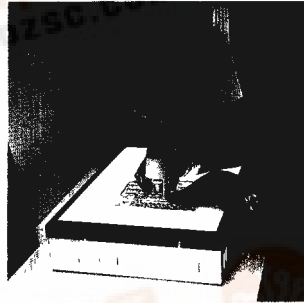


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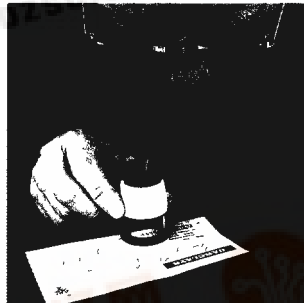
To

456-986

# OPTICAL MEASURING INSTRUMENTS



PORTABLE MEASURING  
MICROSCOPES



POCKET MEASURING  
MAGNIFIERS

MODULAR MICROSCOPE  
SYSTEMS



PCB THROUGH HOLE  
MICROSCOPE

CALIBRATION STANDARDS

## Introduction

When confronted with the problem of optical measurement and analysis, one of the first questions must be how much of the environment of the subject to be inspected – which throughout this booklet we shall term **SPECIMEN** – is also necessary to be seen. The total area seen at any one time is the **FIELD OF VIEW**. The greater the magnification of the specimen, the more limited is the field of view. Hence the eye, unaided, gives a very good field of view, or if supplemented by a wide angled lens system gives still more but at reduced magnification. A reasonably accurate measurement can be made using a measuring scale, particularly if this is on the underside of glass, and placed in firm contact with the specimen being measured. But scale divisions finer than 0.1mm are hard to discern with the naked eye and the use of a magnifier becomes necessary. A **MAGNIFIER** consists of a lens system focussing directly on the object being viewed. With a magnification  $\times 4$ , it may limit the field of view to a diameter of less than 50mm. At  $\times 8$ , the field of view may be down to 25mm. The advantage of a magnifier is that a measuring scale can still be used in close contact with the specimen, but there are limits to the extent of magnification which can be achieved.

The **MICROSCOPE** works by having a second lens system which further magnifies the original magnified picture produced by an objective lens system, thereby achieving a magnification which may be the product of the two magnifications. The **OBJECTIVE LENS** throws an inverted picture of the specimen on to a point in space on which it is focussed. The **EYEPIECE LENS** acts as a magnifier which is also focussed on the same point in space, known as the **IMAGE PLANE**. The eyepiece does not invert the image so that the microscopist has an inverted image of the specimen unless further optics are included to reverse the image back to normal. If a **GRATICULE** is placed at the image plane, its markings will be superimposed on the image seen, but its scale markings relate not to the specimen but to the image of the specimen magnified by the objective lens. Thus before measurements can be taken, the relationship between graticule markings and a measuring scale (**STAGE MICROMETER**) must be established by calibration. An approximation only of the calibration can be obtained from the quoted magnification of the objective lens, and whilst this approximation is useful when choosing components, it should never be relied upon for actual measurements. **PORTABLE MEASURING MICROSCOPES** are normally calibrated to the quoted accuracy before sale.

## Contents

### Maxta Measuring Scales – Magscales

For the measurement of flat objects of lengths outside the field of view of a single magnifier. The measuring scale of length 150mm, 300mm, 12" or 450mm forms part of a built in magnifying system and can yield results to an accuracy better than 0.1mm.

### Maxta Magnifiers

For the examination and measurement of flat objects to an accuracy better than 0.1mm. Measurements are achieved by placing the graticule held in the base of the magnifier in direct contact with the specimen. There is a wide choice of graticule available for this purpose.

### Maxta Portable Measuring Microscopes

For the out of contact measurement and examination of specimens within limited fields of view. Magnifications of  $\times 15$ ,  $\times 20$ ,  $\times 40$ ,  $\times 80$  and  $\times 100$  are available with micrometer scales 6mm, 4mm, 2mm and 1mm divided into 0.02mm and 0.01mm divisions, or alternatively 0.2", 0.1" and 0.05" in 0.001" and 0.0005" divisions. There are special models for Bore Hole examination, Spray Droplet and Particle inspection, Brinell Hardness Impression, CRT inner surface inspection and with erect image reverted by prism. All models are solidly built and suitable for use as part of a tool kit.

### Maxta Microscope Modules

For the construction of microscope measuring and examination systems to suit the particular requirements of the user. Modular systems can be built into machine tools or instruments and the special needs of short or long working distances, very tight tolerances, inaccessible work positions, and unfriendly environments can be catered for either by the user himself, or by design and construction before delivery.

### Maxta Calibration Scales

Glass scales up to 1 metre in length and accurate to 0.015mm. Stage micrometers accurate to 1 or 2 microns.

Glass grids divided 100  $\times$  100mm and 140  $\times$  220mm.

Further certificate of accuracy from an outside source may be obtained as available and at extra cost.

All MAXTA instruments are robustly built to close tolerances, but they should be treated with the care due to any precision instrument. Handled properly an optical instrument will last a life time.

## Ordering Notes

Before placing an order or asking for quotation, it is well to consider the following:

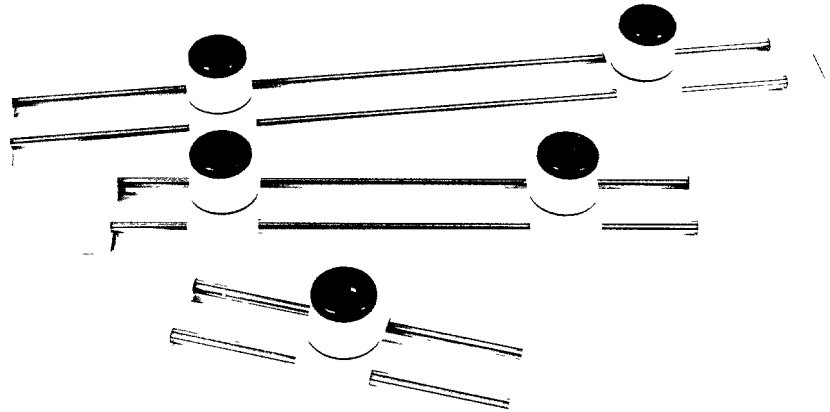
- FIELD OF VIEW:** Do the items selected cover sufficient area to be able to achieve analysis or measurement as required?  
**MAGNIFICATION:** Is this sufficient to achieve the accuracy needed?  
**GRATICULE MARKINGS:** Do these cover the full extent of the specimen to be measured and are the sub-divisions fine enough for the purpose – both interval and line thickness?  
**WORKING DISTANCE:** Is this sufficient?

# Maxta Measuring Scales – Magscales

A range of versatile portable measuring instruments which combine the accuracy of finely divided glass scales with the simplicity of magnifiers. These are ideal tools for the inspection bench, drawing office, workshop and laboratory when measurements exceeding the capacity of a magnifier on its own are needed. The measuring scale needs to be in close contact with the flat specimen. Where this is not possible the use of a co-ordinate measuring microscope such as the **MAXTASCAN** is recommended. (See separate leaflets)

The instrument is built around a glass measuring scale, an accurate dividing in vacuum deposited chromium on the under side of a 6mm thick rectangle of glass. This is mounted in a metal frame finished in white stove enamel with sliding magnifiers which can be focussed individually on the critical points of the specimen to be measured. The slides run on stainless steel bearing rods.

The instrument is placed with the measuring scale in close contact with the specimen to be measured. One magnifier is positioned over the one end of the length, the second magnifier at the other end. When only one magnifier is available as in the smallest instrument, it must slide from end to end. If one of the datum points corresponds to zero on the scale, the length will be that read off at the other end, but it may be easier simply to align the scale to the length to be measured, and to deduce the length from the two readings.



Scale image as might be seen through magnifier

Ideal subjects for Magscale measurements are artwork, industrial and commercial photographs, label prints, general printing, maps, navigation charts, natural history specimens, PCB manufacture, but there is a multitude of other purposes where the specimen is flat so that the scale on the under side of the glass is in close contact with the specimen. When this is not possible, it is repeated that a co-ordinate measuring microscope should be used.

|  | Scale Length | Sub-divisions | No of magnifiers | Dimensions (l x w x h) | Weight grams |
|--|--------------|---------------|------------------|------------------------|--------------|
| Cat Ref <b>CA150</b><br>Order code <b>50E02020</b> | 150mm        | 0.1mm         | one              | 220x52x55mm            | 360          |
| Cat Ref <b>CA310</b><br>Order code <b>50E02021</b> | 300mm        | 0.1mm         | two              | 380x52x55mm            |              |
| Cat Ref <b>CA710</b><br>Order code <b>50E02022</b> | 450mm        | 0.1mm         | two              | 535x52x57mm            | 1,000        |
| Cat Ref <b>CA510</b><br>Order code <b>50E02068</b> | 12"          | 0.005"        | two              | 14x2x2"                | 373          |

Each instrument is supplied ready for use in a wooden carrying case.

*Note* By placing the lower surface of the glass in contact with the specimen being measured, errors due to parallax are avoided. As the divisions are at the point of focus of the magnifiers, travelling cursors or crosslines cannot be used. When contact between scale and specimen is not possible over the length to be measured, a single axis **MAXTASCAN CO-ORDINATE MEASURING MICROSCOPE** (described in separate leaflet) is recommended.

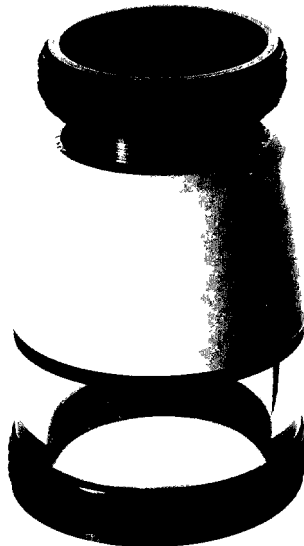
## Replacement glass scales and accessories

|   | Scale Length | Sub-divisions |  |
|---|--------------|---------------|--|
| Cat Ref <b>PCA150</b><br>Order code <b>50B02023</b> | 150mm        | 0.1mm         |  |
| Cat Ref <b>PCA300</b><br>Order code <b>50B02024</b> | 300mm        | 0.1mm         |  |
| Cat Ref <b>PCA500</b><br>Order code <b>50B02025</b> | 12in         | 0.005in       |  |
| Cat Ref <b>PCA700</b><br>Order code <b>50B02026</b> | 450mm        | 0.1mm         |  |

## Maxta Measuring Magnifiers

A range of hand-held magnifiers for measurement and inspection. Their robust construction and flat field, all glass, optics make them ideal aids for those concerned with inspection, quality control, drafting, photography, map making, electronics, etc. The clear base allows ample light to fall on the specimen surface being measured, and the eye lens can be focussed. Interchangeable graticules can be fitted in the base ring to suit the measurement purpose.

|                  |      |
|------------------|------|
| Magnification    | ×8   |
| Field of view    | 25mm |
| Height           | 65mm |
| Overall diameter | 40mm |



Multi element glass lens  
Rubber focussing grip  
Metal body stoved white

### Basic magnifier

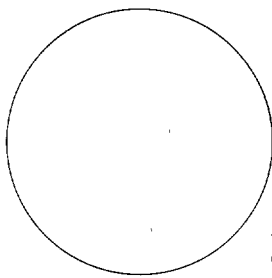
Cat Ref **MAG6**  
Order code **50E02000**

Clear acrylic sleeve  
Graticule retaining ring

Typical applications include the examination of tools, cutters and dies – the examination of printed circuit boards and artworks – the measurement of print lines and characters – crack and fault evaluation in concrete, metals and other materials – optical character recognition – identification of thread pitch and diameter.

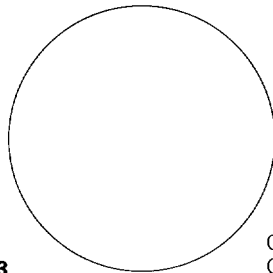
### GRATICULES

Standard graticules are on glass discs with black metalised opaque lines best suited for light backgrounds. For dark backgrounds coloured line graticules are also available (see price list).



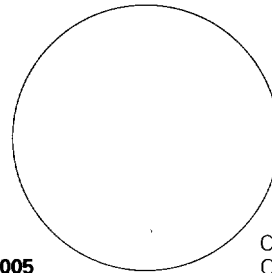
Horizontal Scale  
20mm/0.1mm

Cat Ref **M6T1**  
Order code **50B02003**



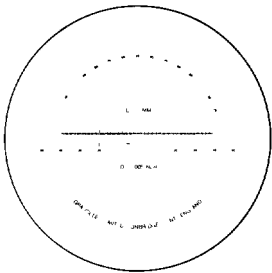
Crossed Scale  
20mm/0.1mm

Cat Ref **M6T3**  
Order code **50B02005**



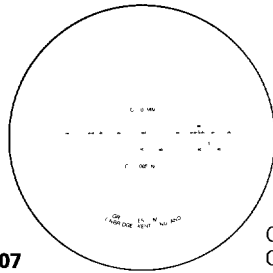
Crossed Scale  
1 inch/0.005

Cat Ref **M6T4**  
Order code **50B02006**



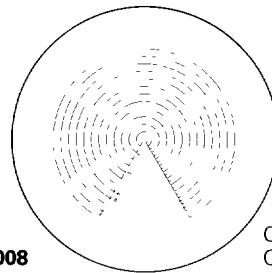
Combination  
Scale  
and Protractor

Cat Ref **M6T8**  
Order code **50B02007**



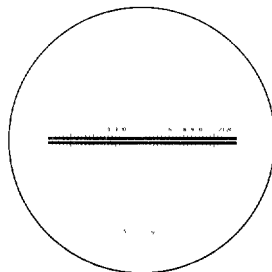
Inch Metric Scale

Cat Ref **M6T20**  
Order code **50B02008**



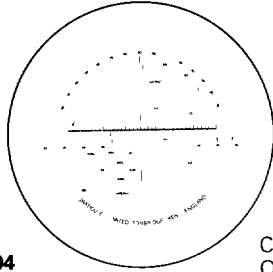
Concentric  
Circles  
2–24mm dia

Cat Ref **M6T50**  
Order code **50B02009**



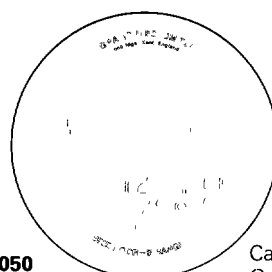
Centre Zero

Cat Ref **M6T10**  
Order code **50B02004**



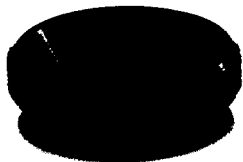
Multipurpose

Cat Ref **M6T40**  
Order code **50B02050**



OCR-B

Cat Ref **M6T85**  
Order code **50B02055**



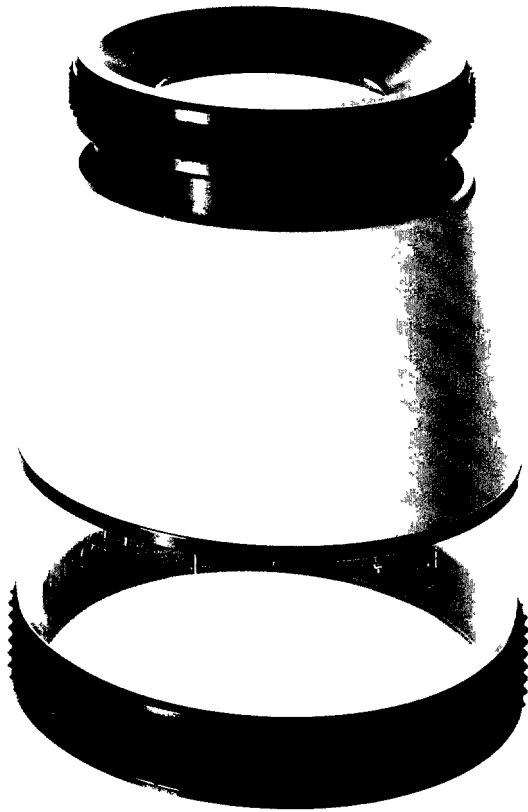
### Inspection magnifier

This magnifier is similar to the MAG 6, but has an extended acrylic base instead of the graticule retaining ring. This allows the more light to fall on the surface of the specimen.

Cat Ref **MAG6A**  
Order code **50E02002**

### Used in

Industrial and Commercial Photography –  
Cartography – Calligraphy – Navigation –  
Building Industry – Banking – Production  
Control – Engineering – Forensic Science –  
Education and Research – Textile



**Large Field magnifier**

Used when the field of view covered is more important than the power of magnification. The field of view is 3¼ times that covered by MAG 6 whereas magnification is only reduced by half. The instrument is suitable for use for all the same purposes as MAG 6.

Magnification        ×4  
 Field of view        60mm  
 Height                85mm  
 Overall diameter    73mm

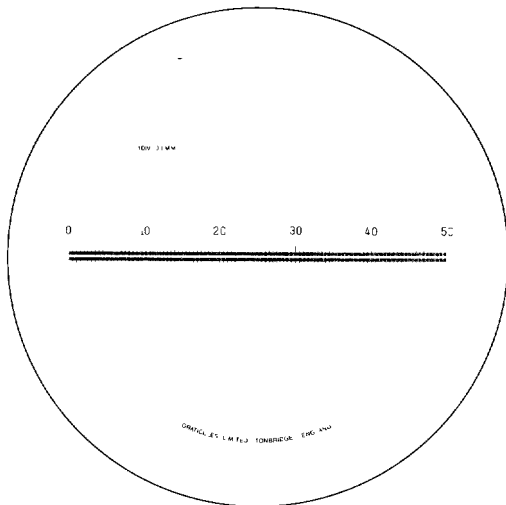
Cat Ref **MAG7**  
 Order code **50E02014**

**Inspection magnifier**

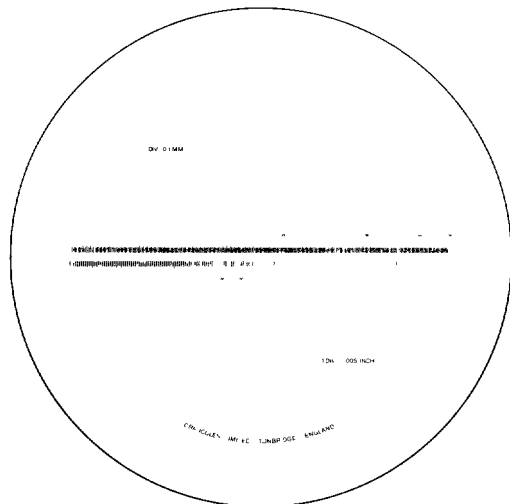
The acrylic tube is extended to the base of the magnifier to allow more light to fall on the surface of the specimen.

Cat Ref **MAG7A**  
 Order code **50E02015**

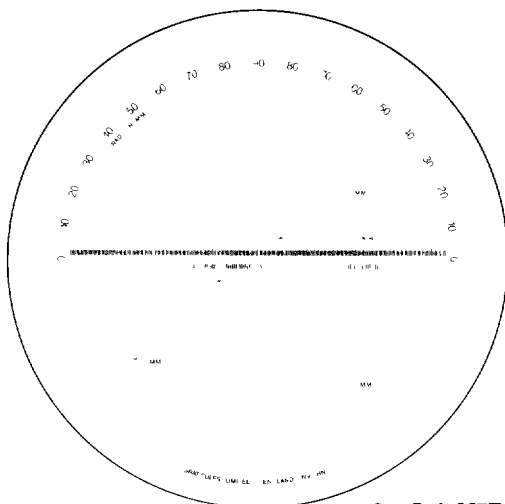
There is no facility for attaching a graticule.



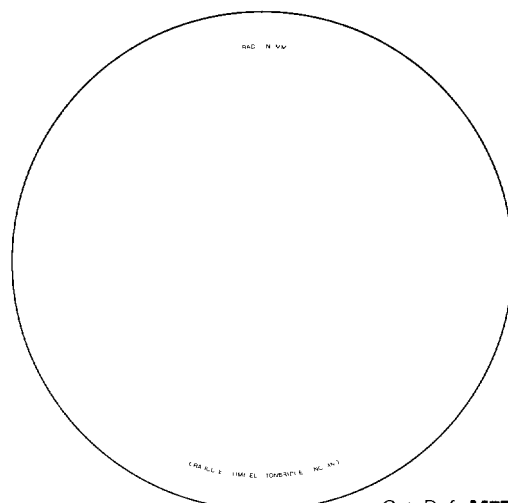
Cat Ref **M7T100**  
 Order code **50B02016**



Cat Ref **M7T108**  
 Order code **50B02017**



Cat Ref **M7T109**  
 Order code **50B02018**



Cat Ref **M7T150**  
 Order code **50B02019**

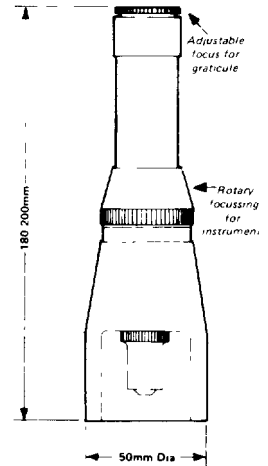
## Maxta Portable Microscopes



These robust instruments are designed for use both in the field and in the laboratory, to yield results as close as possible to those achieved by full sized microscopes. They are particularly useful for analysis where standard microscopes cannot be used. The results obtainable can relieve the pressure on the standard microscopes in the laboratory itself. In the field, the portable microscope provides a vital tool for the engineer.

High grade optical elements are fitted in the metal body. A rotary knurled sleeve focusses on the specimen, with 20mm adjustment possible. The white instrument base allows adequate daylight to fall on the specimen for most viewing purposes. Under more difficult conditions, an adjustable torch is supplied as standard. Alternative lighting systems can be used.

Measurements are made using a graticule scale incorporated in the focussing eyepiece. Graticules are calibrated either in metric or inch units, and the readings therefrom refer directly to the specimen irrespective of size or position.



Typical applications include the measurement of artworks, negatives, transparencies, tracks, drilled holes on PCBs, paint thickness, cracks in concrete, films, metals, plastic components, thread pitch, surface defects, slits and apertures, in foil or cloth, print characters, gems, micro-circuits, dust particles, and liquid droplets.

### Standard Models

| Cat Ref     | Order code      | Approximate Magnification | Useful Field | Calibration      |
|-------------|-----------------|---------------------------|--------------|------------------|
| <b>P821</b> | <b>50E02027</b> | ×20                       | 6mm          | 4mm in 0.02mm    |
| <b>P822</b> | <b>50E02028</b> | ×20                       | 0.25"        | 0.2" in 0.001"   |
| <b>P825</b> | <b>50E02029</b> | ×40                       | 2.5mm        | 2mm in 0.01mm    |
| <b>P826</b> | <b>50E02030</b> | ×40                       | 0.1"         | 0.1" in 0.001"   |
| <b>P827</b> | <b>50E02031</b> | ×80                       | 2mm          | 1mm in 0.01mm    |
| <b>P828</b> | <b>50E02032</b> | ×80                       | 0.08"        | 0.05" in 0.0005" |
| <b>P830</b> | <b>50E02033</b> | ×100                      | 1.3mm        | 1mm in 0.01"     |
| <b>P831</b> | <b>50E02034</b> | ×100                      | 0.05"        | 0.05" in 0.0005" |

The following three models have an image erecting prism in the optical system so that the image is the right way up to the eye.

|             |                 |      |       |               |
|-------------|-----------------|------|-------|---------------|
| <b>P841</b> | <b>50E02035</b> | ×20  | 6mm   | 4mm in 0.02mm |
| <b>P845</b> | <b>50E02036</b> | ×40  | 2.5mm | 2mm in 0.01mm |
| <b>P850</b> | <b>50E02037</b> | ×100 | 1.3mm | 1mm in 0.01mm |

### Cathode Ray Tube Inspector

The shortened base of this microscope, fitted with non-scratch pads allows the inspection of the inside surface of the face of the cathode ray tube on which it can be focussed.

Magnification ×20 Calibrated 4mm in 0.02mm

Cat Ref **P860**  
Order code **50E02038**

### Brinell Hardness Impression Microscope

The special metal base plate allows the modified portable microscope to be placed on small flat specimens.

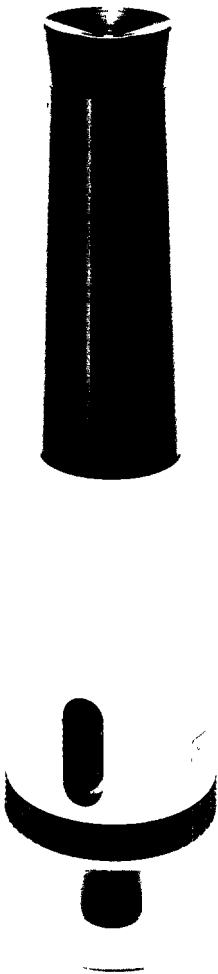
Magnification ×15 Calibration 6mm in 0.1mm

Cat Ref **P890**  
Order code **50E02043**

Wooden Carrying Case for all models

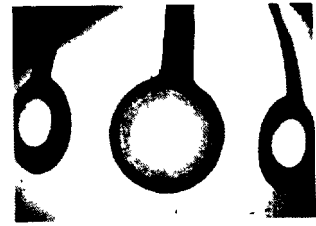
Cat Ref **BX1**  
Order code **50C02060**

## PCB Through Hole Scope

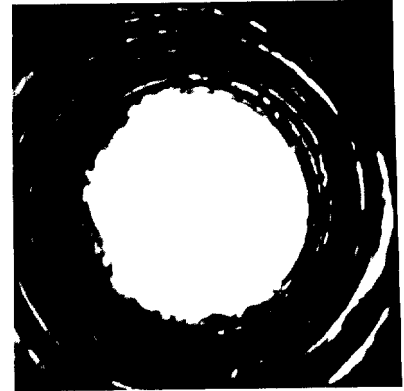


The Maxta PCB Through-Hole Microscope is designed for critical inspection of plated-through holes in printed circuit boards. When using this tool the inspector has a view of the complete hole, the image being distorted to a bucket (truncated cone) shape. When used over a light box voids, drill damage, burrs, obstructions, plating faults can be identified quickly and with certainty.

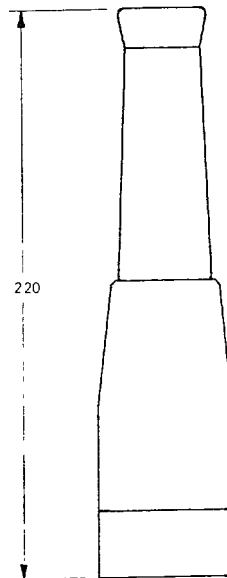
The instrument is supplied ready for use in a wooden carrying case. The standard model is suitable for holes up to 3mm diameter by 3mm deep.



Distance view of plated-through hole to aid centering (upper zoom position)



Typical close up view of plated-through hole (lower zoom position)



- Sealed Optics
- Metal Construction
- Slide Zoom Grip
- Hand Grip
- Clear Acrylic Base

Cat Ref **P875**  
Order code **50E02040**

## Maxta Depthscope

A portable microscope for measuring size and depth of objects the Maxta Depthscope is a versatile tool for use in the workshop, the laboratory or for field studies.

With the Maxta Depthscope you can measure thickness of photographic film, depth of coatings on opaque materials, pits and scratches depth of blind cavities, cracks in opaque and translucent materials, solder thickness, silk screen ink coating, machined surfaces, surface corrosion, indentations etc.

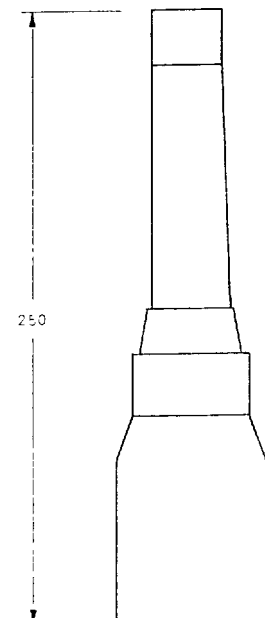
Built entirely in metal with high quality glass optics the microscope is robust and precision engineered to meet the rigours of continuous use in a variety of environments. A vertical illuminator with external power supply is fitted above the objective. Magnification  $\times 200$   
Direct Reading to 10 micron  
Repeatability to 2 micron  
(Estimations to 5 microns or better without the use of verniers)

### Depth Measurements

In use the microscope is focussed on one surface and the zero datum mark adjusted to coincide with the zero of the depth scale. The focus is then adjusted to the second surface and the separation of the two surfaces or depth is read directly from the scale.

The instrument which has a fixed calibration is focussed by means of the rotating central body section.

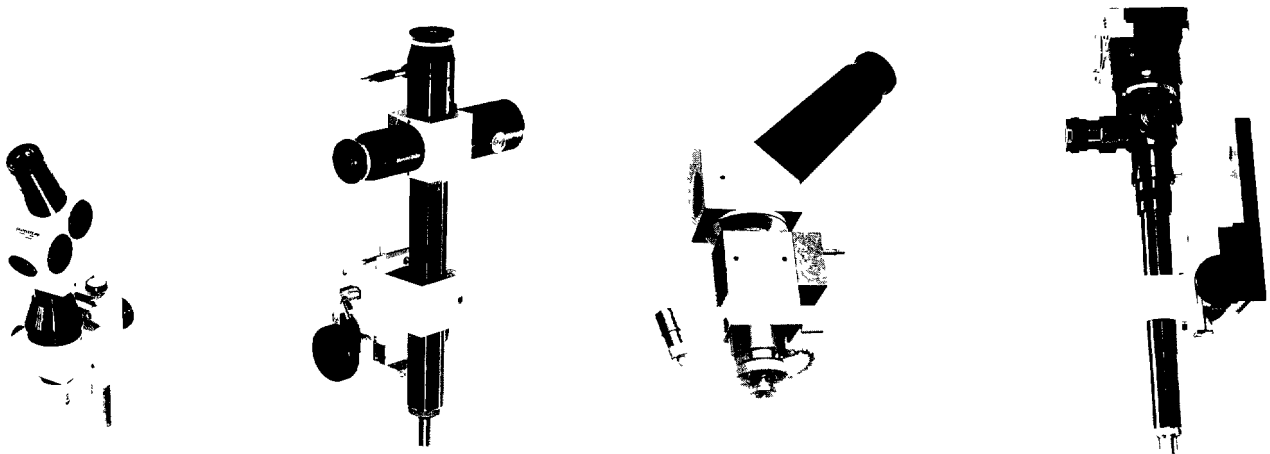
Cat Ref **P879**  
Order code **50E02045**



## Maxta Modular Measuring Microscope Systems

Microscopes are generally associated with medicine and science rather than with industry. In fact the microscope has become a useful and often essential industrial tool for observation, measurement, inspection and quality control. This chapter is written with the engineers and technicians in mind particularly those who may have little knowledge of optics, but need to use a microscope system. The components should fully meet the requirements of all potential users. It is recommended that the glossary at the end of this booklet be used where terminology is not fully understood and when some relevant formulae are needed in order to calculate and design requirements.

The components listed are intended not only for building a complete microscope, but also to enable such a system to be adapted either for attaching to another mechanical system or to be used in a confined space or abnormal circumstances.



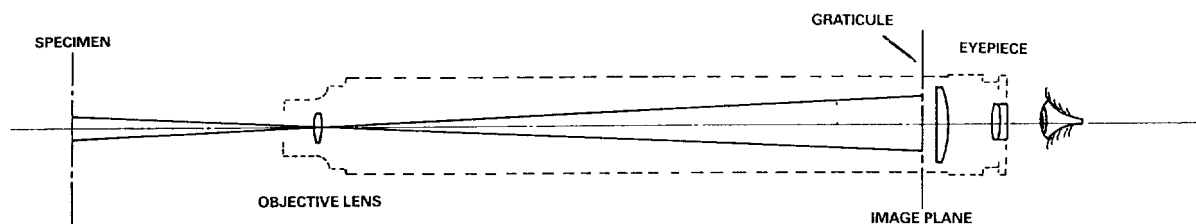
In the illustration, the specimen is magnified by an objective lens which focusses the enlarged image to a point in space known as the image plane. An eyepiece lens, which also serves to magnify, focusses itself onto the image plane so that the viewer sees the specimen magnified by the product of both magnifications. Both objective and eyepiece lenses are housed at either end of the microscope tube. Lenses are normally so constructed as best to fulfil their purposes when the distance between eyepiece and objective is 160mm, which distance is known as the tube length. The actual length of the tube is finally decided by features such as field of view, magnification, modules used etc.

To achieve measurement, a graticule is placed at the image plane so that its markings superimpose themselves in focus over the picture of the specimen. Such markings are magnified to the eye only by the eyepiece lens. Whilst a rough guide to the relationship of eyepiece graticule to specimen can be obtained by considering the respective lens magnifications, this is only approximate and calibration of the eyepiece graticule against a stage micrometer in place of the specimen, is essential for accuracy. The rough estimation may enable a suitable graticule to be chosen. The final total tube length will influence final magnification, the longer the tube the higher the magnification.

The choice of components to achieve a certain magnification is straightforward, but there are other considerations which must be taken into account. In a simple microscope, as illustrated diagrammatically hereunder, the optical path runs straight from specimen through lenses to the eye. In practice this may not be possible so that the path may need to be turned by means of prisms and mirrors. These same may provide the means to erect the image if the normal inverted image is objectionable.

Other relevant factors are Working Distance (WD) between objective and specimen. If this needs to be increased to allow more room, then the tube length will also need to be increased to keep the image plane in focus, and this in turn will increase the magnification of the objective lens. The reverse is the case if WD is reduced. In the first case, the field of view will be reduced, in the latter increased.

Formulae whereby some of these factors may be calculated, are to be found in the glossary at the end of this booklet. Many users will be able to design and construct their requirements, but when in doubt our technical staff will be happy to advise, and construct if necessary.





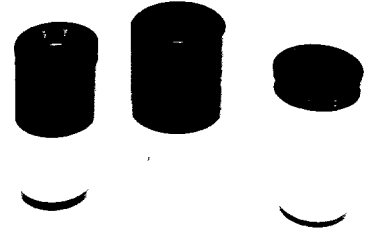
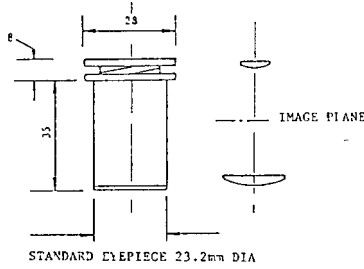
# Eyepieces

## Huygenian Eyepiece $\times 7$

Composed of two plano convex lenses separated by an air space. The image plane is between the two lenses. The top lens is adjusted to bring the graticule into focus.

Field of view 15mm diameter  
Graticule 16mm diameter

Cat Ref **F7**  
Order code **55E02080**

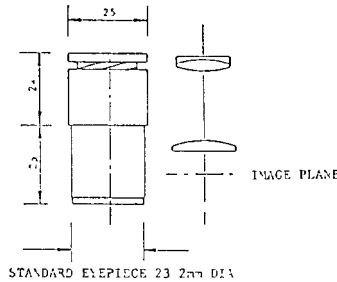


## Kellner Eyepiece $\times 10$

Composed of a plano convex lens and an achromatic lens. The image plane is below the lens elements. The use of an achromatic lens provides a larger field of view, better colour correction and substantial eye relief. The top lens adjusts to focus on the graticule.

Field of view 15mm diameter  
Graticule 16mm diameter

Cat Ref **F10**  
Order code **55E02081**

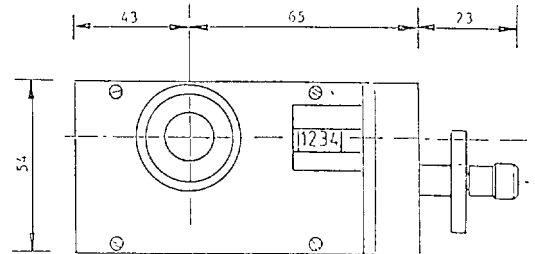


## Kellner Type Eyepiece $\times 10$

with high eye point (useful for spectacle wearer) Non-focussing wide field

Field of view 18mm diameter  
Graticule 19mm diameter

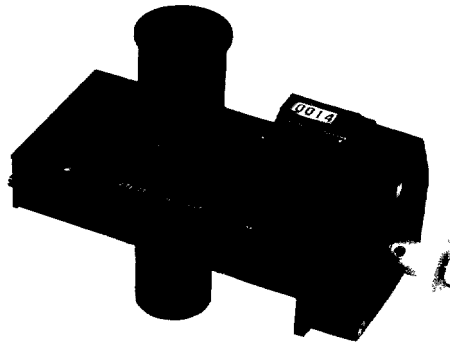
Cat Ref **F12**  
Order code **55E02082**



## Curtain Micrometer Eyepiece $\times 10$

Has semi-opaque curtains controlled by concentric milled heads. Objects are clearly visible through both curtains and the area between. In use, the left curtain is moved until it touches one boundary of the specimen. The righthand curtain is then brought up to the opposite boundary of the specimen. The separation between the curtains is recorded on the digital counter, the value of which depends on the magnification of the microscope objective.

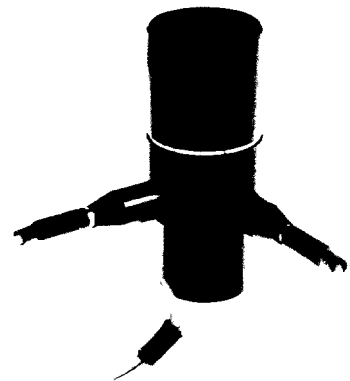
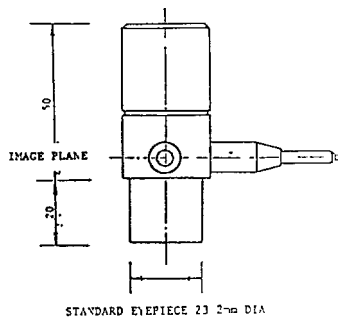
Cat Ref **CM 100**  
Order Code **55F02094**



## Bright Line Eyepiece $\times 10$

fitted with a special graticule etched into the glass and illuminated from the side. Used for viewing objects when a normal graticule pattern is hard to see or when the specimen is dark. Available for any standard of special graticules.

Cat Ref **SIE 25**  
Order code **55E02095**



## TV Adaptor Eyepieces

Eyepiece and graticule adaptors for use with 2/3 vidicon TV camera, either monochrome or colour. The image of both specimen and graticule is displayed on the monitor. Standard C mount thread.

Cat Ref **P264**  
Order Code **90E02511**



Eyepiece and graticule adaptor for use with 1 inch camera tubes. Normal magnification  $\times 10$  can be used with 2/3 vidicon tubes to give larger field of view and  $\times 15$  magnification. Standard C Mount.



## Specify graticule required

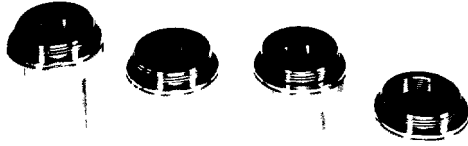
Standard graticules to fit these eyepieces are listed separately.

Graticule 19mm diameter  
Cat Ref **P253**  
Order code **90E02501**

Other types of eyepieces are available to special order, including pointer, Filar and alternative magnification eyepieces.

## Objectives

Standard objectives with B S I objective threads (R M S standards) All lens element surfaces are anti-reflection coated Achromatic lenses substantially reduce spherical aberration and coma, as compared to a single lens of the same focal length Working distances given are the clear air space between specimen and the end of the objective body The magnifications only apply when a 160mm tube is used In all other cases a factor must be applied by calibration



| Cat Ref    | Order code      | Magnification | Working Distance |
|------------|-----------------|---------------|------------------|
| <b>F48</b> | <b>55E02083</b> | × 0.5         | Infinity         |
| <b>F49</b> | <b>55E02084</b> | × 1           | 140mm            |
| <b>F50</b> | <b>55E02085</b> | × 2           | 70mm             |
| <b>F51</b> | <b>55E02086</b> | × 5           | 12mm             |
| <b>F52</b> | <b>55E02087</b> | × 10          | 7mm              |
| <b>F54</b> | <b>55E02088</b> | × 20          | 2mm              |
| <b>F55</b> | <b>55E02089</b> | × 40          | 0.8mm            |
| <b>F56</b> | <b>55E02090</b> | × 60          | 0.5mm            |
| <b>F57</b> | <b>55E02091</b> | × 3           | 35mm             |
| <b>F58</b> | <b>55E02092</b> | × 10          | 15mm             |
| <b>F59</b> | <b>55E02093</b> | × 10          | 22mm             |

The objectives described above have been selected to meet the more popular requirements We can supply all types of objectives including phase contrast oil conversion, reflective and extended working distance If the above standard lenses do not meet your requirements we will endeavour to supply alternatives against specifications

### Notes

When objectives are used with tubes of length other than 160mm, the magnification factor quoted no longer applies The following table gives the magnification achieved with each standard lens when using a 240mm tube length

### Microscope Body Tubes (Optic Tubes)



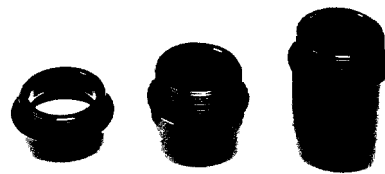
150mm Tube Length  
Cat Ref **P137**  
Order code **80E02521**



70mm Tube Length  
Cat Ref **P136**  
Order code **80E02520**

### Spacer Tubes

These tubes can be added to increase magnification.



5mm Cat Ref **P138**  
Order code **80E02624**

10mm Cat Ref **P139**  
Order code **80E02625**

20mm Cat Ref **P140**  
Order code **80E02626**

### Anti Reflection Inserts

Optical systems can suffer loss of definition due to reflections inside optical tubes To reduce this problem, specially coated black paper is available

4 sheets 100×100mm Cat Ref **P602** Order code **80F02530**

## Viewing heads

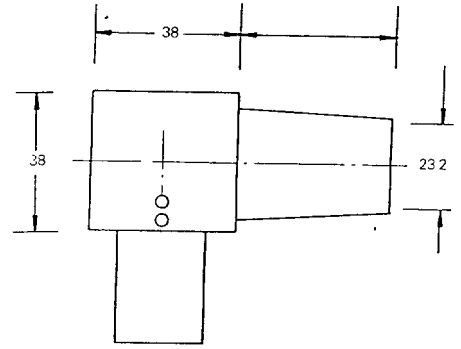
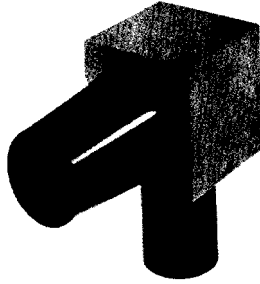
### 90° Viewing Head with Mirror

The optical path is turned through 90° by means of a high grade surface mirror so that the image of the specimen viewed is reversed

Tube length 90mm

Cat ref **P115**

Order code **80E02510**



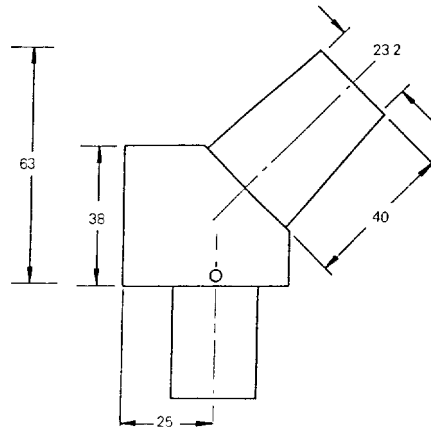
### 90° Viewing Head with Prism

The optical path is turned through 90° by a roof prism giving an erect final image

Tube length 90mm

Cat ref **P114**

Order code **80E02511**



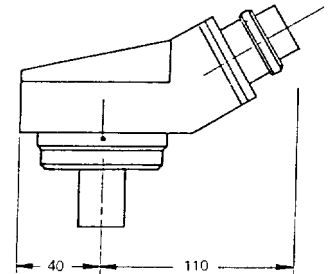
### 45° Viewing Head with Prism

The optical path is turned through 45° by a roof prism giving an erect final image

Tube length 90mm

Cat ref **P113**

Order code **80E02413**

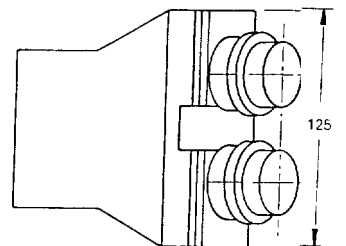
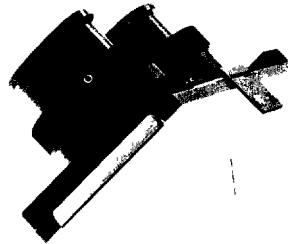


### 30° Binocular Viewing Head with Prism

A binocular head is more restful for continuous viewing, the image is erect and there is adjustment for the distance between the eyepieces and for uneven eyesight

Cat ref **P119**

Order code **80F02415**



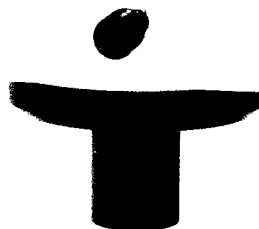
### 30° Trinocular Head with Prism

Binocular viewing as with P119 above but with an additional vertical port which will accept 35mm, polaroid or CCTV cameras

Tube length 120mm

Cat ref **P120**

Order code **80E02518**



**Note Matched eyepieces must be ordered separately for both binocular and trinocular viewing heads**

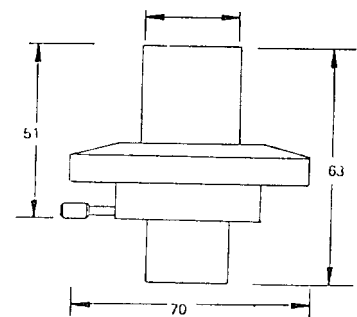
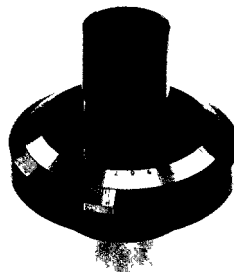
### Protractor Head

Eyepiece and tube are mounted in this protractor head so that angular measurement is possible 360° movement numbered every 10° with vernier scale down to 0.2°

Effective tube length 40mm

Cat Ref **P124**

Order code **80E02462**



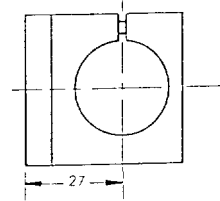
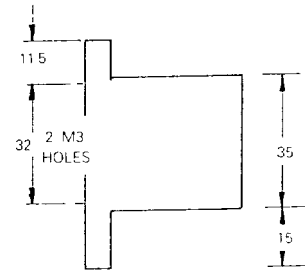
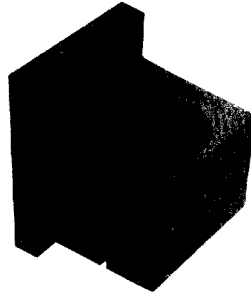
This protractor unit can be placed in optical tubes P136 or P137, or in viewing heads as shown above (P113, P114 & P115)

## Mounting systems

### Slide Mount Block

The slide mount block clamps the microscope tube for fixation either to a flange plate, P166 hereunder, or to a rack and pinion by means of a dovetail adaptor P201 hereunder. It can also be used to attach the tube to a machine or rig in either vertical or horizontal stance.

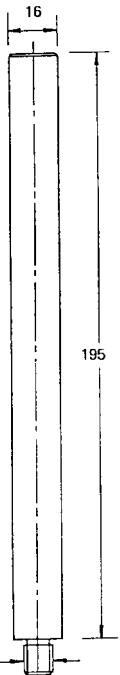
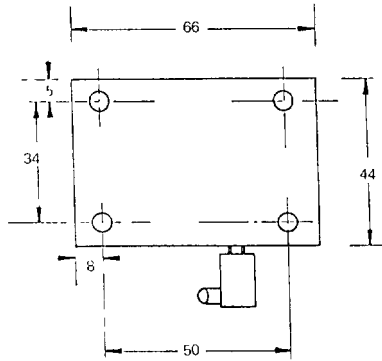
Cat ref **P150**  
Order code **80F02421**



### Flange Plate

The female dovetail will accept all rack and pinion focussing systems. The level arm locks the dovetail. The flange is pre-drilled for 1/4" screws.

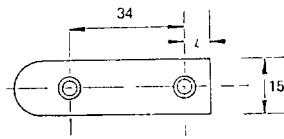
Cat ref **P166**  
Order code **80E02533**



### Rods

Stainless steel rods suitable for fitting to tables, pillars and to the rectangular base.

Cat Ref **P207**  
Order code **80E02535**



### Dovetail Adaptor

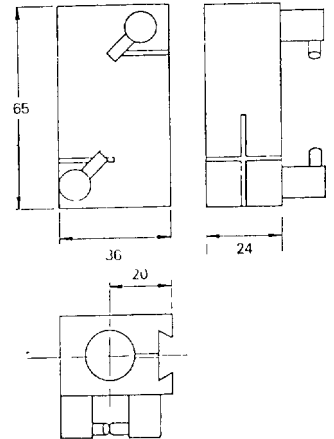
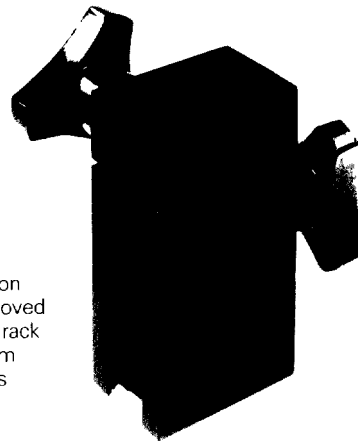
The dovetail can act as a linking piece between the slide mount block and the flange plate, or rod mounting block.

Cat ref **P201**  
Order code **80F02428**

### Rod Attachment Block

By using this block with either the slide mount block alone or with rack and pinion the microscope can be mounted and moved on a rod. Female dovetail will accept all rack and pinion focussing systems. Lever arm locks dovetail. Bore will accept stainless steel rod **P207**.

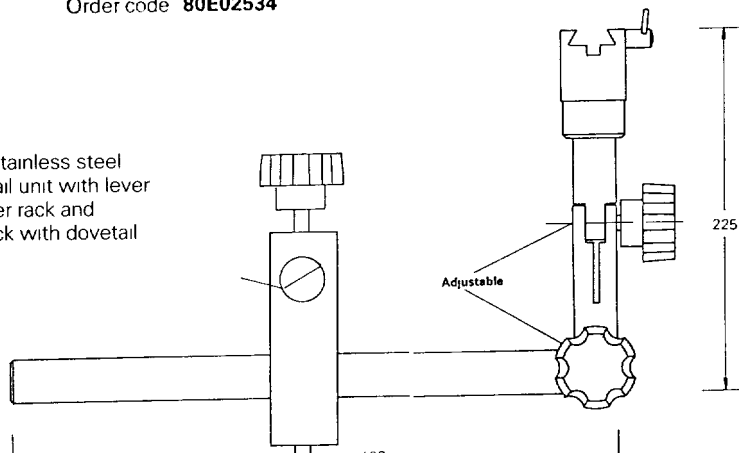
Cat. Ref: **P211**  
Order code **80E02534**



### Adjustable Arm Unit

The adjustable arm fits the stainless steel rod **P207**. The female dovetail unit with lever locking arm, will accept either rack and pinion or slide mounting block with dovetail.

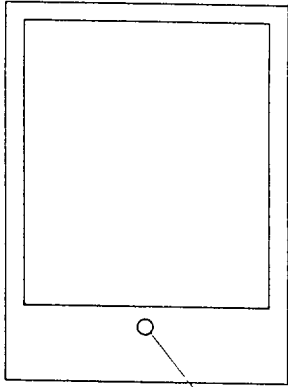
Cat Ref **P209**  
Order code **80F02432**



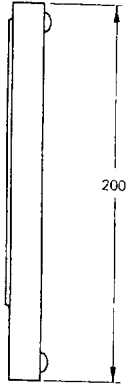
**Rectangular Bases**

Two standard base plates on which bench type microscopes may be set up

Size 150×200mm  
 Cat Ref **P216**  
 Order code **80E0237**

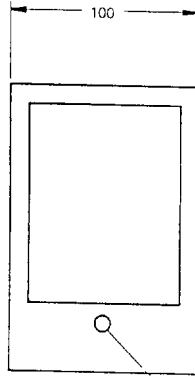


M8 HOLE

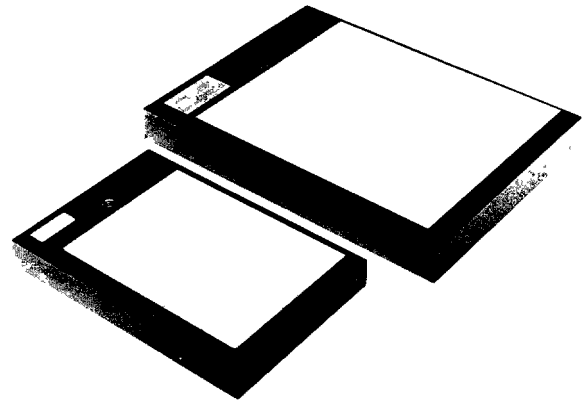


200

Size 100×150mm  
 Cat Ref **P215**  
 Order code **80E02536**



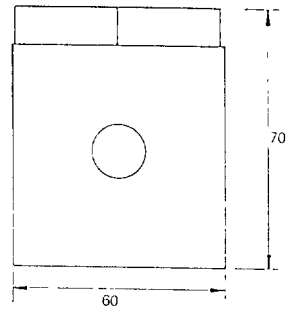
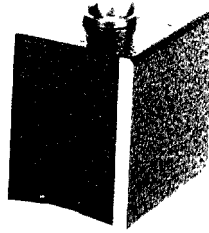
M8 HOLE



**Magnetic Base**

Plunger type magnetic base tapped for stainless steel rod

Cat Ref **P203**  
 Order code **80F02429**

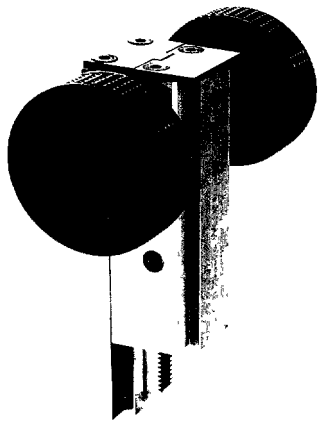


60

70

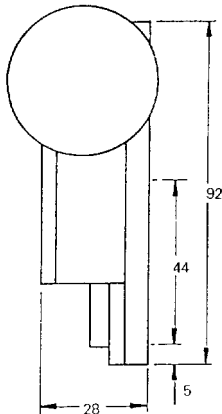
**Focussing Mechanisms**

These consist of a vertical slide of two parts. The coarse movement is achieved by a brass rack and a steel pinion. Maximum movement is 65mm. The fine movement, when fitted, works on a vertical lever mechanism fitted to the flange plate, rod mounting block of flexible joint of the illuminator.



**Coarse**

Cat Ref **P160**  
 Order code **80F02423**

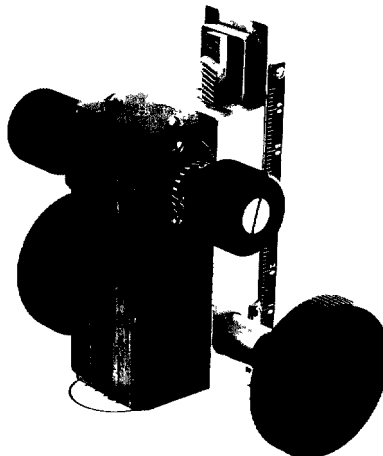


28

92

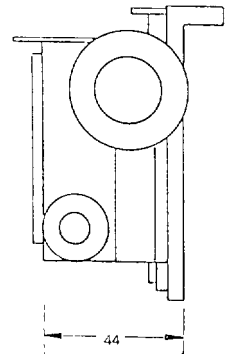
44

5



**Coarse and Fine**

Cat Ref **P162**  
 Order code **80F02424**



44

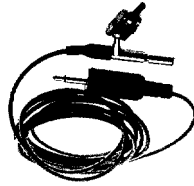
## Illuminators

### Powered miniature lamp

A single lamp holder and bulb on a flexible joint. The bulb has built in condenser lens to concentrate light onto a small area. The lamp unit plugs into a power unit with variable control.

Cat Ref **PL882**

Order code **60E02362**



### Single lamp

Single lamp holder and bulb on flexible joint requires 2.5 volt 100mA supply. Bulb has built in lens to concentrate light to small area.

Cat Ref **PL886**

Order code **60E02364**



### Powered double lamp

Double lamp units on flexible joints and objective mounting ring (standard 17mm). Double outlet power supply with variable control.

Cat Ref **PL887**

Order code **60E02374**

### Vertical illuminator

Vertical illumination is essential when using high power objectives or when illuminating subjects in restricted conditions.

Supplied complete with variable control.

Cat Ref **PL910**

Order code **60E02367**



### Bulbs.

Replacement bulbs for all above lighting systems available in packs of 10.

Cat Ref **PL2**

Order code **60F02369**

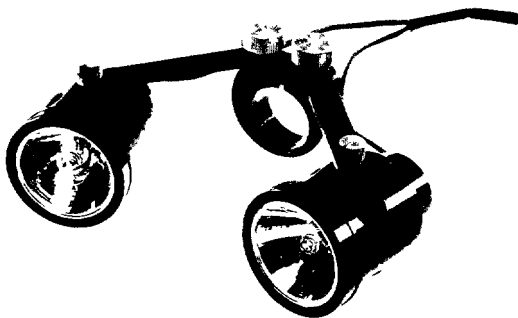
### Surface illuminator

Surface lighting unit most suitable for microscopes fitted with TV cameras. Twin lamps are positioned so as to fully illuminate an area of 25mm. Two 12 volt, 12 watt quartz halogen lamps on adjustable arms. The lighting unit is mounted either directly onto the microscope tube or onto an objective spacer fitted between microscope and objective lens. If spacer is used microscope tube length is increased by 20mm.

Supplied complete with variable control.

Cat Ref **PL889**

Order code **60E02375**

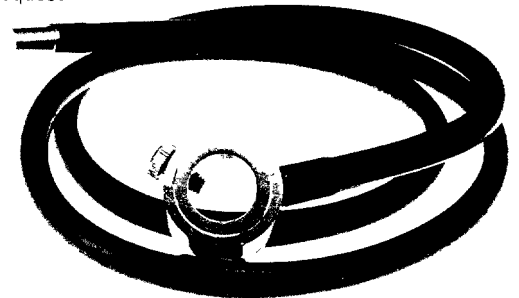


### Fibre Optic Cold Illuminator

Suitable for illuminating large areas with a high power source without transfer of heat from source to specimen. Illuminator fits to standard objectives (17mm dia). Ultra flexible 6mm light guide transmits light from source (P228 P229) to ring. Overall length 1 metre, other lengths available on request.

Cat Ref **P235**

Order code **60E02358**

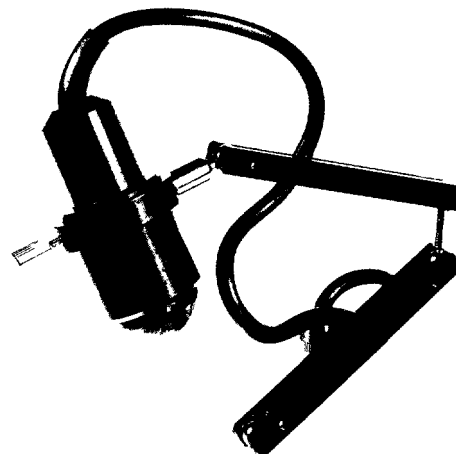


### Portable light unit

A portable light source for bench application, the source is a 6V, 6W tungsten bulb with focussing condenser lamp mounted on an arm allowing easy positioning of the lamp. The arm is connected by flexible joints to a power unit which has variable brightness control.

Cat Ref **PL892**

Order code **60E02366**

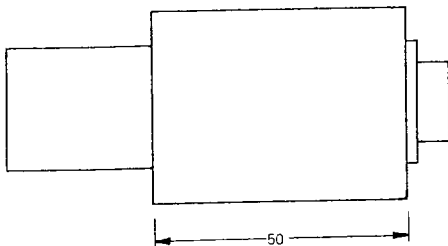
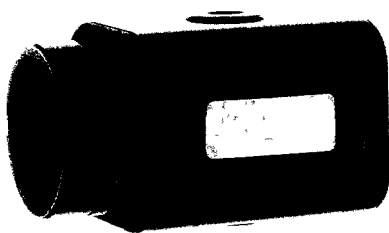


### Note:

All lighting power units are available as 110 volt, models on request.

## CCTV Systems

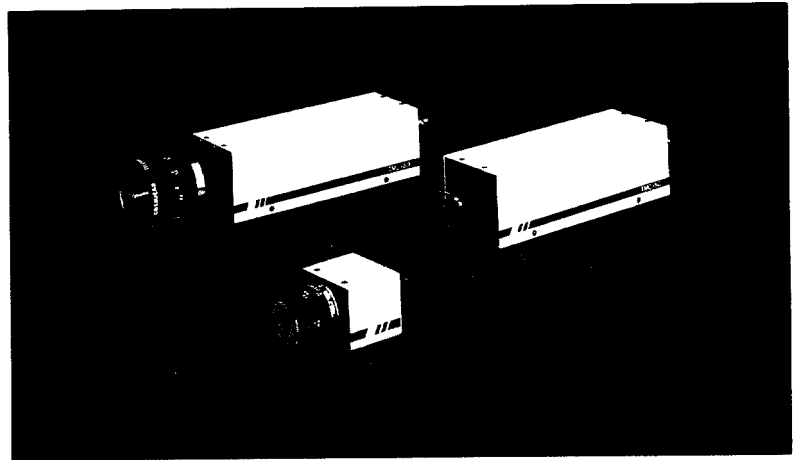
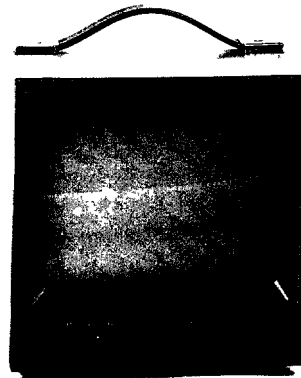
A microscope with added television camera has the advantage not only of reducing operator fatigue but also allowing others to view the screen at the same time. Computers may provide inspection and measurement aids. The choice of camera is wide and new models are constantly being introduced, we recommend at this time the following which meet the exacting requirements of most industrial quality control departments.



### Monitors

Video input composite video signal 1.0 Vp-p sync negative, resolution horizontal 700 lines vertical 350 lines, deflection linearity within 2%, power consumption 28W, height 219 width 234 weight 6.5kg  
Cat Ref **P257** Order code **90F02510**

**Remote head solid state colour camera**  
**Colour monitors: 14" and 20" available on request**



### Solid State Monochrome Camera

Gives long life and reliability. Horizontal resolution more than 300 lines, illumination minimum 18 lux, lens standard C mount, image device 2/3 diagonal size, interline transfer CCD 500 (horizontal) 582 (vertical) picture element. Weight 500 grams  
Cat Ref **P251** Order code **90F02508**

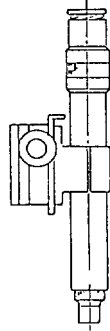
Remember, if you are unable to select components to build your own viewing system, or if the standard components do not allow you to achieve the desired result, then we offer a design and consultancy service. It is essential that you provide full details of the proposed application, dimensions of specimen, magnification, working distances etc. If there is a restricted work space, a hazardous environment, or awkward working position, we need to know. Samples of the specimens to be inspected help us to recommend lighting systems and additional accessories. The components listed in this catalogue are standard, off the shelf items, we manufacture many special accessories including multioutlet viewing heads, extended optic tubes (e.g. 500mm), rotary mounting clamps, strengthened support stands, mounting spigots, centering devices for eyepieces and objectives, micro image projectors, depth measuring accessories, field kits etc.

## Examples of systems with a tube length of 160mm

### Straight Microscope Components

F10 Eyepiece  
 P137 Tube  
 F50 × 2 Objective  
 P160 Rack and pinion  
 P166 Flange mounting block  
 P150 Tube mounting block  
 P139 Spacer

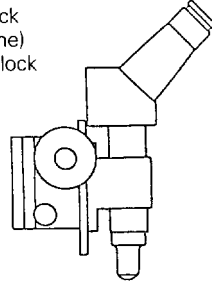
Total Mag ×20  
 WD 68mm  
 Field of view 7mm  
 Focussing 60mm  
 Image inverted



### 45° Head Components

F10 Eyepiece  
 P113 45° Head  
 P132 (70mm) Tube  
 F52 × 10 Objective lens  
 P150 Tube mounting block  
 P162 Rack and pinion (fine)  
 P166 Flange mounting block

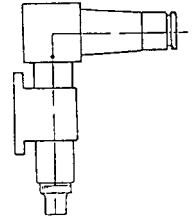
Total Mag ×100  
 WD 7mm  
 Field of view 1.5mm  
 Image corrected



### 90° Head Components

F10 Eyepiece  
 P115 90° Head  
 P132 (80mm) Tube  
 F51 × 5 Objective lens  
 P150 Tube mounting block

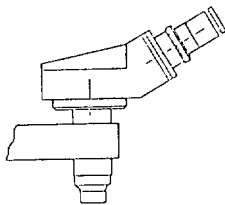
Total Mag ×50  
 WD 13mm  
 Field of view 3mm  
 Image mirror



### 30° Binocular Head (Inverted) Components

F10 Eyepiece  
 P119 Binocular head  
 (40mm) Special tube  
 F50 Objective lens

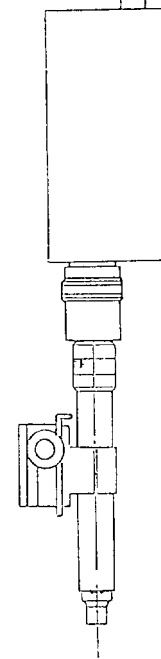
Total Mag ×20  
 WD 68mm  
 Field of view 7mm  
 Image inverted



### Straight Microscope with Monochrome TV Components

P251 Monitor  
 P250 Camera  
 P254 TV Eyepiece  
 P137 160mm Tube  
 F49 Objective lens  
 P150 Tube mounting block  
 P160 Rack and pinion  
 P166 Flange mounting block  
 P139 Spacer

Total Mag to 9 inch monitor ×12  
 WD 140mm  
 Field of view 12mm × 10mm  
 Focussing 60mm  
 Image corrected



F10 Eyepiece  
 P116 90° Head (prism)  
 P132 (70mm) Tube  
 F57 × 3 Objective lens

Total Mag ×30  
 WD 36mm  
 Field of view 5mm  
 Image corrected

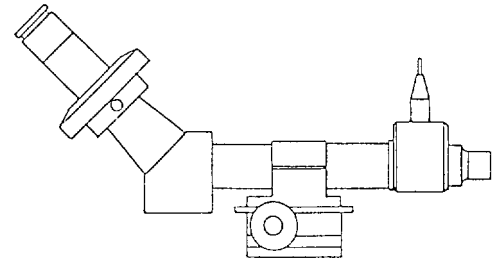
## Examples of systems with a tube length of 240mm

### Components

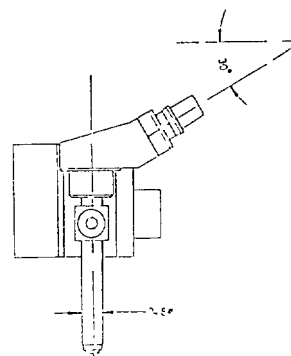
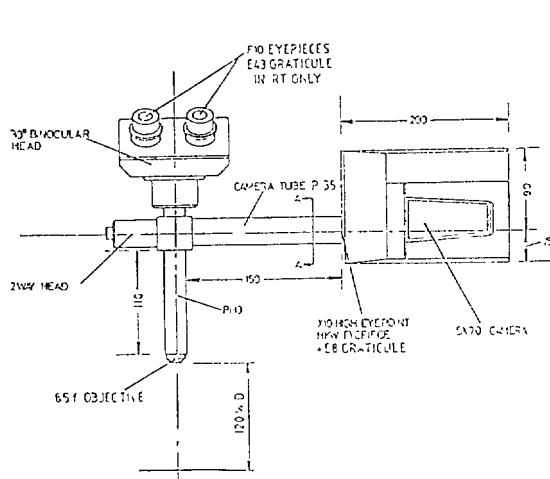
F10 Eyepiece  
 P124 Protractor head  
 P113 45° head  
 P132 (97mm)  
 PL910 Vertical illuminator  
 P150 Tube mounting block  
 P160 Rack and pinion  
 P166 Flange mounting block  
 F57 37mm Focal length lens  
 P138 Spacer

### Specification

Total Mag ×50  
 Field of view 3mm  
 Working distance 30mm

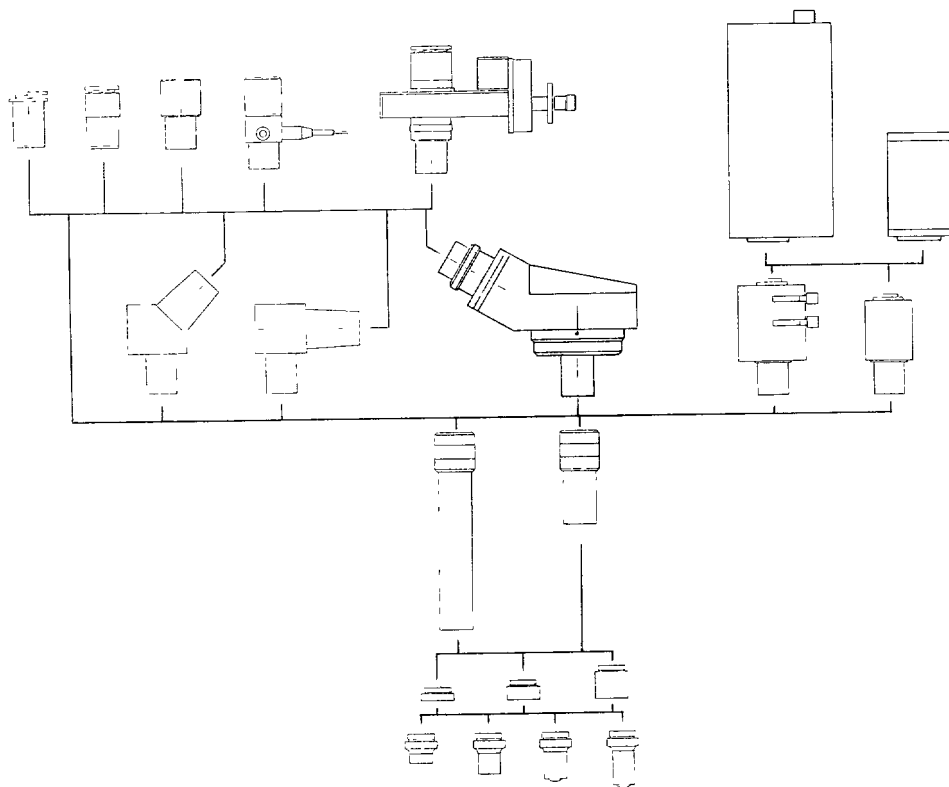


## Examples of instruments designed to meet customers specification



This example shows a viewing system designed to fit into a re-entrant tube of a vacuum chamber and to record the specimen on camera





In this catalogue we have described products which form part of an established standard range. Instruments will be introduced in the future to meet new demand from industry, education, medicine and research. Examples of recent developments are described below. If you have a requirement for an instrument to perform a special task in small or large quantity and our expertise could help then please talk to us. If you are having instruments made overseas or if your existing suppliers are unable to meet your requirements then perhaps we can help.

#### **Long working distance microscopes**

There are many instances where the user requires reasonable magnification of the subject but where a conventional microscope cannot be placed close to the subject.

We have developed a range of special instruments with working distances in excess of 500mm and with magnification greater than 20x. The example illustrated has a working distance of 800mm and a final magnification of 25x. The resulting image can be viewed through the eyepiece or further magnified onto a TV screen.

#### **Co-ordinate Travelling Stages.**

We have built many different types of viewing systems incorporating moving tables either for positioning the specimen under the microscope, or for making measurements over distances greater than the field of view. The range of tables available is too large to describe, but movements from 25mm to 500mm in one or two axis, with solid or illuminated glass tables, with manual or motor drive and with or without readout of position in various degrees of accuracy can be supplied on request.

#### **Fibrescope**

This unique inspection microscope was developed for those industries concerned with the installation and maintenance of fibre optic cable systems for communications. The particular requirement was for a small hand held, high magnification microscope for inspecting fibre end-faces for damage and dirt deep within bulkhead connections without the need for removing the fibre from the rear of the connector. In operation the objective is attached to the connector and then the microscope body is clamped to the objective body. Focussing, lighting and centering facilities are incorporated together with a rotating eyepiece head for awkward situations.

#### **TV attachments for 3D measuring machines**

Many users of 3D measuring machines (CMM) have a need to replace the contact probes with an optical head for the inspection of flat objects.

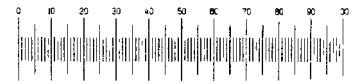
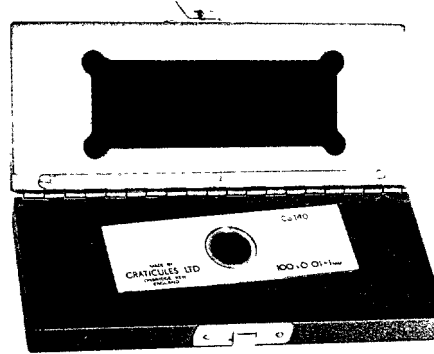
We have developed small lightweight TV microscopes to take the place of the probe unit. All incorporate crossline graticules or scales and some models have depth measuring facilities.

## Maxta Calibration Standards

Standard scales and grids are available for the precise calibration and confirmation of accuracy of optical measuring instruments such as microscopes, profile projectors, 2 and 3 dimensional measuring machines, co-ordinatographs, mechanical X and Y stages, optical benches, etc etc. Certificates of accuracy from specified standard laboratories can be supplied at additional cost

### Linear Scales

Stage micrometers with scales graduated in 0.1mm down to 0.002mm are available on glass discs mounted in metal slides 75x25x2mm. The stage micrometer is used as specimen in order to calibrate the eyepiece scale. Certain patterns are available with cover glass for transmitted light microscopes. Others are reflective without cover glass for use with metallurgical microscopes, etc



| Cat. Ref. | Order code | Dividing      | Line width | Accuracy               |
|-----------|------------|---------------|------------|------------------------|
| PS1       | 05A01040   | 10mm/0.1mm    | 0.005mm    | Within 0.002mm overall |
| PS8       | 05A01042   | 1mm/0.01mm    | 0.002mm    | Within 0.001mm overall |
| PS12      | 05A01043   | 0.1mm/0.002mm | 0.001mm    | Within 0.001mm overall |
| PS78      | 05B01050   | 1mm/0.01mm    | 0.003mm    | Within 0.001mm overall |
| PS4       | 05A01041   | 0.1"/0.001"   | 0.002mm    | Within 0.0001" overall |

### Long Linear Scales

Prepared on long glass rectangles 30mm wide and 6mm thick. Suitable for use with optical measuring instruments, machine tools, profile projectors, two and three dimensional measuring machines, process cameras, TV systems, etc. The pattern is vacuum deposited metal coating for durability.



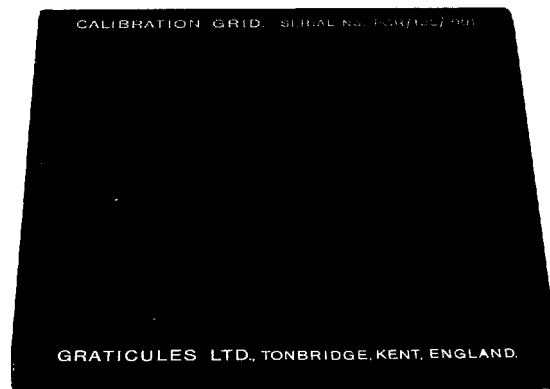
| Cat. Ref. | Order code | Dividing    | Line width | Accuracy                 |
|-----------|------------|-------------|------------|--------------------------|
| PS50      | 05B01051   | 50mm/0.1mm  | 0.03mm     | Within 0.002mm overall   |
| PS150     | 05B01055   | 150mm/0.1mm | 0.03mm     | Within 0.015mm overall   |
| PS300     | 05B01056   | 300mm/0.1mm | 0.03mm     | Within 0.015mm overall   |
| PS500     | 05B01057   | 500mm/1mm   | 0.03mm     | Within 5 microns overall |
| PS1000    | 05B01058   | 1000mm/1mm  | 0.03mm     | Within 5 microns overall |

### Grids

Useful for checking two dimensional instruments for straightness and accuracy. The line patterns are prepared in vacuum deposited coatings on optical glass plates 6mm thick.

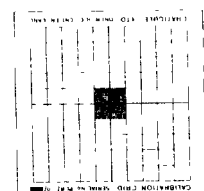
Lines every 10mm  
with central 20mm square sub-divided into 1mm rulings. Overall divided area 100x100mm. Linear accuracy to 0.003mm over 100mm. Linear straightness within 0.002mm. Angular accuracy within 5 seconds of arc. Glass size 120x120x6mm. Line width 0.008mm.

Cat. Ref. **PGR100**  
Order code **05B01030**



Lines every 10mm  
with central 20mm square sub-divided into 1mm rulings. Overall divided area 140x220mm. Glass size 240x160mm. Line width 0.008mm.

Cat. Ref. **PGR200**  
Order code **05B01031**



## Graticules as a company

It was the inventive genius of JULIUS RHEINBERG which enabled him to set up a manufacturing company in 1915 to meet the wartime requirements for gun sights of graticules made by photographic processes which he had invented. Indeed it was he who coined the word 'graticule' for application in the sense of images at the focal plane of optical instruments, rather than its original meaning which referred to markings on a map.

Today, the company GRATICULES still manufactures these items, together with many others. The requirement is always ACCURACY and HIGH DEFINITION and for this the highest quality is essential. The company is still owned and directed by members of the RHEINBERG family, but day-to-day running is carried out through Executive Directors, masters in their own sciences.

Manufacture includes a variety of processes, and instruments in which some of the resultant products are used. Whilst the main production activity concerns the quantity production of a wide range of standard items, many of which are held in large stocks particularly for microscopy – optical and electron, the origin of the company is never forgotten and the need for prototype and one off patterns is always catered for willingly. This applies also to instruments of which perhaps as many are sold modified or designed to special requirements as go out as standard products.

GRATICULES possesses the techniques of high resolution micro photography, photo mechanical processes, electro-forming and optical engineering. It is able to apply computer systems to its products when necessary, and it is always willing to listen to problems and if possible to act thereon. Instrumentation is available to control not only running standards but also the perfection of specially made products.

## Manufacturing Programme

Eyepiece and Stage Micrometers for microscopy  
Graticules for specialised purposes  
Scales and calibration standards  
Radial and linear gratings  
Specimen support meshes for electron microscopy  
Unsupported metal apertures – pinholes  
Evaporated metal on glass.  
Etched graticules  
High quality magnifiers with measuring capabilities  
Portable microscopes  
Specialised microscope systems  
Modular microscopes  
Co-ordinate and depth measuring microscopes  
Electronic reading heads for the conversion of optical/electronic signals

## Glossary

|                     |  |
|---------------------|--|
| aberration          | Deviation from perfect imaging in an optical system  |
| achromatic aperture | A lens in which chromatic and other aberrations have been minimised  |
| depth of focus      | The area of a lens which allows the passage of light. The numerical aperture of an objective, NA, is expressed by the expression $n \sin \mu$ where $n$ is the refractive index of the matter in the working distance, and $\mu$ is half the angular aperture of the lens where an image is focussed       |
| eyepiece            | The distance on either side of the image plane within which the sharpness of the image remains acceptable  |
| field of view       | The lens system nearest to the eye which is responsible for further magnifying the image thrown by the objective lens on to the image plane  |
| focal length        | The part of the image field which is imaged on the observer's retina and hence can be seen at any one time   |
| focal plane         | The distance between a point of intersection of rays within a lens and its point of focus, measured along the optical path   |
| image plane         | A surface at right angles to the optical path of a lens  |
| magnification       | A plane, actual or in space, upon which a focussed image appears   |
| micrometer          | The magnifying power of a lens system  |
| micron              | A device for measuring small distances, which in microscopy takes the form of a graticule scale  |
| objective           | 1 micron = 0.001mm   |
| optical path        | The lens system in a microscope which first magnifies the specimen   |
| prism               | A path in a given direction through which light passes   |
| reticle, reticule   | A block of transparent material with many faces which can be used to disperse light or to deflect it in a different direction  |
| retina              | A word commonly used outside U.K. to describe 'graticule'  |
| specimen            | The light sensitive surface in the eye upon which the image is formed  |
| stage micrometer    | That which is to be studied through magnifier or microscope. In this booklet it is used throughout for this purpose  |
| tube length         | A graticule, often on 3" x 1" glass slip, which is accurately calibrated so that when viewed through a microscope, the proportion of the eyepiece graticule can be deducted making actual measurement possible   |
| coma                | optically this refers to the distance between objective and eyepiece lenses, the standard to which lenses are corrected is 160mm. Mechanically, the tube length is that actually necessary to position the lenses the one to the other bearing in mind the different forms of attachment which may be used |
|                     | An aberration in which the image of an off axis point is deformed to look like a comet   |

## Choosing the correct eyepiece graticule

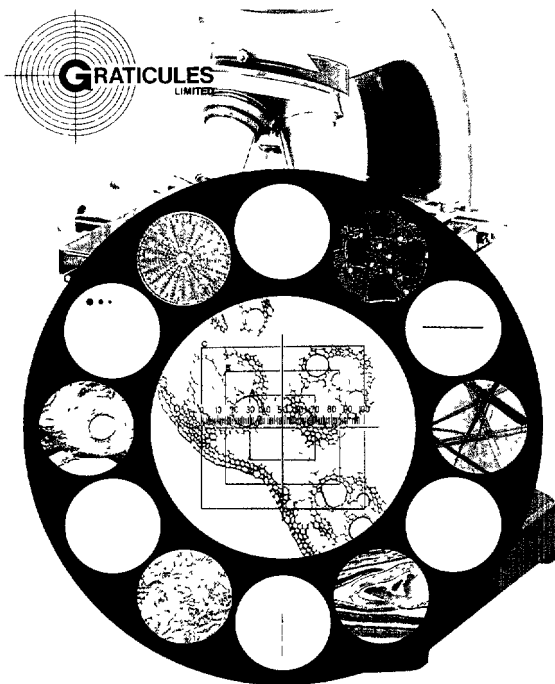
- The eyepiece graticule being situated at the image plane is magnified only by the eyepiece lens, so that its measurements differ from those of the specimen roughly by the magnification of the objective lens, which latter is not a precise figure and also varies in accordance with tube length. The only way to use an eyepiece graticule for measurement is to calibrate it in the instrument in which it is used. A full range of standard graticules and notes on how to calibrate them will be found in a separate catalogue 'GRATICULES FOR LIGHT MICROSCOPY' available on request.
- Bearing in mind that the eyepiece graticule is magnified only by the eyepiece lens, the pattern must be visible to the eye just magnified to that extent. For example subdivisions of 0.01mm (**E28**) will only be discernible with a  $\times 20$  eyepiece. At lower powers, it is wise to choose coarser divisions.
- The **FIELD OF VIEW** of the instrument must be wide enough to contain the graticule pattern chosen. Many eyepieces cover 16mm diameter, but those with higher magnification are more restricted.
- The size of the graticule disc, as opposed to its pattern, will be determined by the size of the eyepiece tube. Eyepiece graticules are available as standards on 16mm, 19mm and 21mm diameter glass discs, but other sizes are available by special order, if required.

### Special Eyepiece Graticules

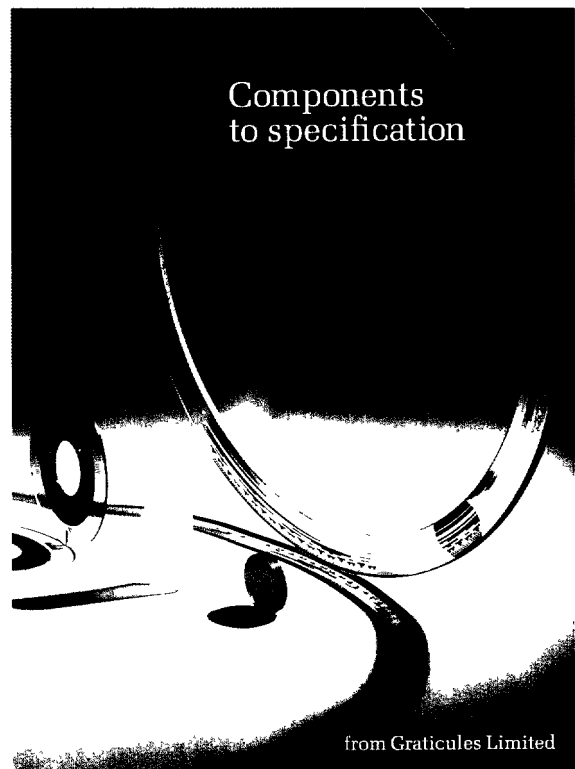
These can be made to order to customer specification, but whilst this service is readily available, the need to prepare a master renders the price high.

Both for quotations and orders the following information is needed -

- Pattern required.
- Details of eyepiece and objective lens magnifications with which it is to be used, specimen area to be covered, and accuracy required.
- Line thickness, if other than normal.  $\times 10$  eyepiece magnification will need lines 0.001/0.01mm thick.
- A precise drawing quoting accuracies and indicating whether this refers to the specimen itself or as required on the graticule disc.



**GRATICULES FOR LIGHT MICROSCOPY**



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