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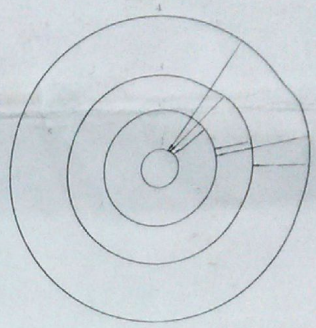
SPECTRUM TUBES



Spectrum tubes contain one or more elements as gaseous atoms or molecules. Energy is supplied through an electric field applied between electrodes at the ends of the tubes. Ions and electrons formed by the field are accelerated; collisions convert the increased kinetic energy to other types, one being electronic. Electrons in energetic or excited atoms occupy one of many well-defined states. An electron with high energy E_3 will return to a lower energy state E_2, simultaneously emitting a photon of energy $E_3 - E_2 = \Delta E = hc/\lambda$; where $h = 6.63 \times 10^{-30}$ J-s is Planck's constant, $c = 3 \times 10^8$ m/s is the speed of light and λ is the wavelength of light (in meters) in the emitted photon.

Each excited atom type emits characteristic wavelengths determined by energy level differences ΔE present in that species. One may observe a particular color with the eye; analysis with a spectrometer will reveal a series of sharp (monochromatic) emission lines.

OBSERVING THE SPECTRA

Spectrum tubes manufactured by Electro-Technic Products, Inc. use research-grade gasses and vapors to provide bright-line spectral lines of the highest clarity. They are designed for optimum intensity and line resolution when examined in a student grade spectrometer equipped with a ca. 200 line/mm (5000 line/inch) diffraction grating.

The pressure of the various gasses in spectrum tubes is a carefully controlled value that will produce the maximum quality of brightness and clarity of the spectral lines.

For some tubes it is not necessarily the same value of pressure that produces maximum continuous operating life of the spectral lines. Tubes should be energized with the Electro-Technic Model SP-200 Spectrum Tube Power Supply, which is made expressly for this purpose. Tube life is extended if operation is cyclic for no more than 30 seconds "on", 30 seconds "off", etc., increasing the usable life of the tubes.

Some tubes using neon, helium and other gases found in cold cathode display signs can run continuously with less deterioration of the quality of the spectral lines. The others, such as hydrogen, the halogens and water vapor, require more care in processing to increase the life. Pure nickel electrodes and the best research grade of gases are used, and meticulous care is taken in processing to increase service life.

However, the tubes all start to contaminate at a very slow rate when used. How soon this can be detected by the user depends on the sensitivity of the measuring equipment. If the tubes are used as recommended and not allowed to get overheated, the useful life, or time it takes to detect contamination with the usual measuring equipment, is very long.

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DESCRIPTIONS OF SPECTRA

Model 4605 HYDROGEN (H_2 gas). Strong violet, blue and red lines are obvious, although others may be seen.

Color	Wavelength, Å
Violet	4200
Violet	4400
Blue	4900
Red	6700
Red	6700

Model 4617 DEUTERIUM (isotopic variant of H_2). Spectrum is the same as for H_2, unaffected by neutron.

Color	Wavelength, Å
Violet	4200
Violet	4400
Blue	4900
Red	6700

Model 4604 HELIUM (He gas). Strong spectrum with 2 violet, 2 green, 1 yellow and 2 red lines being prominent.

Color	Wavelength, Å
Violet	4000
Violet	4000
Violet	4000
Blue	4500
Blue	4550
Blue	4550
Blue	4800
Green	5000
Green	5100
Yellow	5850
Red	6500
Red	6800
Red	7200

Model 4609 NITROGEN (N_2 gas). Strong spectrum of many lines from violet to red.

Color	Wavelength, Å
Violet	4000
Violet	4050
Violet	4100
Violet	4150
Violet	4200
Violet	4250

NITROGEN (Continued)

Violet	4400
Violet	4450
Blue	5000
Blue	5050
Blue	5200
Green	5300
Green	5400
Green	5500
Green	5600
Yellow	5800
Yellow	5850
Yellow	5900
Red	6000
Red	6150
Red	6200
Red	6250
Red	6300
Red	6350
Red	6400
Red	6450
Red	6500
Red	6600
Red	6700
Red	6750
Red	6800
Red	6850

Model 4610 OXYGEN (O_2 gas). Very weak spectrum covering violet, blue/violet, green and red (2 lines) regions.

Color	Wavelength, Å
Violet	4400
Violet	4400
Blue	4900
Green	5250
Green	5400
Green	5400
Green	5500
Green	5650
Red	6150
Red	6250
Red	6600
Red	6650

DESCRIPTIONS OF SPECTRA

Model 4611 WATER (H_2O vapor). Three strong hydrogen lines and weak spectrum from oxygen.

Color	Wavelength, Å
Violet	4300
Violet	4400
Blue	4900
Green	5200
Green	5400
Green	5500
Green	5600
Red	6050
Red	6100
Red	6650

Model 4612 AIR (about 80% N_2, 20% O_2 gases). Strong spectrum is effectively the same as that of pure N_2. See NITROGEN.

Model 4613 CARBON DIOXIDE (CO_2 gas). About 6 intense lines from carbon (C) superimposed on the spectrum from oxygen (O). See CARBONIC ACID.

Model 4602 CARBONIC ACID (H_2CO_3 vapor). Spectrum resembles that of carbon dioxide, plus conspicuous red line from hydrogen.

Color	Wavelength, Å
Violet	4150
Violet	4250
Violet	4450
Violet	4550
Blue	4900
Green	5100
Green	5200
Green	5300
Green	5400
Green	5650
Red	6100
Red	6200
Red	6300
Red	6600

Model 4608 NEON (Ne gas). Strong spectrum of multiple lines in green, yellow, orange, red. Note absence of violet lines. Used in "neon lights".

Color	Wavelength, Å
Blue	4750
Blue	4900

NEON (Continued)

Green	5100
Green	5250
Green	5600
Green	5700
Yellow	5800
Yellow	5900
Yellow	6000
Red	6050
Red	6100
Red	6150
Red	6200
Red	6600
Red	6650
Red	6700
Red	6850
Red	7050
Red	7150

Model 4600 ARGON (Ar gas). Weak multiple lines, most intense in violet, least intense in red.

Color	Wavelength, Å
Violet	4200 (Hazy)
Violet	4400 (Hazy)
Violet	4600
Green	4950
Green	5250
Green	5500
Green	5500
Green	5600
Green	5700
Yellow	5950
Red	6100
Red	6250
Red	6300
Red	6400
Red	6500
Red	6600
Red	6700
Red	6800
Red	7100
Red	7200

Model 4614 KRYPTON (Kr gas). Strong spectral lines in violet, green, orange and red portions.

Color	Wavelength, Å
Violet	4300 (Hazy)
Violet	4400 (Hazy)
Violet	4500
Violet	4550
Blue	4900
Green	5600
Green	5650
Green	5700
Yellow	5900
Red	6100
Red	6300
Red	6500
Red	6650

Model 4616 KRYPTON 86 (^{86}Kr gas). Isotopic variant of naturally occurring krypton, which is mainly ^{84}Kr. Spectrum is not noticeably changed, as with hydrogen and deuterium.

Model 4615 XENON (Xe gas). Weak spectrum of 2 violet and 2 green lines.

Color	Wavelength, Å
Blue	4700
Blue	4700
Green	4850
Green	4850
Green	5000
Green	5000
Red	6250
Red	6400

Model 4607 MERCURY (Hg vapor). Strong spectrum composed of 3 violet, 1 green, 1 yellow and 1 orange lines. Mercury lamps are used as *light sources* for these wavelengths.

Color	Wavelength, Å
Violet	4500
Violet	4500
Violet	4500
Violet	4600
Green	5000
Green	5050
Green	5600
Yellow	5900
Yellow	5900
Red	6100
Red	6250

MERCURY (Continued)

Red	6600
Red	6800
Red	7200
Red	7300

Model 4603 CHLORINE (Cl_2 gas). Medium intensity multiline spectrum from violet to orange, with 3 stronger lines in the blue/green region.

Color	Wavelength, Å
Violet	4450
Violet	4550
Blue	4850
Blue	4850
Green	5100
Green	5200
Green	5200
Green	5400
Green	5450
Green	5700
Yellow	5900
Red	6000
Red	6250
Red	6350
Red	6550
Red	6650

Model 4606 IODINE (I_2 vapor). Strong spectrum with lines so closely spaced that appearance is "blurry", especially in orange/red region.

Model 4601 BROMINE (Br_2 gas). Strong, multiple line spectrum from violet to red, with about 7 prominent lines.

Color	Wavelength, Å
Violet	4200
Violet	4250
Violet	4500
Violet	4500
Blue	4750
Blue	4800
Blue	4800
Blue	4800