Electron Microscope Filaments / Cathodes, Tungsten

Tungsten hairpin filaments are the standard type filaments widely used in Scanning Electron Microscopes, Transmission Electron Microscopes and Microprobe systems. Tungsten filaments are also called cathodes, electron emitters or electron sources. All filaments we offer are made to the original equipment manufacturer's specifications using special tools to guarantee the correct shape for the filaments. The filaments are annealed in vacuum, stress-free and precisely aligned before they are shipped. For virtually all styles of filaments we also offer a re-tipping service. The used bases will be cleaned and reconditioned. After re-tipping, the filament will be pre-centered, vacuum annealed and inspected. Please consult the list below for the correct type of filament.

Instrument	New Filament#	Re-tip #
AEI	**1403**	**1403-R**
AMR / AMRAY (EXCEPT Amray 1200 series)	**1421**	**1421-R**
AMRAY 1200 (Siemens style)	**----**	**1422-R**
ARL	**----**	**----**
Cambridge Instruments (except and S4-10)	**1403**	**1403-R**
Cambridge Instruments S4-10 (Siemens style)	**----**	**1422-R**
Cameca	**----**	**1432-R**
CamScan standard Siemens style	**----**	**1422-R**
CamScan with AEI conversion	**1403**	**1403-R**
CamScan with new Tescan column	**1427**	**1427-R**
ETEC	**----**	**----**
FEI / Philips	**1412**	**1412-R**
Hitachi	**1428**	**1428-R**
ISI/ABT/Topcon 2-pin	**1425**	**1425-R**
ISI/ABT/Topcon 3-pin	**1426**	**1426-R**
JEOL "GC type" older style JSM35, JXA50	**1430**	**1430-R**
JEOL "K" type modern style	**1407**	**1407-R**
Leica	**1403**	**1403-R**
LEO	**1403**	**1403-R**
LEO 1450 (except systems converted to AEI)	**1427**	**1427-R**
Novascan (SEMCO)	**1403**	**1403-R**
Philips V-loop (PSEM 500 and later, EM200 and later)	**1412**	**1412-R**
Tescan	**1427**	**1427-R**
Siemens	**----**	**1422-R**
ZEISS	**1427**	**1427-R**
ZEISS EVO®	**1403**	**1403-R**

■ AEI Filaments for Zeiss (EVO®), LEO, AEI, Cambridge (except S4-10), Novascan, Leica

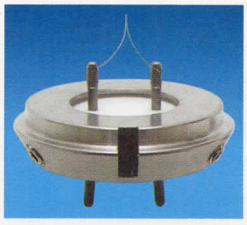
1403 Agar A054 "AEI" Filaments, white base box/10

1403-R Re-tip 1403 Filament . . . . . .each

■ FEI and Philips Filaments

1412 Agar A086 FEI/Phillips V-loop Filaments . . .box/10

1412-R Re-tip A086 Filament . . . . . .each

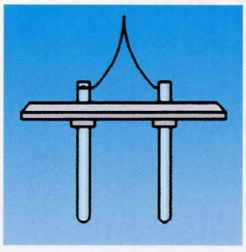


■ JEOL K-type Filaments

Ceramic in stainless steel alignment ring.

1407 Agar A092 JEOL K-type Filament box/6

1407-R Re-tip A092 Filament . . . . . .each

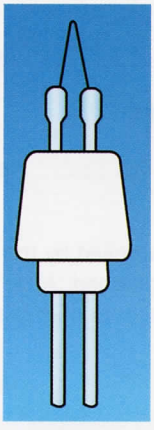


■ JEOL GC Filaments

Older style like JSM35, JXA50

1430 Jeol GC Filaments . .box/10

1430-R Re-tip 1430 Filament . . . . . .each



■ Hitachi S-type Filaments

(newer H-, S- and X- series)

1428 Hitachi H-, S-, and X- series Filaments . box/10

1428-R Re-tip 1428 Filament . . . . . .each

■ Zeiss, LEO (TEM and SEM 1400), Tescan Filaments

1427 Zeiss Filaments box/10

1427-R Re-tip 1427 Filament . . . . . .each

■ AMRAY Filaments, except AMRAY 1200 Series

1421 AMRAY Filaments . .box/10

1421-R Re-tip 1421 Filament . . . . . .each

■ ISI/ABT/Topcon Filaments, 2-prong curved pins

1425 ISI Filaments, 2-prong box/10

1425-R Re-tip 1425 Filament . . . . . .each

■ ISI / ABT / Topcon Filaments, 3-prong

1426 ISI Filaments, 3-prong box/12

1426-R Re-tip 1426 Filament . . . . . .each

■ Re-Tip for Siemens Style Filaments (for AMRAY 1200, CamScan, Cambridge S4-10, Siemens)

1422-R Re-tip Siemens Filament . . . . . .each

■ Re-Tip for Cameca Filaments

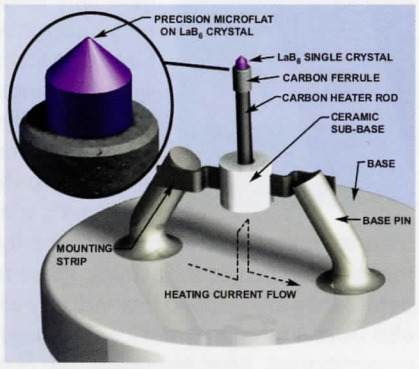
1432-R Re-tip Cameca Filament . . . . . .each

Re-Tip Service Notes:

- New filaments are attached to used bases, supplied by the customer. Used base will be cleaned and reconditioned. After re-tipping, the filament will be pre-centered, vacuum normalized and inspected.

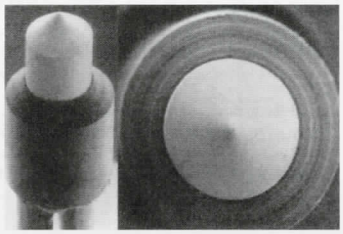
Lanthanum Hexaboride (LaB_6) Cathodes for Electron Microscopes

Manufactured by Kimball Physics

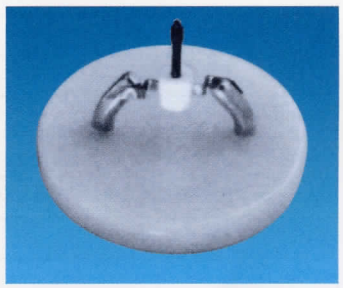


Heating current path through precision-machined, single-piece carbon rod and mounting strips; sub-base provides rigidity and easier mounting.

The Kimball Physics ES-423E (Extended Life) Lanthanum Hexaboride Cathode is a high performance, resistively heated, thermionic electron source. It is currently used in many electron optical systems: SEM's, TEM's, microprobes, electron lithography systems, etc. The LaB_6 source gives a greater brightness (higher current density) and a longer lifetime than standard tungsten filaments. Lifetimes in excess of 6 months of continuous operation are regularly achieved in commercial SEM's and TEM's with suitable gun vacuum (10^{-7} torr or better). The standard emitter is a 15µm diameter <100> oriented single crystal surface mounted on the end of a single piece, stress-free, carbon heater rod, held in place by a carbon ferrule. The single piece carbon heater rod has a precision machined 100µm slot along the axis to direct the heating current; the result is no high temperature carrying high temperature joints. The design together with a high degree of symmetry keeps mechanical movements small which results in increased stability. The small physical size fits most Wehnelt cylinders with ease. Another advantage of the Kimball Physics LaB6 cathode is the reduced material loss which means less Wehnelt contamination; again, this results in greater stability.



Unused LaB_6 crystal mounted on carbon heater rod, and held in place by precision carbon ferrule; note roundness and smoothness of microflat.



LaB_6 crystal mounted on an AEI/Leica base

For Use In:

- Scanning Electron Microscopes
- Transmission Electron Microscopes
- Microprobe Analyzers
- Electron Lithography Systems
- Electron Accelerators

continued on next page

Featuring:

Extended Lifetime

- Thousands of hours in clean vacuum
- Guaranteed life (measured in surface loss)
- Guaranteed against mounting structure failure

Exceptional stability

- Thermal / chemical / mechanical / electrical
- Precision machined carbon mounting
- High over-temperature tolerance

High brightness/low energy spread

- Oriented single-crystal
- Best quality/high purity material
- Low work function (potential barrier)

Accurate microflats

- Superior optics/controlled source size
- Standard diameters available

■ 1440-100 series for standard ES423E with 90° cone and 15µm microflat

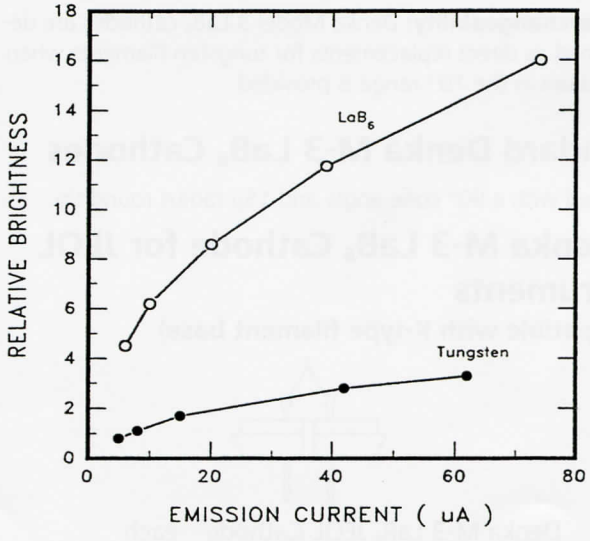
1440-110 LaB_6 cathode with AEI base for Cambridge Instruments/Leica/LEO/Zeiss, Cameca, CamScan and Electroscan . . . . . .each
1440-112 LaB_6 Cathode for Amray . . . . . .each
1440-114 LaB_6 Cathode for FEI/Philips except smaller AEI style on XL30 . . . . . .each
1440-116 LaB_6 Cathode for ZEISS . . . . . .each
1440-118 LaB_6 Cathode for Hitachi HU base . . . . . .each
1440-119 LaB_6 Cathode for Hitachi S base . . . . . .each
1440-120 LaB_6 Cathode for JEOL E base . . . . . .each
1440-121 LaB_6 Cathode for JEOL GC base (JSM) . . . .each
1440-122 LaB_6 Cathode for JEOL K base . . . . . .each
1440-123 LaB_6 Cathode for JEOL amp 10 base . . . . .each
1440-126 LaB_6 Cathode for ISI/ABT/Topcon 2 pin . . .each
1440-127 LaB_6 Cathode for ISI/ABT 002B . . . . . .each
1440-130 LaB_6 Cathode for ETEC/Perkin Elmer . . . . .each
1440-134 LaB_6 Cathode for Siemens base . . . . . .each
1440-136 LaB_6 Cathode for VG . . . . . .each

■ 1440-200 series for standard ES423E with 90° cone and 20µm microflat (longer life time)

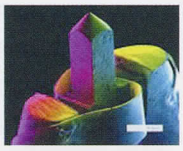
1440-210 LaB_6 cathode with AEI base for Cambridge Instruments/Leica/LEO/Zeiss, Cameca, CamScan and Electroscan . . . . . .each
1440-212 LaB_6 Cathode for Amray . . . . . .each
1440-214 LaB_6 Cathode for FEI/Philips except smaller AEI style on XL30 . . . . . .each
1440-216 LaB_6 Cathode for ZEISS . . . . . .each
1440-218 LaB_6 Cathode for Hitachi HU base . . . . . .each
1440-219 LaB_6 Cathode for Hitachi S base . . . . . .each
1440-220 LaB_6 Cathode for JEOL E base . . . . . .each
1440-221 LaB_6 Cathode for JEOL GC base (JSM) . . . .each
1440-222 LaB_6 Cathode for JEOL K base . . . . . .each
1440-223 LaB_6 Cathode for JEOL amp 10 base . . . . .each
1440-226 LaB_6 Cathode for ISI/ABT/Topcon 2 pin . . .each
1440-227 LaB_6 Cathode for ISI/ABT 002B . . . . . .each
1440-230 LaB_6 Cathode for ETEC/Perkin Elmer . . . . .each
1440-234 LaB_6 Cathode for Siemens base . . . . . .each
1440-236 LaB_6 Cathode for VG . . . . . .each

■ 1440-300 series for standard ES423E with 60° cone and 6µm microflat (Higher Brightness)

1440-310 LaB_6 cathode with AEI base for Cambridge Instruments/Leica/LEO/Zeiss, Cameca, CamScan and Electroscan . . . . . .each
1440-312 LaB_6 Cathode for Amray . . . . . .each
1440-314 LaB_6 Cathode for FEI/Philips except smaller AEI style on XL30 . . . . . .each
1440-316 LaB_6 Cathode for ZEISS . . . . . .each
1440-318 LaB_6 Cathode for Hitachi HU base . . . . . .each
1440-319 LaB_6 Cathode for Hitachi S base . . . . . .each
1440-320 LaB_6 Cathode for JEOL E base . . . . . .each
1440-321 LaB_6 Cathode for JEOL GC base (JSM) . . . .each
1440-322 LaB_6 Cathode for JEOL K base . . . . . .each
1440-323 LaB_6 Cathode for JEOL amp 10 base . . . . .each
1440-326 LaB_6 Cathode for ISI/ABT/Topcon 2 pin . . .each
1440-327 LaB_6 Cathode for ISI/ABT 002B . . . . . .each
1440-330 LaB_6 Cathode for ETEC/Perkin Elmer . . . . .each
1440-334 LaB_6 Cathode for Siemens base . . . . . .each
1440-336 LaB_6 Cathode for VG . . . . . .each



Denka M-3 LaB_6 Cathodes



Advantages

The use of an electron beam enables not only observation of the submicron world (TEM's SEM's and X-ray microanalysers) but also processing with submicron precision (electron beam lithography systems). The optimum cathode material for use in these instruments would possess the following properties:

- Low potential barrier (work function)
- High melting point and stability at high temperatures
- Low vapor pressure so as to reduce evaporation loss
- Chemical stability

The relative drawbacks of tungsten cathodes are a work function of 4.7eV, insufficient beam current, and a short service life. LaB_6 has a work function of 2.66eV – thus more easily emitting electrons – and is a relatively stable material, so it has been increasingly used as a material for cathodes instead of tungsten. Using LaB_6 cathodes with TEM's and SEM's, even with the electron beam narrowed down, it is possible to obtain enough beam current to achieve better resolution and clear micrographs with less noise. The principle advantage, however, is that LaB_6 can be used in a stable condition for a much longer time. Denka manufactures the purest, highest quality LaB_6 crystals for use in their cathode tips.

Benefits

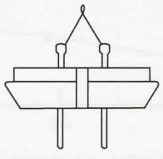
- **High Brightness:** A LaB_6 beam is 10 times brighter than tungsten, has superior resolution, and features a wide range of acceleration voltages. It provides sharp, clear pictures, down to the smallest detail. The initial brightness of a Denka Model 3 cathode (1 x 10^6A/cm^2.Str) is substantially better than that of competing, mini-vogel type cathodes (typically 5 x 10^5A/cm$_2$.Str).
- **Long Life:** Heat and vacuum are the final determinants of any cathode tip's life, but at 1550°C and a vacuum of 10^{-7} Torr, a service life of about 500 hours can be expected.
- **Stability:** Thanks to its simple and durable construction, every Denka Model 3 LaB_6 Cathode offers a stability of better than 3% per hour at 1550°C.
- **Interchangeability:** Denka Model 3 LaB_6 cathodes are designed as direct replacements for tungsten filaments when a vacuum in the 10^{-7} range is provided.

Standard Denka M-3 LaB_6 Cathodes

provided with a 90° cone angle and 15µ radius round tip.

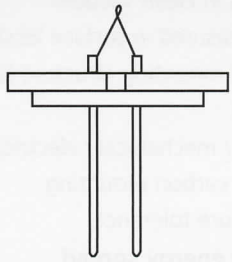
■ Denka M-3 LaB_6 Cathode for JEOL Instruments

(compatible with K-type filament base)



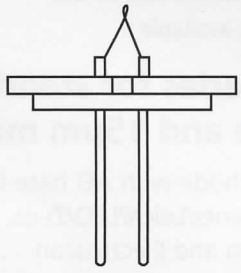
1450 Denka M-3 LaB_6 JEOL Cathode each

■ Denka M-3 LaB_6 Cathode for FEI, Philips (except XL-30) Instruments



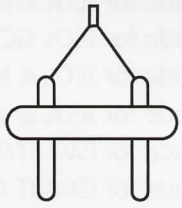
1451 Denka M-3 LaB_6 FEI, Philips Cathode . . . . . .each

■ Denka M-3 LaB_6 Cathode for AMRAY Instruments (except 1200 Series)



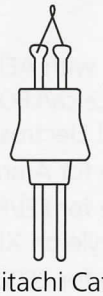
1452 Denka M-3 LaB_6 AMRAY Cathode . . . . . .each

■ Denka M-3 LaB_6 AEI Style Cathodefor Cambridge (except S2A and S4-10), Camscan, Electro Scan, Leica, LEO and Zeiss (EVO®) Instruments



1453 Denka M-3 LaB_6 Cambridge Cathode . . . . . .each

■ Denka M-3 LaB_6 Cathode for Hitachi Instruments



1454 Denka M-3 LaB_6 Hitachi Cathode . . . . . .each

Ordering Information for Denka M-3 LaB_6 Cathodes with Sharp and Flat Tips

AMRAY (Except 1200 Series)

1455 Denka LaB_6 Filament, AM/60-5, Sharp Tip . . . .each
1456 Denka LaB_6 Filament, AM/60-10, Sharp Tip . . .each
1457 Denka LaB_6 Filament, AM/60-20, Flat Tip . . . .each
1458 Denka LaB_6 Filament, AM/60-40, Flat Tip . . . .each
1459 Denka LaB_6 Filament, AM/60-60, Flat Tip . . . .each
1460 Denka LaB_6 Filament, AM/60-100, Flat Tip . . . .each
1461 Denka LaB_6 Filament, AM/90-20, Flat Tip . . . .each
1462 Denka LaB_6 Filament, AM/90-40, Flat Tip . . . .each
1463 Denka LaB_6 Filament, AM/90-60, Flat Tip . . . .each
1464 Denka LaB_6 Filament, AM/90-100, Flat Tip . . . .each

Numbers represent: Cone Angle - Tip Radius in µm

AEI Style Cambridge, Leica, LEO, Zeiss (EVO®)

1465 Denka LaB_6 Filament, CA/60-5, Sharp Tip . . . .each
1466 Denka LaB_6 Filament, CA/60-10, Sharp Tip . . . .each
1467 Denka LaB_6 Filament, CA/60-20, Flat Tip . . . .each
1468 Denka LaB_6 Filament, CA/60-40, Flat Tip . . . .each
1469 Denka LaB_6 Filament, CA/60-60, Flat Tip . . . .each
1470 Denka LaB_6 Filament, CA/60-100, Flat Tip . . . .each
1471 Denka LaB_6 Filament, CA/90-20, Flat Tip . . . .each
1472 Denka LaB_6 Filament,CA/90-40, Flat Tip . . . .each
1473 Denka LaB_6 Filament, CA/90-60, Flat Tip . . . .each
1474 Denka LaB_6 Filament, CA/90-100, Flat Tip . . . .each

Numbers represent: Cone Angle - Tip Radius in µm

Hitachi

1475 Denka LaB_6 Filament, H2/60-5, Sharp Tip . . . .each
1476 Denka LaB_6 Filament, H2/60-10, Sharp Tip . . . .each
1477 Denka LaB_6 Filament, H2/60-20, Flat Tip . . . .each
1478 Denka LaB_6 Filament, H2/60-40, Flat Tip . . . .each
1479 Denka LaB_6 Filament, H2/60-60, Flat Tip . . . .each
1480 Denka LaB_6 Filament, H2/60-100, Flat Tip . . . .each
1481 Denka LaB_6 Filament, H2/90-20, Flat Tip . . . .each
1482 Denka LaB_6 Filament, H2/90-40, Flat Tip . . . .each
1483 Denka LaB_6 Filament, H2/90-60, Flat Tip . . . .each
1484 Denka LaB_6 Filament, H2/90-100, Flat Tip . . . .each

Numbers represent: Cone Angle - Tip Radius in µm

ISI, ABT, Topcon

1492 Denka LaB_6 Filament, ISS/90-20, Flat Tip . . . .each
1493 Denka LaB_6 Filament, ISS/90-40, Flat Tip . . . .each
1500 Denka LaB_6 Filament, ISS/60-40, Flat Tip . . . .each

Numbers represent: Cone Angle - Tip Radius in µm

JEOL (Compatable with U-Type Filament Base)

1507 Denka LaB_6 Filament, LKS/60-20, Flat Tip . . . .each
1508 Denka LaB_6 Filament, LKS/60-40, Flat Tip . . . .each
1509 Denka LaB_6 Filament, LKS/60-60, Flat Tip . . . .each
1510 Denka LaB_6 Filament, LKS/60-100, Flat Tip . . . .each
1511 Denka LaB_6 Filament, LKS/90-20, Flat Tip . . . .each
1512 Denka LaB_6 Filament, LKS/90-40, Flat Tip . . . .each
1513 Denka LaB_6 Filament, LKS/90-60, Flat Tip . . . .each
1514 Denka LaB_6 Filament, LKS/90-100, Flat Tip . . . .each
1515 Denka LaB_6 Filament, LKSH60, Sharp Tip, TEM only . . . .each
1516 Denka LaB_6 Filament, LKSH60S, Sharp Tip, TEM only . . . .each

Numbers represent: Cone Angle - Tip Radius in µm

FEI, Philips (Except XL30)

1517 Denka LaB_6 Filament, PH2/60-5, Sharp Tip . . . .each
1518 Denka LaB_6 Filament, PH2/60-10, Sharp Tip . . .each
1519 Denka LaB_6 Filament, PH2/60-20, Flat Tip . . . .each
1520 Denka LaB_6 Filament, PH2/60-40, Flat Tip . . . .each
1521 Denka LaB_6 Filament, PH2/60-60, Flat Tip . . . .each
1522 Denka LaB_6 Filament, PH2/60-100, Flat Tip . . . .each
1523 Denka LaB_6 Filament, PH2/90-20, Flat Tip . . . .each
1524 Denka LaB_6 Filament, PH2/90-40, Flat Tip . . . .each
1525 Denka LaB_6 Filament, PH2/90-60, Flat Tip . . . .each
1526 Denka LaB_6 Filament, PH2/90-100, Flat Tip . . . .each

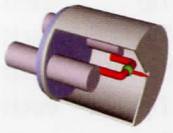
Numbers represent: Cone Angle - Tip Radius in µm

Comparison of Tip Configurations Available with Denka M-3 LaB_6 Cathodes

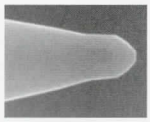
	Flat Tip	Standard (Round) Tip	Sharp Tip
	90° or 60° cone angle 20/40/60/100µm flat tip radius	90° cone angle 15µm tip radius	60° cone angle 5µm and 10µm tip radius
Brightness	About 5 times that of tungsten $2\text{-}5 \times 10^5$ A/cm² • Str	About 10 times that of tungsten 1×10^6 A/cm² • Str	Twice as bright as standard tips 2×10^6 A/cm² • Str
Saturation	Mono spot at about 1,400°C	Mono spot at about 1,500°C	Almost the same as standard tips
Crossover	Large (11-13µm)	Small (7-10µm)	Small (7-10µm)
Angular Distribution	Broad $3.3\text{-}4.2 \times 10^{-2}$rad	Sharp 1.6×10^{-2}rad	Sharp 1.6×10^{-2}rad
Used Temperature	Low Temperature	High Temperature	High Temperature
Lifetime	Long life (usable at low temperatures, and crystallized end changes slowly)	Long life; shorter than flat tips	Short
Operation	Easy (thanks to its large spot size and broad adjusting range)	Not so difficult	Difficult (the point adjustment needed)
Stability	High (invulnerable to thermal expansion or vibration)	High	Middle (vulnerable to thermal expansion or vibration, adjustment is sometimes necessary)
Technology Needed	Ordinary	High	Very High

YPS Schottky Field Emission Sources

Excellent thermal field emission cathodes



YPS Schottky type field emission (FE) sources can be used in many brands of focused electron beam systems including SEM, TEM, Auger and CD-SEM systems. These high quality FE sources are an excellent and cost effective drop-in alternative for FEI and Denka style FE sources. The YPS FE source is a thermal field emitter (TFE) cathode featuring a layer of zirconium oxide on a <100> oriented single crystal tungsten wire with a very sharp tip. The tip is mounted on a hairpin filament that is used to maintain the tip at a temperature of around 1800K.



The tip just penetrates the aperture hole in a cylindrical suppressor electrode mounted around the assembly. Electrons are emitted from the tip due to both thermal excitation and an electrical field at the tip due the potential difference between it and an extractor electrode. The YPS Schottky tip radius is typically 0.3µm to ensure high brightness of the source.

Currently there are three types of FE sources available: The YPS-174, the YPS-184 and the YPS-M20 Mini Module. This product line is aimed to customers who are comfortable with changing field emission sources and know how to change, load and align the TFE cathodes in a clean environment. It is also an excellent product for developers building custom designed electron beam columns using TFE sources. The operating vacuum for TFE sources is typically better than $1x10^{-9}$ mbar. This is higher than the operating vacuum for tungsten or LaB^6 sources, but less stringent than for cold field emission sources.

■ YPS-174 Standard Schottky FE Module

The YPS-174 is the most common standard Schottky field emitter module which is equivalent in dimensions to both FEI – and Denka – standard Schottky field emission cathodes. The suppressor aperture has a diameter of 400µm. The emitter protrudes 250µm from the suppressor electrode. The YPS-174 is compatible with thermal field emission sources used on systems from Amray, Hitachi, JEOL, ZEISS/LEO, FEI (pre 2002), PHI and Riber.

1620-174 YPS-174 TFE Source . . . . . .each

■ YPS-184 Schottky FE Module

The YPS-184 Schottky Module is a drop-in alternative for the FEI SSEM unit. The suppressor aperture has a diameter of 500µm and the emitter protrudes 250µm from the suppressor electrode. The YPS-184 module is also compatible with Tescan FESEMs.

1620-184 YPS-184 TFE Source . . . . . .each

■ YPS-M20 Mini Module TFE Source

The YPS-M20 Mini module TFE source is a complete pre-aligned assembly with a smaller style suppressor, ceramic insulator and extractor. The YPS-M20 Mini Module is a high grade alternative FE source for the Applied Materials/OPAL CD-SEMs.

1620-M20 YPS-M20 Module TFE Source . . . . . .each

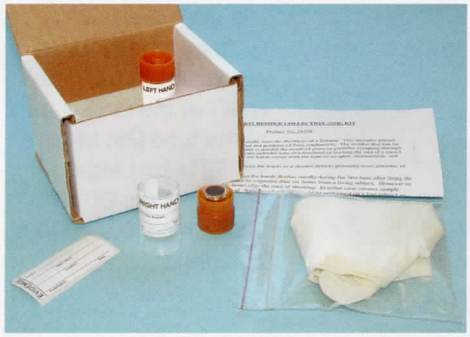
TFE Module Selection Guide

TFE Module	YPS-174	YPS-184	YPS-M20
Amray	X		
Applied / OPAL			X
FEI	X	X	
Hitachi (TFE)	X		
JEOL (TFE)	X		
LEO (Gemini)	X		
PHI	X		
Riber	X		
Tescan		X	
ZEISS (Gemini)	X		

Electron Source Performance Comparison

Emitter Type	Thermionic	Thermionic	Schottky	Cold FE
Cathode material	W	LaB_6	ZrO/W (100)	W(310)
Operating temp.[K]	2,800	1,900	1,800	300
Cathode radius [nm]	60,000	10,000	< 1,000	< 100
Effective source radius [nm]	15,000	5,000	15 (*)	2.5(*)
Emission current density [A/cm²]	3	30	5,300	17,000
Total emission current [µA]	200	80	200	5
Normalized brightness [A/cm².sr.kV]	$1x10^4$	$1x10^5$	$1x10^7$	$2x10^7$
Maximum probe current [nA]	1000	1000	10	0.2
Energy spread @ cathode [eV]	0.59	0.40	0.31	0.26
Energy spread @ gun exit [eV]	1.5 - 2.5	1.3 - 2.5	0.35 - 0.7	0.3 - 0.7
Beam noise [%]	1	1	1	5 - 10
Emission current drift [%/h]	0.1	0.2	< 0.5	5
Operating vacuum hPa/mbar	$< 1x10^{-5}$	$< 1x10^{-6}$	$< 1x10^{-9}$	$< 1x10^{-10}$
Typical Cathode life [h]	100	> 1000	> 5000	> 2000
Cathode regeneration	not required	not required	not required	every 6 to 8 hours
Sensitivity to external influence	minimal	minimal	low	low

Forensic Gunshot Residue Field Kits

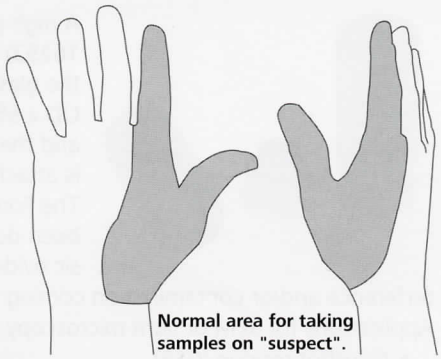


2-Disc GSR Field Kit. The most common of our kits used by many forensic departments. Prod. No. 16256-2.

3-Disc GSR Field Kit. A control disc is added to the two sampling discs to enhance certainty of the analysis. Prod. No. 16256-3.

4-Disc GSR Field Kit. Suitable for sampling palm and back separately on both hands. Prod. No. 16256-4.

5-Disc GSR Field Kit. A control disc is added to the four disc sampling kit to make it compatible with FBI requirements. Prod. No. 16256-5.



A complete line of high quality GSR field sampling kits, containing certified SEM pin stubs with double coated adhesive carbon tabs in plastic tubes. The certified SEM pin stubs have very low amounts of Pb, Sb and Ba, not detectable by SEM/EDX. The caps hold the GSR sample disc for easy and secure GSR collection. The discs are ready to use and the tubes are pre-labeled for the sampling areas. The sturdy transport box is tamper evident sealed.

Each kit comes complete with:

- Certified SEM pin mounts with adhesive carbon discs in pre-labeled tubes
- Pair of powder-free nitrile gloves
- Evidence label
- Chain of custody label on box
- Sturdy cardboard transport box (4-½" W x 3-¾" D x 3" H) (114.3 W x 95.3 D x 76.2mm H)
- Tamper evident seal
- Instruction sheet

16256-2 2-Disc Forensic Gunshot Residue Field Kit . . . .each
16256-3 3-Disc Forensic Gunshot Residue Field Kit . . . .each
16256-4 4-Disc Forensic Gunshot Residue Field Kit . . . .each
16256-5 5-Disc Forensic Gunshot Residue Field Kit . . . .each

Forensic Gunshot Residue Lab Kit

Ten SEM pin mounts in clean, glass storage tubes (25mm OD x 55mm high) held in a compact transport box with labels. GSR Kit is designed to avoid any contamination of the GSR samples. Available with or without mounts and tabs.

16259 Forensic Gunshot Residue Lab Kit: 10 SEM Pin Mounts (12.7mm; ½"), with mounted carbon tabs (12mm; 0.47" dia.) in Glass Tubes with Caps, 12 blank labels . . . . . .each

Sample Kit without pin mounts:

16260 Forensic Sample Kit: 10 Glass Sample Tubes with Caps, 12 blank labels . . . . . .each

Numbered Gunshot Residue Sampler

Numbered, certified aluminum mount that has a double-coated adhesive carbon tab applied to hold sample in a clean, glass vial. Dimensions are 25mm OD x 55mm high (1" OD x 2.17" high).

16251 Numbered Gunshot Residue Sampler box/100

Forensic Field Sampler

A high purity pin mount (see 16253) is placed in the cap of the glass specimen vial (25mm OD x 55mm H; 0.98" x 2.17") and the carbon conductive tab is attached to the pin mount. The Forensic Field Sampler has been designed to collect forensic evidence with minimum interference and/or contamination coming from the sampler.
Applications for SEM or light microscopy investigation:

- Gunshot residue (GSR)
- Fiber collection
- Particle sampling
- Glass fragments
- Paint chips
- Powder samples

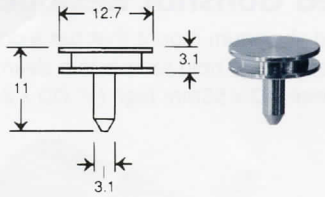
Ideally suited for SEM specimen preparation on the most commonly used SEM pin stub, facilitating easy carbon coating for SEM/EDX investigation.
The Forensic Field Sampler can be safely stored in the glass specimen vial and can be easily shipped since the cap holds the sampler stub in place. Evidence material is held by the adhesive carbon tab.

16250 Forensic Field Sampler without Adhesive Carbon Tab pkg/100

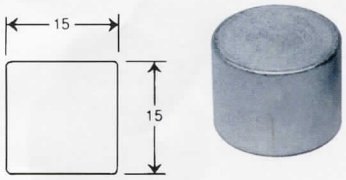
16255 Forensic Field Sampler with Adhesive Carbon Tab pkg/100

Certified Aluminum Alloy Specimen Mounts for Forensic Use

These forensic SEM specimen mounts are made of a special certified aluminum alloy. These certified mounts do not contain elements which might interfere with the collected GSR evidence.



16253 Certified Aluminum Alloy Mounts for Forensic Use, 12.7 x 11mm; ½" x 0.43" . .pkg/500



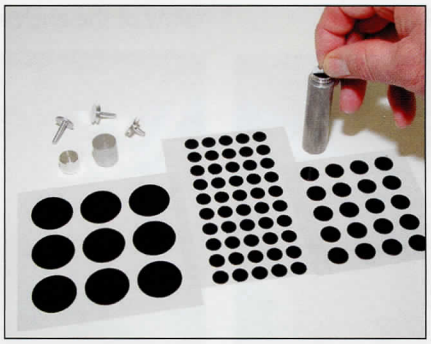
16343 Certified Aluminum Alloy Mounts for Forensic Use, 15 x 15mm; 0.59" x 0.59" pkg/500

Single Mount Storage

The pin mount, ⅛" (3.2mm) pin diameter, is protected and held securely in the base (cap) of the tube (Pin Mount 16253 is sold separately). 24mm OD x 52mm high; 0.94" OD x 2" high.

16630 Single Mount Storage pkg/10

Carbon Conductive Tabs



PELCO Tabs™ allow you to make your own forensic sampler. Both tab sides have a thick conductive adhesive (conductive inner film is 35µm and the adhesive is 45µm on each side for a total of 125µm [5 mils]) with a liner on both sides.

The conductive adhesive is a carbon-filled acrylic glue, free of solvents. It can be removed from the specimen mount with ethyl acetate, ethanol, isopropanol or alcohols. Temperature maximum is 60°C (140°F). Small impurities of Si, Sb, S and very small impurities of Fe, Mg and Na can be found. M

This product may also be used for gunshot residue analysis.

16084-3 PELCO Tabs™, Carbon Conductive Tabs, 9mm; 0.35" OD pkg/98

16084-1 PELCO Tabs™, Carbon Conductive Tabs, 12mm; 0.47" OD pkg/100

16084-2 PELCO Tabs™, Carbon Conductive Tabs, 25mm; 0.98" OD pkg/50

Spectro Tabs™

when you need higher purity carbon

A need existed for a tab with a purer composition in situations such as X-ray analysis. The EDX analysis shows a higher purity for those applications that require critical composition study. M

The graph is linked on our web site:
www.tedpella.com/SEMadhes.htm

16084-4 Spectro Tabs™, higher purity conductive carbon tabs, 12mm; 0.47" OD pkg/120

inch x 25.4= mm
mm x .03937= inch
1mm= 1,000µm
µm ÷ 25.4= mils
1 mil= 0.001"

M = MSDS on web page

Secure-Lock Tamper Resistant Labels

An inexpensive way to safeguard lab shipments, sealed documents or small containers.

Once applied these economical, peel-and-stick labels cannot be removed in one piece! Instead, they are formulated to break apart when stressed, giving clear evidence that tampering has occurred.

Transparent labels display the words "TAMPER RESISTANT" in bold red ink. Ideal for use on boxes, bottles, shipping containers, parts envelopes, even file drawers. Comes in a handy dispenser box. Size ⅝" x 2-½" (16 x 63.5mm).

16250-1 Secure-Lock Tamper Resistant Labels, ⅝" x 2-½"; 16 x 63.5mm pkg/250

Clear Plastic Ziplock Storage Bags

4 mil thickness (0.1mm), plain

139-101 Plastic Ziplock Bag, 2-½" x 3" pkg/100
139-102 Plastic Ziplock Bag, 3 x 4" pkg/100
139-107 Plastic Ziplock Bag, 5 x 8"; pkg/100

2 mil thickness (0.05mm), with write-on area

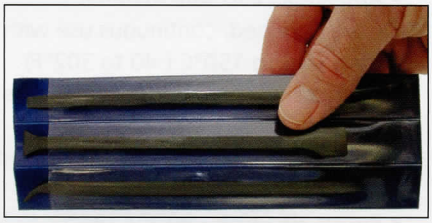
139-301 Plastic Ziplock Bag, 2-½" x 3" pkg/100
139-302 Plastic Ziplock Bag, 3 x 4" pkg/100
139-307 Plastic Ziplock Bag, 5 x 8" pkg/100

Barrier Foil Ziplock Bag

Shown with our Specimen Storage Box and DRICAP® Capsule Dehydrators (p. 00), this barrier bag is ideal for storage of materials sensitive to moisture and/or oxygen. The inside dimension measures 6 x 5.5" with a ziplock and a tear notch above the ziplock. The material is a metal foil-covered 4mil polyethylene with a MVTR (moisture vapor transmission rate) that is 1,000 times lower than a typical poly bag. It is heat sealable and ziplock resealable.

139-310 Barrier Foil Ziplock Bags, 6 x 5.5" pkg/100

PELCO Carbo-Probe™, Carbon Fiber Probes

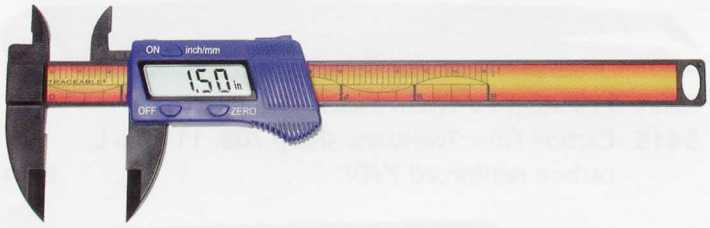


Set of three Carbo-Probes™ in plastic pouch.

The PELCO® Carbo-Probe™ carbon probe tools are made of PVDF, reinforced with conducting carbon fibers. They are wear resistant and the soft tips do not scratch delicate surfaces. Ideal for positioning small specimens/parts/components. Also suited for forensic and microscopy applications. Three different types or a complete set. Available with a straight or curved point being flat on the opposite end or as a double spatula.

13555 PELCO Carbo-Probe™, Set of 3 (Straight, Curved, Spatula) in plastic pouch . . . . . .each
13555-1 PELCO Carbo-Probe™ MPT-1, Straight Point, 150mm L (5.9") . . . . . .each
13555-2 PELCO Carbo-Probe™ MPT-2, Curved Point, 148mm L (5.8") . . . . . .each
13555-3 PELCO Carbo-Probe™ MPT-3, Double Spatula, 140mm L (5.5") . . . . . .each

Digital, Carbon Fiber Caliper, Certified



Switch from inches to millimeters at the touch of a button. Made of strong composite carbon fiber. Great for use in measuring scratch or damage sensitive materials. Will not corrode when used on tissue or other wet materials. This caliper will measure up to 6" (152mm).

The graduated scale on the caliper body is for approximate reference only. The exact measurement (accurate to ±0.1mm/0.01") is shown on the LCD display. Zero button instantly sets unit to zero when jaws are at any position.

Traceable to NIST for accuracy.

54491 Digital Carbon Fiber Calipers with certificate . . . . . .each

Carbon Fiber Reinforced Tweezers

These high performance precision, conductive, ESD safe, SV Carbon Fiber plastic tweezers are ideal for forensic, electronic and sample preparation applications where handling of scratch sensitive material or samples is required. The soft touch surface avoids cutting or damaging hairs, fibers, paper, bullets and rounds. Compatible for clean room applications and suitable for chemical processing.

- Smooth surface, high mechanical strength and toughness
- Anti-static, ESD safe material
- Heat stabilized, continuous use with temperatures ranging from -40° to 150°C (-40 to 302°F)
- High purity / clean room compatible
- High abrasion resistance
- Excellent chemical resistance to most acids, solvents and halones
- Resists HF (40% - 90°C / 194°F); HNO_3 (50% - 90°C / 194°F); HCL (36% - 90°C / 194°F)
- Resistant to UV and X-ray radiation

Typical applications:

- Fire arms / GSR
- Handling of scratch-sensitive samples
- Cleaning and etching processes
- Handling of static and/or static-sensitive components
- Handling of soft specimens
- Handling of magnetic specimens

Sharp Tips

Points: 0.25 width x 0.12mm thickness

5412 Carbon Fiber Tweezers, sharp 707, 114mm L, carbon reinforced PVDF . . . . . .each

Points: 0.25 width x 0.12mm thickness

5415 Carbon Fiber Tweezers, sharp 708, 111mm L, carbon reinforced PVDF . . . . . .each

Points: 0.25 width x 0.12mm thickness

5411 Carbon Fiber Tweezers, sharp 705, 116mm L, carbon reinforced PVDF . . . . . .each

Flat Tips

Points: 3.50 width x 0.12mm thickness

5413 Carbon Fiber Tweezers, flat 709, 116mm L, carbon reinforced PVDF . . . . . .each

Points: 8.0 width x 0.12mm thickness

5414 Carbon Fiber Tweezers, flat 710, 116mm L, carbon reinforced PVDF . . . . . .each

Points: 2.0 width x 0.12mm thickness

5410 Carbon Fiber Tweezers, flat 702A, 116mm L, carbon reinforced PVDF . . . . . .each

Round Magnifiers

A selection of quality magnifying glasses with a favorable price.

The round magnifiers offer 2x, 2.25x and 3.5x magnification. They are of solid construction with a glass lens, a metal rim and a plastic handle. They produce sharp images with minimal distortion.

7401 Round Magnifier, 100mm glass lens, 2x . . . . . .each

7402 Round Magnifier, 75mm glass lens, 2.25x . . . . .each

7403 Round Magnifier, 50mm glass lens, 3.5x . . . . . .each

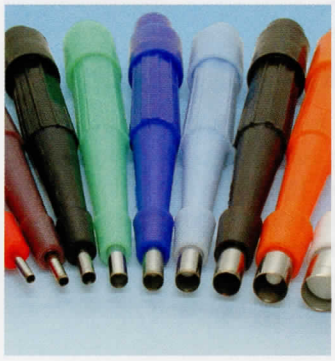
3x and 6x, Dual Plastic Magnifier

The dual plastic magnifier offers 3x and 6x magnification and is ideal to carry in a tool kit for field use.

Overall size is 50.8 x 115.8mm (2" x 4-9/16").

7404 Dual Magnifier, 45 and 19mm plastic lens, 3x and 6x . . . . . .each

Harris Uni-Core



Consists of a razor sharp stainless steel cutting tip, which can cut, retrieve, and store cored samples from source materials such as tissue, gels, paper, cloth, leaves, paint chips, films or other thin, soft substrates. 0.35 - 8.0mm diameter core size. Pouched and sterilized. A small, inert, self-healing cutting mat may also be purchased. See a full description in our Neuroscience section, p. 442.

2x Rectangular Magnifier

The rectangular magnifier with the glass lens has a 2x magnification and a plastic handle.

Lens size is 47.6 x 95.2mm (1-7/8" x 3-3/4").

7407 Rectangular Magnifier, 50 x 100mm glass lens, 2x .each

2x Rectangular Folding Magnifier with 4x Inset

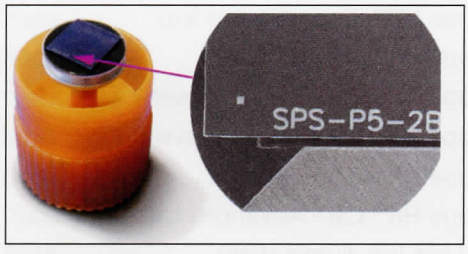
The rectangular magnifier with an inset of 4x magnification has a plastic lens, a folding handle and comes with a vinyl case. This magnifier is the most popular for forensics and field use.

Lens size is 47.6 x 98.4mm (1-7/8" x 3-7/8").

7408 Rectangular Dual Magnifier, 50 x 100mm plastic lens, 2x and 4x . . . . . .each

Forensic Test Specimen: Synthetic Particle Specimen for Gunshot Residue (GSR) SEM/EDX Calibration

This Gunshot Residue Standard is also suitable for use as a calibration and validation sample in the field of analytical Scanning Electron Microscopy (SEM/EDX) investigations.



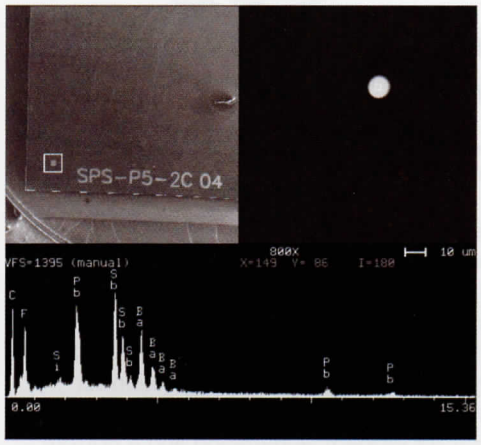
The SPS-5P-2 is specially designed for the adjustment, calibration and validation of analytical SEM/EDX systems when used for automated analysis of GSR particles. It is specially suitable for quick system validation checks and quality assurance procedures.

Using a special process, Pb/Sb/Ba particles are precipitated onto the surface of an 8mm x 8mm silicon chip which is previously applied with a 10µm polyimide layer. The particles are randomly distributed but at known locations. There are four distinct particle sizes of approximately 0.5µm, 0.8µm, 1.2µm and 2.4µm in diameter. In addition the samples are provided with three 10µm particles in order to facilitate a simple data cross-checking of performed automated particle analysis. The GSR Standard is carbon coated to avoid or minimize charging effects.

It is recommended that the BSE signal is used for imaging the particles as this gives a high contrast differential between the Pb/Sb/Ba particles and the silicon substrate. Beam current should not exceed 2 nA.

Note on the performance and evaluation of the automated particle analysis

The automated particle analysis has to be performed on the 7mm x 7mm center area on the silicon chip. In general, a magnification of 200 to 300x will suffice. There is a 100µm x 100µm Pb/Sb/Ba control pad on the chip that can be used to adjust the BSE signal to the required level for analysis. It is recommended to introduce the specimen into the system in such a way that the PB/Sb/Ba pad is displayed in the lower left corner of the BSE image. (see figure, left)



To perform an automated run on the detection of PB/Sb/Ba particles, it is necessary to create a particle class containing the elements Pb, Sb and Ba. Because of the production process, the elements carbon and oxygen (from the protective layer) and silicon and fluorine (from the substrate and the production process, resp.) may also appear.

For the evaluation of the automated search, it is recommended that the data obtained from the detected Pb/Sb/Ba particles (in particular their X/Y coordinates and their diameter) is displayed as an X/Y plot (e.g. with EXCEL). When using an appropriate display area, a direct comparison can be made of the size and position of the detected particles with the true values by overlaying the achieved results and the attached particle map (e.g. using an overhead film copy).

Because of the special production process it may happen that some of the deposited Pb/Sb/Ba particles are not present and therefore less than the regular 100 particles are detected. In addition there may also occur some irregularly shaped Pb/Sb/Ba particles (remaining from etch process), but these particles will appear on different locations than the regular Pb/Sb/Ba particles.

See web page for Gunshot Residue (GSR) Control Standard for Validation and Quality-Assurance Purposes (pdf):
www.tedpella.com/calibrat_html/gunshot.htm

60806-4 SPS-5P-2 GSR Standard on 12.7mm stub (type A mount); 0.5, 0.8, 1.2 and 2.4µm, certified . . . . . .each

The special manufacturing process allows the production of any quantity of identical samples as demanded for the performance of qualified proficiency tests (e.g., according to ISO 5725 and EUROCHEM). Comparable samples where used as test items in the recently performed "International Proficiency Test on Identification of GSR by SEM/EDX - GSR2003", organized and carried out by the European Network of Forensic Science Institutes.

Forensic Stereo Microscope

Motic SMZ-168 with MLC-150C Double Gooseneck

Motic SMZ-168 BL Binocular Stereo Zoom Microscope with Moticam 2300 Digital Color Camera

The SMZ-168 provides clear real 3-D imaging with a convenient zoom magnification range from 7.5 to 50x provided by the combination of the Greenough optical system and the standard 10x super widefield eyepieces. The large working distance of 113mm coupled to the large field of view for the standard configuration makes this an ideal system for setting up a work station for preparation, dissecting, micro-assembly, forensics or quality assurance. Features top light for incident illumination and a bottom light for transmitted illumination. The optional trinocular port accepts an optional video C-mount and SLR camera adapters. The SMZ-168 Series Stereo Microscope is available with a large variety of stands and many options to configure this versatile system to your exact requirements. Shown above with the optional Moticam 2300, 3.0 Megapixel Digital Color Camera.

Illumination with Streamline base post stand

Top light is 12V/10W halogen for incident illumination with adjustable beam and variable control, includes blue filter.

Bottom light is 12V/10W halogen light which provides bright light for transmitted illumination. Cool fluorescent 12V/5W bottom illumination available as an option on FBGF large post stand.

4 position light control: top only/bottom only, top & bottom on/off.

2282-10 SMZ-168BP Binocular Stereo Zoom Microscope with plane base stand, 35° head, WF 10x (FN23) eyepieces . . . . . .each

2282-11 SMZ-168BL Binocular Stereo Zoom Microscope with streamline base, incl. dual illumination, 35° head, WF 10x (FN23) eyepieces . . . . .each

2282-12 SMZ-168TP Trinocular Stereo Zoom Microscope with plane base stand, 35° head, WF 10x (FN23) eyepieces . . . . . .each

2282-14 SMZ-168TL Trinocular Stereo Zoom Microscope with streamline base, incl. dual illumination, 35° head, WF 10x (FN23) eyepieces . . . . .each

2290-120 Moticam 2300, 3.0 Megapixel Digital Color Camera . . . . . .each

22415S MLC-150C Cold Light Source Power Supply with Single Gooseneck . . . . . .each

22415D MLC-150C Cold Light Source Power Supply with Double Gooseneck . . . . . .each

ProScope HR™ USB Handheld, High Resolution, Digital Microscope

a new, revolutionary method of microscopy

The ProScope HR™ is an affordable USB handheld digital microscope designed for both PC and Mac platforms. With a high-quality 1.3 Megapixel CCD, a built-in illumination and a universal lens mount, the ProScope HR™ is a powerful imaging tool for education, lab, forensics, dermatology and inspection. The ProScope HR™ connects to the USB port of computers and laptops, which allows this digital microscopy tool to be taken from the lab to anywhere in the field for instant imaging. A full range of accessories including lenses (from 1x - 400x), CCD adapter and microscope tube adapter creates a versatile microscopy imaging system which can be deployed practically anywhere for virtually unlimited applications. The ProScope HR™ is surprisingly easy to use: One-button image capture for digital still images, time lapse recording or video's, all stored on your computer or laptop.

Optical System - The ProScope HR™ utilizes a high resolution CCD chip with 1280x1024 pixels. This ensures fast live imaging at a high frame rate. Several lenses with a quick release mount are available: 10x; 30x; 50x; 100x; 200x; 400x.

22670-100 ProScope HR™ Base unit w/o lens . . . . . .each

22670-120 ProScope HR™ with 50x lens . . . . . .each

22670-10 ProScope HR™ CSI - Science Level 1 Kit . .each

22670-11 ProScope HR™ CSI - Science Level 2 Kit . .each

22670-12 ProScope HR™ CSI - Lab Kit . . . . . .each

22670-4 ProScope HR™ CSI - Advanced Lab Kit . .each

22670-301 1-10x Lens (no illumination) . . . . . .each

22670-303 30x Lens with non reflective option . . . .each

22670-305 50x Lens with integrated illumination . . .each

22670-310 100x Lens with integrated illumination . .each

22670-320 200x Lens with integrated illumination . .each

22670-340 400x Lens with integrated illumination . .each

22670-350 C-mount Adapter . . . . . .each

22670-360 Microscope Tube Adapter . . . . . .each

22670-200 ProScope HR™ Precision Stand . . . . . .each

22670-441 ProScope HR™ CSI - Lab Kit Case . . . . . .each