NATIONAL
TRADE-MARK

spectroscopic electrodes

For Finest Structure and Highest Levels of ppm Purity

Four Grades Available... A NATIONAL Electrode for Your Every Need

GRAPHITE GRADE AGKSP

Grade AGKSP is a manufactured graphite with the highest crystallinity obtainable. Produced with TOTAL PRODUCT CONTROL within close limits, it offers the optimum graphite properties for spectroscopic applications. Grade AGKSP has the highest thermal conductivity of all the grades and is recommended where this property is a principal requirement. Uniform porosity and structure recommend this grade for porous cup and disc applications in solution techniques.

GRAPHITE GRADE SPK

Union Carbide developed the first high density, extruded graphite, spectroscopic electrode material, Grade SPK. Its density and structure give exceptionally high oxidation resistance and smooth burning characteristics. In spark applications, Grade SPK maintains the very uniform and concentrated spark needed in homogeneity studies.

SPK's lower thermal conductivity characteristics enable it to maintain a high heat concentration in the sample zone. It is best suited for analysis of heavier base materials such as iron, zirconium and titanium.

CARBON GRADE L 113 SP

Grade L 113 SP is a carbon grade and, therefore, shows a very low crystallinity. High electrical resistivity and low thermal conductivity make it especially suitable in direct-current arc techniques where very high heat concentrations in the sample zone and extremely high sensitivity are required but there reproducibility is of secondary importance. Grade L 113 SP is stocked only in rod form due to its machining characteristics, however, special forms can be supplied on request.

GRAPHITE GRADE AGKS

Grade AGKS is a manufactured graphite having a uniform and high crystalline structure. It has moderate purity and is recommended specifically for spark applications where the influence of the electrode impurities and high reproducibility are not critical. Grade AGKS is available in rod form only.

TYPICAL PHYSICAL PROPERTIES

Property	Units	Value			
		AGKSP	SPK	L113SP	AGKS
Bulk Density	g/cc	1.61	1.90	1.45	1.60
Resistivity	ohm-in	2.5×10^{-4}	4.4×10^{-4}	2.0×10^{-3}	2.5×10^{-4}
	ohm-cm	1.0×10^{-4}	1.7×10^{-4}	0.8×10^{-3}	1.0×10^{-4}
Coefficient of Thermal Expansion 300-1000°C	$X10^{-6}$/°C	1.9	2.9	6.9	2.0
1000-2000°C	$X10^{-6}$/°C	2.6	3.4	8.4	2.7
Flexural Strength (¼ in Rods)	lb/in²	3500	8100	2600	3500
	Kg/cm²	246.6	570.8	183.2	246.6
Young's Modulus	lb/in²	2.75×10^{6}	3.2×10^{6}	0.85×10^{6}	2.75×10^{6}
	Kg/cm²	$.19 \times 10^{6}$	$.23 \times 10^{6}$	$.06 \times 10^{6}$	$.19 \times 10^{6}$
Permeability	Millidaracy's	46.3	1.25	4.00	—
Porosity	%	28.5	16.5	31	—
Surface Area Powdered −100 +150 Mesh	M²/g	1.6	3.25	14.0	—

ASTM Classifications For Spectroscopic Electrodes

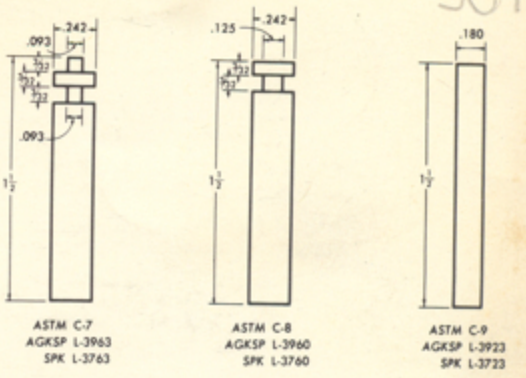
The electrodes designated as classes C, S, P, and D in the following drawings represent shapes and sizes recommended by ASTM for spectrochemical analysis and are cataloged in ASTM numerical sequence. They are stocked in high purity graphite and can be ordered by ASTM number although NATIONAL Spectroscopic Electrode number is preferable. Where ASTM number is used Grade AGKSP will be supplied.

ASTM TOLERANCES

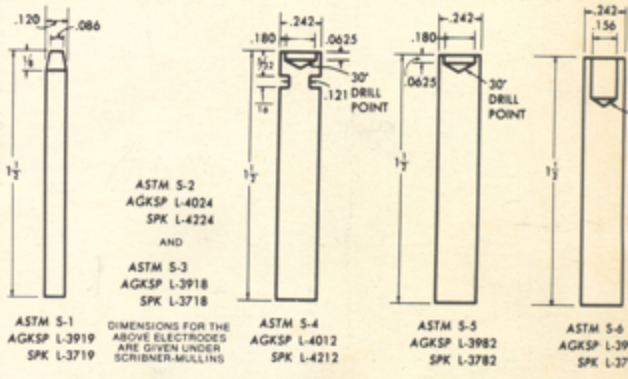
Outside Diameter	±0.002″
Preform Length	±0.016″
Cavity, Inside Diameter	±0.003″
Cavity, Depth	±0.003″
Neck, Outside Diameter	±0.005″
Neck, Location	±0.005″
Neck, Length	±0.005″
Angles	±0.5°
Concentricity:	
Holes under 0.5″ deep and undercuts	0.005″ TIR***
Holes over 0.5″ deep	0.010″
Boiler Caps, Inside Diameter	±0.001″
Porous Cups, Bottom Thickness:	
Up to 1″ Length	+0.002″–0.000″
Over 1″ Length	+0.003″–0.000″

***Total Indicated Reading

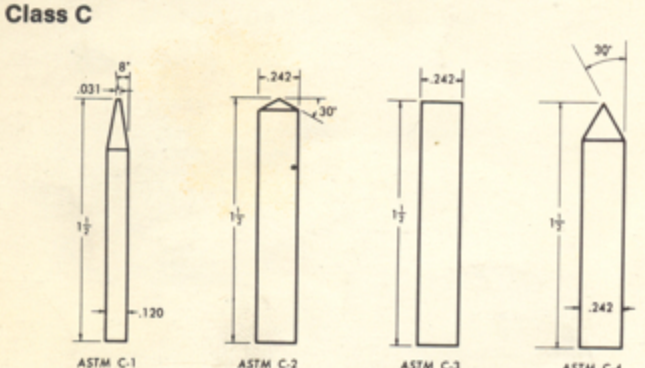
Class C



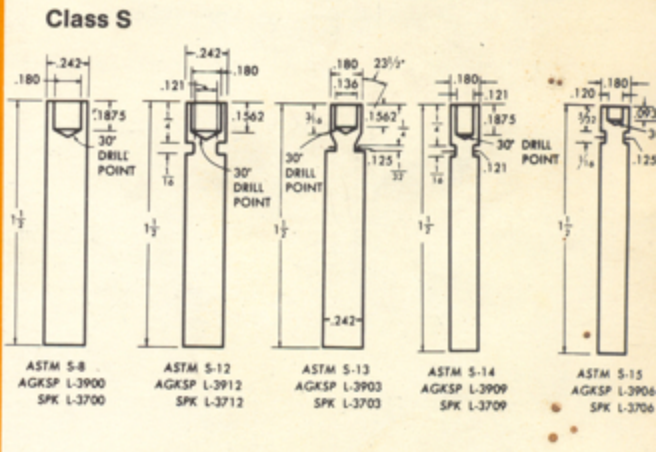
Class S



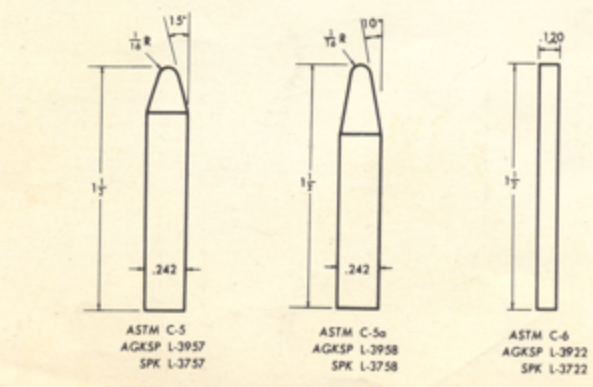
Class C



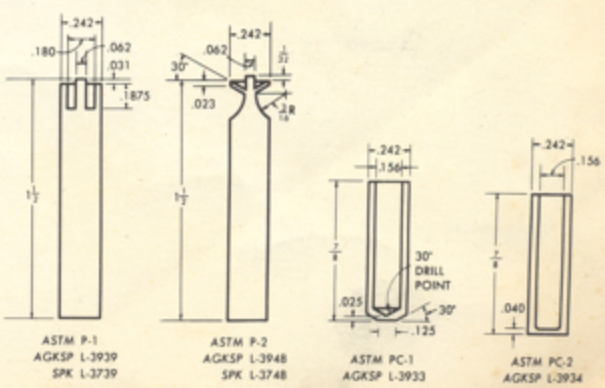
Class S



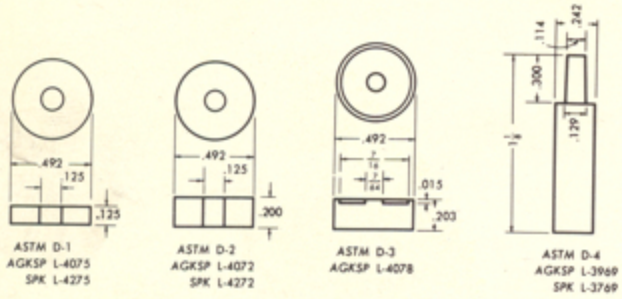
Class C



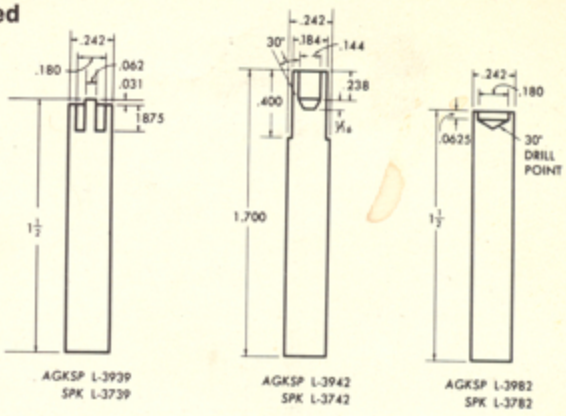
Class P



Class D



Cupped



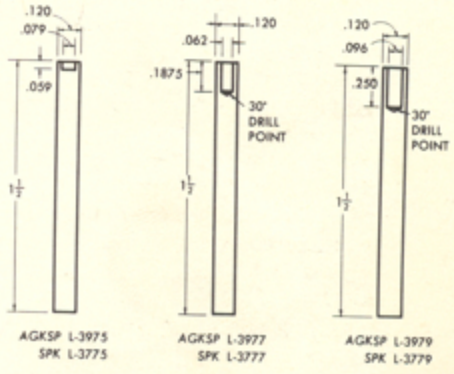
NATIONAL Spectroscopic Electrodes

Powder, Solution, and Counter Type Electrodes are available in high purity Grades AGKSP and SPK and are cataloged in numerical sequence.

Powder Type

Designed for powder-type samples but may also be used in solution applications and small metal chips. Thinner wall cups permit quick carbon burn-off and faster sample consumption. Powder type electrodes are sub-classified into cupped types, Harvey's Series, Scribner Mullins Types, Platform Types and Boiler Caps.

Cupped



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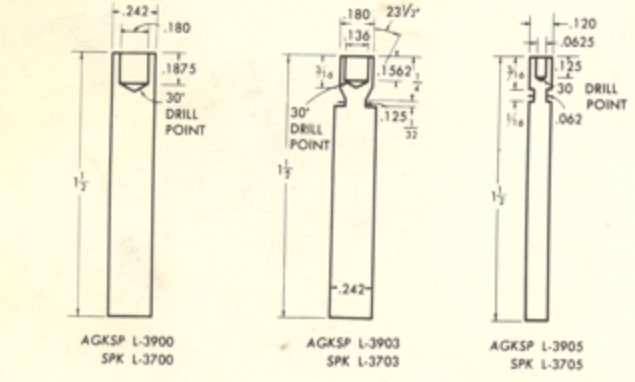

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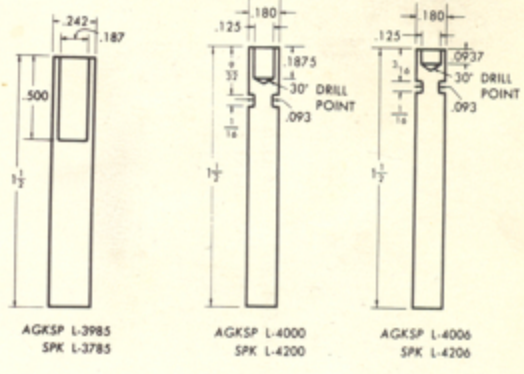

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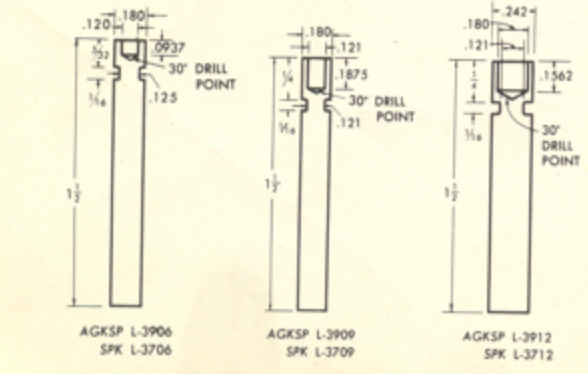
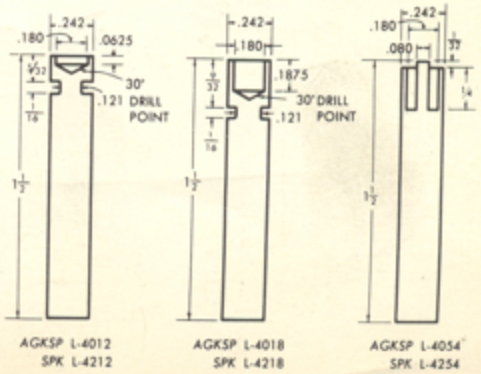
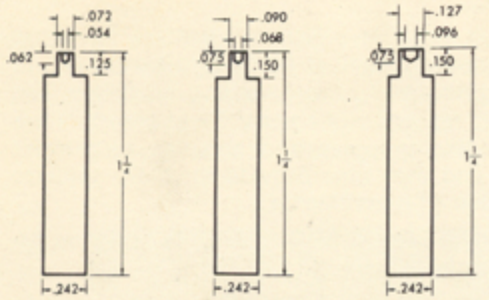


Cupped



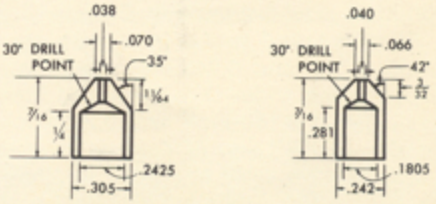
.Finest Structure-Reliable Reproducibility

Harvey's Series



SPK L-4257 SPK L-4258 SPK L-4259

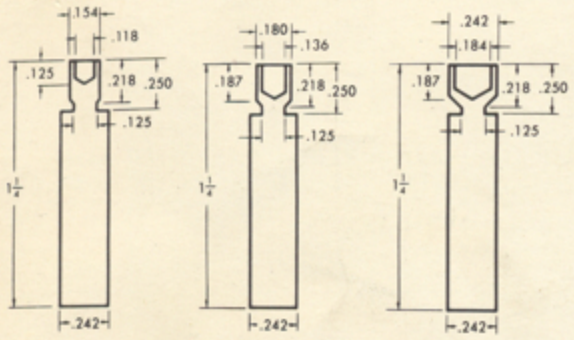
Boiler Caps



AGKSP L-3915 SPK L-3715

AGKSP L-3916 SPK L-3716

Harvey's Series



SPK L-4260 SPK L-4261 SPK L-4262

Solution Type

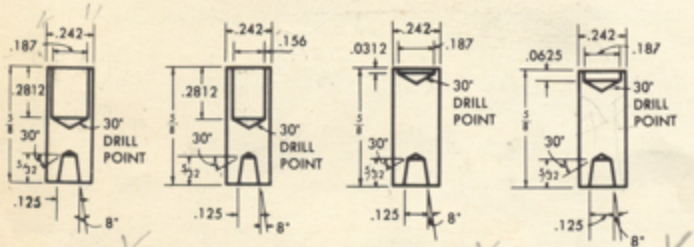
Rotating Disk. For aqueous, low viscosity solutions Grade AGKSP is recommended because its high porosity assures a uniform sample transport into the spark gap. Grade SPK is preferable for viscous solutions because it has a low surface porosity and picks up a thin, uniform film.

Porous Cup Electrodes are available in AGKSP only. The uniformity and porosity of this grade make it an outstanding material for solution applications.

Vacuum Cup. Available only in Grade SPK because of its lower porosity and resistance to solution absorption.

Plain Electrodes and other shapes suggested for solution applications are available in both AGKSP and SPK grades. If absorption of the solution is desired, for best results use AGKSP; if a minimum of solution absorption is desired, use Grade SPK.

Scribner Mullins



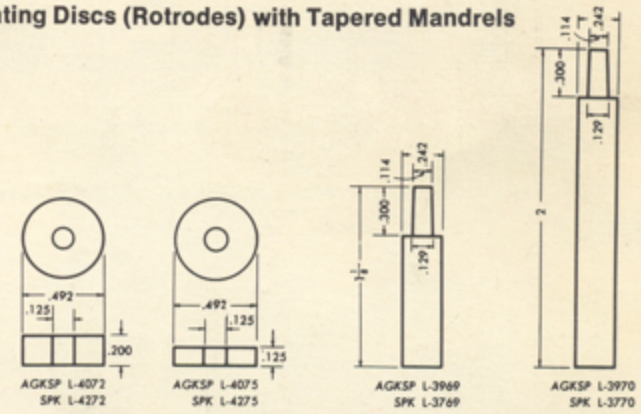
AGKSP L-3918 SPK L-3718

AGKSP L-4024 SPK L-4224

AGKSP L-4030 SPK L-4230

AGKSP L-4031 SPK L-4231

Rotating Discs (Rotrodes) with Tapered Mandrels



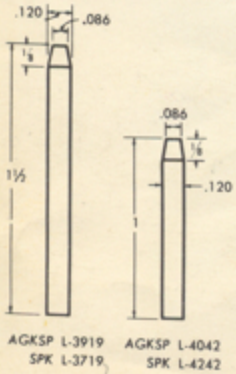
AGKSP L-4072 SPK L-4272

AGKSP L-4075 SPK L-4275

AGKSP L-3969 SPK L-3769

AGKSP L-3970 SPK L-3770

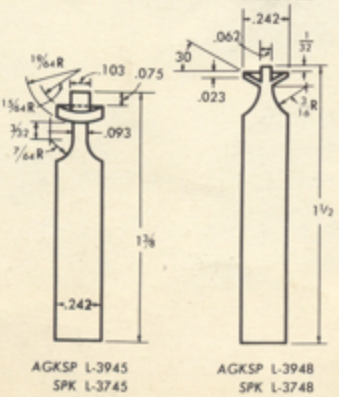
Pedestals for Scribner Mullins



AGKSP L-3919 SPK L-3719

AGKSP L-4042 SPK L-4242

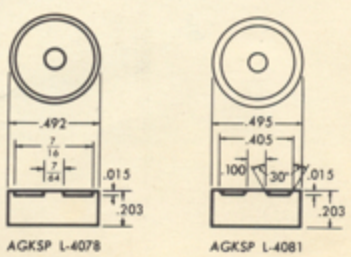
Platform



AGKSP L-3945 SPK L-3745

AGKSP L-3948 SPK L-3748

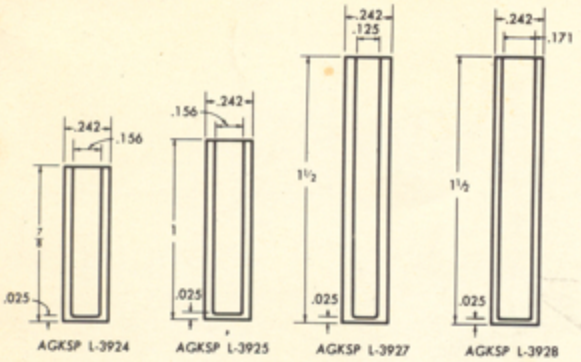
Rotating Discs (Platrodes)



AGKSP L-4078

AGKSP L-4081

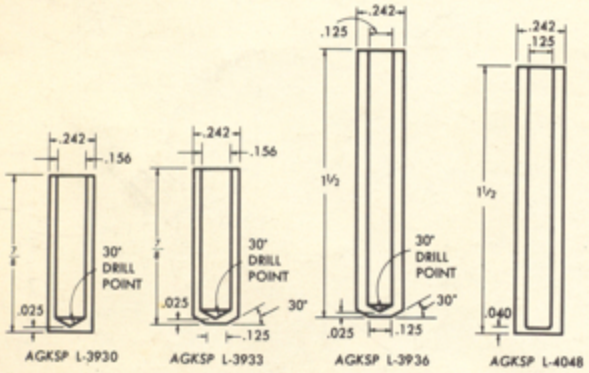
Porous Cups



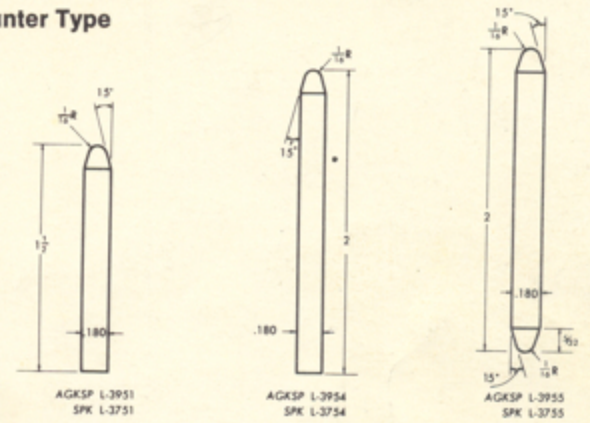
Counter Type

The Counter Electrodes below represent the various shapes used in arc or spark applications and are available in Grades AGKSP or SPK. For spark applications on light base materials such as aluminum and magnesium, use Grade AGKSP. For heavier materials such as iron and refractory metals, use Grade SPK.

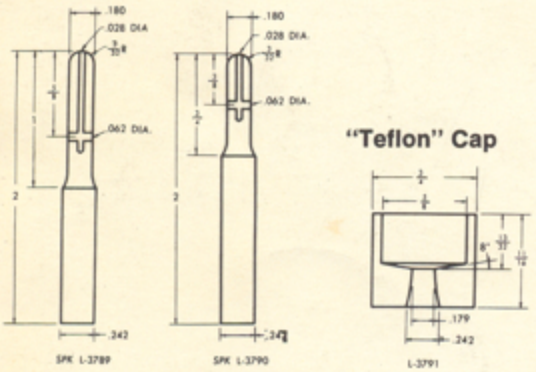
Porous Cups



Counter Type

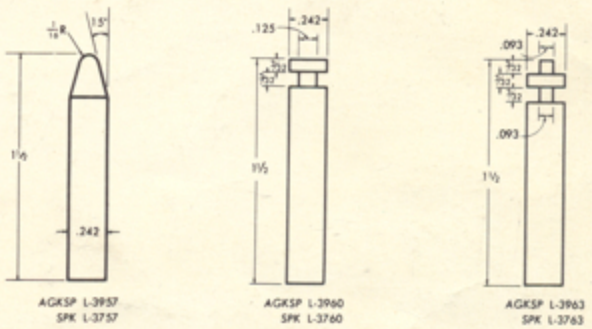


Vacuum Cups

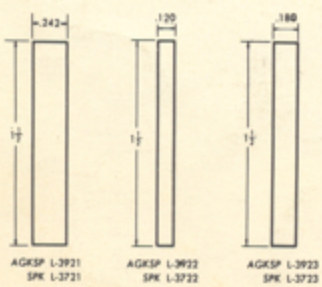


"Teflon" Cap

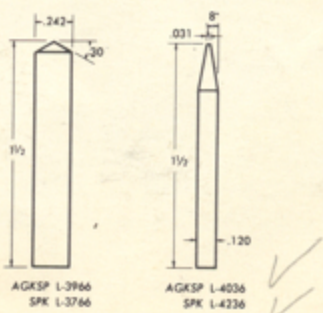
Counter Type



Plain



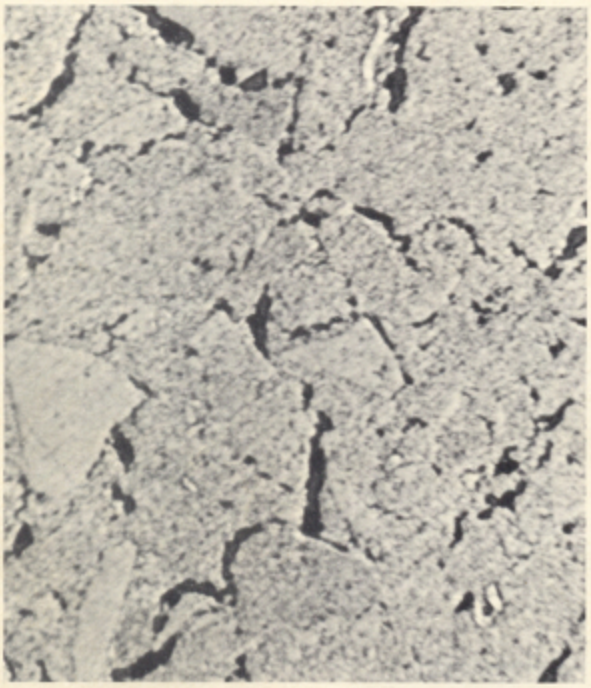
Counter Type



Total Product Control...A NATIONAL Spectroscopic Electrode Exclusive

TPC-Total Product Control from the selection of raw materials to final packing—is an exclusive manufacturing capability of Union Carbide. It is your assurance that NATIONAL Spectroscopic Electrodes maintain the finest structure and deliver reliable reproducibility every time you use them.

The photomicrographs below show the uniform structures of the four NATIONAL Spectroscopic grades.



Grade L113SP Magnified 200X

Grade AGKSP Magnified 200X

Grade AGKS Magnified 200X

Grade SPK Magnified 200X

NATIONAL TRADE-MARK Spectroscopic Rods and Powders

RODS

Two, four, six and twelve-inch rods are available in graphite Grades AGKSP and SPK. Twelve-inch rods are also available in Carbon Grade L113SP.

Two-inch and twelve-inch rods are available in 0.120, 0.180 and 0.242-inch diameters. Four-inch and six-inch rods—Direct Reader Electrodes—are available in 0.180-inch and 0.242-inch diameters, Grades AGKSP and SPK only. For maximum convenience, the two, four and six-inch electrodes come without wrapping, boxed in sturdy, pure materials to avoid contamination.

Twelve-inch rods are individually packaged in plastic tubes to avoid contamination and are packed in sturdy corrugated cartons.

GRAPHITE & CARBON RODS

Size (Inches)		Graphite Grades		Carbon Grade
Diameter	Length	AGKSP Catalog No.	SPK Catalog No.	L113SP Catalog No.
.120	2	L 3952	L 3752	—
.120	12	L 3803	L 3823	L 3863
.180	2	L 3953	L 3753	—
.180	4	L 3804	L 3824	—
.180	6	L 3805	L 3825	—
.180	12	L 3806	L 3826	L 3866
.242	2	L 3956	L 3756	—
.242	4	L 3807	L 3827	—
.242	6	L 3808	L 3828	—
.242	12	L 3809	L 3829	L 3869
.305	12	L 3812	L 3832	—

POWDERS

NATIONAL Spectroscopic Powders are furnished in the following Highest Purity Special Grades of both graphite and carbon with a maximum ash content of less than one ppm. These powders are used in diluting pulverized samples to prevent beading and they also provide for more uniform evaporation of constituents.

- GRAPHITE GRADE SP-1 SERIES is designed especially for pelletizing.
- GRAPHITE GRADE SP-2 is designed for use in powder form only and is not suitable for forming pellets.
- CARBON GRADE SP-3 is also designed for use in powder form only and cannot be successfully pelletized.

Grade	Catalog Number	Mesh Specification
Graphite Grades SP-1	L-4100	65-75% through 200 mesh
SP-1C	L-4118	90-95% through 200 mesh
Graphite Grade SP-2	L-4160	90-95% through 200 mesh
Carbon Grade SP-3	L-4165	55-65% through 200 mesh

Other mesh sizes available on request.

ORDERING INFORMATION

Please specify NATIONAL Spectroscopic Electrode number and grade. Refer to the following Price List Catalog Sections:

- A-4010 — Highest purity grades of carbon and graphite preforms and rods.
- A-4011 — Highest purity graphite rotrodes and mandrels for solution analysis.
- A-4012—Graphite rods.
- A-4013 — Highest purity grades of carbon and graphite powders.

Please Direct All *Mail* Inquiries to Nearest Carbon Products Division Sales Office

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875 Greentree Road

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Pittsburgh, Pa. (412) 922-5700 • San Francisco, Calif. (415) 765-1000

UNION CARBIDE

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In Canada: Union Carbide Canada Limited, Toronto

CP 4014

Litho in U.S.A.