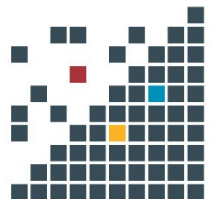
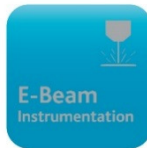




## CENTAURUS BSE & CL

Operation Manual V13.2  
Part Number: 3005-5001



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## 2.0 Introduction

**CENTAURUS** is a multi-purpose detector for either Backscattered (BSE) or Cathodoluminescence (CL) imaging. Interchangeable tips allow for use in either application.

Performance of **CENTAURUS** in either mode exceeds that of most other comparable detectors. When shipped, **CENTAURUS** is supplied with the tip type requested, additional BSE or CL tips are optionally available.

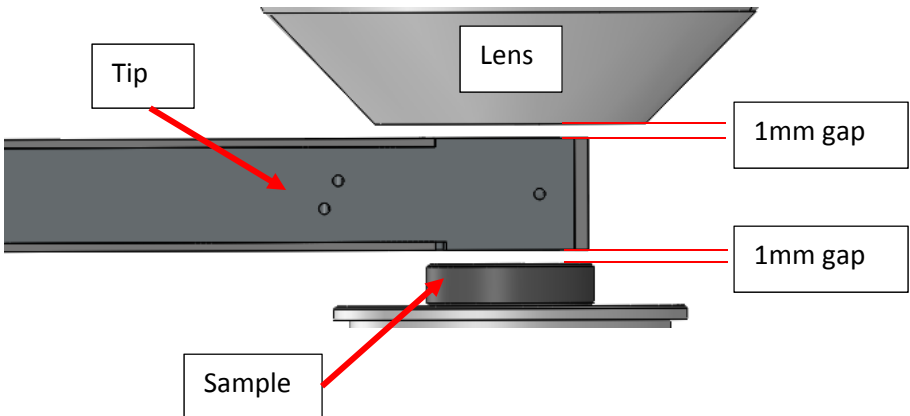
**CENTAURUS** is highly sensitive and will produce images down to extremely low levels of probe current. It is also suitable for Low kV operation with results possible with accelerating voltages down as low as 1kV in BSE mode.

**CENTAURUS** is fully retractable and may be removed from the area below the final lens when not required, preventing possible conflicts within the specimen chamber.

## 3.0 Operation

### 3.1 Basics

**CENTAURUS** detector tip is inserted to a position just below the final lens and just above the specimen where it will collect the greatest signal. The recommended distance between the top of the tip and lens is 1mm. The recommended distance between sample and underside of tip is also 1mm. To insert the detector, release retraction lock and turn the large knob to slowly insert the detector.



The use of an **IR CHAMBERSCOPE CAMERA** is recommended to protect against collision damage. A camera will provide a clear view inside the specimen chamber to give early warning of potential conflicts. It also speeds up specimen exchange and final positioning by taking away the uncertainty of the specimen position with respect to final lens and other detectors.

Ideal specimen working distance will be between 8 and 9mm. The procedure to get best signal is to get an image at approximately 12mm working distance then move the sample up until you get peak image signal but keeping the sample no less than 1mm below the mirror.

An image may be obtained using the SE detector to ensure that the correct part of the specimen is in view, and to ensure that the **CENTAURUS** detector is correctly centred. If the detector requires alignment refer to installation section.

Switch on Control Unit and increase BRIGHTNESS until display screen is mid grey, then increase CONTRAST until the desired image is seen, adjusting BRIGHTNESS level as necessary to give a balanced picture.

Backscattered Imaging should be possible at all probe currents on the SEM at kV settings of at least 3kV. As the kV is lowered, the probe current may need to be increased to obtain a good backscattered image.

Cathodoluminescence Imaging will require much higher than normal probe currents.

If signal level increases to excessive levels an automatic trip will operate to remove high voltage from the detectors sensitive photomultiplier tube. The **RESET** button will restore high voltage and resume operation. This function is designed to protect the tube from overload signals that may damage it, such as when light is inadvertently admitted into the chamber.

## 3.2 Backscattered (BSE) operation

Backscattered Electron Images are produced by collecting the higher energy electrons that are reflected from the surface of the specimen. Backscattered signals are roughly proportional to the atomic number of the composition of the specimen. Therefore, higher atomic numbers generally give a higher signal output.

In many cases, the best backscattered images are acquired when the SEM is running at a high kV and with a large probe current (spot size). However, these conditions often do not favour the specimen or the SEMs spatial resolution, therefore a lower level of each maybe required.

**CENTAURUS BSE** detector is sensitive, and probe currents of a similar magnitude to those used for normal SE detection are routinely used. As **CONTRAST** is increased background noise will increase. Therefore, a point will be reached where further increases in **CONTRAST** may not produce a better image. Generally, the **CONTRAST** control should be kept below about 80% for the best image.

If higher settings are required, it is normally better to increase either probe current or primary kV. **CONTRAST** settings higher than 800V may require slow scan operation to overcome effects of noise. Operation near maximum setting may require record speeds or frame averaging to overcome noise. **CENTAURUS** is particularly efficient at low kVs. Low kV backscattered detection gives completely different images to those normally associated with backscattered detectors.

Atomic number contrast gradually reduces for elements as the kV is lowered. By 5kV the elements above, will tend to give similar signal outputs, and below 5kV, the atomic number discrimination for higher atomic numbers may reverse. As kV is lowered even further, so does the point at which this reversal takes place. If the kV is reduced to around 1.5kV, it is normally possible to produce backscattered images from totally uncoated or insulated specimens. The results obtained will generally be free from usual charging effects. If charging does occur this may often be removed by experimenting with other kVs in the range from 1kV to 1.8kV. The usual figure for zero charging is around 1.3kV.

At these voltages, CENTAURUS will still function, but response will fall off rapidly as voltage is lowered further. Therefore, if charging is not a problem, slightly higher kV settings should give a substantial increase in signal level.

Backscattered Detectors are normally used for atomic number contrast. For this reason, they are designed to reject most topographic information. Where topography is required it may be achieved by partially retracting the tip so the electron beam, instead of passing through the tip aperture, passes near to its end. This asymmetric configuration will give an excellent mix of both composition and topography.



### 3.3 Cathodoluminescence (CL) operation

**CENTAURUS** may be supplied with a CL tip. If supplied as an additional tip, to change it, open the specimen chamber and remove the BSE tip. This is achieved by screwing in the set screws either side of the tip with a 1.5mm hex key, where it joins the round section, and by pulling it out. The CL tip fits in place of it.

Probe currents for CL detection will be much higher than those used for SE or BSE detection. Expect to use 10nA or more in many cases. Certain materials have very high CL outputs, and for these low probe currents will be required.

The spectral response of the Photomultiplier Tube (PMT) which has been selected to give a good output for the scintillator tip fitted for BSE detection and CL. The PMT normally fitted has a response from 185nm to 850nm. This PMT peaks at the high end of the blue spectrum which gives a good collection spectrum towards the bottom end of IR. For near-infrared operation, the 400nm to 1200nm PMT should be specified. Due to its very low output in the visual spectrum, it is not suitable for BSE operation. Please ask Deben UK Ltd, for advice if other ranges are desired.

## 4.0 Installation

**CENTAURUS** Detector consists of two main items, the Electronic Control Unit, and the chamber mounted Arm. Place the Control Unit on a suitable flat surface away from high temperatures. Make certain, at this stage, that the mains power input selector is correctly set for the supply to be used. The ideal mains supply will be from an accessory socket on the SEM. Check this carefully, as this may be considerably different to the supply voltage in your country.

### IMPORTANT NOTE

Check the fuse type and rating agree with the details on the rear panel.

This is for your safety, so please fit the correct fuse in all cases. Replacement fuses are available from Deben UK Ltd

Install the Arm on a suitable chamber port. Often there is no second choice for this position and the unit will have been ordered and manufactured for a specific port. When the arm is correctly fitted and gives free movement both in and out, install the tip with the scintillator (open side) towards the specimen

Fit the supplied adaptor flange to the SEM chamber making sure the supplied O-ring is fitted. There may be a separate flange assembly drawing supplied.

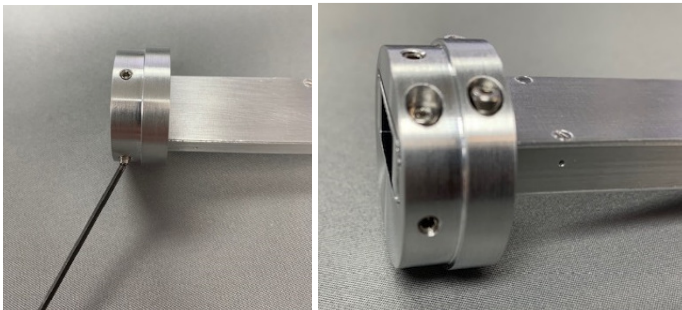
Remove the plastic protector from the end of the PMT tube assembly.

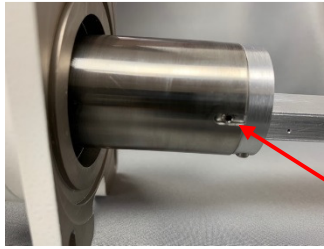


Fit the light guide to the end of the tube, CL light guide shown below:

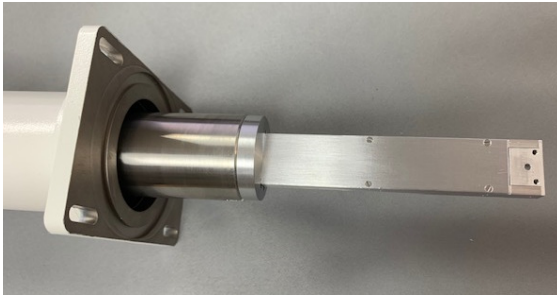


The light guide is fitted by unscrewing the four fixing grub screws once fitted to the tube, the screws will un-screw and lock the light guide to the tube.





Once fitted unscrew (x4) to lock



Light guide fitted to tube with mirror/phosphor facing down towards the sample.

**Do NOT touch the sensitive surface of the detector.**

The Arm will retract the sensitive tip well away from the area above the specimen when it is not in use to avoid conflicts with other detectors etc.

With the light guide retracted, mount the Centaurus arm to the chamber making sure the supplied O-ring is fitted. Initially fit at the lowest possible position.

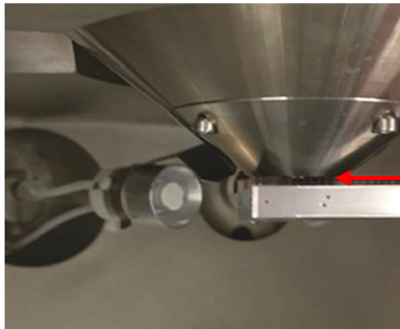


When inserted, the small aperture in the tip should fit close to the SEMs lens and concentric with it. There are adjustments for all three axes. Adjustments are accessed externally to provide precise alignment. To align the tip, carefully insert the Arm with the chamber door open. Set the up down alignment first. This is done by slackening the four screws on its mounting plate.



Slide whole assembly up and down to set height

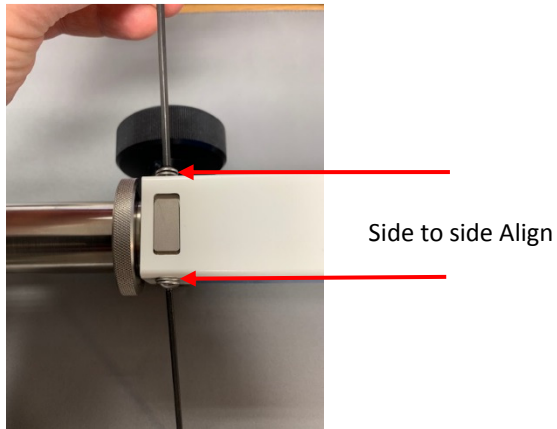
The assembly may then be moved over a range of 11mm. The gap between the top of the tip and the lens should normally be as small as possible, but preferably no more than 1mm. If the gap is too small, there is a risk of scratching the lens when operating the retraction mechanism.



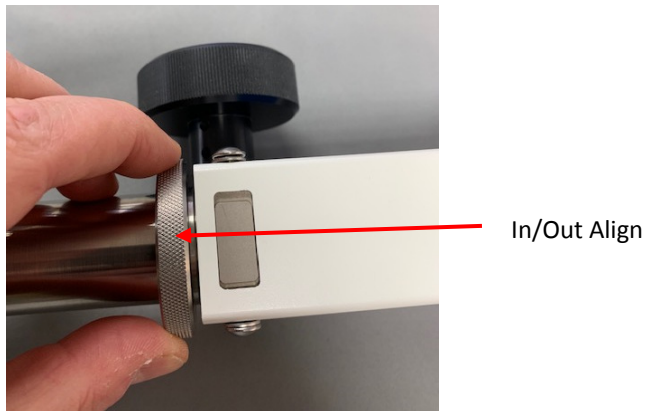
Adjust for 1mm gap

*Tip positioning with respect to final lens*

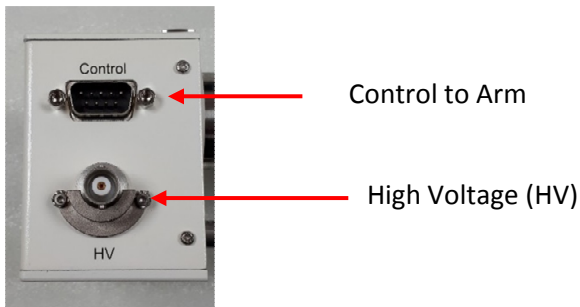
To set the other axes, use a small hand mirror and hold this below the final lens so that alignment can easily be seen. Firstly, make certain that the two screws used for side to side alignment are set to mid position.



The In/Out alignment is adjusted by the knurled ring on the end of the square section of the body of the Arm. This can always be adjusted later, even under vacuum, but get it as close as possible now. If all looks well, retract the arm and commence pumping the chamber. Connect the multi-pin cable between the Control Unit and the Arm. Connect the HV lead (Lead 5). Note that, when installed, this is held captive at both ends by small half ring clamps. This is to prevent the cable from being disconnected thereby reducing the risk of electric shock. Up to 1200V may be carried by this cable. To remove the half rings, remove both fixing screws.



## Electrical connections



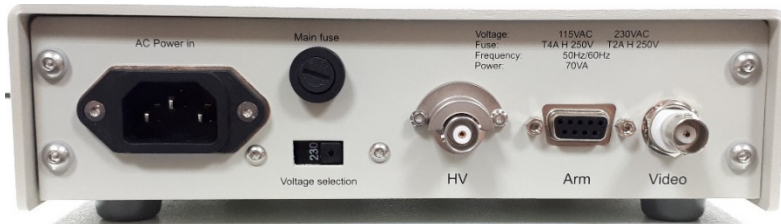
*Arm electrical connections*

Connect the HV cable between the control unit and the arm, make sure the connector clamps are replaced following installation, to prevent the connectors being removed when high voltage is applied.

Video out must be connected to the SEM AUX video input using the cable supplied, voltage levels have been pre-set to match the SEM the system has been ordered for, default is +/- 1V.

The supplied control cable should be connected between the Centaurus arm and the control unit.

Finally, check the voltage selection switch is in the correct position for power in your region and connect the supplied power cable to AC Power in.



*Centaurus control box - rear*

The unit is now ready for testing. Acquire a SE image on the SEM as normal, insert detector and select AUX video input in the SEM software.

Before switching on, turn **CONTRAST** control to minimum value (fully anti-clockwise).



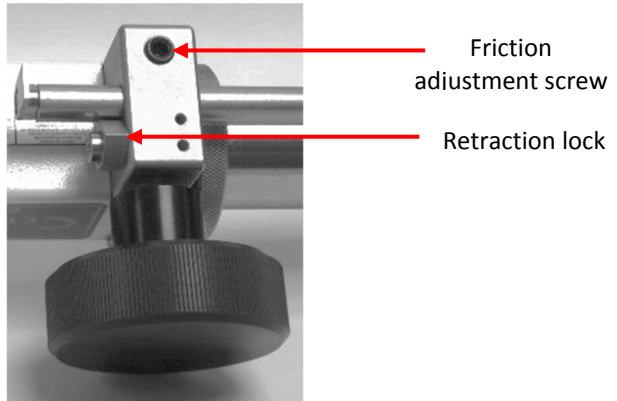
*Centaurus control box - front*

Switch on power and the switch should illuminate. If possible, test that the signal is wired to the correct input of the SEM by turning up the **BRIGHTNESS** control. This should change brightness on the display screen or on the signal metering. Note that some SEMs will need to be 'vacuum ready' before this can be done. When the vacuum is ready, check that the SEM is functioning satisfactorily in its normal SE mode.

We recommend using a chamberscope when inserting **CENTAURUS**, to ensure the path of the detector is clear. Release the Retraction Lock and carefully insert the Arm by turning the large knob to the side. Remember that it is always good practice to insert any detector slowly to prevent the possibility of a vacuum leak. If a small leak during movement is likely to cause any problems in your SEM, close the chamber isolation valve before moving the Arm.



If the friction on the system is incorrect, the arm may either be stiff to insert, or may be dragged in by the vacuum. This may be adjusted by loosening or tightening the small setscrew beneath the gearbox as shown below.



*Friction lock adjustment*

In practice, it has been found that the friction lessens over the first few months, and frequent tightening may be necessary. If the friction is too small, it may be possible for the arm to creep in, and this could result in some damage to other detectors or the specimen. When the Arm is in position, use the SE image at low magnifications to ensure that the **CENTAURUS** is correctly aligned. Small misalignments are acceptable, but if higher magnifications are required this alignment should be improved to prevent astigmatism due to the beam passing asymmetrically through the detector aperture.

Adjustments to the alignment may still be made, if necessary, with the SEM operating. The **CENTAURUS** detector may now be operated as described earlier. If no signal is seen, check first that the video output is going to the correct input socket and that the appropriate channel is selected on the SEM. If this is correct, as should be seen by the screen brightness variation with the **BRIGHTNESS** control.

## 5.0 Maintenance

The **CENTAURUS** arm is made from high quality materials and should operate satisfactorily for a reasonable period. However, should the movement become stiff and difficult, it could be that the O ring seals require lubrication. Sliding seals in a vacuum need periodic maintenance. They must be kept clean and carefully lubricated.

This should be done with the correct fluid, as many vacuum types of grease are not suitable for use in high vacuum systems. We would recommend the use of a small quantity of Fomblin Y Vac 18/8 or similar oil. Place a very small quantity on the top of the shaft, (inside the chamber), near to the seal. When the Arm is retracted, this should then run into the seal. Wipe any excess off the shaft with a lint free cloth after a few in-out cycles. Other parts of the Arm mechanism may need occasional lubrication. Use normal oil for all parts outside the vacuum, but do not let this oil contaminate any vacuum part.

The **CENTAURUS** tip will have a lifetime depending on the amount of use that it receives. The life expectancy is at least two years for a tip used regularly. If the performance falls off, the tip is damaged or contaminated; Deben UK Ltd can supply a replacement for you. In any correspondence, please always quote the serial number of the system, which will be found on the back of the Control Unit. From this it will be possible to identify all parts of the **CENTAURUS** system.

## 6.0 Troubleshooting

### There is no picture following installation.

Make certain that the Vacuum Interlock Plug is inserted into its socket or that a suitable interlock signal is connected. The CONTROL UNIT will not operate without this connection. See INSTALLATION section.

### There is not enough friction to prevent the arm from being sucked in by the vacuum.

The friction screw may need to be tightened. This is located beneath the gearbox. See INSTALLATION section.

### The SEM vacuum trips when moving the detector in or out.

A small vacuum leak is always possible with sliding seals. Ensure that the stainless tube is free from scratches or contamination and is correctly lubricated. Try moving the detector more slowly. If the problem persists, only move the detector with the chamber isolation valve closed.

### OVERLOAD light keeps illuminating.

This is a protective feature to prevent damage to the photomultiplier if the chamber is opened with the detector operating. Certain specimens can produce excessive signals that can 'trip' the system. Reduce the CONTRAST and try again.

### Excess noise on the image.

As the **CONTRAST** voltage is increased so will the signal, and that includes noise. At about 800V the noise may become excessive and increasing the voltage above these levels will not give any sensible increase in signal level. This figure may vary due to a wide spread in the characteristics of photomultiplier tubes. A high gain tube, which becomes noisy at 800V, will give the same image as a low gain tube, which becomes noisy at 1200V.

## 7.0 Service, spares & warranty

For replacement parts please contact Deben UK Ltd., or our local representative. The serial number that is marked on the back of the Control Unit should be quoted in all correspondence. This will identify the instrument and enable them to supply the correct parts or to offer advice.

The Deben UK Ltd **CENTAURUS** DETECTOR is a precision instrument using the latest in electronics and semiconductor technology. It is inherently reliable, but in the event of a fault occurring within the period of **ONE YEAR** from the date of purchase, it will be repaired or replaced free of charge, provided that the system is returned carriage paid to Deben UK Ltd, at our factory in the UK. The Detector Tip is very fragile and is NOT warranted against accidental damage.

Before returning any system for service please contact our Service Department, or local agent, for a Returns Movement Authorisation number (RMA) and a copy of the Declaration of Contamination.

In any communication and when ordering spare parts, always quote the full Serial Number that may be found on the rear panel. Instruments returned for service must include brief details of the fault, a return address and telephone contact, plus a Purchase Order Number to cover repairs outside of warranty.

### IMPORTANT

**In all cases the Declaration of Contamination must be completed and returned with the equipment. A copy must be attached to the outside of the package. Failure to do this will result in the product being returned unopened.**

**CENTAURUS** detector is made to the highest possible standards of safety. It complies with the current EU directives and is CE marked.

## 8.0 WEEE Directive



This product is marked according to the European directive 2012/19/EU on Waste Electrical and Electronic Equipment (WEEE). By ensuring this product is disposed of correctly, you will help prevent potential negative consequences for the environment and human health, which could otherwise be caused by inappropriate waste handling of this product.

A Crossed-Out Wheelie Bin symbol on the product, or on documents accompanying the product indicate that this product may not be treated as household waste. Instead it shall be handed over to the applicable collection point for the recycling of electrical and electronic equipment. Disposal must be carried out in accordance with local environmental regulations for waste disposal. For more detailed information about treatment, recovery and recycling of this product, please contact your local authority, your household waste disposal service or the supplier where you purchased the product.

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