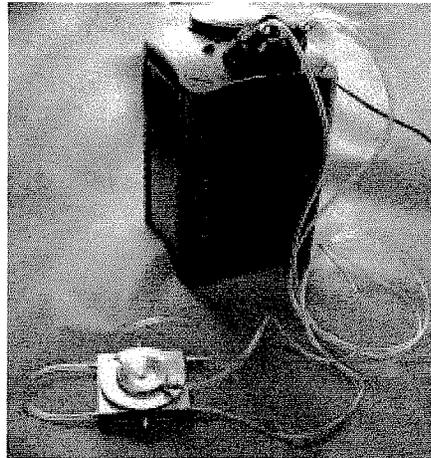
Now replace the water connectors and push down the catch to lock the connectors in place.



### *Connecting the tubes between ECP and TS1500*

The two longest tubes simply push onto the brass water connectors on the ECP.

Connect the other tubes as shown in the picture below.



### *Connecting the 220V ECP*

Unclip the metal catches around the top of the ECP. When the catches are released remove the black plastic pump section of the ECP.

Fill the large green plastic container with water right up to the edge. Leave the container filled with water in a sink as water will spill over the edges when you replace the pump. Replace the pump. Make sure that the large rubber O'ring is seated in the correct place.

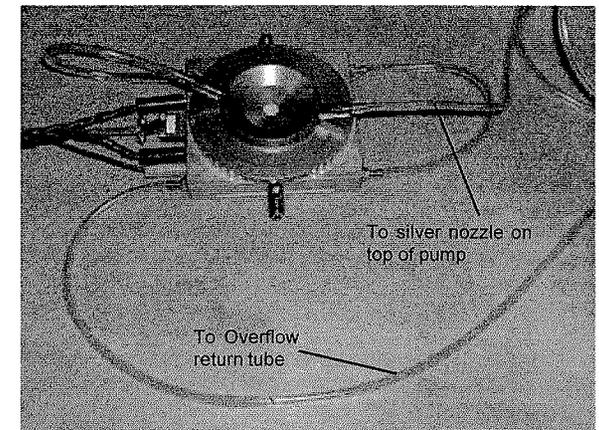
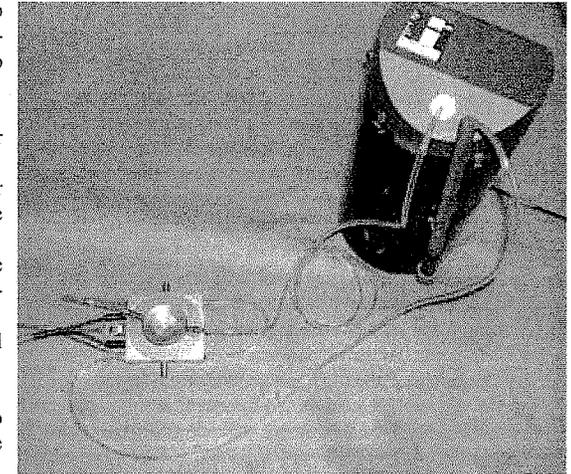
Water should squirt from the metal nozzle on the top of the pump.

It is very important that there are no airpockets beneath the pump and the surface of the water.

Top up the water level by filling the overflow tube attached to the side of the green container.

There are two long tubes supplied. Place one in the overflow return pipe at the side of the container and connect the other to the silver metal nozzle on top of the pump as seen in picture below.

Connect the remainder of the tubes as shown in the pictures below.



### Loading a Sample

The samples are loaded into the ceramic heating crucible on either a 7mm sapphire disc or in a 6mm platinum crucible. The total mass of sample and sample carrier (sapphire disc or Pt crucible) must not exceed 120mg as this will overload the heating element and equipment will not perform to specification. (Check the load light on the front of the PSU, if it is not flashing evenly, or continuously on, then there is too much sample in the crucible or if the gas flow into the stage maybe too fast.

When loading a sample take care that it does not spill over the edges. Molten sample is not easily removed from the ceramic heating element. If sample comes into contact with the thermocouple it will cause permanent damage.

Place the ceramic heat shield (small ceramic disc) on top of the crucible, this will create a closed furnace to ensure uniform sample heating. The heat shield also prevents a majority of volatiles

condensing on the quartz window when heating.

When heating above 300°C ensure that the ECP water pump is connected and switched on and that the water is flowing. The stage body will become very hot when above 1000°C if the water is not flowing.

#### WARNING

If heating above 1200°C you will see that heating element glows brightly. You will need a light filter in the trinocular (or binocular) head of your microscope to prevent potential retina damage.

The filters used in welding goggles/masks works well in this application.

### Using the TS 1500 stage

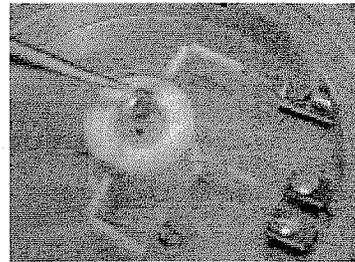
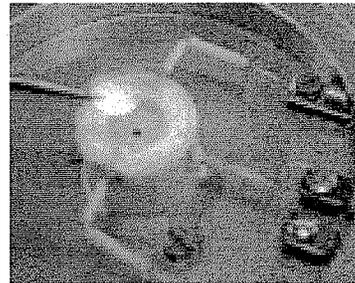
To prolong the life of the stage, try to avoid consistently high heating rates and temperatures as this can lead to excessive grain growth in the platinum heater with the resulting effect that the wire becomes thinner and finally fails.

Above 300°C, if the EXIT key is pressed or if the end of profile is reached, the TMS 94/1500 will cool at a controlled rate of 200°C/min down to 300°C before shutting off.

This prevents the sudden drop in temperature which could cause the ceramic cup and its supports to crack. A programmed cool to 300°C should always be used.

The TS1500 responds very quickly to changes in temperature on the sample, so to prevent any damage to the heater it is strongly advised that no COLD samples be introduced at higher temperatures and that the sample be as thin and as light as possible.

Samples must always be placed on the either the W7S sapphire disc or Pt crucible as the sample can fuse into the ceramic cup or can attack the thermocouple causing incorrect temperatures and leading to a



#### Failure of the heater.

For the same reasons quartz discs should not be used at temperatures >1000°C.

### Atmospheric Control

To control the atmosphere in the stage there are gas ports on either side of the stage. To open the gas port, insert the small silver gas opening insert supplied with the stage, and attach your gas line to this.

Gas flow into the stage should be limited to about 60 cc/min as flows greater than this can cause problems with the temperature control and the accuracy of the temperature measured. Thermally conductive gases such as helium can also effect the temperature control and limit temperature accuracy.

If the quartz window in the lid becomes dirty or stained it may be cleaned and polished using a small quantity of jewellers rouge.

### Stage heater protection

The TS 1500 stage is protected in the programmer by a solid state cut-out. If for any reason the current into the heater exceeds a pre-set level the power will be automatically turned off and the message 'PWR SURGE' will be displayed on the programmer. This could happen for instance if a cold sample is introduced at high temperatures or if a gas flow was too high.

To reset the programmer allow the stage to cool and then press any key on the programmer.

