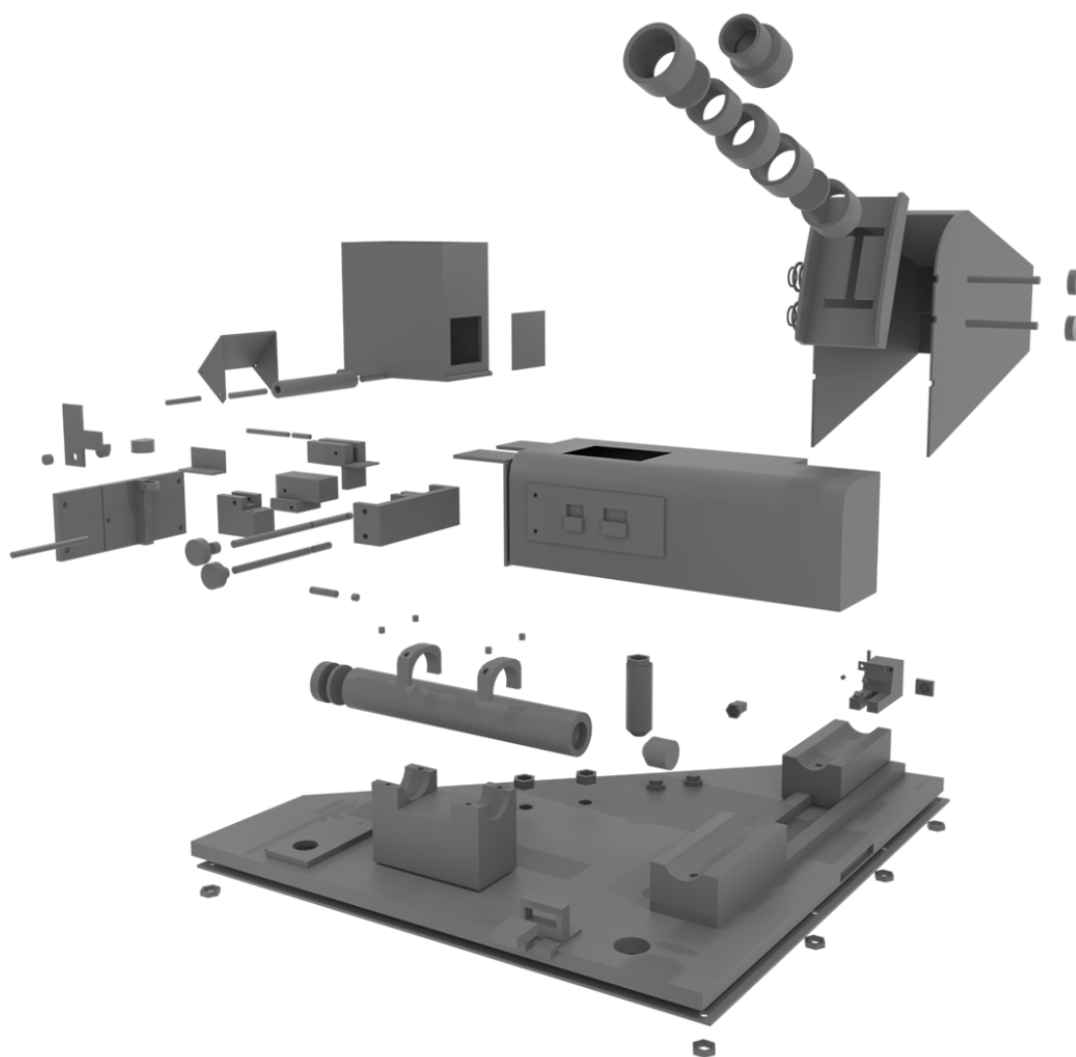


OPERATING INSTRUCTIONS

VREELAND MODEL 6A

SPECTROSCOPE



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USES & PURPOSE

The Vreeland spectroscope is used to identify elements in a sample by burning the sample and turning it into a gas. The wavelengths produced by those gases are then used to determine what elements are present. This makes the instrument useful in mineralogy for analyzing collected samples.

The spectroscope can quickly and accurately identify many common metals and their components, making it especially useful for identifying stainless steels and detecting impurities in metallurgical processes.

It can also be used to measure air and water pollution after contaminants have been collected on a filter and ashed, or evaporated to a residue.

Because the spectroscope has reference films for all major inorganic elements, it is well suited for detecting trace inorganic elements in materials such as leaf compressions, soils, and similar samples.

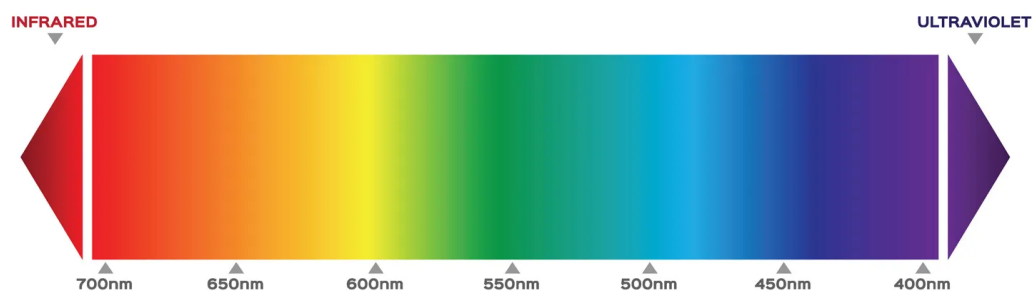
In an academic setting, the spectroscope is useful for demonstrating optical principles such as diffraction and for showing how spectra are produced and interpreted.

HOW IT WORKS

The spectroscope uses a heat source to fuse minerals which has a heat index of 2000 to 3000 degrees celcius. This incredibly high heat index allows materials like minerals to fuse as quickly as possible, giving us accurate results.

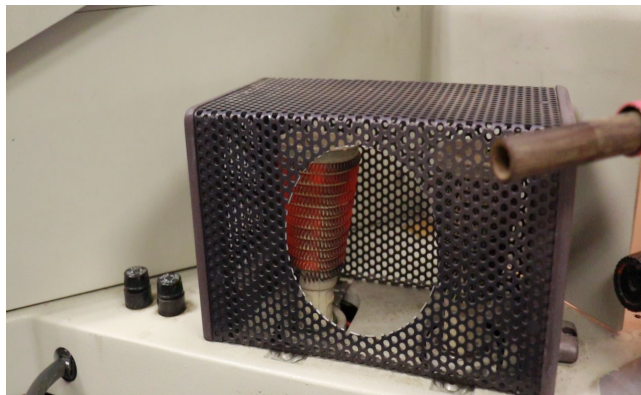
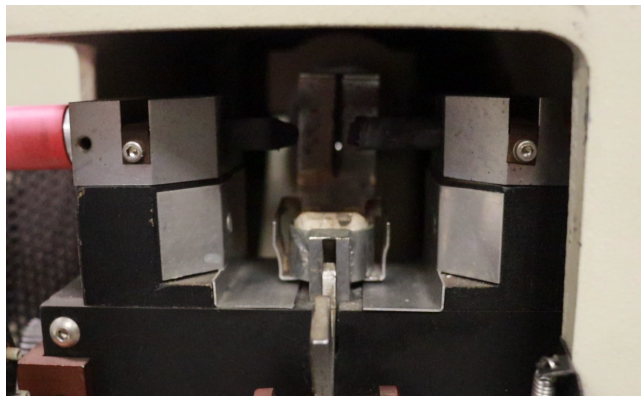
The instrument then separates the light emitted by the heated sample into its individual wavelengths, creating a spectrum that can be observed by the human eye. Different elements produce different colors and spectral patterns, allowing them to be identified. When atoms are heated, their electrons absorb energy and move to higher energy levels. As the electrons return to lower energy levels, they release energy in the form of light. Because each element has a unique electron arrangement, it produces a unique spectrum that can be used for identification (Figure 1).

SPECTRUM



SAFETY PRECAUTIONS

1. Use only under a fume hood.
2. Do not come anywhere near the electrodes (Figure 2) while the machine is plugged in.
3. Do not touch the resistors (Figure 3) while it is plugged in.
4. Only watch the process through the welding glass.
5. Wear safety glasses while grinding samples.

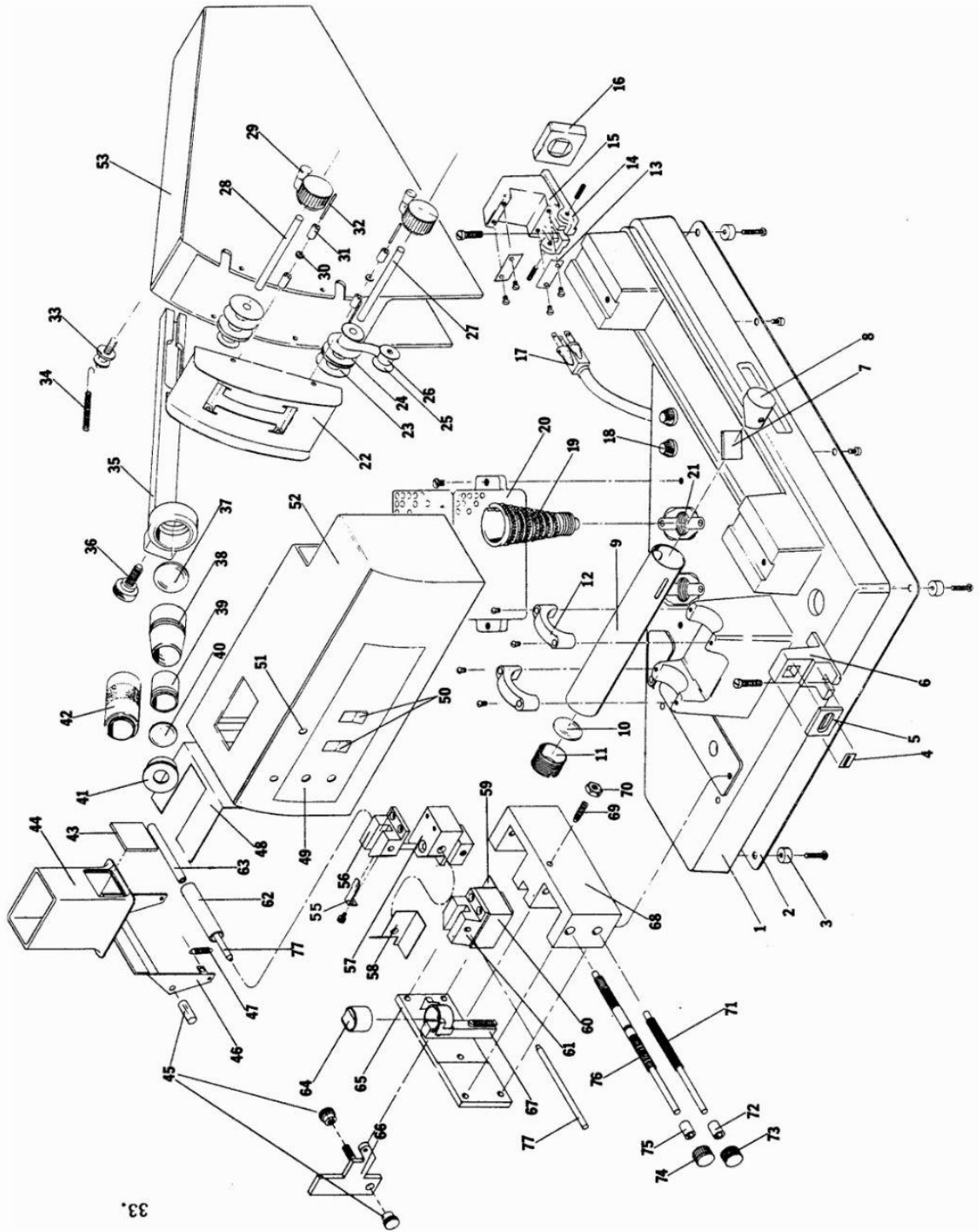


USING THE SPECTROSCOPE

1. After choosing a mineral or material you would like to analyze, using a mortar and pestle grind your sample into a fine powder weighing about 25mg.
2. Place your sample on a ceramic hearth (figure 4) and deposit it beneath the electrodes, you can use the sample feed knob (#74) to make placement easier.
3. Align the electrodes using the electrode alignment lever (#66) so that the tips of the electrodes touch each side of the lever.
4. Turn the electrode feed knob one half turn clockwise then remove the alignment lever.
5. Set the awning (#46) to a down position
6. Plug the spectroscope in and flip the power switch (#50R)
7. Fiddle with the electron feed knob (#73) until you see sparks, an ideal distance between electrodes is usually about 1/8th of an inch.
8. Continuously feed your sample into the arc with the sample feed knob (#74).
9. Swap your attention to the film viewer and referring to the element spectrum spreadsheet, search for your desired element.
10. Use the double sodium lines to align the film, sodium will always appear on the film as it is in the electrodes.



CONTINUE TO PAGE 7 FOR READING & INTERPRETATION



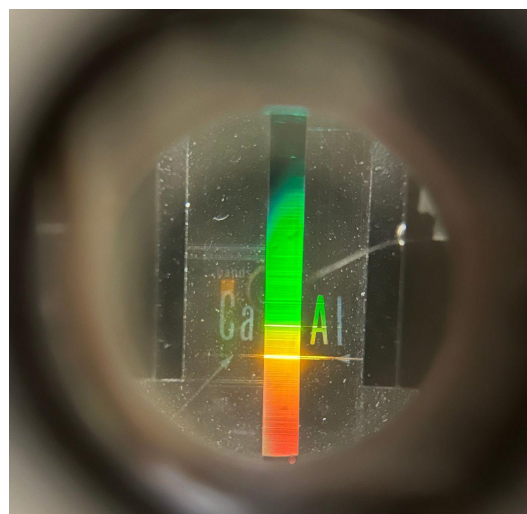
READING AND INTERPRETATION

As you are looking through the spectroscope's film viewer (#41) , use the cranks on the right side of the scope to find the film for the element you are looking for, or the film that has lines that match the lines you see.

To find what element corresponds to what section of film under the eyepiece, there is a plaque with information (Figure 5). Make sure to line up the film with the sodium lines that are on every section of film (Figure 6).

STANDARD SPECTROGRAMS ALPHABETICAL ORDER				STANDARD SPECTROGRAMS FILM ORDER			
FILM NO.	ELEMENT	FILM NO.	ELEMENT	FILM NO.	ELEMENT	FILM NO.	ELEMENT
1	ALUMINUM	24	NICKEL	41	SCANDIUM-BANDS	58	STRONTIUM
2	ALUMINUM-BANDS	25	NICKEL-BANDS	42	SCANDIUM-BANDS	59	STRONTIUM-BANDS
3	BARIUM	26	NICKEL-BANDS	43	SCANDIUM-BANDS	60	STRONTIUM-BANDS
4	BARIUM-BANDS	27	NICKEL-BANDS	44	SCANDIUM-BANDS	61	STRONTIUM-BANDS
5	BISMUTH	28	NICKEL-BANDS	45	SCANDIUM-BANDS	62	STRONTIUM-BANDS
6	BISMUTH-BANDS	29	NICKEL-BANDS	46	SCANDIUM-BANDS	63	STRONTIUM-BANDS
7	CADMIUM	30	NICKEL-BANDS	47	SCANDIUM-BANDS	64	STRONTIUM-BANDS
8	CADMIUM-BANDS	31	NICKEL-BANDS	48	SCANDIUM-BANDS	65	STRONTIUM-BANDS
9	CALCIUM	32	NICKEL-BANDS	49	SCANDIUM-BANDS	66	STRONTIUM-BANDS
10	CALCIUM-BANDS	33	NICKEL-BANDS	50	SCANDIUM-BANDS	67	STRONTIUM-BANDS
11	CALCIUM-BANDS	34	NICKEL-BANDS	51	SCANDIUM-BANDS	68	STRONTIUM-BANDS
12	CALCIUM-BANDS	35	NICKEL-BANDS	52	SCANDIUM-BANDS	69	STRONTIUM-BANDS
13	CALCIUM-BANDS	36	NICKEL-BANDS	53	SCANDIUM-BANDS	70	STRONTIUM-BANDS
14	CALCIUM-BANDS	37	NICKEL-BANDS	54	SCANDIUM-BANDS	71	STRONTIUM-BANDS
15	CALCIUM-BANDS	38	NICKEL-BANDS	55	SCANDIUM-BANDS	72	STRONTIUM-BANDS
16	CALCIUM-BANDS	39	NICKEL-BANDS	56	SCANDIUM-BANDS	73	STRONTIUM-BANDS
17	CALCIUM-BANDS	40	NICKEL-BANDS	57	SCANDIUM-BANDS	74	STRONTIUM-BANDS
18	CALCIUM-BANDS	41	NICKEL-BANDS	58	SCANDIUM-BANDS	75	STRONTIUM-BANDS
19	CALCIUM-BANDS	42	NICKEL-BANDS	59	SCANDIUM-BANDS	76	STRONTIUM-BANDS
20	CALCIUM-BANDS	43	NICKEL-BANDS	60	SCANDIUM-BANDS	77	STRONTIUM-BANDS
21	CALCIUM-BANDS	44	NICKEL-BANDS	61	SCANDIUM-BANDS	78	STRONTIUM-BANDS
22	CALCIUM-BANDS	45	NICKEL-BANDS	62	SCANDIUM-BANDS	79	STRONTIUM-BANDS
23	CALCIUM-BANDS	46	NICKEL-BANDS	63	SCANDIUM-BANDS	80	STRONTIUM-BANDS
24	CALCIUM-BANDS	47	NICKEL-BANDS	64	SCANDIUM-BANDS	81	STRONTIUM-BANDS
25	CALCIUM-BANDS	48	NICKEL-BANDS	65	SCANDIUM-BANDS	82	STRONTIUM-BANDS
26	CALCIUM-BANDS	49	NICKEL-BANDS	66	SCANDIUM-BANDS	83	STRONTIUM-BANDS
27	CALCIUM-BANDS	50	NICKEL-BANDS	67	SCANDIUM-BANDS	84	STRONTIUM-BANDS
28	CALCIUM-BANDS	51	NICKEL-BANDS	68	SCANDIUM-BANDS	85	STRONTIUM-BANDS
29	CALCIUM-BANDS	52	NICKEL-BANDS	69	SCANDIUM-BANDS	86	STRONTIUM-BANDS
30	CALCIUM-BANDS	53	NICKEL-BANDS	70	SCANDIUM-BANDS	87	STRONTIUM-BANDS
31	CALCIUM-BANDS	54	NICKEL-BANDS	71	SCANDIUM-BANDS	88	STRONTIUM-BANDS
32	CALCIUM-BANDS	55	NICKEL-BANDS	72	SCANDIUM-BANDS	89	STRONTIUM-BANDS
33	CALCIUM-BANDS	56	NICKEL-BANDS	73	SCANDIUM-BANDS	90	STRONTIUM-BANDS
34	CALCIUM-BANDS	57	NICKEL-BANDS	74	SCANDIUM-BANDS	91	STRONTIUM-BANDS
35	CALCIUM-BANDS	58	NICKEL-BANDS	75	SCANDIUM-BANDS	92	STRONTIUM-BANDS
36	CALCIUM-BANDS	59	NICKEL-BANDS	76	SCANDIUM-BANDS	93	STRONTIUM-BANDS
37	CALCIUM-BANDS	60	NICKEL-BANDS	77	SCANDIUM-BANDS	94	STRONTIUM-BANDS
38	CALCIUM-BANDS	61	NICKEL-BANDS	78	SCANDIUM-BANDS	95	STRONTIUM-BANDS
39	CALCIUM-BANDS	62	NICKEL-BANDS	79	SCANDIUM-BANDS	96	STRONTIUM-BANDS
40	CALCIUM-BANDS	63	NICKEL-BANDS	80	SCANDIUM-BANDS	97	STRONTIUM-BANDS
41	CALCIUM-BANDS	64	NICKEL-BANDS	81	SCANDIUM-BANDS	98	STRONTIUM-BANDS
42	CALCIUM-BANDS	65	NICKEL-BANDS	82	SCANDIUM-BANDS	99	STRONTIUM-BANDS
43	CALCIUM-BANDS	66	NICKEL-BANDS	83	SCANDIUM-BANDS	100	STRONTIUM-BANDS
44	CALCIUM-BANDS	67	NICKEL-BANDS	84	SCANDIUM-BANDS		
45	CALCIUM-BANDS	68	NICKEL-BANDS	85	SCANDIUM-BANDS		
46	CALCIUM-BANDS	69	NICKEL-BANDS	86	SCANDIUM-BANDS		
47	CALCIUM-BANDS	70	NICKEL-BANDS	87	SCANDIUM-BANDS		
48	CALCIUM-BANDS	71	NICKEL-BANDS	88	SCANDIUM-BANDS		
49	CALCIUM-BANDS	72	NICKEL-BANDS	89	SCANDIUM-BANDS		
50	CALCIUM-BANDS	73	NICKEL-BANDS	90	SCANDIUM-BANDS		
51	CALCIUM-BANDS	74	NICKEL-BANDS	91	SCANDIUM-BANDS		
52	CALCIUM-BANDS	75	NICKEL-BANDS	92	SCANDIUM-BANDS		
53	CALCIUM-BANDS	76	NICKEL-BANDS	93	SCANDIUM-BANDS		
54	CALCIUM-BANDS	77	NICKEL-BANDS	94	SCANDIUM-BANDS		
55	CALCIUM-BANDS	78	NICKEL-BANDS	95	SCANDIUM-BANDS		
56	CALCIUM-BANDS	79	NICKEL-BANDS	96	SCANDIUM-BANDS		
57	CALCIUM-BANDS	80	NICKEL-BANDS	97	SCANDIUM-BANDS		
58	CALCIUM-BANDS	81	NICKEL-BANDS	98	SCANDIUM-BANDS		
59	CALCIUM-BANDS	82	NICKEL-BANDS	99	SCANDIUM-BANDS		
60	CALCIUM-BANDS	83	NICKEL-BANDS	100	SCANDIUM-BANDS		
61	CALCIUM-BANDS	84	NICKEL-BANDS				
62	CALCIUM-BANDS	85	NICKEL-BANDS				
63	CALCIUM-BANDS	86	NICKEL-BANDS				
64	CALCIUM-BANDS	87	NICKEL-BANDS				
65	CALCIUM-BANDS	88	NICKEL-BANDS				
66	CALCIUM-BANDS	89	NICKEL-BANDS				
67	CALCIUM-BANDS	90	NICKEL-BANDS				
68	CALCIUM-BANDS	91	NICKEL-BANDS				
69	CALCIUM-BANDS	92	NICKEL-BANDS				
70	CALCIUM-BANDS	93	NICKEL-BANDS				
71	CALCIUM-BANDS	94	NICKEL-BANDS				
72	CALCIUM-BANDS	95	NICKEL-BANDS				
73	CALCIUM-BANDS	96	NICKEL-BANDS				
74	CALCIUM-BANDS	97	NICKEL-BANDS				
75	CALCIUM-BANDS	98	NICKEL-BANDS				
76	CALCIUM-BANDS	99	NICKEL-BANDS				
77	CALCIUM-BANDS	100	NICKEL-BANDS				
78	CALCIUM-BANDS						
79	CALCIUM-BANDS						
80	CALCIUM-BANDS						
81	CALCIUM-BANDS						
82	CALCIUM-BANDS						
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93	CALCIUM-BANDS						
94	CALCIUM-BANDS						
95	CALCIUM-BANDS						
96	CALCIUM-BANDS						
97	CALCIUM-BANDS						
98	CALCIUM-BANDS						
99	CALCIUM-BANDS						
100	CALCIUM-BANDS						

Note that carbon is always present because the rods contain both carbon and sodium. To see if your sample has sodium, there will be the two



standard lines as well as other lines that match up to sodium film lines.

Some samples need to be diluted so they do not melt; these samples also need to be heated on the hotter setting, as their melting point is too high. Anything with a melting point above 2000 degrees Celsius must be diluted and heated with the increase heat switch (#50L) , and anything above 3000 degrees cannot be melted or detected by the machine.

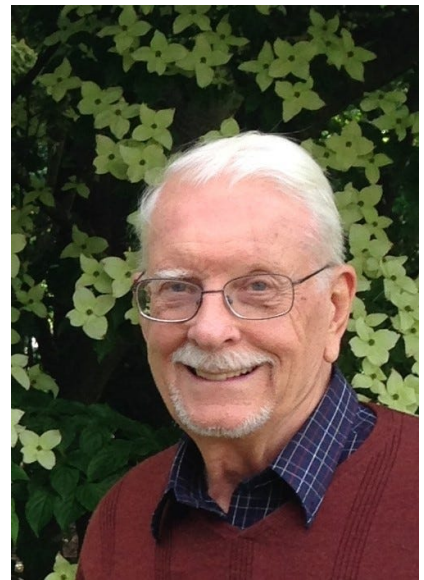
Above is an example of the typical Spectrogram of salt.

ADDITIONAL INFORMATION

John Hoyte:

In 2026 John Hoyte, Frederick K Vreeland's nephew, generously donated his remaining model 6 spectroscope to Whatcom Community College.

John Hoyte was born in 1932 to medical missionary parents in Ping Fang Yu, China. He attended a British-run boarding school in the Shantung Province, which was interned by Japanese forces during WWII. After the war, Hoyte and his family moved to England, where he attended Saint John's College, Cambridge. During his time at college Hoyte put together a team of eight people to recreate Hannibal's famous expedition through the Swiss Alps with a live elephant named Jumbo. Hoyte moved to the United States at the age of 27, and worked as an engineer in Palo Alto, California. After six years, he founded his own company, Spectrex Corporation which focused on the direct reading spectroscope invented by his uncle, Fred Vreeland. After managing Spectrex for 50 years, Hoyte sold the company to his employees. He now lives in Bellingham, Washington with his wife, Luci Shaw, and enjoys sailing, painting, sketching, and playing the guitar (Hoyte, 2026).



Spectroscope haiku:

Beautiful device
Telling information with
Colorful wavelengths

-Zoe Norman

SOURCES & ACKNOWLEDGEMENTS

Manual Created by Trilian Usinowicz, Gary Redd and Zoe Norman

Special thank you to Alec Hunter and Katja Kraft for editing!

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Standard Spectrograms in Alphabetical Order

		Film No.			Film No.
Aluminum	(Al)	4	* Osmium	(Os)	36
Aluminum Bands		75	Palladium	(Pd)	37
Barium	(Ba)	46	Potassium	(K)	43
* Beryllium	(Be)	50	Platinum	(Pt)	34
Bismuth	(Bi)	8	Praseodymium	(Pr)	68
Carbon Bands	(C)	74	Rhenium	(Re)	40
Cadmium	(Cd)	14	Rhodium	(Rh)	38
Calcium	(Ca)	48	Rubidium	(Rb)	42
Calcium Bands	(Ca)	76	Ruthenium	(Ru)	39
Calcium Fluoride	(CaF)	77	Samarium	(Sm)	70
Caesium	(Cs)	41	Scandium	(Sc)	64
Cerium	(Ce)	67	Scandium Bands	(Sc)	80
Chromium	(Cr)	21	Silver	(Ag)	9
Cobalt	(Co) i	23	Sodium	(Na)	44
Cobalt	(Co) e	53	Strontium	(Sr)	47
Columbium	(Cb) i	26	Strontium Bands	(Sr)	78
Columbium	(Cb) e	59	Tantalum	(Ta)	27
Copper	(Cu)	12	Tantalum	(Ta) i	60
Europium	(Eu)	72	Thallium	(Tl) e	1
Fluorine Bands	(F)	77	Thorium	(Th)	30
Gadolinium	(Gd)	71	Titanium	(Ti) i	17
Gallium	(Ga)	3	Titanium	(Ti) e	61
Germanium	(Ge)	5	Tin	(Sn)	6
Gold	(Au)	11	Tungsten	(W) i	28
Hafnium	(Hf)	32	Tungsten	(W) e	57
Indium	(In)	2	Uranium	(U)	29
Iridium	(Ir)	35	Vanadium	(V) i	25
Iron	(Fe) i	22	Vanadium	(V) e	58
Iron	(Fe) e	52	Yttrium	(Y)	65
Lanthanum	(La)	66	Yttrium Bands	(Y)	79
* Lead	(Pb)	7	Zinc	(Zn)	15
Lithium	(Li)	45	Zirconium	(Zr) i	31
Magnesium	(Mg) i	18	Zircon	(Zr) e	62
Magnesium	(Mg) e	49			
Manganese	(Mn) i	16			
Manganese	(Mn) e	55			
* Mercury	(Hg)	13	Angstrom Scales		10, 33, 60E
Molybdenum	(Mo) i	19	Key Lines		20, 60D
Molybdenum	(Mo) e	56	Key Lines (singlet)		51
Neodymium	(Nd)	69	Key Lines (doublets)		
Nickel	(Ni) i	25	Key Lines (triplets)		63
Nickel	(Ni) e	54	Key Lines (4 to 7 line groups)		73

i = Identification film

e = Elimination film

* = Danger Toxic. Use fume hood

Melting Points of Elements on Films

	Melting Point °C	Boiling Point °C
Aluminum	659.7	2057
Barium	725	1140
Beryllium	1278	2970
Bismuth	271.3	1560
Carbon	>3550	4200
Cadmium	321	767
Calcium	842	1240
Cesium	28.5	670
Cerium	804	1400
Chromium	1890	2480
Cobalt	1495	2900
Columbium	2500	3700
Copper	1083	2336
Europium	1150	---
Gadolinium	---	---
Gallium	29.78	1983
Germanium	958.5	2700
Gold	1063	2600
Hafnium	1700	>3200
Indium	156.4	2000
Iridium	2454	>4800
Iron	1535	3000
Lanthanum	826	1620
Lead	327.43	1336
Lithium	186	1107
Magnesium	651	1900
Manganese	1260	356.58
Mercury	-38.37	4800
Molybdenum	2620	2900
Neodymium	840	>5300
Nickel	1455	2200
Osmium	2700	760
Palladium	1549.4	4300
Potassium	62.3	2500
Platinum	1773.5	700
Praseodymium	940	2700
Rhenium	3167	
Rodium	1966	2400
Rubidium	38.5	1950
Ruthenium	2450	880
Samarium	1300	1150
Scandium	1200	4100
Silver	960.8	1457
Sodium	97.5	4500
Strontium	774	
Tantalum	2996	
Thallium	302	
Thorium	1845	

Melting Points of Elements on Films

	Melting Point (°C)	Boiling Point (°C)
Titanium	1800	3000
Tin	231.89	2270
Tungsten	3370	5900
Uranium	1130	---
Vanadium	1710	3000
Yttrium	1490	2500
Zinc	419.47	907
Zirconium	1857	2900

Elements without Master Films Which Have Visible Lines
(Use Angstrom Scale For Identification)

Element	Wave Length	
Dysprosium	4000.4 Å	4211.7 Å
Erbium	5414.6 Å	
Holmium	4882.9 Å	
Lutecium	5476.6 Å	
Ruthenium	4554.51 Å	6923.2 Å
Terbium	4276.71 Å	4278.5 Å
Thulium	4242.1 Å	4359.9 Å
Ytterbium	6667.8 Å	6799.6 Å

Elements Identified With UV/IR Modification

Elements	Wave Length	
Antimony	2528.5 Å	
Arsenic	2860.5 Å	
Boron	2496.7 Å	2497.7 Å
Silicon	2881.5 Å	
Tellurium	2383.2 Å	2385.7 Å

Minimum Detection Limits of Elements identified on the Vreeland Spectroscope

These figures have to be used with some reservation due to the variability of matrix effects.

	%		%
Aluminum	.003	Molybdenum	.001
Barium	.003	Neodymium	.1
Beryllium	.2	Nickel	.01
Bismuth	.01	Osmium	.1
Carbon	No Standards	Palladium	.01 -.05
Cadmium	.05	Platinum	.1
Calcium	.005	Potassium	.05
Calcium Fluoride	.5	Praseodymium	.5
Cesium	.5	Rhenium	.1
Cerium	.05	Rhodium	.1
Chromium	.002	Rubidium	.1
Cobalt	.02	Ruthenium	.1
Columbium	.2	Samarium	.1
Copper	.001	Scandium	.01
Europium	.5	Silver	.003
Gadolinium	.05	Sodium	.0005
Gallium	.01	Strontium	.005
Germanium	.05	Tantalum	.1
Gold	.05	Thallium	.001 -.01
Hafnium	No Standards	Thorium	.5
Indium	.01	Tin	.005
Iridium	.1	Titanium	.002
Iron	.0015	Tungsten	.05
Lanthanum	.05	Uranium	.1
Lead	.0015	Vanadium	.002
Lithium	.002	Yttrium	.01
Magnesium	.003	Zinc	.003
Manganese	.005	Zirconium	.01
Mercury	.1		

Note: 1 part per million = 0.0001%
100 parts per million = 0.01%