



Linkam Scientific Instruments

TST350

**Temperature Controlled
Tensile Stress Testing Stage**

USER GUIDE

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Before Setting Up Your Equipment

Please register your products by going to the technical support section of our web site www.linkam.co.uk

You will need to register your equipment with us to:

- Activate your warranty and technical support
- Access the online setup videos
- Permanently unlock LINK software (if purchased)

If you have purchased LINK software, or want to try a demonstration of it, please install it first. You will be guided through the LINK software registration process the first time that the software is used, and will need the LINK software registration card to complete this.

Important Notice

Please check that your Linkam equipment has not been damaged during transit. 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.

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

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

Use a small quantity of isopropyl alcohol with a soft cloth and gently wipe the surface. To clean the hotstage, use isopropyl alcohol (IPA) and cotton swabs. Take great care not to touch the platinum temperature sensor protruding from the side of the heating element. The sensor is very fragile.

Handling Liquid Nitrogen

To cool samples below room temperature a LNP95 liquid nitrogen pump is required. Please refer to your health and safety manual for instructions on how to handle liquid nitrogen safely. Always use in a well ventilated room.

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 stage.
- 3) Never use the equipment if any cables have been damaged. Do not allow any heavy objects to rest on the cables. Never lay the cables on the floor.
- 4) 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.
- 5) 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.
- 6) The equipment is not intended to be used outdoors.
- 7) If any problems occur then turn all Linkam equipment off and contact Linkam Scientific Technical Support.
- 8) Do not remove any covers from the equipment, any servicing should be carried out by qualified service personnel.

Symbol References

Caution:

The user must not make or remove any connections while the equipment is powered on.

To avoid electric shock do not remove the cover. Refer servicing to qualified service personnel.



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



Introduction

Thank you for purchasing the TST350 temperature controlled Tensile Stress Testing System. Please take the time to read through the manual as it will help you to make the most out of the equipment.

Visit our website (www.linkam.co.uk) to register your equipment, this will ensure that we can update you if there are any firmware updates available to your System Controller and Linksys32 software.

TST350 Stage Specifications

Maximum temperature:	350°C
Minimum temperature:	-196°C
Maximum heating rate:	30°C/min
Maximum cooling rate:	30°C/min
Objective Lens WD:	7.7mm
Condenser lens WD:	12.5mm
Aperture for heating block:	5.5x1.5mm
Maximum force:	20N or 200N
Force resolution for 20N beam:	0.001N
Force resolution for 200N beam:	0.01N
Jaws travel distance:	80mm
Positional resolution:	0.01mm
Maximum Speed:	1000µm/s
Minimum speed:	1µm/s
Maximum sample width:	7mm
Maximum sample length:	106mm
Minimum sample length:	26mm
Maximum sample thickness:	2mm



TST350 System with LNP95

TST350 System

The system consists of a TST350 stage, a T95 System Controller, LINK software and optional LNP95 liquid nitrogen cooling pump system.

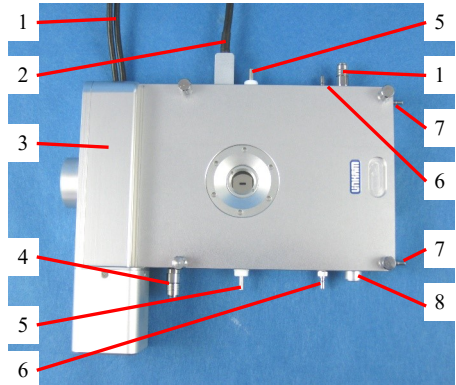
LINK-DV video capture software can be added as an option.

The TST350 stage is mounted onto the microscope by using either specific stage clamps or an adaptor plate.

Stage Anatomy

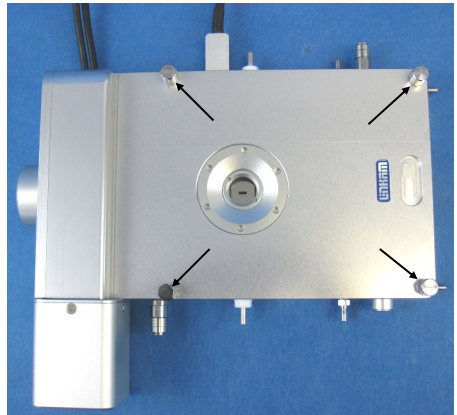
Connectors Assembly

1. TST and TSTMOT Cables
2. T95 Stage Cable
3. Motor Cover
4. Gas Purge Valve
5. Liquid Nitrogen Cooling Connector
6. Stage Body Water Cooling Connector
7. Bypass Stage Body Water Cooling Connector
8. Optional 4 pin Lemo Connector For TSTE350

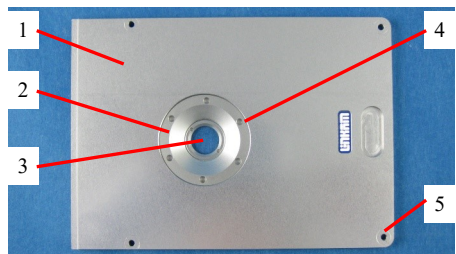


Lid Assembly

Unscrew the top 4 thumbscrews as shown by the arrows in the opposite photo to remove the Lid from the Stage.

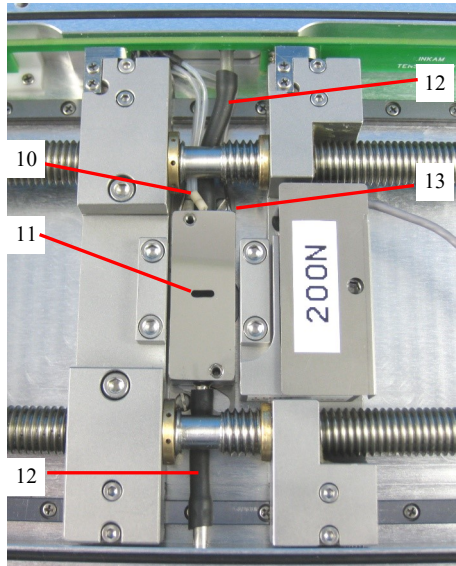
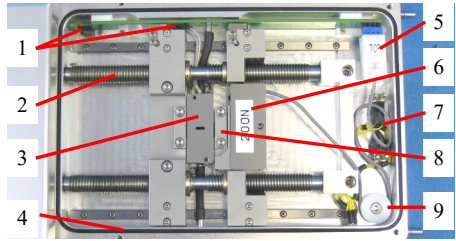


1. Stage Lid
2. Lid Insert
3. Viewing Window (22 x 0.5mm Quartz)
4. Holes for Tube Clip Holder or Window Tool
5. Hole for Lid Thumbscrew



Stage Anatomy

1. Micro Switch
 2. Lead Screw
 3. Copper/Nickel plated Heater/Cooling Block
 4. Rubber seal for Lid and Stage
 5. Transducer Sensor Connector
 6. Transducer Force Sensor (200N)
 7. Optional Internal Spring Electrical Contacts for TSTE350
 8. Sample Clamping Jaw
 9. Transducer Wire Clamp
-
10. PT100 Platinum Temperature Sensor
 11. Aperture (5.5 x 1.5mm)
 12. Liquid Nitrogen Cooling Tube
 13. Heating Element Wire



Mounting Stage to Microscope with Dovetail Substage

The following description is for mounting the stage on to microscopes which have a circular dovetail substage assembly (1).

Attach the curved stage clamps (part no. 9548) to the base of the stage using the supplied hex screws and the outer most holes in the base plate.

Adjust the two positioning grub screws (2) and locking thumbscrew (3) so that approximately 5mm of thread is exposed on the inside edge of the clamp. This will roughly position the stage in the centre of the dovetail.

Place the stage onto the dovetail, then focus a 5x objective lens on the rectangular aperture of the silver block. Using the two positioning grub screws (2) ensure that the aperture is in the centre of the field of view and lock the stage in place by tightening the locking thumbscrew (3).

For other types of microscope substage, refer to the diagram included with the stage adaptor.

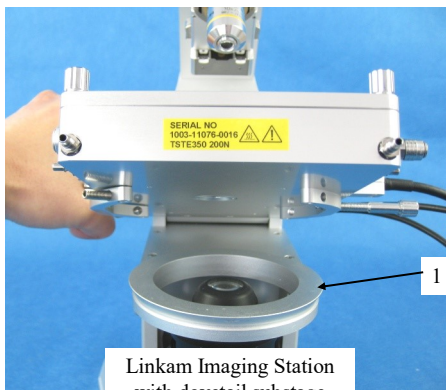
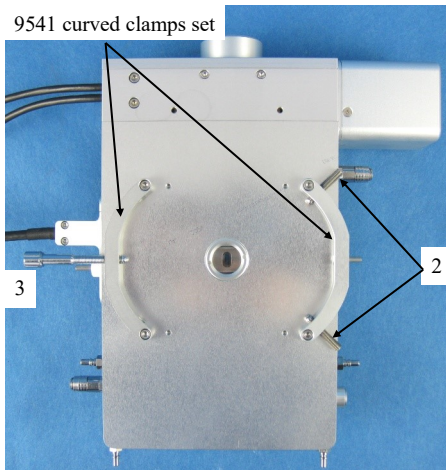
Setting up the Condenser for Koehler Illumination.

Place a sample on the TST350 and stretch the sample so it is flat against the surface of the heater. Use a 5X or a 10X lens to focus on the sample. Now close down the microscope field diaphragm and adjust the condenser focus so that the edges of the diaphragm are in focus. Now use the condenser positioning screws to centre the condenser in your field of view. Open the diaphragm so that it just fills the field of view.

For more information about Koehler illumination see the extremely informative 'Microscopy Primer' on the Molecular Expressions website.

<http://micro.magnet.fsu.edu/primer/index.html>

9541 curved clamps set



Linkam Imaging Station with dovetail substage



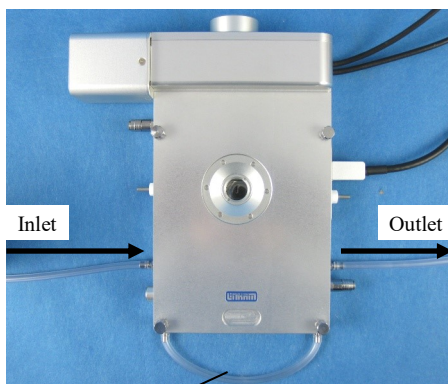
Setting Up ECP

Water Circulator Pump

If you have purchased the ECP with the system, read the following to set up the ECP with the TST350 stage. Refer to the ECP manual for more details.



When heating the stage above 300°C for a prolonged period of time, the metal casing body of the stage can get quite hot. Connect the tubing from the ECP as shown in the opposite picture to cool the stage.



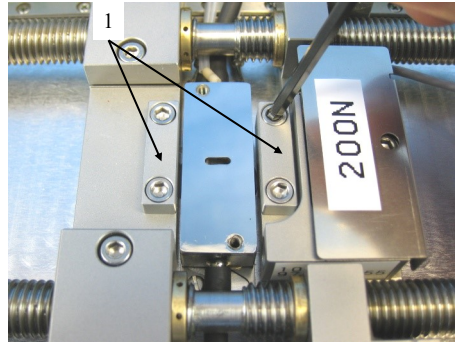
Note: the performance of the stage is not affected whether the ECP is in use or not.

Sample Preparation

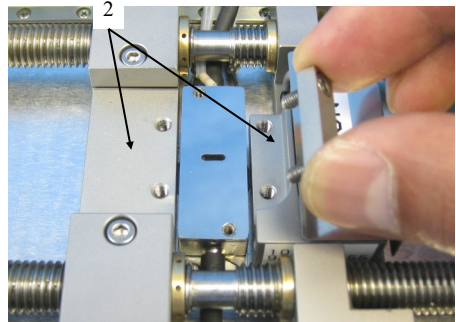
For accurate results it is most important that the surface of the heating/cooling block is extremely clean, since air gaps between the block and the sample window will result in temperature errors. Use IPA (isopropanol) and a soft cloth to clean the top surface of the heater block.

Remove Clamping Jaws:

Using the hex key supplied unscrew the 4x screws from the Clamping Jaws (1).



Leave the screws in place and carefully lift the Clamping Jaws away from the Clamping Assembly (2).



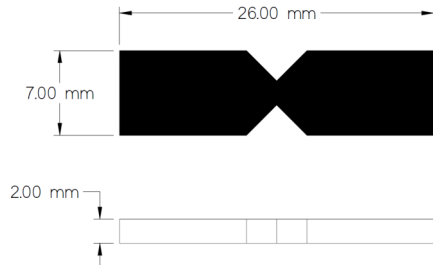
Prepare Bow-Tie Shape Sample:

It is recommended that the sample is cut into a Bow-Tie shape.

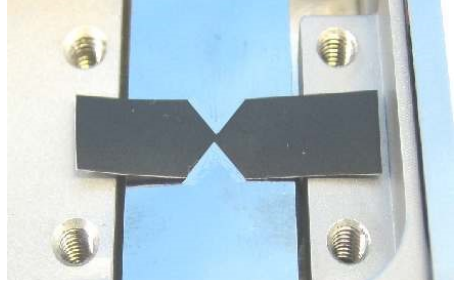
Maximum length: 26.00mm
Minimum width: 7.00mm
Maximum thickness: 2.00mm

The narrowest area of sample is placed in middle of the heating element and is therefore in the field of view with the microscope. By making the bow-tie shape the point of failure is predictable and can be closely monitored.

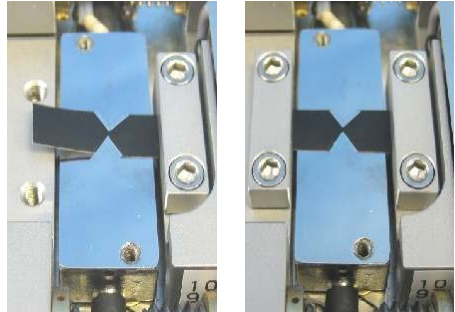
Note: accurate temperatures can be obtained by keeping the sample as thin as possible.



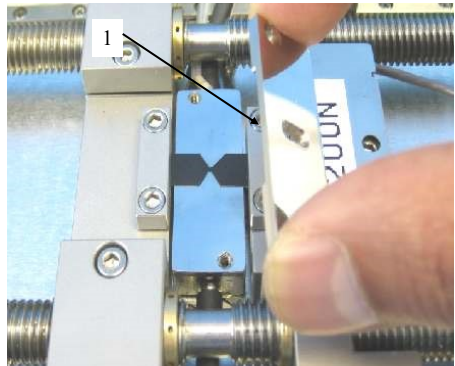
Place the sample between the screw holes on the Clamping Assembly and make sure the narrow part of the sample is over the aperture (if using transmitted light observation).



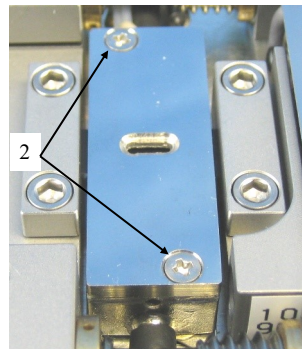
Screw the Jaw Clamps back into position but before tightening the screws, make sure that the sample is pulled through the Jaws so that it lies straight, flat against the heater block and in the correct position.



The optional Heat Shield (1) can be used. The Heat Shield works like an 'oven' and is used to provide temperature stability for the sample.



Place the Heat Shield over the sample and screw it in place with the 2x screws (2).



Cooling Connections

These connections need only be made if the experiments are to be carried out below room temperature using the LNP95 System.

The Dewar siphon (1) is the thick white foam tubing and is attached to the liquid nitrogen Dewar. The thin black capillary tube inside the white foam tube must be inserted into the liquid nitrogen cooling connectors on the stage.

The white tubing slides on to the outside of the connector. Twist the siphon whilst sliding it on and push until it comes to a stop. It does not need to go all the way to the base of the connector.

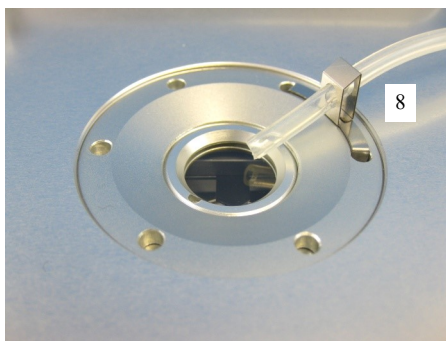
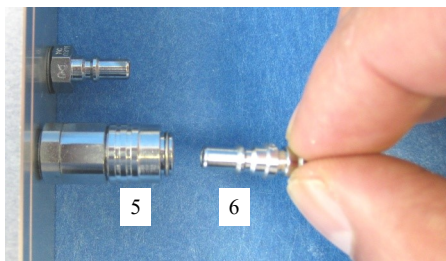
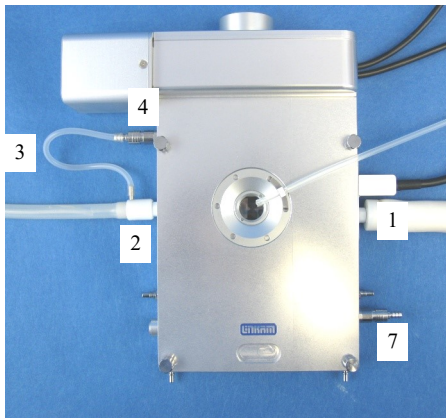
The thicker silicon tube from the LNP95 cooling pump ends in a white PTFE connector (2), this is pushed over the end of the other stainless steel connector as seen in the image.

The short tube branching from the side of this white connector is the Gas Purging Tube (3). There is a valve opening Insert connector (4) inserted into the end of this tube. During the purging procedure, insert this connector into the Gas Purge Valve (5) on the side of the stage to open it.

The Gas Purge Valve (5) is opened when the Gas Insert (6) is pushed firmly into the connector, a “click” is heard when the two parts are connected properly. To remove the Gas Insert, push the outer sleeve of Gas Purge Valve toward the stage and the Gas Insert (6) should drop out.

There is a second Gas Purge Valve on the opposite side of the stage to allow the gas to leave the stage. A Gas Insert must also be inserted into this Gas Purge Valve (7) when purging.

The smaller tube from the outlet on the LNP95 should be placed in position on the top of the lid using the Tube Clip Holder (8). This tube blows warm recycled nitrogen gas across the lid window to prevent condensation on the viewing window surface.



Filling Liquid Nitrogen Dewar

Please follow your health and safety manual for directions on how to handle liquid nitrogen and ensure that you have the correct safety equipment including gloves and safety goggles.

Fill the Dewar approximately 2/3 full and replace the lid with siphon attached.

DO NOT FASTEN THE CATCHES.

Wait for the nitrogen to stop bubbling before fastening the catches.

Take care when placing lid on a table to always have the black capillary pointing upwards. It is easily damaged which will impair N₂ flow



Purging Procedure

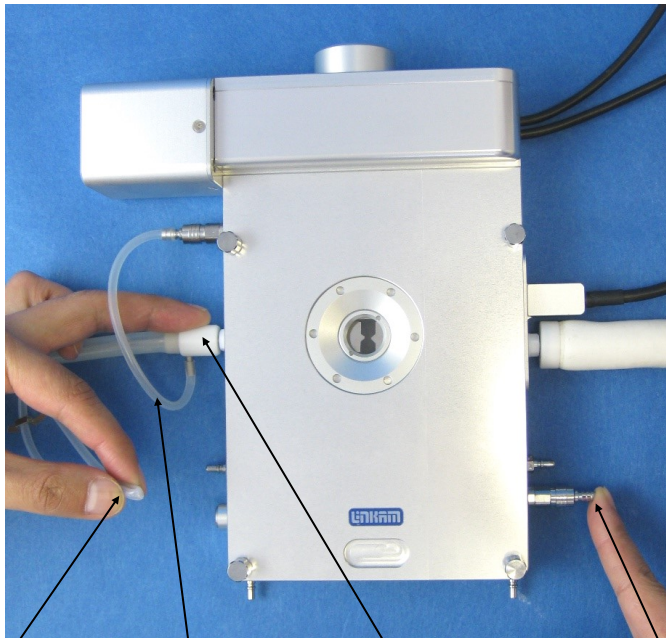
Before starting a cooling experiment, you will need to purge air from the stage chamber with dry nitrogen. This will remove the water in the air which would otherwise condense and freeze on the sample disrupting your image quality.

The following purging procedures require the temperature of the stage and LNP95 cooling flow rate to be set. This can be accomplished by using either a LinkPad or LINK software, please refer to the relevant user manual.

Purging the Stage Method 1

Method 1 uses recycled nitrogen gas produced by the LNP95 from the 2L Dewar.

1. Make sure the stage lid is in place.
2. Heat the stage to 40°C, and hold at that temperature.
3. Switch on the LNP95 cooling system and set it to manual mode, with the speed set to 100.
4. Check that the Gas Inserts are locked into place
5. Using a finger on the left hand, block the hole in the white plastic pump connector found on the perpendicular side to the purging tube. Still working with the left hand, pinch the narrow window tube to block it. This action will divert all of the nitrogen gas to the Purging Tube and through the Stage Chamber.
6. With the nitrogen gas flowing through the Sample Chamber, use a finger on the right hand to block the gas outlet for a few seconds to allow pressure build, then release the gas . Do this for a few minutes to purge the stage.
7. The purging procedure allows mixing of nitrogen gas with the residual air inside the Sample Chamber. By pressurising the chamber with nitrogen gas and releasing it, the air inside the Chamber is being diluted with the nitrogen gas.
8. Remove the two Gas Inserts and unblock the pump connector and window tube.



Pinch window tube
with left hand

Purging
tube

Block hole in
Connector with finger

Block and release outlet
valve with finger

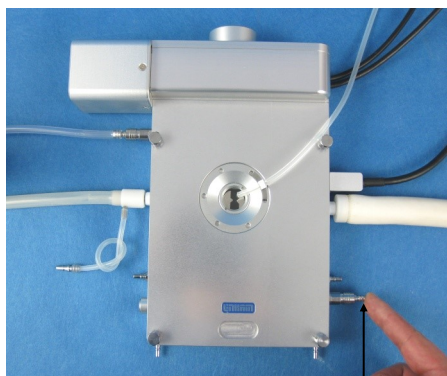
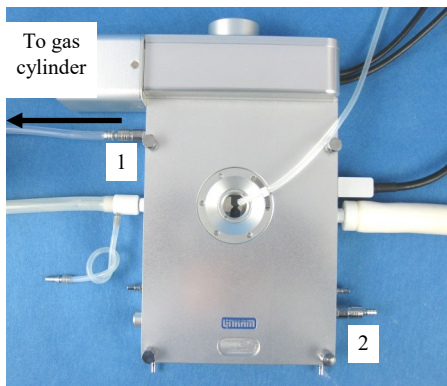
Purging the Stage Method 2

This method uses an inert gas from a gas cylinder to purge the stage at temperatures above ambient when the LNP95 is not required.

1. Make sure the Stage Lid is in place and the Stage Door is closed.
2. From a gas cylinder connect the Gas Insert with a tubing 3mm inner diameter and 6mm outer diameter to the Gas Purge Valve (1).
3. Connect a Gas Insert to the opposite side Gas Purge Valve (2).
4. Use the gas regulator to set a gas flow rate of 1.5L/min.
5. With the gas flowing through the Sample Chamber, block the gas outlet for a few seconds and releasing the gas outlet valve with a finger. Do this for a few minutes to purge the stage.

Reduce the gas flow rate to 20cc/min to continuously purge the stage or remove the two Gas Inserts to keep the chamber under closed inert atmosphere.

Note: Helium gas is not recommended for continuous purging. This gas has a very high thermal conductivity and will cool the heating block too much during an experiment and may cause the temperature to fluctuate.



Block and release outlet valve with finger

Appendix

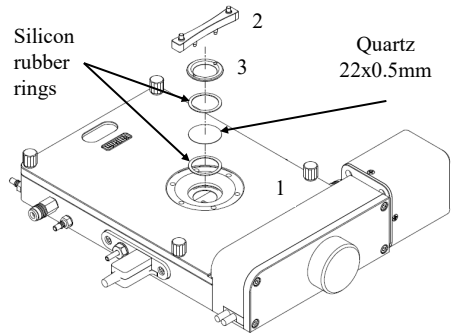
Window Assembly

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.

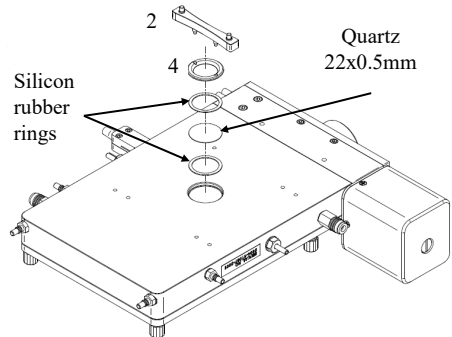
The Lid Insert should be screwed down until the cover slips are held firmly, then turn the assembly over and screw down the Lid Insert until it is felt to come to a stop.



Bottom Window Assembly

Use the 22mm Lock 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

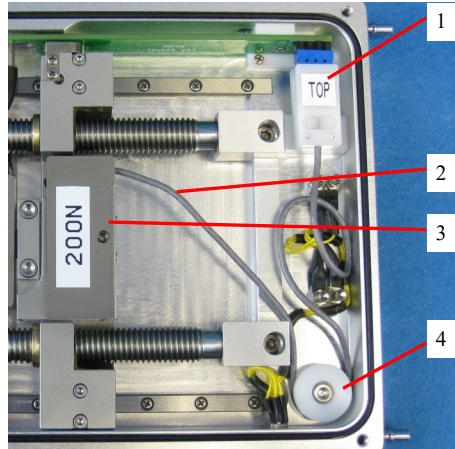


Replacing Transducer Force Sensor

Your stage is fitted with a 20N or a 200N transducer.

Force Transducer Assembly

1. Transducer Sensor Connector
2. Transducer Cable
3. Transducer Assembly
4. Wire Clamp



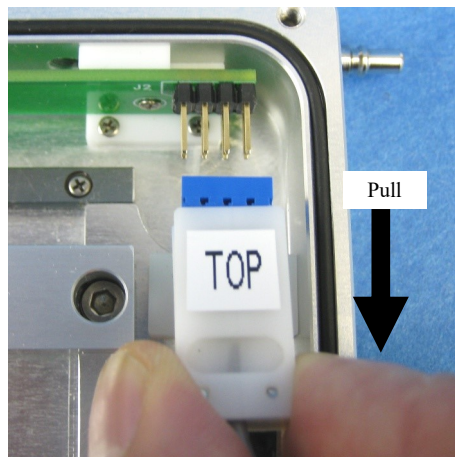
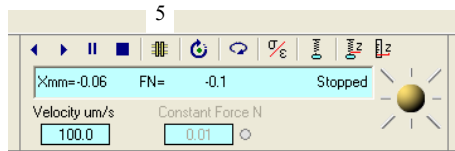
Replacing Transducer Force Sensor

Additional transducers can be purchased and fitted to the stage.

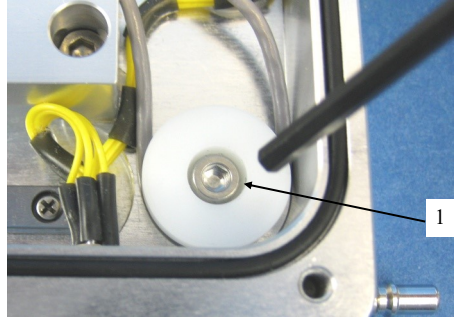
Important note: make sure the Jaws are closed, and also ensure that all equipment is **switched off** during the replacement.

Firmly grip the Transducer Sensor Connector and gently pull the connector from the TST350 stage.

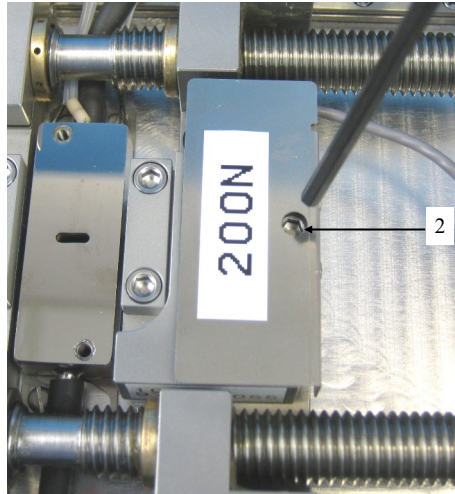
Please Note: You cannot place beams from a T94 controlled stage into a T95 controlled stage or vice versa. This will throw out the beam calibrations.



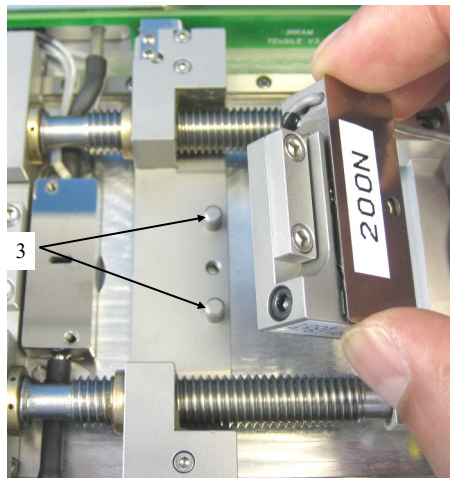
Unscrew the hex screw (1) in the Wire Clamp to free the Transducer Cable.



Unscrew the fixing screw (2) in the Transducer Assembly.

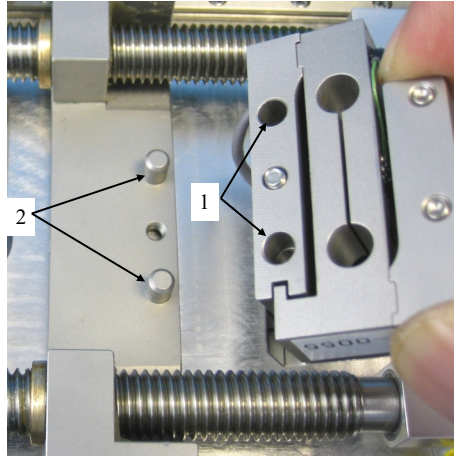


Lift the Transducer Assembly carefully off the 2x pillars (3) on the base of the stage.

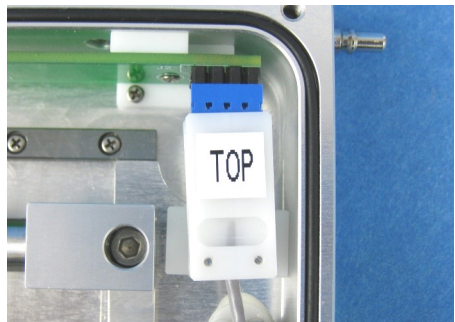


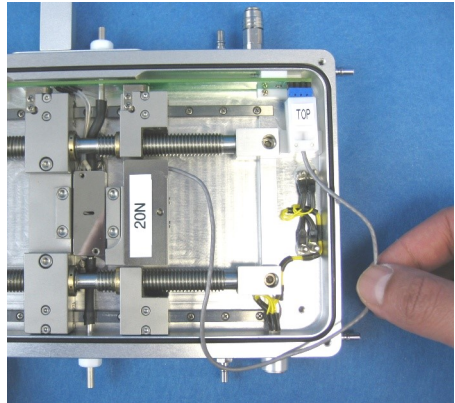
To install the new Transducer Sensor.

Align the two holes (1) on the base of the Transducer with the two pillars (2) on the base of the TST350 and screw the new Transducer in place.

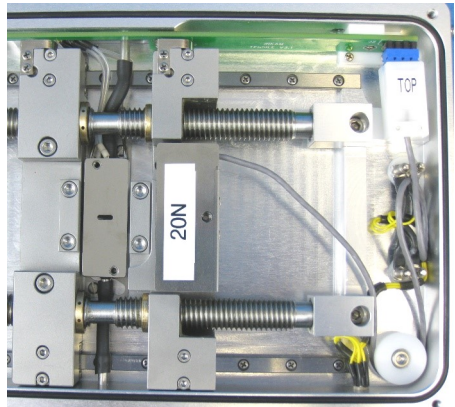


Plug in the Transducer Connector and make sure the word 'TOP' is on top.





Wrap the Transducer Cable around the Wire Clamps and fix it into place. Do not tighten the screw as yet, adjust the length of the Transducer Cable from the Transducer to the Wire Clamps as shown in the opposite photo and tighten the screw.



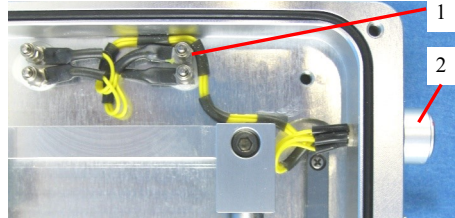
The calibration values and limits are stored in a chip in the Transducer Connector. When connected LINK software will recognise that a different sensor is connected and adjust the settings automatically.

You must do a **Distance Calibration** for the TST350 stage to work correctly with the new Transducer. Please refer to the LinkPad or LINK user manuals.

TSTE350 with Internal Spring Electrical Contacts Option

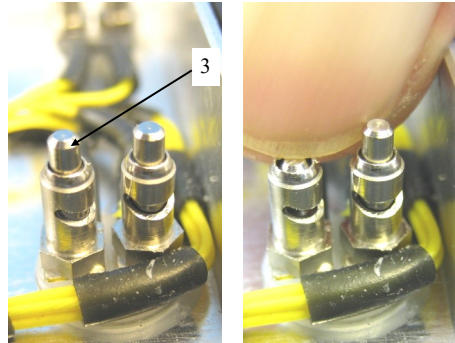
A variation of the TST350 is the TSTE350 Stage. This stage is supplied with 2 or 4 Internal Spring Electrical Contact connectors (1) wired to an external Lemo socket (2).

Picture show TSTE350 with 4 internal electrical contacts.



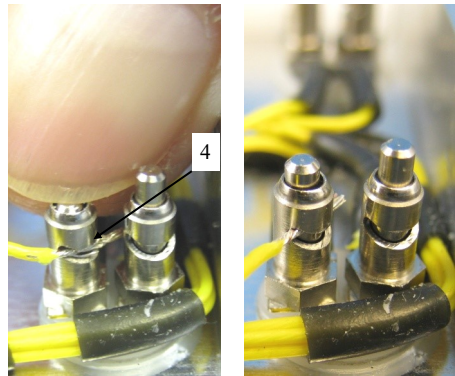
Each Electrical Contact has a self-closing spring loaded pin (3).

Using a finger tip push down the pin to open the Electrical Contact connector.



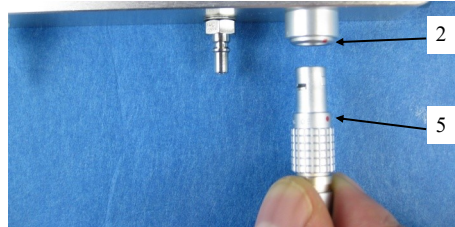
Insert a wire into the open contact (4).

Release the finger when the wire is in place.



To connect the supplied Lemo plug, line up the red dot on the Lemo plug (5) to the red dot on the Lemo socket (2) and push the Lemo firmly into place.

Note: remove the Lemo plug by holding it firmly and pull it gently away from the Stage.



Troubleshooting

Cooling fault diagnosis

Ensure that all connections to the stage and Dewar are as described in the specific manual and that the stage lid and top windows are properly sealed.

1. *The cooling rate is less than programmed.*

There can be several causes of this problem, the most likely being that one of the connectors has become blocked or damaged. Check that each tube is fitted tightly to the connector and that none of the tubing is twisted or has come loose. The larger diameter tube leading from the LNP95 consists of a tube within a tube, check that the internal tube is connected, it may have come loose. Any constrictions of either the tubing or the connector will have a drastic effect on the cooling ability of the LNP95. If the connectors and tubing are OK, check that the capillary tubing to the Dewar flask is not bent or damaged and that the filter is intact and unblocked. If any damage has occurred to any of these items then it will be necessary to replace them. If no damage is found, check that the silver block is not constricted. This can be checked, simply by blowing through one of the steel cooling tubes using a compressed air line.

2. *Condensation and ice forming on the upper side of window*

Realign the window gas tube clip to the required position in the stage lid.

4. *Condensation on the sample and/or the underside of lid window*

This is due to the stage not being sealed properly and therefore allowing moisture in during purging or cooling. Check that the lid and bottom window are sealed correctly and that the silicon seals are in position.

Please visit www.Linkam.co.uk for more FAQ for the stage and instruments.

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