Leica EM TXP

Operating Manual

Version 16214032 10/2010

Living up to Life

Leica
MICROSYSTEMS

Important Note

Leica reserves the right to change technical specifications as well as manufacturing processes without prior notice. Only in this way is it possible to continuously improve the technology and manufacturing techniques used to provide our customers with excellent products.

Issued by:

Leica Mikrosysteme GmbH
Hernalser Hauptstrasse 219
A-1170 Vienna

Leica EM TXP

Operating Manual

Leica EM TXP Serial Number:

Date of purchase:

For the instrument serial number, please refer to the name type label on the back of the instrument!

Please read this instruction manual carefully before operating the instrument.

Table of contents

1. Safety instructions 4
2. Description 5
3. Design and principle of operation 6
4. Installation of the Leica EM TXP 7
4.1 Unpacking the instrument 7
4.2 Installation of the stereo microscope 8
4.2.1 If the instrument is equipped with S6 stereo microscope: 8
4.2.2 If the instrument is equipped with M80 with objective adaptor: 8
4.2.3 If the instrument is equipped with M80 and moveable objective adaptor: 9
4.2.4 Eyepieces 9
4.3 Electrical connections (rear side of the instrument) 10
4.4 Connection of the extraction and filtration unit 10
4.5 Back light illumination 11
4.6 Inserting the milling tool 11
4.7 Inserting the cut-off wheel or arbor for polishing foil carrier 12
4.8 Adaptor for specimen holder 12
4.9 Angle adjustment adaptor (optional) 13
4.10 Inserting the specimen holder 13
4.11 Installing the lubricant/cooling system 14
4.12 Attaching the polishing foil onto the carrier 15
5. Description of the control panel 16
6. Settings 18
6.1 Rotation speed setting 18
6.2 Lubricant flow setting 19
6.3 Saw speed setting 19
6.4 Count down setting 20
6.5 Step size setting 20
6.6 Force limit setting 20
6.7 Cutting window setting 21
6.8 Light menu 22
7. Milling a specimen 24
7.1 Switching on the instrument 24
7.2 Clamping the specimen block 25
7.3 Insert the miller (as described in 1.6) 25
7.4 Adjusting and centring the specimen 25
7.5 Milling the cutting face 27
7.6 Producing a pyramid or a sloping face 28
8. Distance determination 29
8.1 Approaching a specimen target along the longitudinal axis 29
8.2 Distance measurement 30
8.2.1 Calibrating the reticule 30
8.2.2. Distance measurement 31

9. Sawing/polishing sample preparation examples 32
9.1 PCB crosssectioning of a through hole..... 32
9.2 Example results 36
9.3 Slicing 37
9.3.1 Front face slicing 37
9.3.2 Back face slicing..... 37
10. Useful hints..... 39
10.1 Recommended sample size 39
10.2 Diamond disc cutter..... 39
10.3 Diamond miller..... 39
10.3.1Surfacing of ductile materials and hard polymers..... 39
10.4 Sample holders..... 40
11. Maintenance..... 41
11.1 Replacing the fuse..... 41
11.2 Replacing the tubes of the peristaltic pump..... 41

Symbols in this manual and their meaning:

Attention, take extra care!

Important information.

1. Safety instructions

The instrument has been designed and manufactured so the user is not exposed to any danger if the instrument is used as intended.

It is necessary that the user is trained in the use of this type of instrument.
The instrument should be opened by authorized service personnel only.
Before opening any covers the instrument must be disconnected from the electrical supply.

The instrument is equipped with protected ground. Before connecting it to the local electrical supply make sure that the mains has the required ground and that the instrument is connected to it according to the local regulations.
Unplug the instrument before installing or changing fuses.

High speed motor spindle

When switching on the mains switch, the motor spindle mechanism initialises and the instrument is ready for use. The miller is shielded by a protective cover allowing the miller to operate only when it is closed.
The user must not make any manipulation in the milling area while the miller is on and rotating.

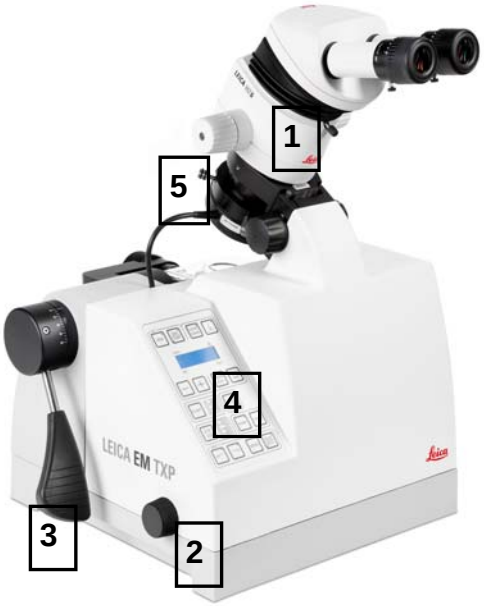
Only tools recommended for use with this machine should be used.

The tools must be installed in accordance with the instructions (chapter 4.6. and 4.7.). Loose or wrongly installed tools can lead to injury and may damage the machine.

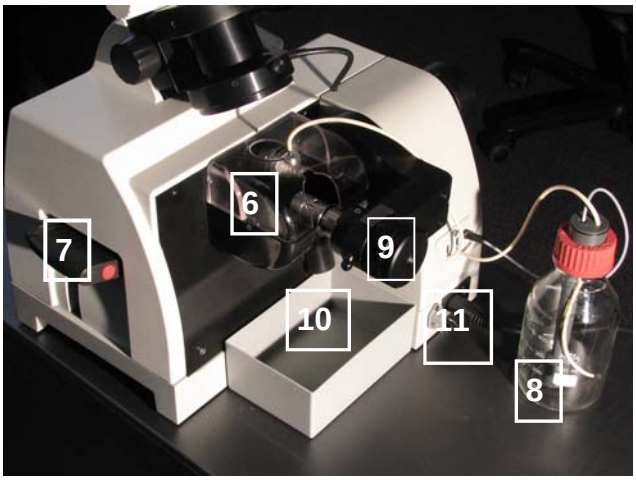
Using the feed hand wheel (2) or HOME button, the spindle has to be retracted completely before operation to prevent a collision between tools and specimen holder.

The angle of the pyramid is adjusted with the lever (3). For milling and sawing only, a setting between 0 and 30 is recommended. Higher angle values can lead to a dangerous and destructive contact between specimen holder and tool (depending on the protruding length of the sample).

2. Description



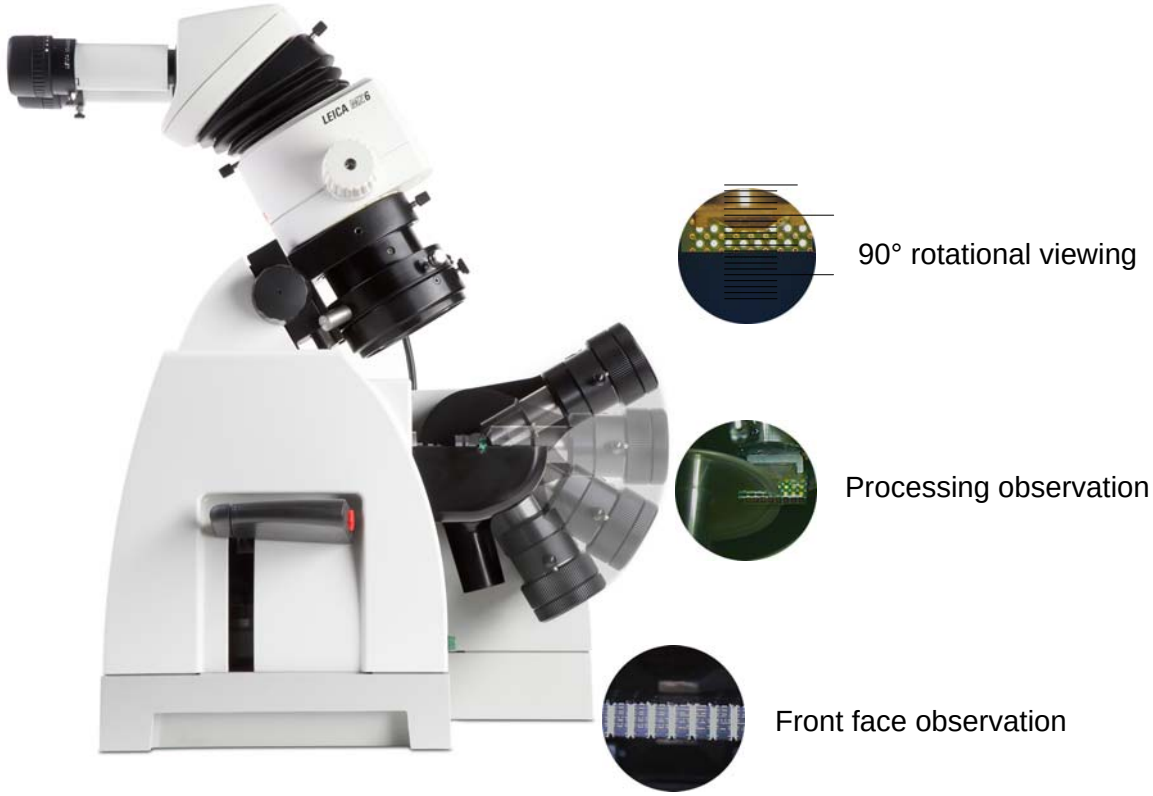
1 stereo microscope
2 feed and wheel
3 specimen pivot arm lever
4 control panel
5 top light ring illuminator
6 protective cover
7 tool control lever (E-W movement)
7.1 lever for auto E-W movement
8 lubricant/cooling system
9 adjustment mechanism
10 hose connection of the extraction unit
11 mains switch and electrical connections



3. Design and principle of operation

The Leica EM TXP is a unique target preparation device especially developed for cutting and polishing samples prior to examination by SEM, TEM and LM techniques. It excels with challenging specimens where pinpointing and preparing barely visible targets becomes easy. Sawing, milling grinding and polishing exactly to the target is performed during observation via the stereo microscope. Investigation of the prepared surface can be done without removing the sample.

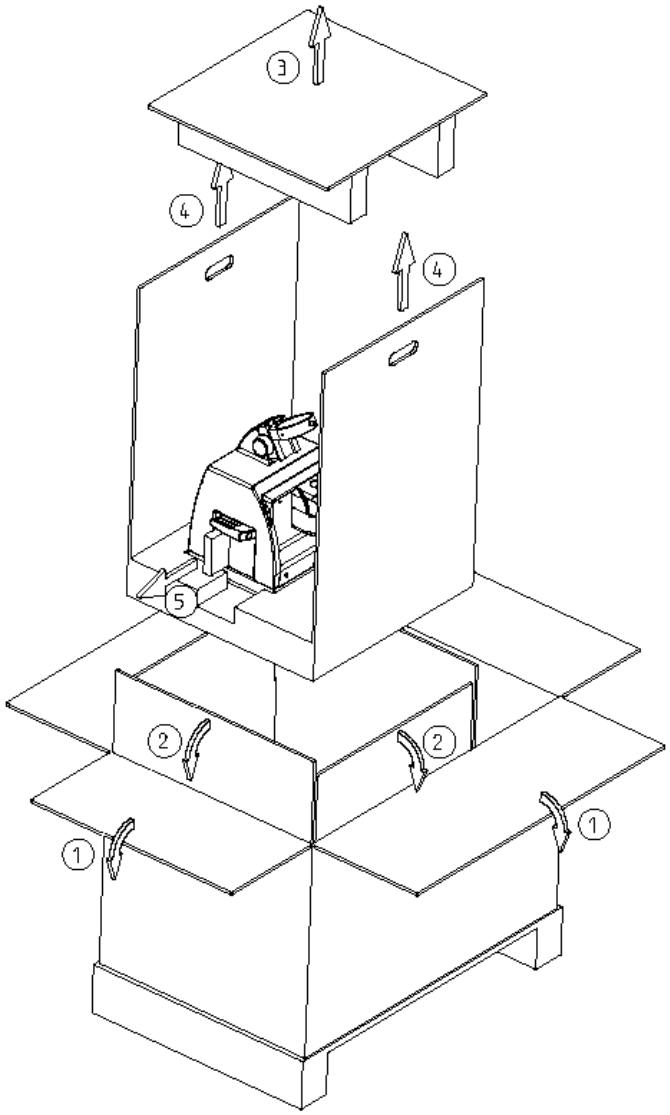
The EM TXP is a preparation unit with variable speed from 300 to 20 000 rpm, with an integrated stereo microscope and ring LED illuminator. A pivot arm and adjustment assembly holds the specimen carrier for maximum orientation.
It can be used with either milling tools, cut-off wheel or polishing tools.
The area of interest can be centred +/- 2mm and rotated about its longitudinal axis with the 90° click stop adjustment mechanism. The selected detail remains in the centre of the field during each operation.
The 90° rotation view allows distance definition i.e. from the front face of the sample.



4. Installation of the Leica EM TXP

4.1 Unpacking the instrument

Unfold the four lateral walls (1) from the outer carton. Remove separate packaging of the stereo microscope and accessories. Unfold the lateral wall (2) and remove plate (3). Two persons should lift the instrument out of the box using carton handles (4). Place the instrument on the working table. Remove transport lock of the miller control lever (5). The top light ring illuminator is connected to the stereo microscope carrier with cable ties. Remove these using wire cutters.



4.2 Installation of the stereo microscope

4.2.1 If the instrument is equipped with S6 stereo microscope:

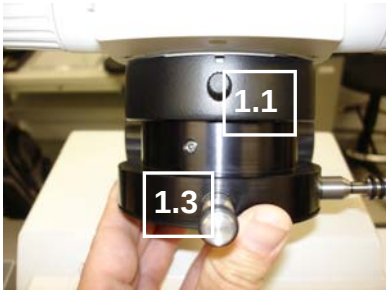
Insert stereo microscope in the carrier and clamp it with the knurled screw. Slide the top-light ring-illuminator onto the objective mounting of the stereo microscope. Clamp the illuminator with attached screw.

4.2.2 If the instrument is equipped with M80 with objective adaptor:

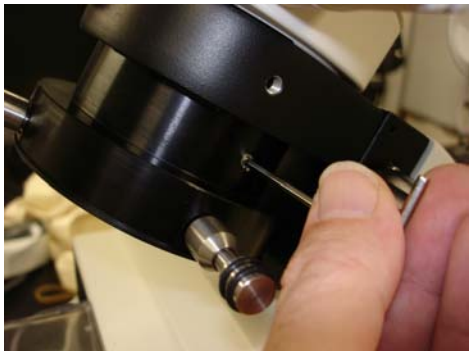
Screw in the objective adaptor into the M80 carrier. Insert objective in the objective adaptor. Place the ergo-wedge and the binocular tube onto the M80 carrier. Insert stereo microscope and illuminator in the same manner as described above.

4.2.3 If the instrument is equipped with M80 and moveable objective adaptor:

Insert stereo microscope in the carrier of the instrument and clamp it with the knurled screw (1.1) Slide the movable lens adaptor (1.2) onto the M80 carrier to the end stop.



Clamp the movable adaptor (1.2) with the two hexagonal screws. Locate the vertical set screw (1.3) in the same vertical orientation as the clamping screw (1.1) of the stereo.



Screw the objective lens into the movable lens adaptor.
Slide the top light ring illuminator onto the objective mounting of the stereo microscope. Clamp the illuminator with attached screw.

Place the ergo-wedge and the binocular tube onto the M80 carrier.

The movable objective adaptor is equipped with two set screws allowing a shift of the objective lens +/- 5mm. Both set screws are provided with an indicator mark for the centre position of the lens. See chapter 8.2.2. for further information.

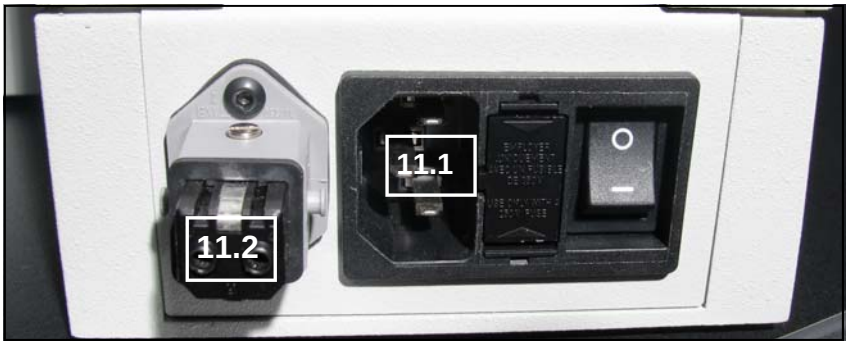
Please see information about operation of stereo microscope in the manual enclosed in the packaging of the microscope.

4.2.4 Eyepieces

Insert the eyepieces into the binocular tubes of the stereo microscope. Make sure the eyepiece with the reticule is inserted in the side of your dominant eye.

4.3 Electrical connections (rear side of the instrument)

The instrument is equipped with a full range power supply for a voltage input range from 100 to 240VAC 50/60 Hz. Insert the plug of the power cord into the socket (11.1).



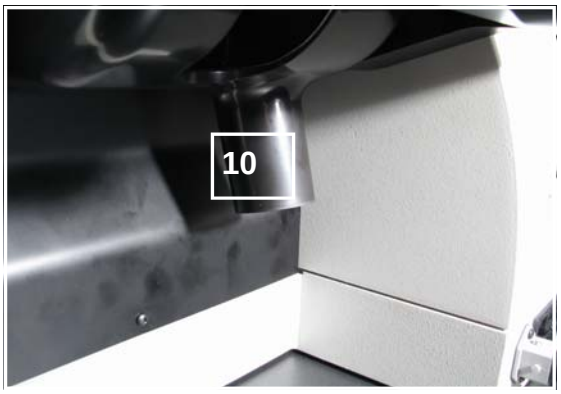
The switched outlet (11.2) is provided to supply mains voltage from the wall outlet to the Leica extraction and filtration unit only!
Connecting any other vacuum cleaner could destroy the instrument. Other vacuum cleaners have to be connected directly to the wall outlets.

4.4 Connection of the extraction and filtration unit

(supplied by Leica)

Connect the mains cord of the extraction unit to the switched outlet (11.2). Using this connection will switch the extraction unit on and off automatically when the trimming motor is switched on and off.
Note: make sure the mains switch of the extraction unit is in the on position (see manual of the extraction unit)

Insert the straight end of the extraction hose into the opening (10) on the rear side of the instrument. Insert the end with the sleeve into the extraction unit.



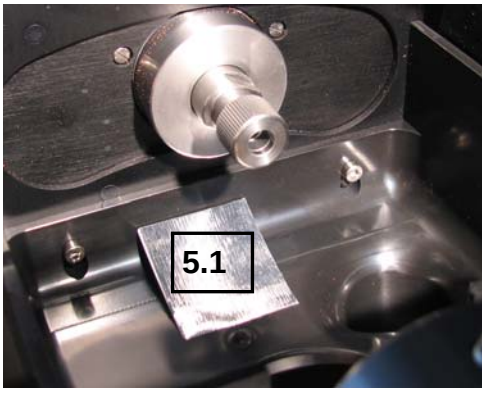
To exchange the filter inserts of the extraction unit please see extraction unit manual.

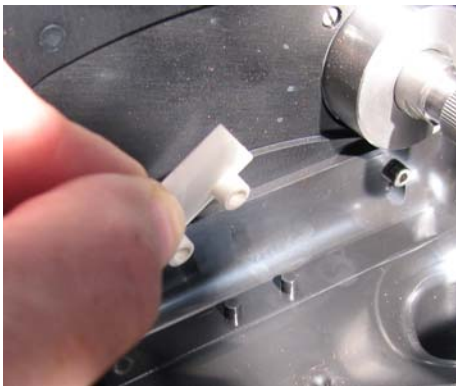
The extraction and filtration should only be used during milling and sawing without activated lubricant system (PUMP OFF). Any liquid which is extracted into the filtration unit will damage the unit. Please remove the exhaust tube when the lubricant system is in use.

4.5 Back light illumination

The instrument is equipped with a special back light illumination component (5.1) which increases the visibility of the sample. To maintain its brightness keep the illumination foil clean. It can be removed for cleaning if necessary.

Reinstall the illuminator (5.1) with the black pins of the safety cover inserted into the white holes of the component.





4.6 Inserting the milling tool

Remove the transparent protective cover (6). Hold the spindle with the flat wrench no. 16 and loosen the nut manually or with flat wrench no. 14. Carefully insert the miller with protective cover all the way to the end stop and tighten the nut until the miller is firmly clamped. Remove protective cover from the miller.
When using the glass slide holder (optional) the miller can be pulled out by 4mm in order to mill samples with a thickness less than 4mm.

The miller is enclosed by a protective casing. A magnetic switch allows the miller to operate only when it is closed. A brake function of the motor ensures the miller stops as quickly as possible when the cover is opened.

Do not manipulate inside the protective chamber with any magnetic tool or while wearing magnetic decoration while the instrument is connected to the mains.
Do not use the diamond miller for trimming of:

- ***glass or glass fibre enforced material since this will physically damage the diamond miller***
- ***material containing iron, cobalt, nickel, manganese, chromium, tungsten, tantalum, titanium and zirconium as it will result in the cutting edge wearing out very quickly.***

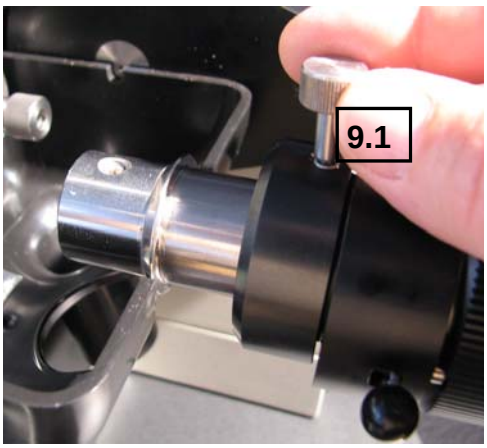
4.7 Inserting the cut-off wheel or arbor for polishing foil carrier

Remove the transparent protective cover (6). Hold the spindle with the flat wrench no. 16 and loosen the nut manually or with flat wrench no. 14. Carefully insert tool into the nut until the indication mark is aligned with the rim of the nut and tighten the nut until the tool is firmly clamped.

The chuck is equipped with a safety clamping mechanism. To remove the tool from the chuck open the nut with the two flat wrenches, manually turn the nut to its next stop, then use the two wrenches again to open chuck completely.

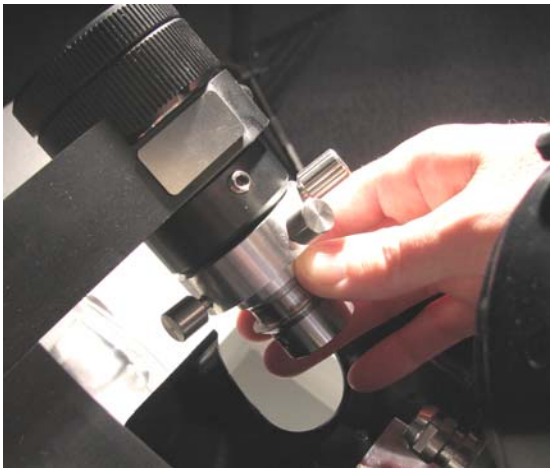
4.8 Adaptor for specimen holder

Insert the adaptor into the adjustment mechanism of the pivot arm and lock it with the locking screw using the Allen key (9.1).



4.9 Angle adjustment adaptor (optional)

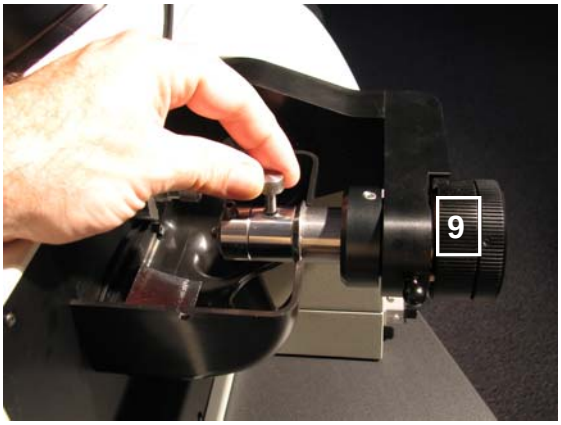
If the sample needs to be accurately aligned (+/-5°) an angle adjustment adaptor can be inserted instead of the above mentioned adaptor.



Swivel the specimen pivot arm in the 90° viewing position (chapter 8.1). Insert adaptor to its end stop position. Swivel specimen pivot arm to the 0° position (chapter 7.5.). Adjust adaptor with the horizontal set screw (located at the top position) and the vertical set screw (located on the right hand side). Use the reticule of the eyepiece for alignment after opening the knurled head clamping screw. Use the indication marks on the set screw for the 0 position.

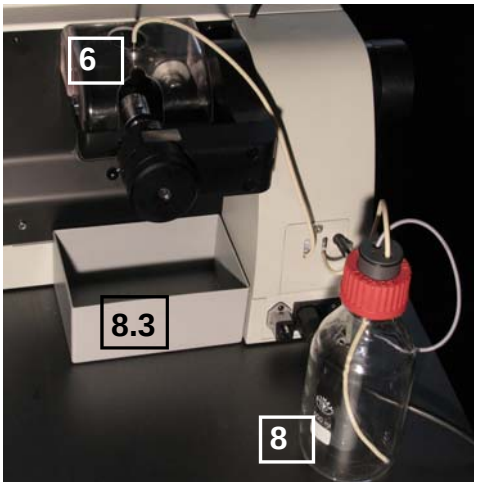
4.10 Inserting the specimen holder

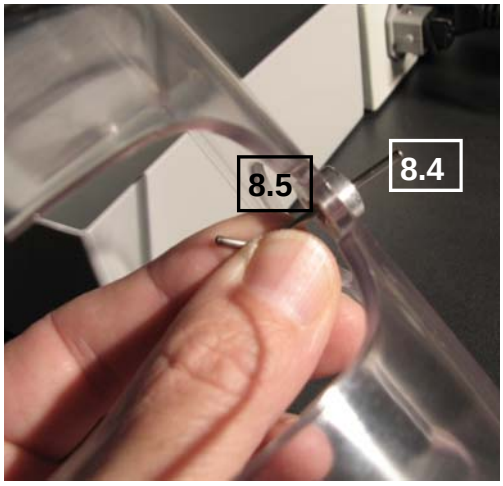
The specimen holder is inserted in one of the adaptors and locked with the locking screw. The adjustment mechanism (9) of the pivot arm permits centring of the specimen into the middle of the field of view (chapter 7.4.)



4.11 Installing the lubricant/cooling system

The instrument is equipped with a lubricant/cooling system which must be activated when using the diamond cut-off wheel and the polishing foil inserts. It can also be used for cooling during milling to improve the surface quality. The bottle is normally filled with water and a few drops of liquid soap.





A peristaltic pump (8.1) is located inside the case. The right hand tube should be inserted into the lubricant bottle (8.2) and the left to the spout (8.4). Insert one tube into the lubricant bottle through the hole of the lid to the bottom of the bottle. The other tube is connected to the spout located on the protective cover (6). Insert spout (8.4) into the alignment part (8.5) of the cover, either with the straight end from the outer side or from the inner side (pictured and recommended), depending on the sample length. By tilting and turning the spout the water stream can be adjusted to the tool.
Place the waste container (8.3) beneath the milling area close to the corner of the instrument. Connect the grey cable of the level sensor into the pug near the tube of (8.1).

If the bottle is empty and the level sensor is connected, the instrument will not run or will stop automatically to protect the sample during an automated run (EMPTY will be displayed on the LCD display on the control panel). If the sensor is disconnected the instrument will run (when using other suspensions).

4.12 Attaching the polishing foil onto the carrier

There are two different types of carrier available. One steel carrier which is useful for the diamond foils used for hard and brittle material. Using this carrier the so called “edge rounding” is almost avoided but the durability to the foil is less than with the other carrier which is equipped with a rubber layer and recommended for use with aluminium oxide foils.

Before attaching the foil, clean the carrier with ethanol to make sure no particles are on the surface which could influence the polishing result.



The polishing foils have an adhesive film which is covered by a transparent foil. Remove this foil with the finger nail or razor blade. Place the polishing foil on a finger tip and avoid touching the adhesive film. Centre the polishing foil to the carrier and press it onto the carrier starting at the rim to avoid air bubbles between foil and carrier.

Recommended scope of the polishing foils:

<u>Diamond polishing foils</u> are suitable for hard and brittle materials like: glass, ceramic, chilled cast iron, carbide, silicon, sapphire.

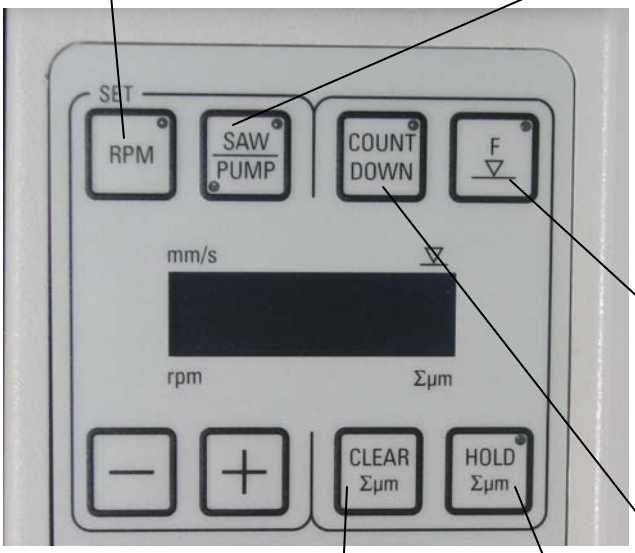
<u>Aluminium oxide foils</u> are suitable for materials like: aluminium, brass, copper, titanium, mild steel, tool steel, high-grade steel, nickel and some hard polymers.

<u>For hard and soft material</u> (e.g. gold wire bonding on Si) the use of SiC foils on steel carrier subsequent a diamond past applied on the neoprene cloth is recommended.

5. Description of the control panel

Change speed from 300 to 20000rpm using +/- button.

Change speed of the E_W spindle movement from 0.025 to 0.5 mm/sec. Press button again to change over to set the lubricant flow from 2 to 20 ml/min .(value is displayed on the upper left corner of the LCD display). Use +/- button to set values.



Button to activate force function. Press button longer than one second to set force limit (LED blinks) using +/- button.

Press button once DIST is displayed to set distance count down or press it again to set TIME count down value with the +/- button while the LED is blinking.

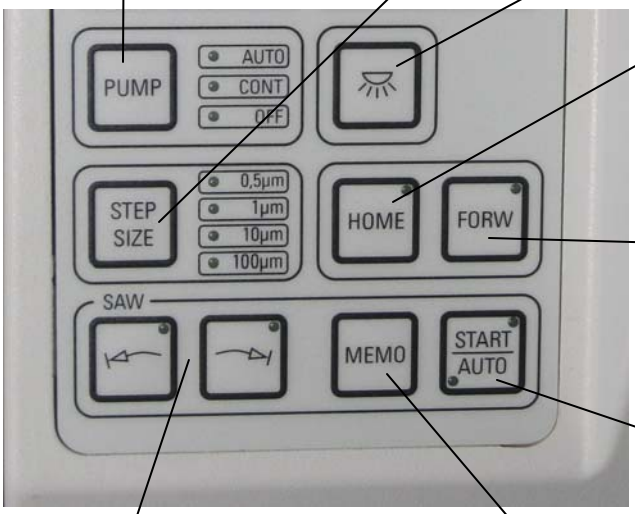
Set advance indication to zero.

Freeze advance indication.

Press button to toggle between:
AUTO pump starts when the motor is switched on.
CONT pump is continuously running (spout setting)
OFF (e.g. if extraction unit is connected)

Select step size of the spindle advance. Press button to toggle between four different step sizes.

Light control



Retract spindle to the HOME position of the 12mm travel range. Movement stops when button is pressed again.

Spindle moves towards the sample as long this button is pressed.

Button to switch the spindle motor on and off. One cycle will be performed if the lever for auto E-W movement is pulled out. Press button longer than one second to start continuous motor driven E-W movement.

Active if lever for auto E-W movement (7.1) is pulled out.
Spindle moves to the right (west) and to the left (east) side by pressing the corresponding button.

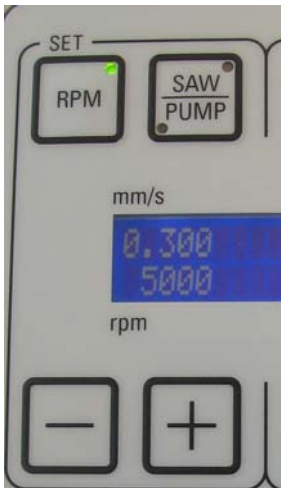
Button to set the cutting (polishing) window.

6. Settings

When switching on the mains-switch on the rear side of the instrument, the motor spindle mechanism initialises and moves to the home position. The instrument is now ready for use.

6.1 Rotation speed setting

Press RPM button the LED goes on and the appropriate speed value can be set by using the - or + button. The speed is displayed on the LCD display above the rpm inscription.



Recommended values:

Miller	***12000 ~ 20 000 rpm***
diamond disc cutter	***~ 15 000 rpm***
core drill	***~ 8 000 rpm***
diamond lapping foil	***~ 2 200 rpm***
aluminium oxide foil	***~ 1 000 rpm***
neoprene cloth	***~ 300 rpm***

Above values can be adjusted according to the sample; they are guide values only.

6.2 Lubricant flow setting

Press SAW/PUMP button until the LED in the PUMP field goes on. Select desired lubricant flow between 2 and 20ml/min. The value is indicated beneath the mm/s inscription. The LCD displays “ml”.

Recommended values:
Miller and diamond disc cutter …~ 12ml
lapping foils …~ 5 - 13ml

6.3 Saw speed setting

(E-W movement of the spindle)

The east west movement of the spindle can be automated by pulling out the lever 7.1. It is useful especially a count down is activated.
Press SAW/PUMP button until the LED in the SAW field goes on. Select desired speed between 0.025 and 0.5mm/sec. The value is indicated beneath the mm/s inscription. If the value is set to zero DRILL will be indicated when lever (7.1) is not pulled out. This function is used for auto drill in conjunction with the core drill.

Recommended values:
sawing with diamond disc cutter:
0.025 to 0.05 mm/sec
target approaching with 10µm steps with diamond disc cutter: ~ 0.3mm/sec.
polishing: ~ 0.35mm/sec

Above values can be adjusted according to the sample; they are guide values only.

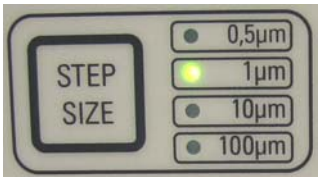
6.4 Count down setting

Press COUNT DOWN button once the LED starts blinking and DIST is displayed. Use + or - button to set the distance to count down, it is displayed instead of the advance indication (lower right corner). Press COUNT DOWN again to store (LED is constantly illuminated).
Press the COUNT DOWN button twice TIME is displayed and a time count down can be set using the + or - button. This is useful e.g. for polishing with neoprene cloth without an advance has to be performed. The pressure can be set during the polishing process using the feed hand wheel. Activate force information by pressing the F button.

After the START/AUTO button is pressed, the LED in the AUTO field goes on and the instrument starts the count down procedure.

6.5 Step size setting

During processing the advance of the spindle can be performed manually using the feed hand wheel (2) or during the auto processing mode automatically. The step size can be selected using the STEP SIZE button toggling from 100µm to 0.5µm. Each click stop of the feed hand wheel or each cycle of the auto E-W movement corresponds to the selected size.



Select a step size of 1µm or 0.5µm for the polishing process.
During count down toggling through the step size depends on the remaining distance e.g. for 90µ remaining distance toggling can only be done between 10µm, 1µm and 0.5mm

6.6 Force limit setting

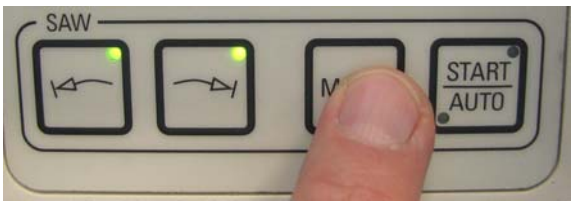
While using the auto E-W movement (if lever 7.1. is pulled out) or drilling (set SAW speed to zero when lever is in) the instrument will perform an advance (according the selected step size) on each cycle which could increase the pressure on the sample. Because the polishing foil may not remove the sample material on each cycle according the step size. In order to avoid sample damage a force limit can be set. In case of distance count down and continuous approach the instrument will only perform the advance if the force value is below the limit value. The limit depends on the sample material and the polishing foil which is in use.

Press F button longer than one second until the LED starts blinking. Use the + or - button to set the value which is displayed beneath the triangle. (upper right corner). Press F again to store (LED is constantly illuminated). To activate the force regulation just press F button less than one second. The limit can also be changed during the polishing process by pressing F button longer than one second.

By using TIME count down the instrument will not perform an advance. The spindle will move from left to right without advance and retraction of 10µm at the end position. Hence, setting the force limit is not useful in this mode but the force can be observed and adjusted using the feed hand wheel while the spindle is moving.

6.7 Cutting window setting

The complete auto E-W travel range is about 24 mm which might be too large for certain samples and would increase the processing lead time. Therefore, a cutting widow for sawing and polishing can be set.
Pull out the lever for the auto E-W movement (7.1) and carefully lower it to its rest position. Use the right arrow button to move the cutting wheel or polishing insert to its start position.



Press the MEMO button; the LEDs of both arrow buttons blink. Press the left arrow button to store start position. Lower the cutting wheel to its end position using the right arrow button. Press MEMO again followed by the right arrow button to store end position. The cutting window is now set. Move the cutting wheel or polishing insert to the start position using the left arrow button and start processing.

The start position for the polishing insert should be in a position overlapping the sample.
At the end position, the spindle retracts 10µm when using the distance count down and continues approach. Hence, the end position for sawing must be set after the outer edge of the sample in order to avoid collision between sample and cut-off wheel.

6.8 Light menu

Different segments of the ring LED illumination can be selected to observe the sample at a different illumination angle. Thus, some sample details could become visible.

By pressing the light button longer than one second the light menu is entered indicated by LIGHT on the display.

Each time when the light button is pressed different illumination segments can be selected.

i. Full ring light 

ii. Half of the ring light 

iii. Two diagonal segments 

iv. One segment 

The intensity can be set in the light menu by pressing + or – button.

To leave the light menu press the CLEAR button. The position of the selected segment(s) can be changed by pressing the light button. The actual position is indicated on the display if F is not activated.

7. Milling a specimen

7.1 Switching on the instrument

The instrument is switched on (and off) using the switch (11.3) on the rear side of the instrument.

7.2 Clamping the specimen block

Clamp the specimen block in the specimen holder in such a manner that it protrudes from the holder by at least the same amount as the diameter of the specimen. Make sure that the milling control lever (7) is in its top position. Insert the specimen holder into the adapter (see 4.10.)

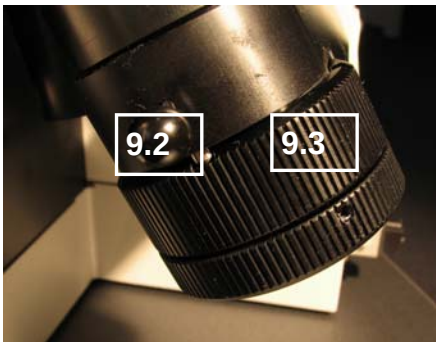
7.3 Insert the miller (as described in 1.6)

7.4 Adjusting and centring the specimen

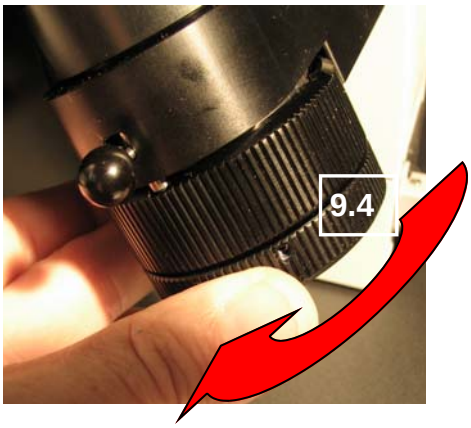
Swivel the specimen pivot arm (3.1) using lever (3) into the front face observation position (end-stop, indication 60). In this position the specimen axis and the observation axis are parallel. Focus the microscope on the specimen using knob (1.6)

The adjustment mechanism is designed to provide a rigid connection between the sample holder and the pivot arm after the specimen is aligned. To open the connection the locking pin (9.2) must be engaged into one of the four slots of the knurled ring (9.3).

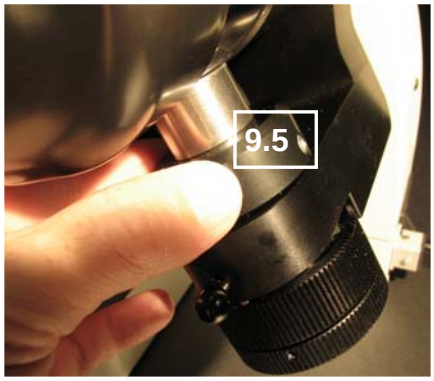
To engage the locking pin (9.2) move the pin from the rest position and turn knurled ring (9.3) until the locking pin snaps into one of the slots. The locking pin is spring loaded and will snap in automatically as soon a slot is in the correct position.

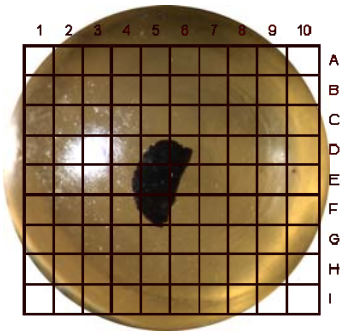


Open the alignment mechanism by turning the knurled clamping ring (9.4) clockwise (from operator's point of view)

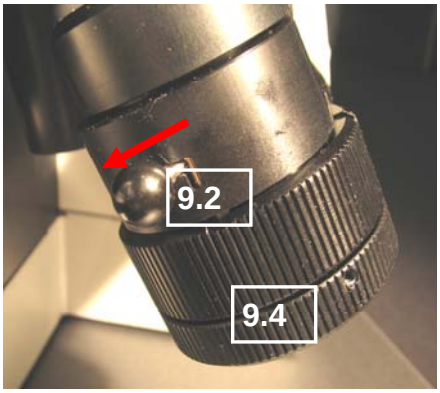


Grip the alignment ring (9.5) and move the sliding stage during observation in the stereo microscope to centre the specimen so the area of interest is in the centre of the eyepiece reticule.



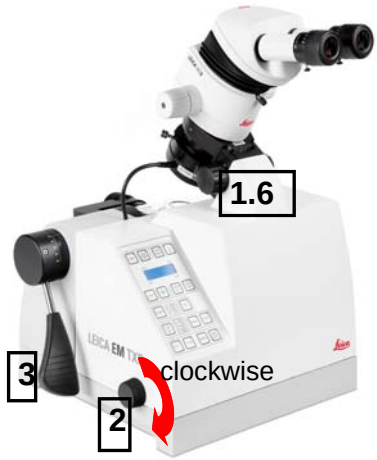


Clamp the alignment mechanism by turning the clamping ring (9.4) counter clockwise. Unlatch the locking pin (9.2) by moving it to its rest position.



7.5 Milling the cutting face

Swivel the specimen pivot arm (3.1) to its end stop using lever (3) (indication 0). In this position the specimen and miller axes are parallel. Focus the microscope on the specimen using knob (1.6) on the stereo microscope carrier. Make sure the milling tool will not touch the sample by moving the tool control lever (7). If necessary rotate feed hand wheel (2) clockwise to retract, or use HOME button of the control panel.



Select appropriate rotation speed.
Switch on the motor by pressing the red button less than one second. The spindle motor rotates until the button is pressed again. If the button is pressed longer than one second the spindle motor rotates until the button is released. The spindle motor can be switched on by pressing the START button as well.

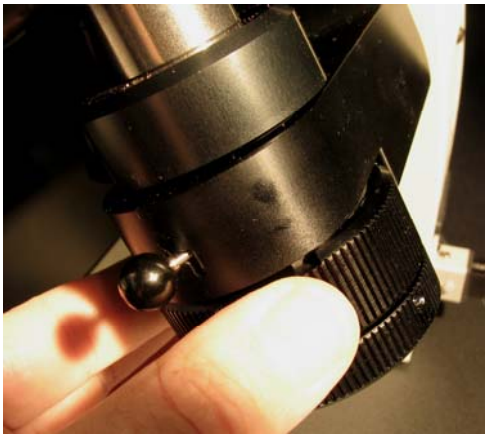
While observing in the stereo microscope, move the milling control lever (7) slowly down. If no material is removed rotate the feed hand wheel counter-clockwise (advancing the miller towards the specimen).
One click stop of the feed hand wheel (2) corresponds to the selected step size on the control panel.

Continue with the above mentioned procedure until a milled face is produced. For best results milling should always take place from left to right. That means the advance of the miller should be performed when the miller is on the left side of sample. Also the milled material is then thrown down into the waste channel.

The best surface quality can be achieved using a 1 µm or 0.5µm step advance and a very slow movement of the milling control lever for the final pass. The prepared face can be judged by swivelling the specimen pivot arm (3.1) into the front face observation position (indication 60). Additionally, the surface quality will be improved by cooling the miller. In this case disconnect the hose of the extraction unit.

7.6 Producing a pyramid or a sloping face

Swivel the specimen pivot arm using lever (3) to the desired pyramid angle between 30° and 45° (recommended for producing a pyramid)



Rotate the specimen using the knurled ring (9.3) until the first click stop position. Make sure that the 90° click stop position is correctly engaged.

The milling operation for producing the pyramid sides are the same as described for the cutting face.

By swivelling the specimen pivot arm the specimen moves closer to the miller and might interfere with the miller. Before you start milling make sure the miller will not cut the sample with an uncontrolled advance. We recommend to retract the miller by turning the feed hand wheel clockwise or with the HOME button of the control panel.

While observing in the stereo microscope move the milling control lever (7) slowly down. If no material is removed rotate the feed hand wheel counter clockwise (advancing the miller towards the specimen).
One click stop of the feed hand wheel (2) corresponds to the selected step size to advance the miller.

After the first pyramid face is produced, retract the miller and rotate the specimen using the knurled ring (9.3) to the next click stop position and proceed as described above until all four sides of the pyramid are produced.

It is not necessary to trim the cutting face with the 90° click stop position of ring (9.3), although we recommend this. The specimen may be rotated any amount so that trapezoids or any other shapes can be produced.

8. Distance determination

The specimen pivot arm (3.1) can be set to the 90° position perpendicular to the sample which allows accurate approach to a sample detail along the sample axis. Distance to the sample can be determined with an eyepiece reticule in conjunction with the M80 stereo microscope and movable objective adaptor.

8.1 Approaching a specimen target along the longitudinal axis

90° viewing position:
pull the specimen pivot arm (3) to the left and turn it down to the end stop position (indication mark). This position is useful to align the sample and/or to approach the sample target.

In this position the location of the area of interest can be observed perpendicular to the cutting face or sample edge. Accurate approach to the area of interest can be performed after swivelling back the specimen pivot arm to the processing position (indication 0).

8.2 Distance measurement

In conjunction with the M80 stereo microscope, reticule with measuring pitches and movable objective adaptor, the distance from the cut edge to the area of interest of the sample can be determined.

8.2.1 Calibrating the reticule

The reticule is only magnified by the eyepiece. The total magnification of the specimen does however depend on the objective lens, magnification changer (zoom), eyepiece and additional tube possibly used (e.g. coaxial light sources) and changes whenever these factors are altered. The true dimensions of the specimen can only be established once the calibrated value has been defined.

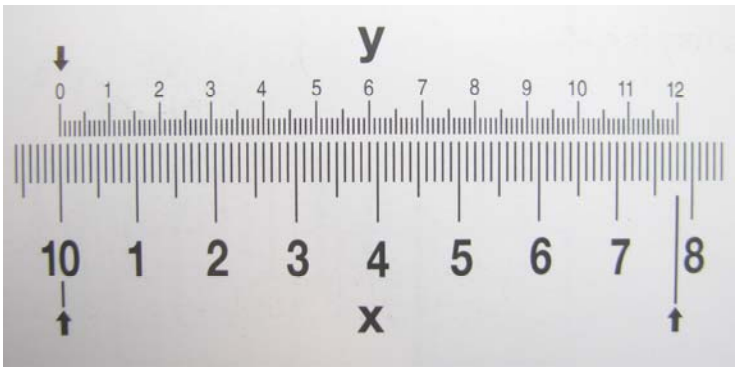
The calibration value of each of your optics/magnification combinations used has to be established only once. Keep a table of the appropriate calibration values.
When working with a stereo microscope with engage able zoom settings (Leica M80) or adjustable stops (Leica S6), the specific magnifications can always be re-produced exactly (refer to directions for use of the stereo microscope).

Swivel the pivot arm to the front face observation (chapter 7.4.). Place stage micrometer onto the specimen holder (without specimen) use plasticine or similar for fixing or use the glass slide holder offered by Leica. Select the magnification with which you will later want to take measurements (the highest value will provide measurements that are more accurate).

Turn eyepiece with reticule anticlockwise until it reaches the stop. Slowly turn eyepiece with reticule clockwise until you can clearly see the measuring lines of the reticule. Observe the stage micrometer through the eyepiece with the reticule (keep the other eye closed) and focus.

Check whether the eyepiece is free of parallax by looking into the eyepiece with reticule and slightly move your head. The reticule and sample (stage micrometer) must not move towards one another, i.e. they must be clearly focused in one plane (free of parallax). If this is not the case, please repeat the process.

Align stage micrometer (x) close to and in parallel with the eyepiece graticule (y). Use the set screws of the movable objective adaptor to align the pitch lines.



Count the number of mm of the stage micrometer (x) corresponding to a certain number of intervals on the eyepiece reticule (y).
In the example: 7.8mm on the stage micrometer corresponds to 120 intervals on the eyepiece reticule.

Calibration formula: $\frac{x}{y}$ (stage micrometer: number of mm)
y (eyepiece graticule: number of intervals)

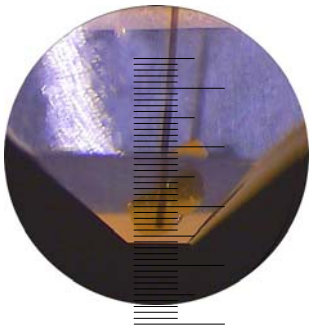
Calibration value (in the example):

7.8mm on the stage micrometer corresponds to 120 intervals on the reticule

$$\frac{7.8}{120}$$ **mm = 0.065mm calibration value**

8.2.2. Distance measurement

Swivel the pivot arm to the 90° position (chapter 8.1.) Set the zoom of the stereo microscope to a calibrated magnification (the highest value will provide measurements that are more accurate). It might happen that the pitch line of the reticule is not coincident with the cutting edge. Use the setscrews of the movable objective adaptor to set the pitch line coincident to the cutting edge.



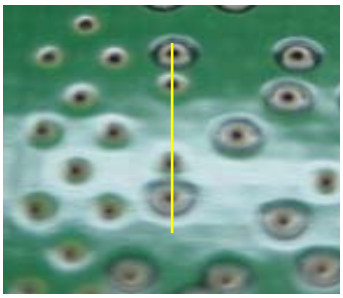
Measuring (in the example):
reading on the reticule: e.g. 2 intervals

2 intervals x 0.065mm = 0.13mm (length of measurement distance)

Once the distance is measured, the specimen pivot arm can be swivelled into the processing position (indication 0) to its end stop. The measured value can than be removed by advancing the tool correspondingly. One click stop of the feed hand wheel advances the tool according the selected step size.

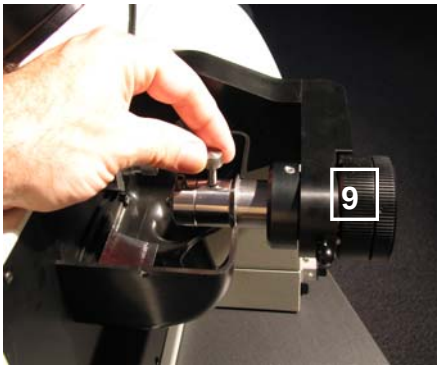
9. Sawing/polishing sample preparation examples

9.1 PCB crosssectioning of a through hole



Clamping the specimen:

- Insert the specimen into the flat specimen holder and roughly align the target parallel to the jaws of the holder.
- Clamp the specimen with the Allen key.
- Insert specimen holder in the adaptor (chapter 4.10.)

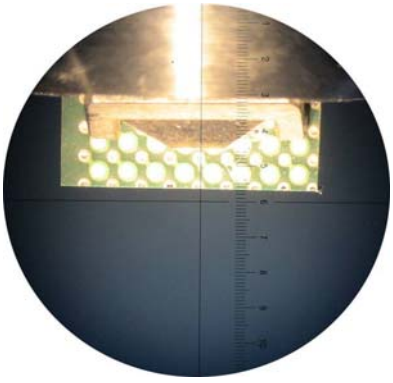


Alignment cut:

- Insert the diamond disc cutter (chapter 4.7.)
- Select a rotation speed of about 15 000 rpm.
- Align the water droplets by moving the spout of the cooling system (chapter 4.11). The cooling solvent (normally water with some droplets of liquid soap) should drop onto the tool.
- Adjust lubricant flow (chapter 6.2)
- Switch on the instrument either with the red button on the E-W control lever (7) or by pressing the START button on the control panel.
- Slowly move lever (7) down until the specimen is sawn through.

Alignment and distance definition:

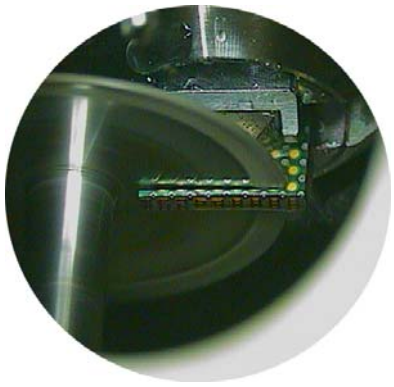
- Swivel the specimen pivot arm in the 90° viewing position (chapter 8.1)
- Align the cross hair of the eyepiece reticule parallel to the cutting edge. Use the set screws of the moveable lens adaptor (chapter 4.2.3.) to coincide with the cutting edge and the reticule line and fixate eyepiece with the clamping screw
- Align the specimen parallel to the reticule line either manually (by opening the clamping screw of the holder) or by using the vertical set screw of the angle adjustment adaptor (chapter 4.9.)
- Measure the distance to the target (chapter 8.)



Target cut with the diamond-cutting wheel:

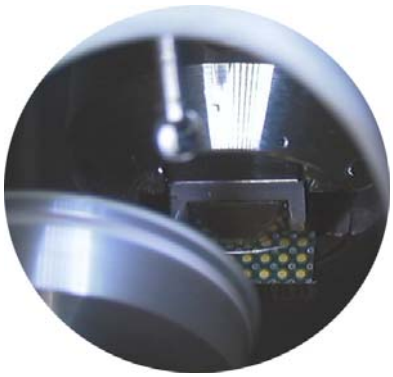
To achieve a higher surface quality an automatic E-W movement of the tooling spindle is recommended.

- Swivel the specimen pivot arm in the 0° processing position to its end stop (chapter 7.5.)
- Clear advance indication (chapter 5)
- Retract the spindle 10µm using feed hand wheel (2).
- Set the cutting window (chapter 6.7)
- Advance the disc cutter to the measured position using the feed hand wheel or FORW button. Reduce the amount removed to allow for grinding and polishing after cutting.
- Switch on the instrument by pressing the START button. Once the end position is reached, the spindle retracts 10µm and moves to the start position. An advance of 10µm will be performed afterwards



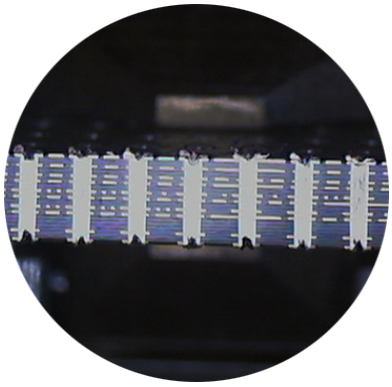
Cross polishing to the target:

- Slide in lever for auto E-W movement (7.1)
- Swivel specimen pivot arm to the 0° processing position
- Remove diamond disc cutter
- Insert arbor for polishing foil carrier (chapter 4.7.)
- Screw into the carrier with the 9µm diamond polishing foil
- Retract spindle until the foil misses the sample
- Set speed to ~ 2200 rpm (chapter 6.1)
- Switch on the spindle motor and align water stream of the spout
- Activate the force measuring mode by pressing F button (chapter 6.6.)
- Select a step size of 10µm or 1µm for fragile samples (chapter 6.5.)
- Advance with the feed hand wheel until the F values changes or you hear a contact noise.
- Retract the spindle about 10µm
- Set the cutting window (chapter 6.7.) Start point in overlapping position
- Select 1µm step advance
- Press START button longer than one second (AUTO LED is on)



The instrument will now perform continuous cycles. The Spindle will retract 10µm at the end position of the cutting window and will advance 10µm + the selected step size at the start position of the cutting window. This process should continue until the marks from the former process are removed. You may interrupt the process at any time by pressing the START button once and the instrument will finish the cycle, or twice and the instrument will stop immediately.

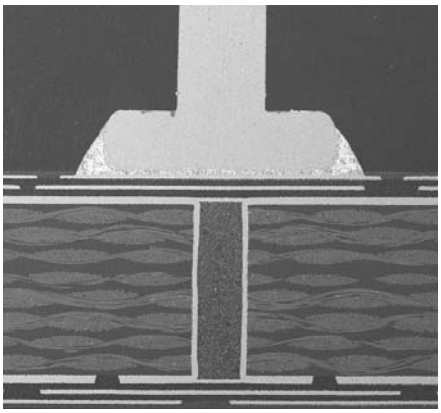
By swivelling the specimen pivot arm to the front face position (60° indication) the surface can be investigated. Once the sample shows uniform surface the next foil with a finer grade should be used by replacing the insert. The arbor stays in the spindle.



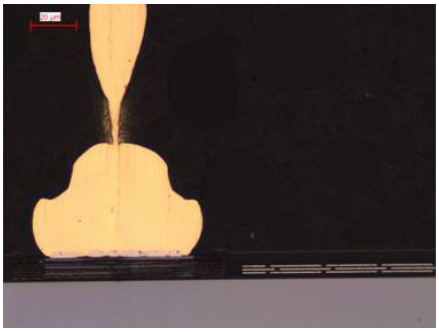
If the target is hidden (e.g. gold wire bonding in a IC package) after sawing through the sample you may approach towards the target using the disc cutter in the auto run mode with a step size of 10µm. As soon as the gold wire becomes visible change, to the 9µ diamond foil followed by 6µm, 3µm and 1µm (if necessary to 0.5µm as well).

9.2 Example results

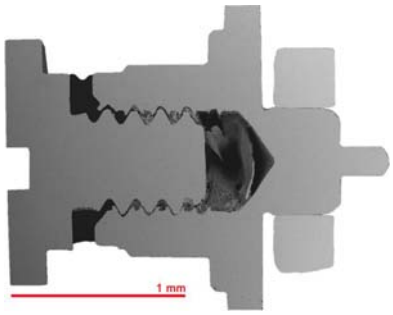
PCB - through hole:
Processed as described on previous pages using 9µm, 6µm, 3µm and 1µm diamond polishing foils.



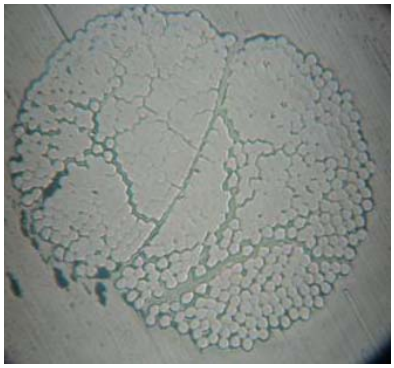
Gold wire bonding on IC package:
Processed as described on previous pages. Target approach was carried out by using the diamond disc cutter. Alignment was performed using the angle adjustment adapter 16702830. The sample was ground with 15µm, 9µm, 5µm SiC lapping foils subsequently polished with 3µm, 1µm and 0.25µm diamond paste on neoprene cloth.



Bolted joint (watch parts):
Non-embedded parts were clamped in the AFM insert. Grinding and polishing has been performed with 9µm, 6µm, 3µm, 1µm diamond foils (LA-type)



Polymer cord from a tyre:
Sample was embedded (for support). The surface was smoothed with a diamond miller at 20 000 rpm (cooled with water) prior to a 3µm and 1µm aluminium oxide foil polishing process.



9.3 Slicing

Once the surface is prepared it may be necessary to produce a thin slice of the sample. This can be also prepared on the instrument.

9.3.1 Front face slicing

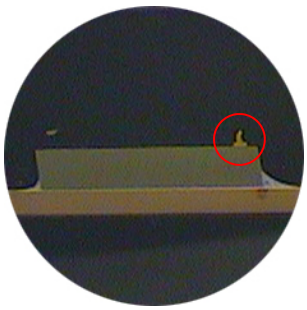
- Insert cut-off wheel
- Switch on the instrument and deactivate the pump (OFF)
- Approach the disc using the feed hand wheel. Gently touch just a small surface corner of the sample with the front face of the disc cutter until a very small amount of material is removed or you hear a contact noise.
- Swivel the E-W arm away from the sample
- Clear the advance indication
- Advance the spindle to the desired slice thickness plus the thickness of the disc cutter (should be measured before).
- Cut the sample at this location with the disc cutter, either manually or with the automatic E-W movement.
- To avoid the sample becoming damaged when it falls down onto the protective cover, you can place a wet tissue below the sample. Be careful the tissue does not touch the spindle as it will wind around it.

Using this technique the minimum thickness of slice can be about 100µm, depending on the sample material.

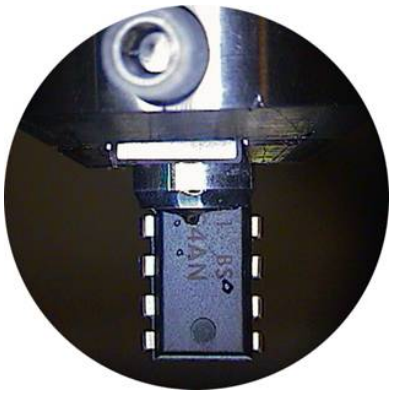
9.3.2 Back face slicing

Some samples need to be sliced thinner than 100µm and polished on both sides as well.
The following describes a process to achieve a 20µm double side polished slice of a gold wire bonding on IC package.

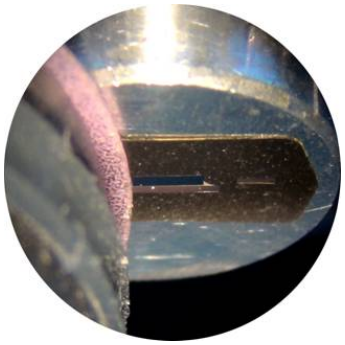
- Prepare the first side of the sample as described in chapter 9.2.
- Once the first side is prepared remove the sample from the holder
- Take the SEM stub or an aluminium rod to support the sample and insert it in an appropriate holder

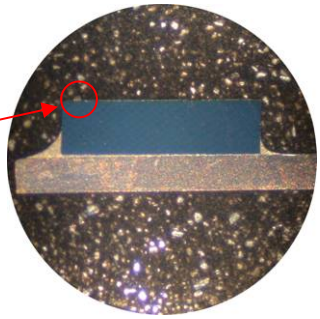


- Flatten the surface of the SEM stub or rod using the tungsten carbide miller. The prepared surface is perpendicular to the tool axis.
- Remove the holder (keep in mind the orientation of the holder).
- Glue the sample with the polished side down onto the surface of the rod. In this case “crystal bond” wax was used. Make sure that the side of the stub or rod is not covered with a layer of glue



- Insert sample into the instrument
- Insert disc cutter and advance the disc cutter until the front face of the disc cutter gently touches the “glue free” part of the stub or rod.
- Clear the advance indication.
- Retract the spindle to the desired value (in this case 80µm) and cut the sample through.
- Exchange disc cutter with the polishing inserts (9µm, 6µm, 3µm, and 1µm (and 0.5µm). Polish down the sample until the desired value is indicated. Take into account the layer thickness of the glue which reduces the actual thickness of the sample. Use the HOLD function when replacing the tool (foils)





20µm slice of a gold wire bonding on IC with conductive layers

10. Useful hints

10.1 Recommended sample size

For polishing, we recommend preparing samples with a size up to 60mm² maximum as the polishing inserts diameter is 30mm. Preparing larger samples may result in the polishing foils quickly wearing which would influence the quality of the surface as well the lead-time.

10.2 Diamond disc cutter

The diamond disc cutter should only be used for hard and brittle material (e.g. glass, silicon etc.) or hard and brittle samples with inclusions of a small amount of ductile materials (e.g. copper, gold etc.) Using the diamond disc cutter for large ductile samples (copper, aluminium, etc.) would smear the cutting area of the diamond disc, which will result in the cutting edge wearing rapidly. Use an appropriate cut-off wheel instead. Clean the diamond disc cutter with a commercially available dressing stone from time to time.

10.3 Diamond miller

To achieve the best-milled surface quality the use of the diamond miller is recommended. However, please bear in mind:

- glass or glass fibre reinforced material will physically damage the diamond miller
- material containing iron, cobalt, nickel, manganese, chromium, tungsten, tantalum, titanium and zirconium it will result in the cutting edge wearing quickly. Where appropriate, use a tungsten carbide miller instead.

10.3.1 Surfacing of ductile materials and hard polymers

The lead time to prepare the surface of such materials can be significantly reduced using the diamond miller in conjunction with the cooling system (water+ droplets of liquid soap), slow (manual) E-W movement with the lever (7) and choosing a step size between 0.5µm and 1µm. A surface finish produced in this way allows the use of 3µm followed by 1µm (and if necessary 0.3µm) aluminium oxide foils afterwards, instead of higher grade foils.

10.4 Sample holders

Depending on the sample size and application there are different sample holder available:

Universal holder (steel) o/n 16701761
to clamp round as well as flat specimens of 3-8mm.

Flat specimen holder 0-4mm (steel) o/n 16701772
to clamp flat specimens between 0-4mm thickness and a width of up to 15mm

Flat specimen holder 3-8mm (steel) o/n 16702843
to clamp flat specimen between 3-8mm thickness and a width of up to 15mm

Holder suitable for different inserts (steel) o/n 16702829
These inserts are used for investigation after sample preparation without removing the sample from the holder.

AFM insert 0-2mm (steel) o/n 16702448
to clamp specimen between 0-2mm thickness and a width of up to 8mm

AFM insert 2-4mm (steel) o/n 16702844
to clamp specimen between 2-4mm thickness and a width of up to 8mm

Single tablet holder (polycarbonate) o/n 16702895 (100pcs.)
for gluing spherical samples. The insert surface can be milled flat to take flat samples.

SEM stub with M4 thread (aluminium) o/n 16702875
for gluing specimens on the flat surface for insertion into the SEM. The insert surface can be milled flat and perpendicular to the tool axes to prepare parallel samples surfaces.

Glass slide holder for 1”x3” (25x76mm) glass slides o/n 16702831
used to prepare samples on a glass slide with the tungsten carbide or diamond miller.

11. Maintenance

11.1 Replacing the fuse

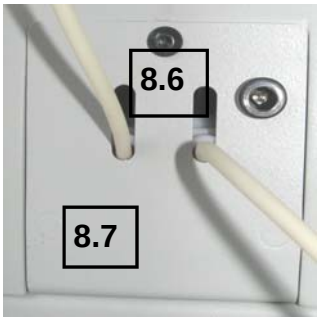
- switch off the instrument and disconnect it from the mains.
- remove fuse holder (11.3) using a screwdriver to open the clamping mechanism

- replace fuses, the type according to the type plate on the rear of the instrument

11.2 Replacing the tubes of the peristaltic pump

If the water flow of the cooling system is significantly reduced it might be necessary to replace the tubing of the peristaltic pump as the tubes become worn out after a period of time.

- switch off the instrument and disconnect it from the mains
- disconnect tubes from the lubricant bottle and spout
- open the pump casing by removing the hex screw (8.6)
- flap out the plate (8.7)
- pinch the clamping clips of the tube casing (8.8) and pull it out
- thread new tubes into the plate and slide the pump casing onto the pump motor spindle until the clips are engaged
- attach left tube to the spout and insert right tube into the lubricant bottle



EC Declaration

EC Declaration of Conformity
EG Konformitäts-Erklärung
Déclaration CE de Conformité

We/Wir/Nous

Leica Mikrosysteme GmbH
Hernalser Hauptstrasse 219
A-1170 Wien, Austria

declare in exclusive responsibility that the product
erklären in alleiniger Verantwortung, dass das Produkt
déclarons sous notre seule responsabilité que le produit

Model	**LEICA EM TXP**
Modell	**LEICA EM TXP**
modèle	**LEICA EM TXP**
Type/Typenbezeichnung/type	**EM TXP**

to which this declaration relates is in conformity with the following standards:
auf das sich diese Erklärung bezieht, mit den folgenden Normen übereinstimmt:
auquel se réfère cette déclaration est conforme aux normes :

EN 61010-1

EN 61326-1

following the provisions of directive
gemäss den Bestimmungen der Richtlinie
conformément aux dispositions de directive

2004/108/EC	(Electromagnetic compatibility) (Elektromagnetische Verträglichkeit)
2006/95/EC	(Low Voltage Equipment) (Niederspannungsrichtlinie)
2006/42/EC	(Machinery) (Maschinen)

Wien, 9. November 2007

Dr. Reinhard Lihl
Entwicklungsleiter
R & D Manager
Chef du service développement

Leica Microsysteme GmbH
Hernalser Hauptstrasse 219
A-1170 Wien

Tel. +43 1 48899
Fax +43 1 48899-350
www.leica-microsystems.com

www.leica-microsystems.com

Leica
MICROSYSTEMS