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nuclear - chicago

C O R P O R A T I O N

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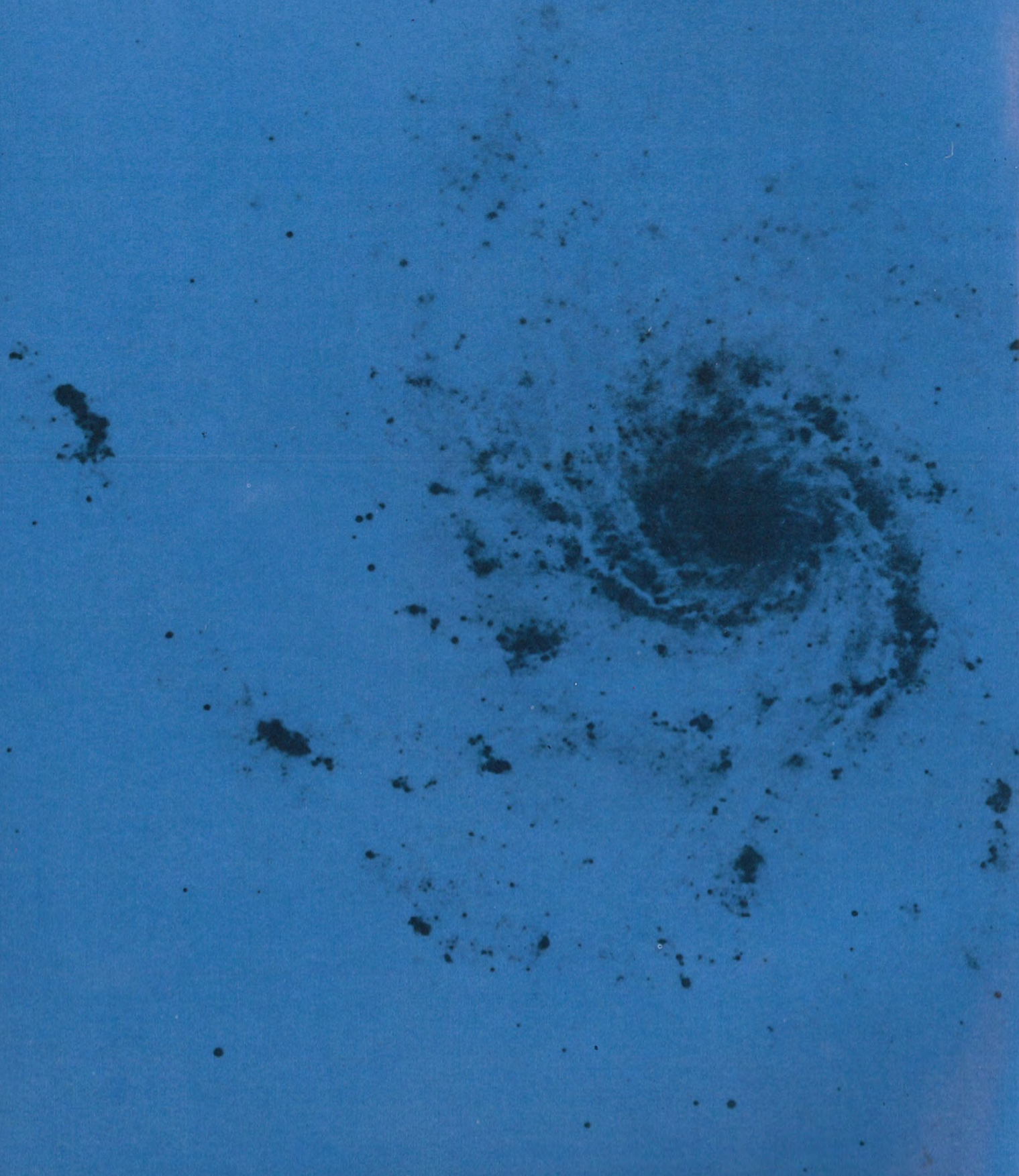
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PRECISION IN



TRUMENTATION FOR NUCLEAR MEASUREMENT

In this catalog is presented the most modern and complete line of quality radiation-measuring instruments manufactured in the world. The largest catalog ever printed by Nuclear-Chicago, it introduces thirty new products, illuminating more clearly than ever before the goal of Nuclear-Chicago: to design and produce the highest quality, most integrated line of nucleonic equipment.

Every attempt has been made to provide a complete line of radioactivity instrumentation from sample preparation aids to elaborate counting devices. Complete laboratory groupings are available for the most simple counting operations to the most complex. Auxiliary monitoring equipment is available to fulfill every need.

An experienced staff of physicists, chemists and engineers is available to advise on instrumentation of a standard or special nature and on the application of nuclear techniques to problems in industrial, medical, and academic fields. Your inquiries regarding the solution of individual problems are invited.

Nuclear-Chicago's chemistry department is prepared to develop on special order all types of radiation sources and products. In addition, more than 160 carbon-14 compounds are available from Nuclear-Chicago either from stock or on short delivery.

Nuclear-Chicago Corporation should be your first stop for complete nucleonic services, instruments, and radiochemicals.



- Nuclear-Chicago's finest scaler, providing unequalled versatility and precision
- one millivolt to 0.8 volt input sensitivity for Geiger, scintillation or proportional counting
- four decades — choice of one or five microseconds resolving time
- automatic built-in preset count and precision preset time circuits
- new, high-speed electrical reset of decades, register, and timer
- regulated wide range high voltage supply variable from 500 to 5000 volts with expanded meter scales

The Ultrascaler is the finest commercial scaling unit ever designed by Nuclear-Chicago. The new instrument may be used with all G-M, scintillation, or proportional detectors, offers a new, wide range high voltage supply, four decade circuits with a choice of one or five microseconds resolution time, a line frequency calibration circuit, a unique new precision timer, preset count and preset time circuits for maximum automatic versatility, and electrical reset of decades, register and timer.

amplifier—The input sensitivity of the wide band, non-overloading amplifier is controlled by fixed attenuators from 1 millivolt to 800 millivolts. A stable Schmitt discriminator circuit permits reproducible counting over long periods of time, while the regulated low voltage power supply greatly increases the overall stability of the entire input circuit. Extreme care has been taken in the design of the amplifier and discriminator circuits to insure freedom from stray pickup and line noise.

decades—The Ultrascaler employs four decade scaling strips followed by a high speed register. Normally supplied with a five-microsecond first decade as Model 192A, the unit is available with a new, ultra-fast one-microsecond first decade as Model 192A-P. This exclusive plug-in circuit employs a *Magnetron Beam Switching Tube* triggered sequentially through its 10 stable states by a fast Eccles-Jordan flip-flop circuit. For those users requiring a *very fast* scale the 192A-P offers an absolutely true one-microsecond resolution time.

register and preset count—The four decades provide maximum scaling factor of 10,000, and additional scaling factors of 10, 40, 100, 400, 1000 and 4000 may be chosen. The special electrically reset register following the decade can totalize 9999. A *preset count* switch enables the user to automatically stop the count after 10, 100, or 1000 registered counts. By properly setting the scale selector switch and the preset count switch the operator can select any one of

Model 192A is shown in use with the C110B Automatic Sample Changer system, D47 gas flow counter, and D47-P Preamplifier. One millivolt sensitivity permits the scaler's use with all G-M, scintillation, or proportional detectors.

possible predetermined count settings ranging from 100 to 10^7 total counts. When the preset count is accumulated, the scaler stops and the elapsed time may be read on the built-in timer which reads to 999.99 minutes. Depressing the reset switch operates electrical reset of the register, timer and decades.

elapsed timer and preset time—The Ultrascaler's new precision timer is absolutely unique, permitting greater timing accuracy and versatility than ever before possible. It allows the user to select (in increments of 0.1 minute) *any* predetermined time setting from 0.1 minute to 999.9 minutes with an accuracy of ± 0.04 second.

Four 10-position switches control the preset time. If the operator wishes to count for 105.8 minutes, the four switches are set to 1, 0, 5, and 8. When this exact time has elapsed, the scaler stops and the accumulated count may be read directly from the register and decades. A repeat count can be immediately taken, since the preset time is fixed until the four switches are changed by the operator. *This precision timer, exclusive with Nuclear-Chicago, is available only on the Ultrascaler and Model 132.*

time-count—The time-count circuit, another exclusive Ultrascaler feature, may be utilized to automatically stop the scaling action at *any* preset time or preset count (depending on which occurs first).

high voltage—The Ultrascaler incorporates a completely new and exclusive continuously variable high voltage supply. The meter scale has two calibrations; one reading from 0 to 2500 volts, the other from 2500 to 5000 volts. The entire range from 0 to 5000 volts can be read with equal facility since each small meter division represents 50 volts. A stand-by switch is provided to reduce the high voltage to zero at any time.

general—Conservative circuit design, the use of quality components, precision workmanship, and a thorough 50 hour test before shipment contribute toward the extreme dependability of the Ultrascaler. The double cabinet provides a generous amount of space for all components, keeps temperatures down to a minimum and allows easy servicing. Where quality, versatility, and reliability are of greatest importance, the Nuclear-Chicago Ultrascaler is the finest choice.



SPECIFICATIONS

range—Four direct reading decade plug-in units with scale selection of 10, 40, 100, 400, 1000, 4000, and 10,000. Choice of one or five microsecond resolution time of first decade.

register—Electro-mechanical register follows decades, can totalize 9999. Preset count circuit can stop scaler after 100, 400, 1,000, 4,000, 10,000, 40,000, 100,000, 400,000, 1,000,000, 4,000,000, or 10,000,000 counts. Register will operate at 1000 counts per minute for periodic pulses.

timer—Odometer type timer reads total of 999.99 minutes with an accuracy of 0.01 minute. Preset time circuit can stop scaler in 0.1 minute increments up to 999.9 minutes. Repeat preset time accuracy is 0.04 seconds.

amplifier sensitivity—Variable from 1 millivolt to 800 millivolts in 18 steps with stable attenuator networks. Separate position provides 0.1 to 0.8 volt input for G-M or scintillation counters. Dynamic range greater than 1000 to 1 at *all* gain settings. 0.25 microsecond amplifier rise time. Stable Schmitt discriminator circuit has one microsecond resolving time to assure low coincidence losses.

amplifier—Single input connector with all switching done internally. Input section shielded and shock mounted. Useful frequency response extends beyond two megacycles, allows high speed counting. Two three-tube feedback loops provide high gain stability and independence of tube aging characteristics. A count rate meter output provides a standardized pulse for operating any count rate meter or another scaler.

power supplies—High voltage continuously variable from 500 to 5000 volts. Depressed zero provides high reading accuracy above 2500 volts. Flutter-free voltage reference tube. Less than 0.002% change in high voltage for 1% line voltage change between 100 and 130 volts. Separate high voltage transformer. Time delay and relay interlock protect Geiger tubes and meter. Regulated low voltage supply with oil-filled condensers in filter section. All transformers electrostatically shielded.

test signal—Line frequency test signal permits operational check at any time.

at rear of chassis—High voltage and master fuses, ground connector, external a-c timer outlet, a-c outlet, external pre-amp connector, auxiliary connector, ratemeter connector, pre-amp input connector, input connector, decade input connector, a-c line cord.

power requirements—200 watts, 115 volts, 60 cycles. Available for 230 volt and/or 50 cycle operation on request.

dimensions—16-13/16" x 20-3/16" x 11 7/8".

weight—120 lbs., shipping weight 135 lbs.

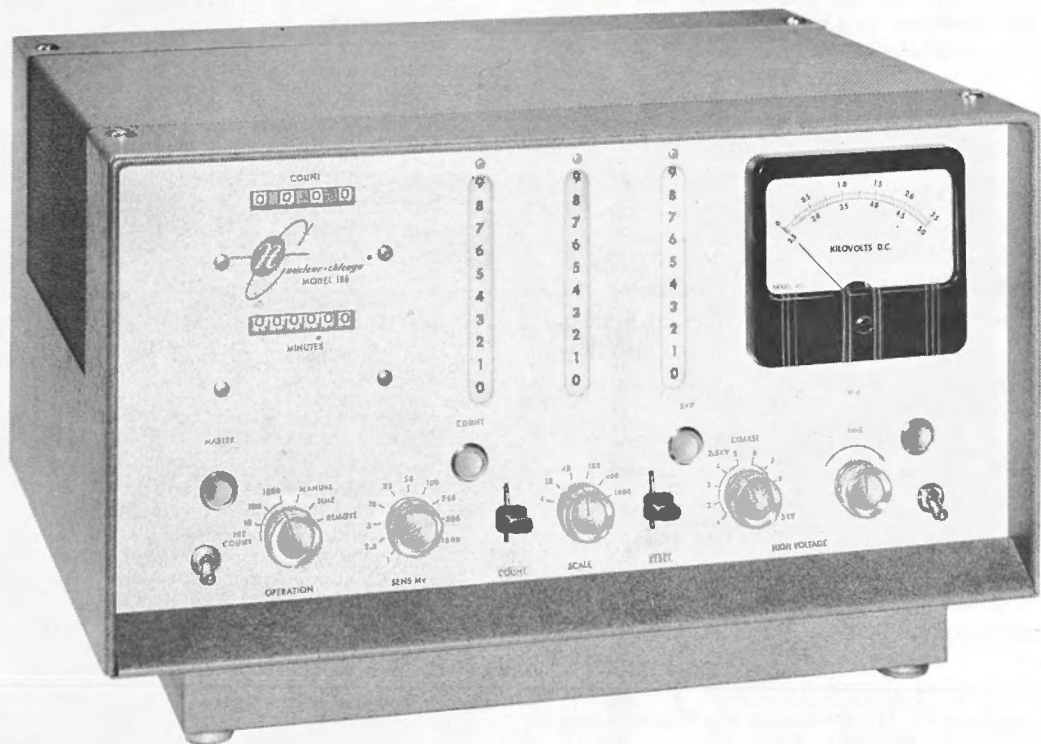
supplied with—PC9, PC10, PC30 cables, PC7 cable adapter, instruction manual.

external detectors—The Ultrascaler may be used with all G-M detectors, Models DS5 series or DS1-A scintillation detectors, D47 Gas Flow Counter (in both the proportional or Geiger regions), AP4 Alpha probe, DN3 Neutron probe, and other radiation detectors.

models available—Model 192A with 5 microsecond first decade. Model 192A-P with 1 microsecond first decade.

DECADE SCALERS

MODELS: 186, 186-P IMPERIAL SCALER



The Imperial Scaler is a completely new, versatile decade scaler for use with all Geiger, scintillation or proportional radiation detectors. The instrument, an outstanding addition to the Nuclear-Chicago scaler line, incorporates an extremely precise wide range high voltage supply, a wide range non-overloading amplifier, three decade scaling strips with choice of the new revolutionary one-microsecond *Magnetron Beam Switching* decade, a built-in preset count circuit, a line frequency test circuit, and high speed electrical reset of the decades, register, and timer. It may be operated manually or by an external system such as the Automatic Sample Changer.

Exceeded only by the Ultrascaler in versatility, the new Imperial is unrivaled among medium priced one millivolt scaling units. Its precision workmanship and brilliant design make it a truly fine addition to any radioisotope laboratory where Geiger, scintillation, or proportional counting is done.

amplifier—A new simple non-overloading amplifier has been designed for the Imperial. Input sensitivity is controlled by a single 11 position selector switch from 1 millivolt to 1000 millivolts with a standard 0.25 volt position for G-M counters. The entire input circuit is shock mounted and shielded from pickup or dust. All components are conservatively rated for 1 millivolt input at 5000 volts. The scaler low voltage supply is electronically regulated with long lived full-wave selenium rectifiers to guarantee amplifier reliability and discriminator threshold stability.

decades—The Imperial Scaler employs three decade scaling strips followed by a high speed register to indicate total counts recorded. The instrument, normally supplied with a five-microsecond first decade circuit as Model 186, is also available with a new one-microsecond first decade as Model 186-P. Employing a *Magnetron Beam Switching Tube* in an exclusive decade design which assures high reliability and true one-microsecond resolution, the 186-P is recommended for all those requiring an extremely fast scaler for scintillation and proportional counting.

register and preset count—The three decades provide a maximum scaling factor of 1000. Additional scaling factors of 4, 10, 40, 100 or 400 may be chosen with the scale selector switch. The high-speed four-digit register following the decades reads to 9999. The operator can automatically stop the scaling action with the *preset count* switch after 10, 100, or 1000 register counts have been accumulated. This switch, in combination with the scale selector switch, enables the user to select any one of 10 possible predetermined count settings ranging from 40 to 10^6 total counts. When the preset count has been accumulated, the scaler automatically stops and the elapsed time may be read on the built-in 6-digit timer.

elapsed timer and preset time—The Imperial Scaler is supplied with an elapsed time clock which is actuated at the start of a counting run and reads to 9999.99 minutes maxi-

Model 186 Imperial Scaler is shown with the Model DS5-5 Scintillation Well Counter for measurement of gamma emitting liquid samples.

- one millivolt to one volt input sensitivity for Geiger, scintillation, or proportional counting
- three decades — choice of one or five microseconds resolving time
- automatic built-in preset count circuit with provision for connecting an external preset timer
- new, high-speed electrical reset of decades, register and timer
- regulated wide range high voltage supply variable from 500 to 5000 volts with expanded meter scales.

mum. This timer, the register, and the decades can be electrically reset to zero by stopping the count and depressing the reset switch.

A connector is provided at the rear of the instrument to accept a T1 Timer for preset time operation. The T1 may be used to preset the counting time at any 1/2 second increment between two seconds and 60 minutes. The scaler automatically stops counting when the preset time has elapsed.

high voltage—Models 186 and 186-P incorporate the new and exclusive 500 to 5000 volt supply available only on the Imperial and Ultrascaler lines. This range, wide enough for all commercially available radiation detectors, is precisely controlled by a 10 position coarse switch and continuously variable fine control. The high voltage meter has two 50 division calibrations; one reading from 0-2500 volts, the other from 2500 to 5000 volts. A panel light glows when the higher scale is to be read. The depressed zero provides high reading accuracy.

The high voltage may be reduced to zero at any time by means of the stand-by switch.

general—Only slightly less versatile than the Ultrascaler, the Models 186 and 186-P Imperial Scalers incorporate the finest, conservatively rated components, the most modern design, and careful workmanship and testing. Either of these instruments is an excellent choice for laboratories doing Geiger, scintillation, or proportional counting.



SPECIFICATIONS

range—Three direct reading decade plug-in units with scale selection of 4, 10, 40, 100, 400, and 1000. (When one-microsecond decade is used, 4 position is inoperative). Choice of one or five microsecond resolution time of first decade.

register—Electro-mechanical register follows decades, can totalize 9999. Preset count circuit can stop scaler after 40, 100, 400, 1,000, 4,000, 10,000, 40,000, 100,000, 400,000 or 1,000,000 counts. Register will operate at 1000 counts per minute for periodic signals.

timer—Odometer type timer reads total of 9999.99 minutes with an accuracy of 0.01 minute. External T1 timer may be utilized for preset time operation.

amplifier sensitivity—Variable from 1 millivolt to 1000 millivolts in 10 fixed steps (1, 2.5, 5, 10, 25, 50, 100, 250, 500, 1000) with 1% attenuators. Separate switch position for applying line frequency signal to check scaler operation.

amplifier—Input section shielded and shock mounted. Will handle wide range of pulse shapes without double pulsing. Single teflon input connector. 0.25 microsecond amplifier rise time. Useful frequency response extends beyond 2 megacycles, allows high speed counting. Approximately 20 d.b. effective feedback. Clipping time of 2.2 microseconds. Low impedance preamplifier input. Regulated supply voltage for stability and freedom from transients. Stable Schmitt discriminator provides exceptional reproducibility.

power supplies—High voltage continuously variable from 500 to 5000 volts with coarse and fine controls. Depressed zero on 2500-5000 volt range provides high reading accuracy above 2500 volts. Flutter-free voltage reference tube. Less than 0.002% change in high voltage for 1% line voltage change between 100 and 130 volts. Separate high voltage transformer. 30 second time delay interlock prevents overshoot and protects radiation detectors and meter. Regulated selenium rectifier low voltage supply with long life condensers in filter section. All high and low voltage transformers electrostatically shielded.

at rear of chassis—High voltage and master fuses, ground connector, a-c power outlet, auxiliary connector for T1 timer or Automatic Sample Changer operation, ratemeter connector, pre-amp power connector, signal input connector, a-c line cord. Pre-amp connector permits use of all input sensitivities.

power requirements—145 watts, 115 volts, 60 cycles. Available for 230 volt and/or 50 cycle operation on request.

dimensions—11 1/4" x 19 1/8" x 16".

weight—55 lbs., shipping weight, 65 lbs.

supplied with—PC10 cable, adapter, and instruction manual.

external detectors—The Imperial may be used with all G-M detectors, Models DS5 series or DS1-A scintillation detectors, D47 Gas Flow Counter (in both the proportional or Geiger regions), AP4 Alpha probe, DN3 Neutron probe, and other radiation detectors.

models available—Model 186 with 5 microsecond first decade. Model 186-P with 1 microsecond first decade.

DECADE SCALERS

MODELS: 181A, 181A-P



The new Royal Scaler is a completely revised and improved version of our previous Model 181 Decade Scaler. The new instrument has all of the features of the older unit and in addition offers more scaling factors, an entirely new circuit to provide a wide choice of predetermined count settings, and a choice of one or five microseconds resolution time.

A stable, wide-range high voltage supply, one-quarter volt input sensitivity, and a connector providing voltages for operation of a preamplifier circuit permit the instrument's use with all commercially available Geiger or scintillation detectors. The unit also features a line frequency test circuit to check proper decade operation at any time.

decades—The instrument, normally supplied with a five-microsecond first decade as Model 181A, is available as Model 181A-P with a new and exclusive one-microsecond first decade for those requiring a very fast resolution time. This one-microsecond decade circuit is identical to that offered with the more elaborate 192A-P and 186-P scalers. It employs a revolutionary *Magnetron Beam Switching Tube* which is triggered sequentially through its 10 stable states by a fast Eccles-Jordan flip-flop circuit. We recommend the 181A-P for those users counting at very high rates with a scintillation counter, while the 181A is recommended for

normal scintillation counter work and for those using a Geiger counter.

register and preset count—The three decades provide a maximum scaling factor of 1000, with additional scaling factors of 4, 10, 40, 100, and 400 provided. A special high-speed 4-digit register follows the decades. A *preset count* switch enables the operator to stop the scaling action after 10, 100, or 1000 register counts. By properly setting the scale selector switch and the preset count switch the user can select any one of 10 possible predetermined count settings ranging from 40 to 1,000,000 total counts. When the preset count is accumulated, the scaler automatically stops and the elapsed time may be read on an external T101 or T1 timer. Depressing a single reset lever at the end of a counting run zeros the decades and register.

elapsed timer and preset time—The scaler is provided with connectors at the rear of the chassis to accept either a T101 elapsed time clock or an elapsed time clock and preset timer such as the T1. The use of a T1 is recommended since it enables the operator to preset accurately the counting time at any $\frac{1}{2}$ second increment between two seconds and 60 minutes. The scaler then records the number of disintegrations detected during this time interval and automatically stops counting when the time has elapsed.

ROYAL SCALER

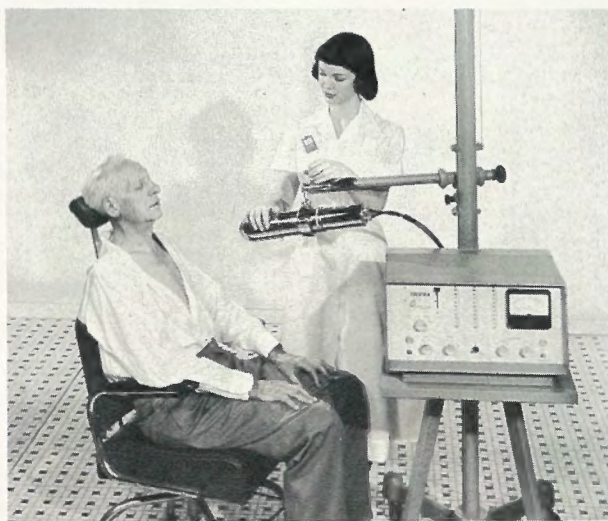
- 0.25 volt input for Geiger or scintillation counting
- automatic built-in preset count circuit with provision for connecting an external preset timer
- three decades — choice of 1 or 5 microsecond resolving time
- regulated high voltage variable from 400 to 3000 volts

high voltage supply—A special R-F type high voltage supply is used. It is well regulated, shielded, and stabilized, and continuously variable with coarse and fine controls from 400 to 3000 volts. The high voltage is read on the four-inch panel meter which is calibrated to within $\pm 2\%$ of full scale.

general—The new Models 181A and 181A-P scalers are the most versatile and outstanding low-cost decade scalers available today. These instruments, among the most popular in the Nuclear-Chicago line, feature simplicity of operation, ease of reading, and reliable, trouble-free operation. The new one-microsecond decade supplied with the 181A-P is truly a Nuclear-Chicago first, while the new scaling factors and preset count circuit offer the user exceptional versatility in such an economically priced instrument.

The 181A and 181A-P are recommended for all applications where a decade indication is preferred and where the likelihood of future use of a proportional detector is low. Diagnostic and therapeutic clinical tests, radiochemical studies, and routine sample counting either with a manual or automatic sample changer are easily made with the 181A or 181A-P scalers. Low power dissipation resulting from the use of selenium rectifiers, reliably rated circuit components, and careful overall construction techniques assure high reliability and provide exceptionally long operational life.

Model 181A is often chosen for clinical work. It is shown with the Model SA1-A Stand and Model DS5-2 Scintillation Detector.



SPECIFICATIONS

range—Three direct reading decade plug-in units with scale selection of 4, 10, 40, 100, 400 and 1000. Choice of one or five microsecond resolution time of first decade.

mechanical register—Register follows scaling circuit, can totalize 9999. Preset count circuit can stop scaler after 40, 100, 400, 1000, 4000, 10,000, 40,000, 100,000, 400,000, or 1,000,000 counts (on Model 181A-P the 40 position is inoperative). High speed register will operate at 1000 counts per minute for periodic signals.

reset—Single lever is depressed to zero register and decades.

external timer—Provision has been made for connecting either a Model T101 timer for indicating elapsed time or a Model T1 dual timer to indicate elapsed time, or for predetermined time operation.

amplifier sensitivity—Factory set at 0.25 volt. Can be varied with screwdriver chassis adjustment from 0.1 to 1.0 volt.

high voltage—Well shielded R-F type high voltage supply, continuously variable with coarse and fine panel controls from 400 to 3000 volts. Stabilization is such that there is only 0.01% change in high voltage for 1% change in line voltage between 100 and 130 volts. High voltage supply will deliver 300 microamperes to load at 3000 volts. A 250 volt adjustment is provided by the fine control. A stabilized B+ supply is provided with amplifier and high voltage stabilizer circuit.

at rear of chassis—Auxiliary connector for Automatic Sample Changer or remote T1 timer, timer outlet, pre-amp power connector, oscilloscope connector, fuses, counter input connector, high voltage connector, line cord.

power requirements—110 watts, 115 volts, 50-60 cycles. Available for 230 volt operation on request.

dimensions—11 $\frac{1}{4}$ " x 19 $\frac{1}{8}$ " x 16".

weight—31 lbs., shipping weight 38 lbs.

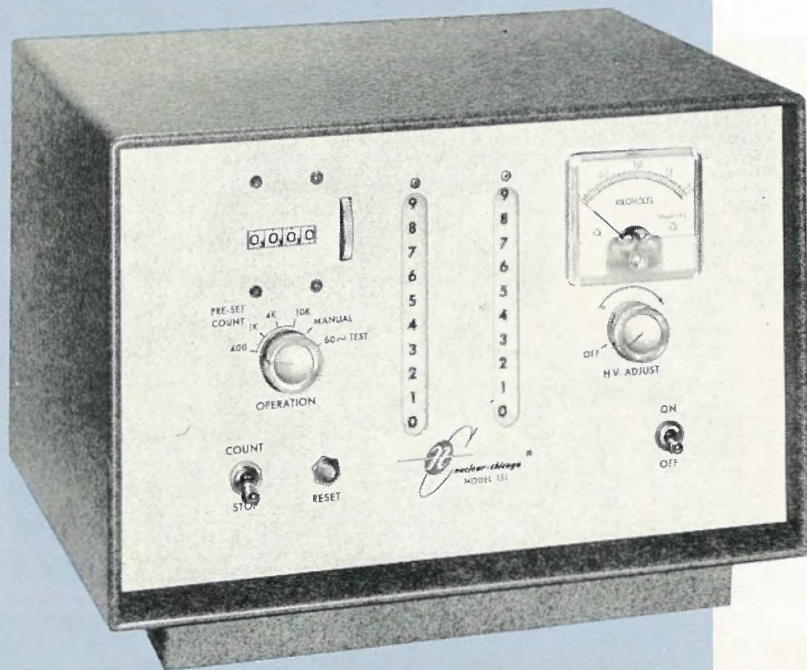
supplied with—PC10 cable and instruction manual.

external detectors—The Royal scaler may be used with all G-M detectors, Models DS5 series or DS1-A scintillation detectors, D47 Gas Flow Counter (in the Geiger region), AP4 Alpha probe, DN3 Neutron probe, and other radiation detectors.

models available—Model 181A with five microsecond first decade. Model 181A-P with one microsecond first decade.

DECADE SCALER

MODEL 151 BASIC DECADE SCALER



- for use with all Nuclear-Chicago G-M or scintillation detectors
- decade indication with fast 4-digit register
- automatic built-in preset count circuit with provision for connecting an external preset timer
- regulated high voltage variable from 500 to 2000 volts

SPECIFICATIONS

input sensitivity—0.25 volt negative pulse. Chassis control permits adjustment from 0.15 to 3 volts.

resolving time—Five microseconds for pulse pairs. Maximum steady repetition rate is 100 kc/sec. Coincidence loss of 1% for average count rate of 100,000 counts per minute.

scaling factor—Decade scale of 100 for manual counting. Four-digit register allows total count storage of 999,999.

predetermined count—400, 1000, 4000 and 10,000 give standard errors of 5, 3.2, 1.6, and 1%.

maximum register speed—17 per second.

line test—Internal test signal allows counting line frequency with scale of 100.

high voltage supply—Continuously variable from 500 to 2000 volts. Meter accuracy within $\pm 2\%$ of full scale. Regulation of 0.1% for line voltage changes from 105-130 volts. Will supply a minimum of 500 to 200 microamperes between voltage limits stated. With loads less than 50 microamperes the supply will regulate at 2000 volts. Simple modification required to deliver higher currents at 2000 volts for use with Model 1810 Radiation Analyzer. Uses separate high voltage transformer. A 30-second time delay relay protects G-M tubes. Stand-by switch reduces counter voltage to zero when not counting.

connectors—Auxiliary 9-pin connector for T1 preset timer, counter input connector, pre-amp power connector, T101 timer outlet.

fuses—Separate high voltage and low voltage fuses.

power requirements—70 watts, 115 volts, 50-60 cycles. Available for 230 volt operation on request.

dimensions—11-11/16" x 9 7/8" x 13-5/16"

weight—25 lbs., shipping weight 31 lbs.

external detectors—The 151 Basic Decade Scaler may be used with all G-M detectors, Models DS5 series or DS1-A scintillation detectors, D47 Gas Flow Counter (in the Geiger region), AP4 Alpha probe, DN3 Neutron probe, and other G-M or scintillation detectors.

supplied with—Instruction manual and PC11 cable.

The Model 151 Basic Decade Scaler is a new addition to Nuclear-Chicago's complete line of scaling units. Designed especially for those wishing to enter the radioactivity field with a minimum of capital outlay, the instrument is also ideal as a precision training unit or as a stand-by unit for peak work loads. Thoroughly field tested for precision and ruggedness, it contains the same reliable decade circuits used in our more expensive decade scaling instruments.

The most versatile scaler in its price class, the Model 151 may be used with every Geiger or scintillation counter shown in this catalog. It is an excellent choice for those laboratories wanting to determine the feasibility of a radioactive approach without great expense. It is designed for easy operation, and is a complete unit requiring only a radiation detector and a Model T1 or Model T101 timer.

features—The instrument features (1) two plug-in decade scaling circuits providing a scaling factor of 100, (2) a high-speed four-digit manually reset register, (3) a line frequency test signal for checking proper scaling action, (4) continuously variable high voltage supply, (5) provision for connecting either a T101 elapsed time clock or a T1 elapsed time clock and preset timer, and (6) a predetermined count circuit which may be set to automatically stop the scaler after 400, 1000, 4000 or 10,000 total counts.

The low initial cost and low maintenance of the Model 151 make it the answer to many budget problems, and its lightweight and portability make it easy to move around between laboratories or counting locations.

MODEL 2800 PORTABLE SCALER

SPECIAL DECADE SCALER

- for precision measurement of radioactivity in field or laboratory use
- supplied with internal batteries for field use or may be operated directly from an a-c line
- for use with Geiger, scintillation, and proportional detectors
- five glow-tube decades read to 99,999 total counts
- spring wound preset timer



SPECIFICATIONS

range—Five glow-tube decades provide scaling range of 100,000. Maximum steady repetition rate is 6000/sec. Resolution for pulse pairs 125 μ sec.

reset—A push-button reset is provided to zero all five decades.

timer—A built-in spring wound timer provides a predetermined time counting range from 0.25 minutes to 6 minutes, incorporates stop-count switch. Repeat accuracy within 1.5% over a range from 30° F to 125° F.

amplifier—Accepts negative input pulses. Sensitivity (internal adjustment) from 30 to 300 millivolts, factory set at 0.25 volts. Amplifier rise time is 1.5 microseconds. D-C coupled bistable discriminator multivibrator has constant threshold with change in supply voltage.

high voltage—Adjustable over the range from 700 to 1300 volts by internal screwdriver adjustment. Long term stability within 2%. Regulation within 1/2% for maximum supply voltage variations. Maximum load current cannot exceed 10 μ amperes. Ripple and noise will not produce spurious counts.

power supply—Choice of battery or a-c line operation is provided by master switch with Battery, Off, and AC positions. A 6 ft. a-c line cord is provided. In Battery position the unit is powered from a 6 volt Willard rechargeable battery and a vibrator transformer power pack. Battery life on continuous use or more than 4 hours per day is 35 hours. Discharge is indicated by a test switch and panel light which indicates when the battery needs recharging. An automatic charger recharges the battery whenever the unit is plugged into the a-c line. A complete recharge is easily obtained over a 36 hour period, and a typical full day's use overnight. Power components are long lived semi-conductor variety.

test—A line frequency or vibrator frequency test position may be used to check scaler at any time.

power requirements—6 volts d-c at 1 ampere or 115 volts, 50-60 cycles at 10 watts. 230 volt a-c operation on request.

dimensions—12" x 11" x 8". Unit is housed in a rugged aluminum cabinet with detachable cover and carrying handle.

weight—26 lbs., shipping weight 33 lbs.

supplied with—6 ft. a-c line cord, spare fuses, batteries, and instruction manual.

The Nuclear-Chicago Model 2800 Portable Scaler is a unique, precision instrument which performs with equal high accuracy from its self-contained rechargeable battery or from an a-c line. Designed to operate over an ambient temperature range from 15° F to 125° F, it is ideal for field work in soil moisture and density determinations, in upgrading uranium ore at the mine, and in other industrial, medical and biochemical applications where a-c power may be unavailable.

features—The instrument features (1) a wide band feedback pulse amplifier, (2) five glow-tube decades providing a scaling range of 100,000 with push-button reset, (3) a test position for checking decade operation at any time, (4) a spring wound timer providing a predetermined time counting range from 0.25 to 6 minutes with a stop-count switch for manual counting, (5) a regulated high voltage supply, (6) a self-contained battery charger regulator with automatic controls to prevent over-charging, and (7) a Battery, Off, AC master switch.

The counter voltage is normally variable from 700 to 1300 volts by an internal control. This range can be modified for specific counters. In field use the unit is powered from an internal rechargeable battery and a unique vibrator-transformer power pack.

Model D34 (or similar) mica end window counters with the P11 Probe are suggested as accessories for hand counting, while the D34 may be used with the 3053 lead shield and Model 2800 for radioactive sample counting.

BINARY SCALING UNITS

MODEL: 183B COUNT-O-MATIC



- 0.25 volt input for Geiger or scintillation counting
- binary scale of 256
- chassis switch provides choice of 1 or 5 micro-seconds resolution
- high voltage variable from 500 to 2500 volts
- new, high speed electrical reset of decades, register and timer
- automatic built-in preset count circuit with provision for connecting an external preset timer

Model 183B Count-O-Matic scaler is often chosen as the nucleus of a new counting laboratory. It is illustrated with the Model 3053 manual sample changer which contains a D34 thin-window Geiger counter.



SCALER

The Model 183B Count-O-Matic binary scaler is one of the most popular scaling instruments in the Nuclear-Chicago line. Its wide use by physicians, biochemists and research workers is due to its well-known reliability, versatile automatic features, and wide range of scaling factors.

Ideally suited for both Geiger and scintillation counting, the Model 183B incorporates a regulated high voltage supply, eight diode coupled binary scaling stages, a line frequency test circuit for checking proper operation of the scaling stages, a built-in preset count circuit, electrically reset register and timer, and provision for connecting an external Model T1 timer for preset time operation.

scaling stages—Eight binary scaling stages provide an electronic scaling factor of 256. A scale selector switch permits selection of scaling factors of 4, 8, 16, 32, 64, 128, or 256. An exclusive feature of the Model 183B is a chassis switch which provides a choice of 1 or 5 microseconds resolution time.

register and preset count—A high speed mechanical register follows the scaling stages and reads to 9999. A preset count switch enables the user to automatically stop the scaling action after 10, 100, or 1000 register counts. By properly setting the scale selector switch and the preset count switch the operator can select any one of 21 possible predetermined count settings between 40 and 256,000 counts. When the preset count is reached, the scaler stops and the time required to accumulate the count is read on the timer.

elapsed timer and preset time—Model 183B is supplied with a built-in elapsed time clock which is actuated at the

start of a counting run and reads to 9999.99 minutes. A connector at the rear of the instrument is provided to accept a Model T1 Timer for presetting the counting time at any $\frac{1}{2}$ second increment between two seconds and 60 minutes. The scaler automatically stops counting when the preset time has elapsed. Any count accumulated during this time interval is then read from the register and interpolation lamps.

high voltage—The instrument incorporates a well regulated high voltage supply which is continuously variable with a coarse and a fine control from 500 to 2500 volts. This range is more than adequate for Geiger or scintillation detectors. High voltage is indicated on a four-inch panel meter calibrated to within $\pm 2\%$ of full scale. The high voltage may be reduced to 300 volts at any time without changing the coarse and fine controls by simply turning the operation switch into the *stand-by* position.

general—The Model 183B Count-O-Matic scaler is an excellent and logical choice for any work program in which Geiger or scintillation counters are used and where a binary presentation is preferred. The short resolving time and scaling factor of 256 make possible rapid counting with low coincidence losses. The automatic counting features of the instrument make it extremely useful in clinical procedures such as thyroid uptake studies or scintillation well counting applications, and in routine soft beta sample counting with either a Model D47 Gas Flow Counter or a thin window counter. The large number of scaling factors make the 183B ideal for use with the Model C110B Automatic Sample Changer and Model 1700 Isotope Scanner.

SPECIFICATIONS

range—Diode coupled binary scale of 256, with scale selection of 4, 8, 16, 32, 64, 128, and 256 followed by four-digit built-in mechanical register.

timer—Odometer type timer reads total of 9999.99 minutes with an accuracy of 0.01 minute. External Model T1 timer may be utilized to stop scaler at any predetermined time between two seconds and 60 minutes.

amplifier sensitivity—Factory set at 0.25 volt. Can be varied with screwdriver chassis adjustment from 0.15 to 2 volts.

resolving time—Choice of resolution times of one or five microseconds by chassis switch. One microsecond resolution time used for fast scintillation counting, five microseconds for normal use where high reliability is most important.

high voltage—Continuously variable between 500 and 2500 volts, with coarse and fine controls. Four inch expanded scale meter. Sealed transformer and sub-mounted rectifier tubes provide high reliability. Flutter-free voltage reference tube. Regulation is such that there is less than 0.002% change in high voltage for 1% line voltage change between 100 and 130 volts. High voltage on-off and stand-by positions provided.

test signal—Line frequency test signal permits check of scaling stages.

predetermined count—Pre-count switch of 10, 100, or 1000 times the scaling factor provides wide range of predetermined count settings (ranging from 40 to 256,000 counts). Scaler may be set to stop automatically when predetermined number of counts have been accumulated.

at rear of chassis—High voltage and master fuses, external a-c timer outlet, high voltage connector, auxiliary connector for remote operation with Model C110B Automatic Sample Changer, preamplifier power connector, oscilloscope connector, input connector, a-c line cord.

power requirements—185 watts, 115 volts, 60 cycles. Available for 230 volt and/or 50 cycle operation on request.

dimensions—11 $\frac{1}{4}$ " x 19 $\frac{1}{8}$ " x 16".

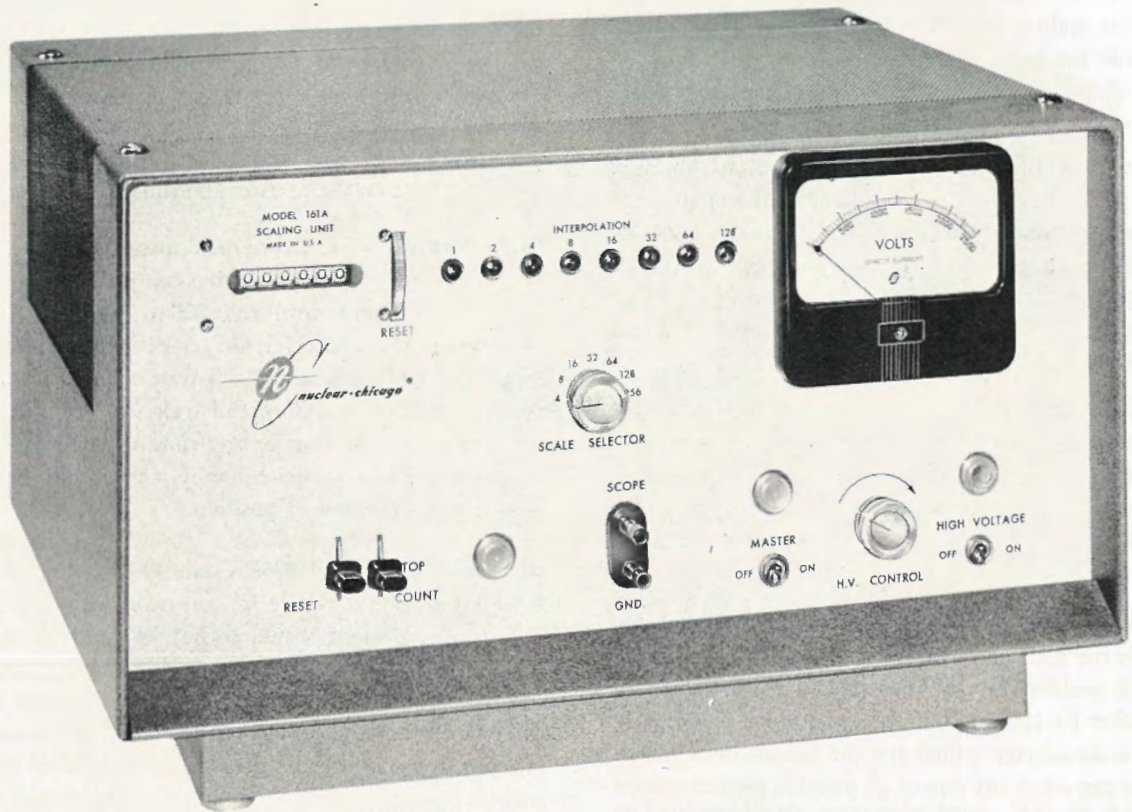
weight—61 lbs., shipping weight 68 lbs.

external detectors—Model 183B may be used with all G-M detectors, Models DS5 series or DS1-A scintillation detectors, D47 Gas Flow Counter (in the Geiger region), AP4 Alpha Probe, DN3 Neutron Probe, and other G-M or scintillation detectors.

supplied with—PC10 cable and instruction manual.

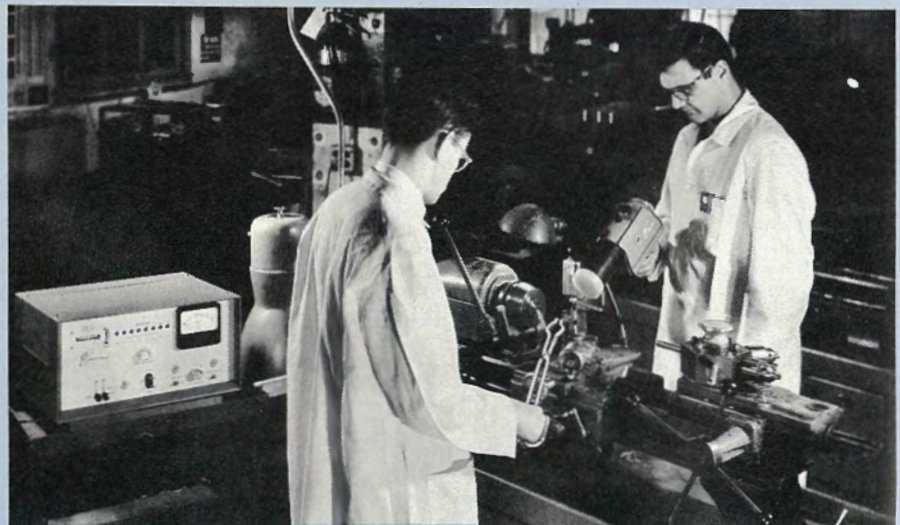
BINARY SCALING UNITS

MODEL: **161A** BASIC BINARY



- 0.25 volt input for Geiger or scintillation counting
- binary scale of 256
- high voltage variable from 500 to 2500 volts
- provision for connecting an external preset timer
- manually reset register
- simple, highly reliable circuitry

Model 161A is an economical, precision unit for use with Geiger or scintillation detectors. It is shown in use with the DS5-5 scintillation well counter to measure the wear of a radioactive tool bit.



SCALER

The Nuclear-Chicago Model 161A Basic Binary Scaler is an economical, precision counting instrument designed for use with either Geiger or scintillation detectors. Its low cost, extreme reliability and simplicity of operation have contributed toward making it the most popular scaler in the Nuclear-Chicago line.

The instrument has found wide use in diagnostic and therapeutic procedures in medical applications, in radiochemical studies, in assay work, and in many other routine radioactivity counting jobs. A regulated high voltage supply, one-quarter volt sensitivity, and preamplifier power permit the instrument's use with all commercially available Geiger or scintillation detectors. The wide range of scaling factors provided by this instrument make it ideal for use with the Model C110B Automatic Sample Changer and with the Model 1700 Isotope Scanner.

The use of quality components, simple circuits, and careful overall construction assure high reliability and accuracy over long periods of use. As with all the other scalers in the Nuclear-Chicago line, a thorough 50-hour operating test is made on each instrument before shipment.

scaling stages—Eight binary scaling stages provide an electronic scaling factor of 256, and the scale selector switch may be used to select additional factors of 4, 8, 16, 32, 64, or 128. The total recorded count is determined by multiplying the scaling factor by the register reading and adding the numbers of the lighted interpolation lamps.

register—A high speed mechanical register follows the

binary scaling stages and can totalize 999,999 counts. A manually operated reset wheel is provided to zero the register at the end of a count.

elapsed time and preset time—Connectors at the rear of the 161A are provided to accept either Model T-101 elapsed time clock or Model T1 elapsed time clock and preset timer. The use of a T1 is recommended since it enables the operator to read not only elapsed time but also to preset the counting time at any $\frac{1}{2}$ second increment between two seconds and 60 minutes. When the preset time has elapsed, the scaler automatically stops counting. Any count accumulated during this time interval is then read from the register and interpolation lamps.

high voltage—Model 161A incorporates a well regulated high voltage supply which is continuously variable with a front panel control from 500 to 2500 volts. This wide range is sufficient to cover the operating plateau of all commercially available Geiger and scintillation detectors. High voltage is indicated on the four-inch panel meter which is calibrated to within $\pm 2\%$ of full scale.

general—The Model 161A, although lacking many of the automatic features of other Nuclear-Chicago scalers, is a sturdy, reliable, and precision instrument for radioactivity measurements. Designed for easy operation, it is an excellent choice for training purposes, or for any radioisotope laboratory as a second scaler. Its high dependability and simplicity, combined with its initial low cost, make it an ideal nucleus of any radioactivity measuring laboratory.

SPECIFICATIONS

range—Diode coupled binary scale of 256, with scale selection of 4, 8, 16, 32, 64, 128, and 256 followed by six-digit built-in mechanical register.

mechanical register—High speed register follows scaling circuit, can totalize to 999,999. Register will operate at 1000 counts per minute for periodic signals.

external timer—Connectors are provided at the rear for either Model T-101 or T1 Timers.

amplifier sensitivity—Factory set at 0.25 volt. Can be varied with screwdriver chassis adjustment from 0.1 to 0.75 volt.

resolving time—Five microseconds for paired pulses. As many as 120,000 counts per minute result in less than 1% coincidence loss.

high voltage—Continuously variable from 500 to 2500 volts with front panel control. High voltage is well stabilized and filtered and is indicated on a four-inch panel mounted meter. Regulation is such that there is less than 0.01%

change in high voltage for a 1% change in line voltage between 100 and 130 volts.

connectors—Scope connector on front panel. Counter input, pre-amplifier connector, timer outlet, high voltage connector, auxiliary connector for remote operation with Models T1 Timer or C110B Automatic Sample Changer, normal-remote switch, master fuses, and line cord on rear panel. High voltage fuse on chassis.

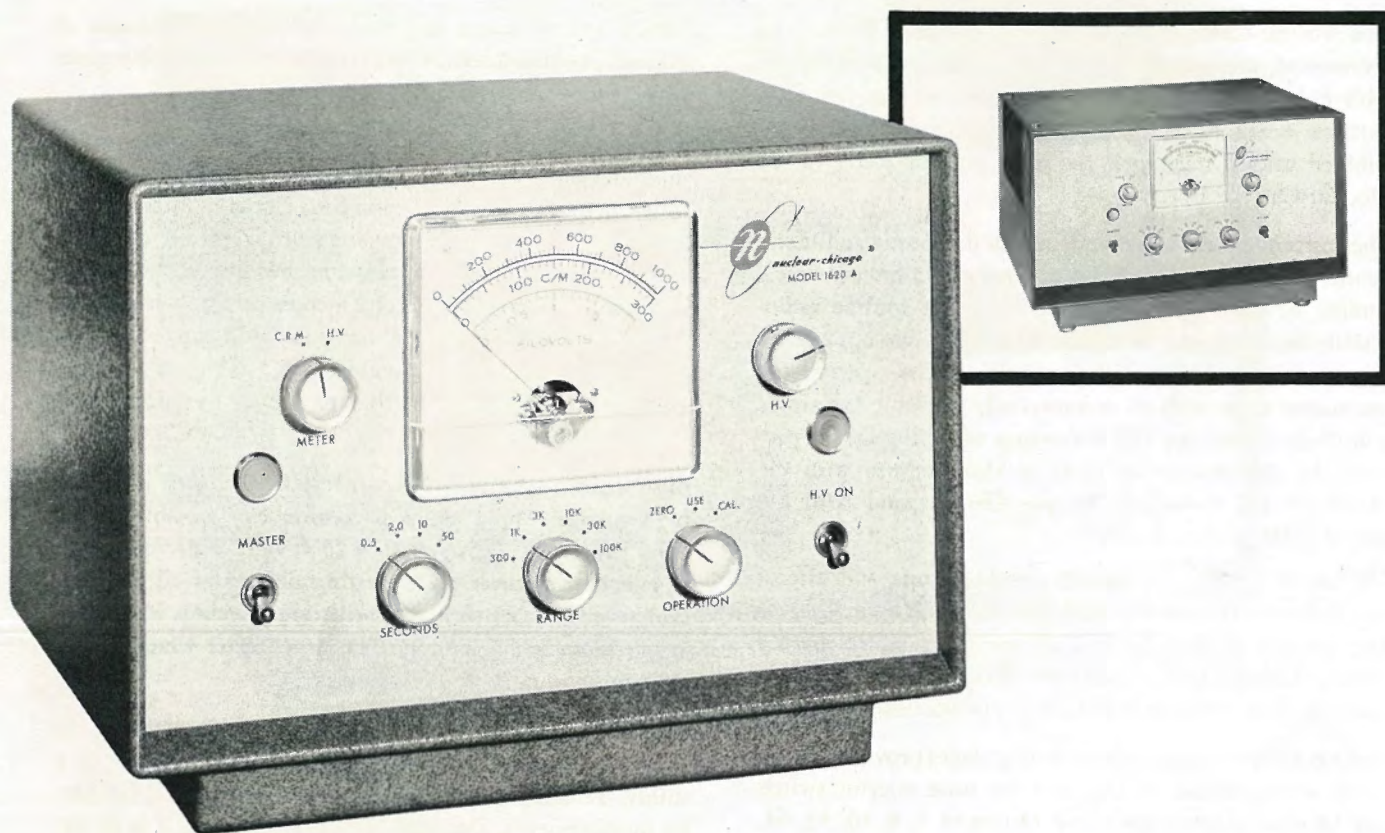
power requirements—150 watts, 115 volts, 50-60 cycles. Available for 230 volt operation on request.

dimensions— $11\frac{1}{4}$ " x $19\frac{1}{8}$ " x 16".

weight—53 lbs., shipping weight 61 lbs.

external detectors—Model 161A may be used with all G-M detectors, Models DS5 series or DS1-A scintillation detectors, D47 Gas Flow Counter (in the Geiger region), AP4 Alpha Probe, DN3 Neutron Probe, and other G-M or scintillation detectors.

supplied with—PC10 cable and instruction manual.



The Model 1620A Analytical Count Rate Meter is an outstanding, precision integrating instrument for accurate radioactivity measurements. Designed for use with Geiger or scintillation detectors, it converts their randomly occurring pulses into average count rate per minute, and presents this average on the large panel meter.

A ratemeter type of presentation is more convenient and informative than a scaler presentation for many nuclear applications. Model 1620A is particularly suited for measurement of flow or diffusion of radioactivity. Changes in count rate are quickly indicated and immediately obvious, while permanent chart recordings of activity are easily made by utilizing an external chart recorder.

range—Six full scale ranges of 300, 1000, 3000, 10,000, 30,000, and 100,000 counts per minute are provided, with separate scales for highest reading accuracy. Basic circuit non-linearity from zero to full scale is less than 0.25%. An exclusive Nuclear-Chicago feature is an individual chassis calibration control for each range with an additional master calibration control which normally compensates for any small calibration shifts which might occur.

Resolution losses are less than 1% on all ranges. A high gain, completely fed-back amplifier provides linearity and independence of tube characteristics. The meter is part of a balanced bridge arrangement to achieve stability for line voltage changes. Overall ratemeter linearity is primarily determined by the 2% accuracy of the meter.

time constants—Four time constants of 0.5, 2.0, 10, or 50 seconds may be chosen. The shorter time constants are used when changes in count rate are of interest, and the longer when the overall average counting rate is of primary importance. A quick charge circuit for the unused condensers allows equilibrium times to be reached quickly. Probable error readings as low as 2.5% can be obtained within a few seconds on the 300 cpm range by utilizing this feature.

calibration and meter zero—The operation switch, set at USE for normal operation, has zero and line frequency calibration positions. The meter is provided with a red check mark at 3000 cpm (for 50 cycle operation) and at 3600 cpm (for 60 cycle operation). Calibration and meter zero are exceptionally stable. Master calibration and zero set potentiometers are located at the rear of the instrument.

RATE METER

- 0.25 volt input for Geiger or scintillation counting
- six ranges to 100,000 counts per minute
- choice of time constants of 0.5, 2.0, 10 and 50 seconds
- individual and master range calibrations
- regulated high voltage variable from 600 to 2000 volts
- accepts either 1 milliamperere or 10 millivolt chart recorders

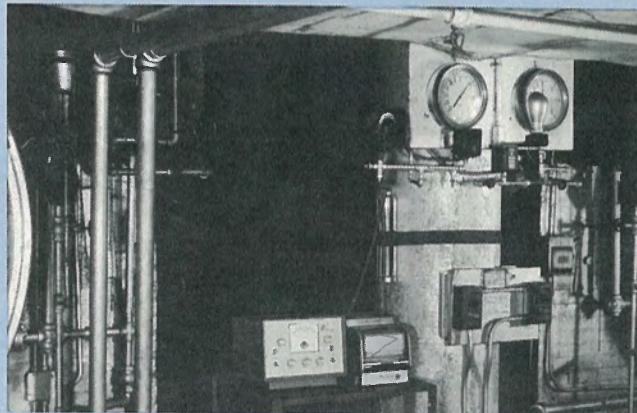
recorders—A connector at the rear is provided to accept either a one milliamperere or ten millivolt chart type recorder. A selector switch provides the proper output.

speaker—A loud speaker for aural monitoring is supplied. A rear control adjusts the volume to the desired level.

general—The Model 1620A Analytical Count Rate Meter is the finest ratemeter ever offered by Nuclear-Chicago. Exceptional stability is obtained by the use of precision wire wound resistors and temperature stable capacitors. Its wide range, individual and master range calibrations, well regulated high voltage, and adaptability for various recorders makes it a truly fine addition to any radioisotope laboratory. Conservative circuit design and long-lived components permit the instrument's continuous use.

The instrument is available in a standard scaler size cabinet as Model 1620A, in a small portable cabinet (see large photo on previous page) as Model 1620A-S, or may be combined with the Model 1810 Radiation Analyzer or a scaler in a double cabinet. Please specify either Model 1620A or 1620A-S when ordering.

Model 1620A-S is used with the Houston Recorder and DS1-A scintillation detector to record the velocity of catalyst movement through a large pipe by measurement of time between passages of radioactive pellets mixed with the catalyst.



SPECIFICATIONS

range—Six full scale ranges of 300, 1000, 3000, 10,000, 30,000, and 100,000 counts per minute indicated on 4½" panel meter. Separate meter scales for the 300 and 1000 cpm ranges.

time constants—Four time constants of 0.5, 2.0, 10, and 50 seconds permit easy calculation of probable error and equilibrium times. A three section special Mylar film condenser in the circuit is used to obtain high insulation resistance and low dielectric absorption at temperatures to 85° C.

sensitivity—A wide band input amplifier is used. Input sensitivity is variable from 0.1 to 1 volt by means of a chassis control and is preset to 0.25 volt at the factory.

operation switch—Normal operation position is USE. CAL and ZERO positions are provided for checking calibration or zero at any time during operation. In normal use, the meter zero and calibration will remain stable to within ± 1% for periods of 24 hours or more. Calibration will remain constant to within ± 2% for line changes from 105 to 130 volts.

accuracy—Basic circuit error is less than 0.25%. Overall circuit error is determined by the meter and is less than ± 2% of meter reading.

resolution losses—Resolution loss for pulse pairs is less than 1% at full scale. Loss is constant on all ranges.

high voltage—Continuously variable from 600 to 2000 volts with front panel control. Rated 600 to 1800 volts. Will deliver 100 microamperes to load at 1800 volts and 0.5 milliamperere at 650 volts. Compensating circuits allow less than 0.01% change in output voltage for a 1% line voltage change between 105 and 130 volts. The low voltage supplies in the instrument are regulated to increase zero and calibration stability.

at rear of chassis—Volume control for loud-speaker, master zero control, calibration control, speaker plug, input connector, preamplifier connector, recorder connector, switch for normal, 10 mv or 1 ma recorder operation, line cord, fuse.

chassis controls—Six screwdriver calibration controls for individual ranges, input sensitivity adjustment, high voltage calibration control.

power requirements—65 watts, 115 volts, 50-60 cycles. Available for 230 volt operation on request. On 50 cycle operation, calibration point will be at 3000 cpm on the meter.

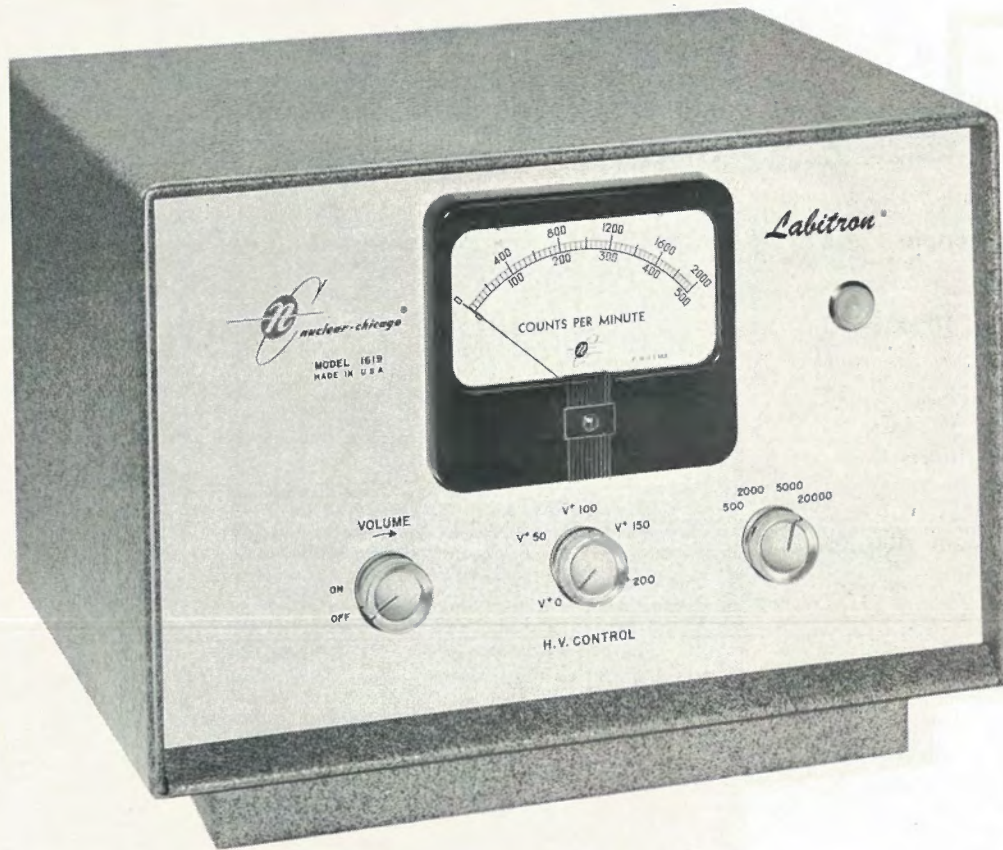
recorder—Instrument will accept either 1 milliamperere or 10 millivolt chart recorders without modification. Power for recorder is separately controlled by a recorder on-off switch and is fused.

dimensions—Large cabinet dimensions 11¼" x 19½" x 16". Small cabinet dimensions 9⅞" x 11¾" x 13¼".

weight—Large cabinet 31 lbs., shipping weight 37 lbs. Small cabinet 27 lbs., shipping weight 33 lbs.

supplied with—Instruction manual, PC 32 recorder cable.

models available—Model 1620A is supplied in large cabinet. Model 1620A-S is supplied in small cabinet.



- 0.25 volt input for Geiger counting
- four ranges to 20,000 counts per minute
- provision for connecting a 1 milliamper chart recorder
- time constants changed by range switch

The Model 1619 "Labitron" is an a-c operated count rate meter for use with a Geiger counter. Designed primarily for monitoring work, the instrument converts the randomly spaced pulses from the external detector into average counts per minute, and presents this reading on the four-inch panel mounted meter.

The Labitron is especially useful for (1) routine surveying for radiation contamination on hands, clothing, benches, glassware, etc., (2) steady monitoring of laboratory "background" in order to detect large fluctuations from various sources which might interfere with precise experiments, and (3) routine measurement of radioactivity for medical diagnosis, tracer work, or process control where the use of a scaler is inconvenient.

The instrument may be used with the Model D34 thin window Geiger tube mounted in a P11 probe for routine surveying for contamination or monitoring of laboratory background, or may be used with the D34 G-M tube and a M2 Mount or 3053 Sample Changer for sample counting.

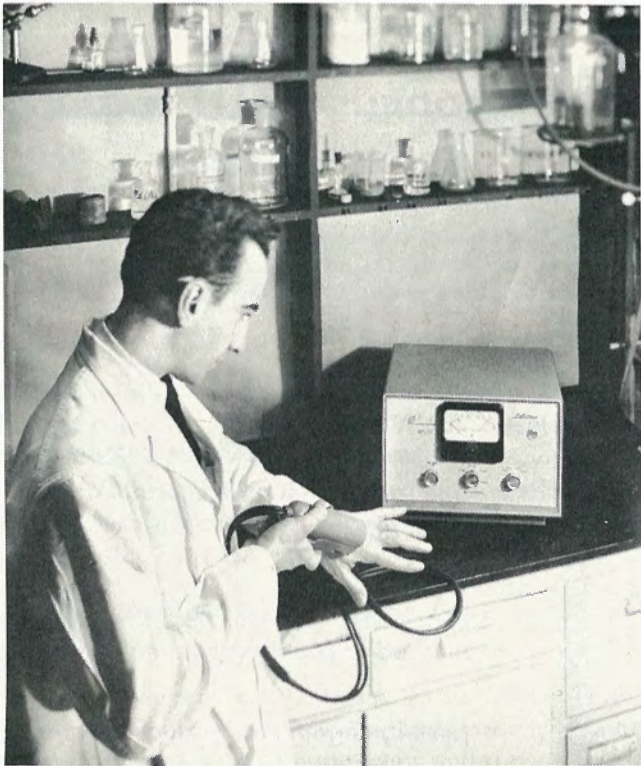
range—Four separate ranges covering 0-500, 0-2000, 0-5000, and 0-20,000 counts per minute are provided. Aver-

age counting rate is indicated on a four-inch panel meter which is calibrated in counts per minute. The simplicity of the circuit insures high reliability and long operational life.

front panel controls—Panel controls of the Model 1619 include an on-off switch which also serves as a volume control for the built-in loud speaker, a continuously variable high voltage control which provides 900 to 1100 volts for the external Geiger counter, and a four-position range selector switch. A master on-off neon pilot lamp is also provided.

operation—Operation of the instrument is simple and consists of turning the unit on, setting the high voltage at the proper point for the Geiger counter, and turning the range switch to the appropriate range. The user may then read the radiation, in terms of counts per minute, directly on the meter. A loud speaker within the unit provides an audible indication of counting rate. The volume control on the front panel may be adjusted to suit the user.

high voltage supply—High voltage is continuously variable from a reference voltage ("V") to "V" + 200 volts. "V" is determined by the voltage regulator tube and is equal to 900 volts unless another voltage is specifically requested.



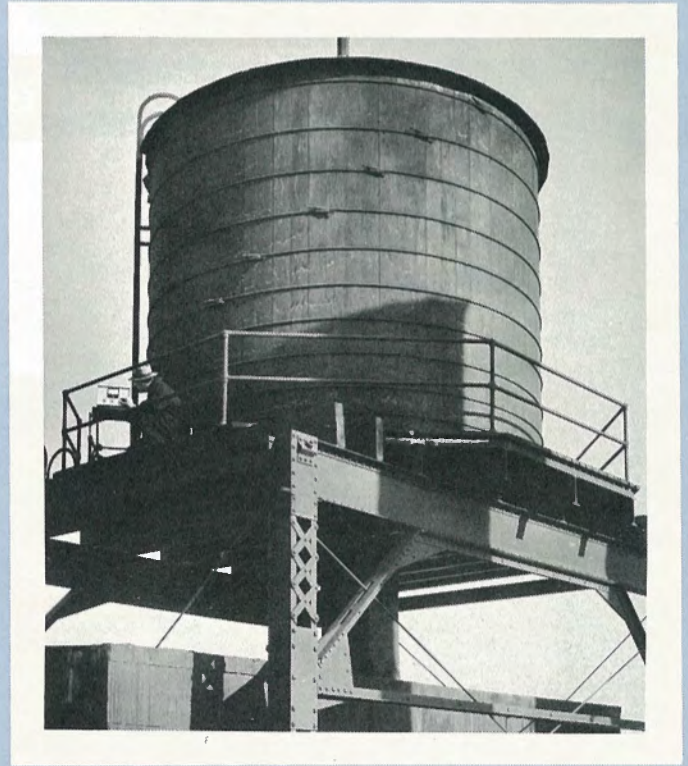
Model 1619 Labitron is frequently used as an A.C. operated laboratory monitor as illustrated above. It is being used with a D34 thin window G-M tube and a P10 probe. The instrument is shown at upper right in use as a simple liquid level gauge. Sources and detectors are placed at points on the outside of the tank. The on-or-off signal indicates the liquid level.

High voltage regulation is such that there is less than 0.1% change in high voltage for a 1% change in line voltage between 105 and 130 volts.

special features—There is absolutely no zero shift. Calibration for evenly spaced pulses is accurate to better than $\pm 5\%$ of full scale on all ranges, will remain stable for long periods of time and is unaffected by line voltage fluctuations. Time constants of the count rate circuit are changed by the range switch to provide the best compromise between probable error in reading and speed of response. Probable error is approximately 5% on the 500 counts per minute range and $1\frac{1}{2}\%$ on the 20,000 cpm range. The panel meter has been overdamped to reduce meter fluctuation.

A connector at the rear of the chassis accepts any one-milliamper chart recorder to provide a continuous record of the count rate vs. time. A recorder on-off switch is located at the rear of the chassis.

The Model 1619 Labitron is housed in an attractive, compact cabinet. Low power dissipation, minimum number of tubes, reliably rated circuit components, and good construction techniques assure reliability and long operation life.



SPECIFICATIONS

ranges—Four ranges of 0-500, 0-2000, 0-5000, and 0-20,000 counts per minute. Individual range calibration for evenly spaced pulses is within 5%.

calibration—Independent of line voltage from 100 to 130 volts and is unaffected by vacuum tube replacement. Separate adjustment for each range.

time constant—Fixed for each range.

resolution—Resolution loss for random pulses approximately 10% at 20,000 counts per minute. Less than 5% on lower ranges.

input sensitivity—Fixed at approximately 0.5 volt.

meter—Four inch panel meter is calibrated in counts per minute.

controls—On-Off-Volume control, four position range selector switch, high voltage adjust, recorder on-off switch at rear. Screwdriver calibration controls on chassis.

high voltage—900 volts, corona tube regulation with 200 volt adjustment provided by front panel control. Regulation is such that there is less than 0.1% high voltage change for 1% line voltage change between 105 and 130 volts.

loud speaker—Loud speaker is mounted on chassis, volume is adjustable with front panel control. Easily audible at considerable distances.

tube complement—6SL7 amplifier, 2050 trigger, VR75 voltage regulator, 1B3-GT high voltage rectifier, 6X5-GT low voltage rectifier, CK1038 900 volt corona regulator.

at rear of chassis—Input, recorder connector, recorder on-off switch, scope connector, line cord, fuse.

power requirements—36 watts, 115 volts, 50-60 cycles. Available for 230 volt operation on request.

dimensions— $9\frac{7}{8}$ " x $11\frac{3}{4}$ " x $13\frac{1}{4}$ ".

weight—25 lbs., shipping weight 31 lbs.

supplied with instruction manual.

GAMMA-RAY SPECTROMETERS

MODEL: **1810** RADIATI



- for use with scalers or ratemeters and gamma sensitive scintillation detectors
- provides the most modern, efficient method of counting gamma radiation
- permits significant reduction of extraneous "background" and scatter radiation
- allows the measurement of one gamma emitting isotope in the presence of others

Model 1810 Radiation Analyzer is a new, single channel differential pulse height analyzer for use with scalers or ratemeters and gamma sensitive scintillation detectors. By providing a means for discriminating between gamma rays of different energies, the instrument permits a large reduction in "background" and scatter radiation in routine gamma counting. Through its use, the most minute quantities of gamma radiation may be measured with high accuracy, and modern counting techniques such as multiple-isotope tracer experiments are made possible.

Model 1810 incorporates a non-overloading linear amplifier, a single-channel pulse height analyzer, and post-regulation of the scaler or ratemeter voltage supplied to the detector. The instrument may be used with any Nuclear-Chicago scintillation detector and with any scaler or ratemeter having a 2000 volt or higher power supply. Simple controls and exceptional long-term stability permit the instrument's use by completely inexperienced laboratory personnel.

theory—Nuclear-Chicago scintillation detectors are supplied with an "Analyzer" circuit which provides an output

pulse which is proportional to the energy of the gamma ray striking the crystal. These small proportional pulses are fed to the 1810 where they are first amplified, then sent to discriminator circuits which pass to the scaler or ratemeter for measurement only those pulses which correspond to the desired gamma ray energy. By rejecting gamma or other radiation with energies above and below that desired, background and scattered radiation is greatly reduced. For low level gamma counting particularly, the Model 1810 is invaluable. In a "well" counter, for instance, background radiation can be reduced from more than 300 counts per minute to less than 30 counts per minute with only a slight reduction in source measurement efficiency.

operation—A Model RT-2 Cesium-137 source is supplied with the unit to enable the user quickly to calibrate the instrument in terms of energy. For initial calibration of the unit, the Cs-137 source (662 kev photopeak) is positioned near the scintillation detector and the 10-turn base level potentiometer is set at 662. The counts switch is set at the "window" position, the window width control, which determines the percentage of the spectrum the Analyzer will

ANALYZER

Model 1810 Radiation Analyzer is often ordered in a double cabinet in combination with a scaler or ratemeter. It is shown with the 183B scaler and DS5-5 scintillation well counter.

"see", is usually set at 1 or 2 volts and the gain setting at the mid-point (4). The 10-turn HV Adj. potentiometer, which varies the high voltage supplied to the scintillation detector, is then turned to the position which results in the highest counts per minute reading on the scaler or ratemeter. At this point, the "window" of the Radiation Analyzer is straddling the 662 kev Cesium photopeak and the Analyzer is rejecting all radiation with energies greater or less than the window setting.

If one now desires to count an isotope such as I-131 (principal photopeak at 364 kev), the base level potentiometer is simply turned to 364 and tuned slightly so that the window straddles the iodine photopeak. For greater discrimination against unwanted background and scatter radiation, the window width can be reduced to as low as 1/4% of the total spectrum. By varying the base level setting, the gain control, or the high voltage, the user may set the photopeak at any desired combination of settings.

The counts switch is provided with a base (integral) position in addition to the window (differential) position so that the user can count all gamma radiation with energies greater than the base level setting.

scatter elimination—Significant errors may be incurred in gamma counting because of scattering of primary rays by surrounding material. Lead or other metal around a sample, or tissue around a thyroid gland can produce secondary rays which are normally counted by a simple scintillation detector-scaler combination. Use of the Radiation Analyzer permits effective elimination of these lower energy secondary rays and greatly improves the measurement reliability.

double labelling procedures—The Radiation Analyzer is invaluable in measurement of radioisotopes in double labelling procedures. Through pulse height selection, accurate measurements of individual gamma emitting isotopes in a mixture may be made if the gamma ray spectra of the components are sufficiently different.

general—The Model 1810 Radiation Analyzer is the product of careful research, precision manufacturing, and thorough testing. The detailed specifications listed at right are reliable and conservative. The instrument, normally supplied in a single cabinet as pictured on the opposite page, may be ordered in a double cabinet in combination with Models 161A, 181A, 183B, or 186 scalers or Model 1620A Ratemeter.



SPECIFICATIONS

linear amplifier—Accepts positive input signals. Maximum useful integral counting rate approximately 10^7 counts per minute. Maximum gain without delay line shaper is $2500 \pm 10\%$; 1250 when properly matched with delay line. Input resistance is 2700 ohms with delay line attached.

Coarse gain attenuation over 16:1 range in steps of 2. Overall rise time of 0.3 μ sec on lowest position. Pulse has 0.75 μ sec flat top and a decay time of 0.4 μ sec. Amplifier linearity is better than 1% between 5 and 100 v. output. Line variations between 105-125 volts produce less than 1% gain change. Separate cathode follower output with gain of 0.9.

Non-overloading. Input pulses 50 times overload value will widen from 1.6 to 2.5 μ sec. Resolution time is 1 μ sec for two normal pulses in the window. Pulse 50 times overload value followed by normal pulse will be recorded within 5 μ sec. Resolution is within 2 μ sec for a 20 to 1 overload.

discriminators—Base line adjustable to 100 volts with 10-turn precision potentiometer. Each small division represents 0.1 volt. Window width adjustable 0 to 10 volts with single-turn potentiometer. Normal minimum usable window is 0.25 volts. Window width independent of base level setting to within 2% from 5 to 100 volts.

Overall resolution for equal pulse pairs is approximately 1 μ sec. Base level constant within 1% and channel width stable to approximately 0.5% for line changes from 105-125 volts. Panel switch allows recording either base (integral) or window (differential) counts. Separate connector provided to permit second scaler to monitor base output. Switch permits remote base level control. After warm-up, base line and window width will remain constant within 1% for periods of 24 hours (channel widths of 2 volts or more). Two discriminator outputs: one to pre-regulated scaler high voltage; one for ratemeter. Output pulse is 10 volts negative, 1 μ sec in duration. Output impedance is approximately 200 ohms.

high voltage regulation—Provides regulated output over range of +500 to +1500 volts. Variable with 10-turn precision potentiometer with small divisions of 1 volt. Regulation is approximately 200 for input voltage variations. Ripple voltage is less than 5 mv at 1000 volts and 30 microampere drain. Line changes from 105-125 volts produce less than 0.25 volts change in output voltage.

After one-hour warm-up, high voltage will remain stable to 0.05% for periods of 24 hours—taking into account normal room temperature variations. Temperature coefficient of the voltage supply is approximately $-0.005\%/^{\circ}$ F. Long term drift in voltage calibration is less than 0.5%.

low voltage regulation—Provides adjustable regulated low voltage of 300 volts stable to ± 0.25 volt for line variations from 105-125 volts. Long term stability is ± 2 volts.

power requirements—150 watts, 115 volts, 50-60 cycles. Available for 230 volt operation on request.

dimensions— $11\frac{1}{4}'' \times 19\frac{1}{8}'' \times 16''$.

weight—47 lbs., shipping weight 54 lbs.

supplied with—PC4 cable, RT2 Cesium-137 calibration source, and instruction manual.



- a single, compact counting system for use with scintillation detectors
- combines a pulse height analyzer, regulated high voltage supply, and scaler in one chassis
- automatic built-in preset count and precision preset time circuits
- completely automatic push-button operation with high speed electrical reset

The Model 132 Analyzer Computer is a new, unique and complete counting system for use with all gamma-sensitive scintillation detectors. Combining a precision single channel pulse-height analyzer, a reliable binary scaler and a push-button computing circuit in a compact chassis, this single instrument provides the most modern, efficient means of counting gamma radiation. By means of pulse height selection the operator can "tune in" the desired gamma ray and thus exclude errors due to background and scatter radiation. The versatile binary scaler with eight scale selections from 4 to 512 features automatic preset count of 100, a precision preset time circuit, and complete push-button operation including electrical reset. The electronic circuitry used in this new, outstanding instrument has been thoroughly field tested for highest stability and reliability.

analyzer section—The single channel pulse height analyzer incorporated in the new Model 132 has the same controls and circuit specifications as has the Model 1810 Radiation Analyzer described on pages 20 and 21 in this catalog. The panel controls consist of a 10-turn H.V. Adjust

control which varies the high voltage to the external scintillation counter from 500 to 1500 volts, a 10-turn Base-Level control, and the Window potentiometer which determines the percentage of the gamma spectrum the Analyzer will pass to the scaler section of the unit for measurement. The Window control is provided with a switch position at the maximum counter-clockwise position of the dial to record base (integral) counts only. The Gain switch on the 132 is located at the rear panel.

scaler section—The scaler section of the Model 132 Analyzer Computer is designed for maximum automatic flexibility and precision. A two-microsecond binary scale of 512 is provided with a choice of 8 scale selections from 4 to 512 and a line frequency test position. The wide choice of scale selections permit maximum usefulness with the Model 1700 Isotope Scanner.

automatic features—Model 132 is provided with push button start, stop, and reset controls. The reset button operates automatic electrical reset of scaling stages, register, and timer. In *Manual* operation, the start and stop functions are

COMPUTER

controlled manually and the panel timer indicates elapsed time to 999.99 minutes maximum.

In *preset time* operation the user may select (in increments of 0.01 minute) any predetermined time setting from 0.01 minute to 99.99 minutes. This precision timer, similar to that provided on the 192A Ultrascaler, is controlled by four timer knobs. When the preset time has elapsed, the instrument stops counting. A repeat count can be immediately taken, since the preset time is fixed until the four switches are changed by the operator.

In *Auto* operation the instrument counts until the register reaches 100. This can represent any one of eight different predetermined counts from 400 to 51,200 counts as determined by the scale selector switch. When the register reaches 100 the "Set Std." light appears. At this point, the four timer knobs are set to the time indicated on the panel timer. When the new count is taken, the unit automatically stops at the pre-selected time, the "Read %" light comes on, and the register indicates the percentage reading. This exclusive feature is invaluable whenever one or more radioactive samples or sources is to be measured in terms of a standard.

general—Model 132 Analyzer Computer is the culmination of extensive work on gamma-ray spectrometer and computing systems for nuclear research. From the standpoint of compactness, versatility and precision, the Model 132 represents a truly extraordinary instrument for the measurement of gamma radiation.

SPECIFICATIONS

analyzer section—Specifications for the linear amplifier, discriminators, low voltage, and high voltage portions of the Model 132 are identical with the specifications given for the Model 1810 Radiation Analyzer. See page 21 in this catalog for complete detailed specifications.

scaling circuits—Binary scale of 512 with choice of scaling factors of 4, 8, 16, 32, 64, 128, 256, and 512. Two microsecond resolution for paired pulses. Scaling unit consists of two plug-in scales of 16 preceded by a diode-coupled fast input binary. All 5% matched components and premium computer tubes are used to insure long reliable life. Overall scaler resolution loss at an average counting rate of 5000 counts-per-second is approximately 1 percent.

register—Four-digit mechanical register follows scaling stages. Register can be driven at a rate in excess of 17 per second at any scale selection. Disconnect switch allows register to be shut-off during Isotope Scanner use.

timer—Odometer type timer reads total of 999.99 minutes with an accuracy of 0.01 minute. Preset time circuit can stop unit in 0.01 minute increments up to 99.99 minutes. Repeat preset time accuracy is 0.04 seconds.

start-stop—Start, stop, and reset controlled by interlocked push buttons.

test—Line frequency test position with scale of 512 provided on scale selector switch.

predetermined count—In "Auto" operation the unit automatically stops when the register reaches 100. This can be any one of eight different preset counts from 400 to 51,200 depending upon the position of the scale selector switch. To indicate percentages directly the indicated elapsed time is set into the four timer switches. All subsequent measurements are stopped at this time and the register will then read percentage directly.

power requirements—190 watts, 115 volts, 60 cycles. Available for 230 volt and/or 50 cycle operation on request.

dimensions—11¼" x 19⅞" x 16".

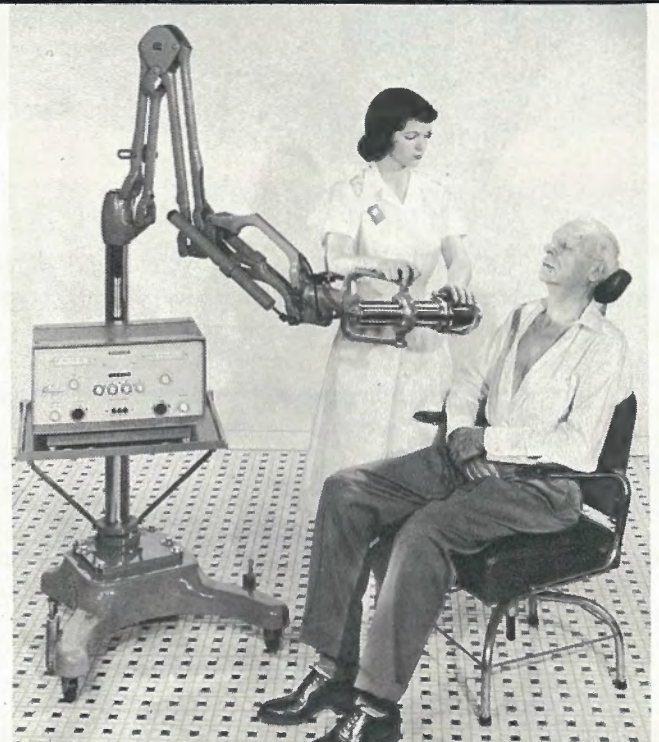
weight—55 lbs., shipping weight 65 lbs.

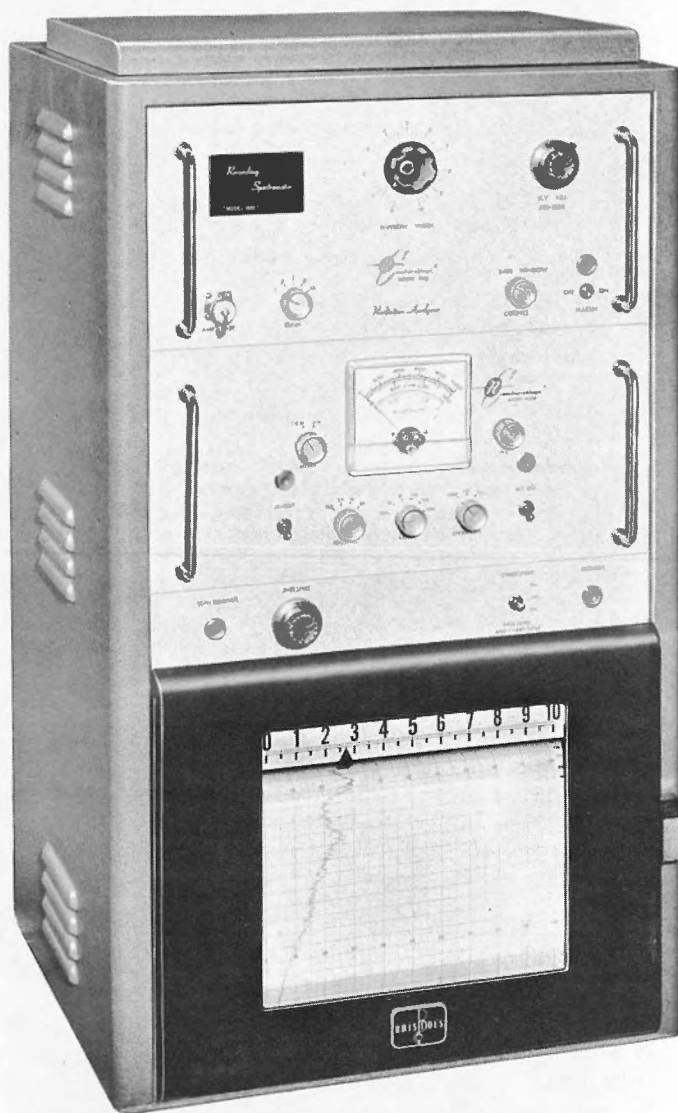
external detectors—Model 132 may be used with all Model DS5 series scintillation detectors, or with the DS1-A directional scintillation detector.

supplied with instruction manual, RT2 Cesium-137 calibration source.

MODEL: 7000 MEDIAC II

Three new instruments offered by Nuclear-Chicago have been combined into the most modern, efficient medical counting system ever offered. Designated as the Model 7000 Mediac II, the complete system consists of the Model 132 Analyzer Computer, the Model DS5-1P Medical Scintillation Detector, and the Model SA2 Stand. The Analyzer Computer permits pulse-height discrimination techniques to reduce background and scatter radiation, the three collimators supplied with the DS5-1P provide maximum versatility while the 2" crystal gives greatest sensitivity, and the SA2 Stand is the most rugged and versatile available. We unhesitatingly recommend the Model 7000 Mediac II for those desiring the very finest clinical radiation measuring system.





- completely automatic scanning and recording of gamma-ray spectra
- motor-driven base level potentiometer with automatic shut-off
- window width continuously variable from zero to 10 percent of spectrum range
- exceptional non-overloading characteristic of linear amplifier
- wide choice of full scale ranges, time constants, scanning speeds, chart lengths
- extremely stable, wide range high voltage supply

The Nuclear-Chicago Model 1820 Recording Spectrometer is an automatic scanning single channel pulse height analyzer system designed for quantitative energy separation of gamma ray spectra. The instrument, when used with a Nuclear-Chicago scintillation detector, provides a continuous graphic record of the activity and energy distribution of any gamma emitting sample. Its use greatly facilitates multiple-isotope tracer analysis, identification of unknown gamma emitting isotopes, studies of relative isotopic abundance, determination of radiochemical purity, and other nuclear techniques in which a true record of count rate vs. energy is required.

components—The Model 1820 Recording Spectrometer consists of (1) a standard Model 1810 Radiation Analyzer with the base level potentiometer removed, (2) a standard Model 1620A Analytical Count Rate Meter with slight modification of the high voltage supply, (3) a scan control panel containing the motor driven base level potentiometer and recorder controls, and (4) a 10 millivolt recorder.

Complete description and specifications of the Model 18 are given on pages 20 and 21 in this catalog, while the Model 1620A is fully described on pages 16 and 17.

The scan control chassis contains the recorder power and chart drive switch and the motor driven base level control. The base level potentiometer controls the position of the window and is motor driven to provide automatic scanning. The dial may be turned manually to start the scan at any position on the base level dial and to record any fraction of the spectrum. To start automatic scanning, the toggle switch is flipped to the "recorder power and chart drive on" position. The potentiometer is then automatically turned back to zero by the drive motor. The dial itself turns so that the user always knows the base level position during the scan. When the potentiometer reaches zero the drive motor and recorder are stopped and the "scan complete" lamp lights.

A third position is provided on the toggle switch so that the drive motor is disconnected from the base level control and only the recorder power is on. The operator can utilize this position to plot decay or to make manual measurements.

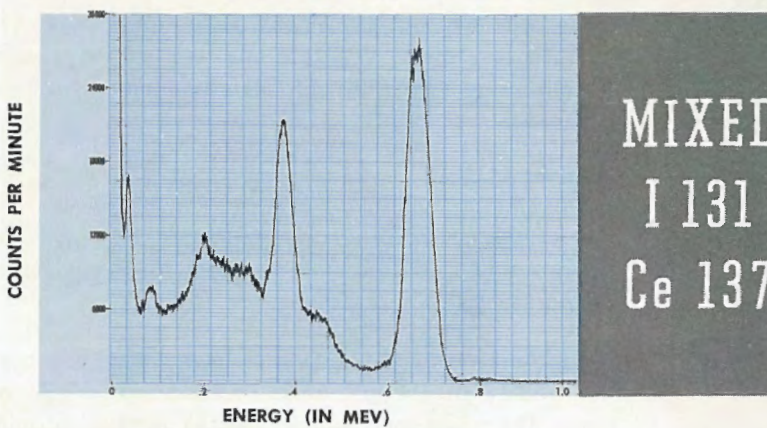
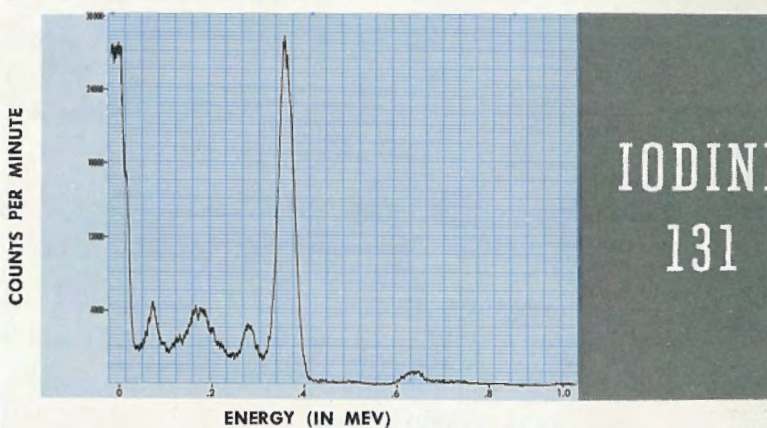
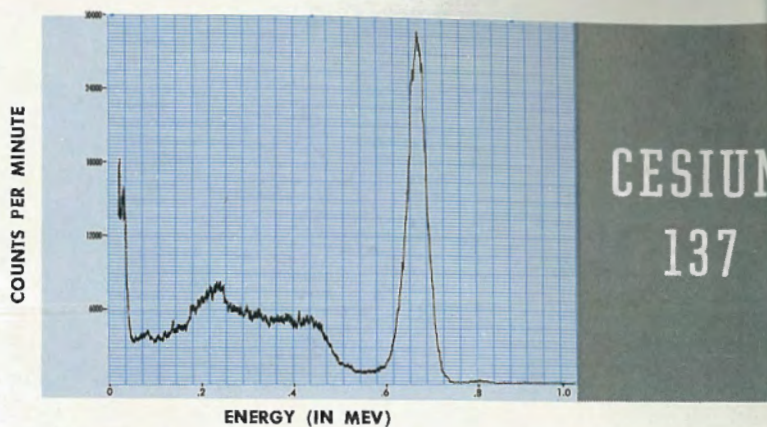
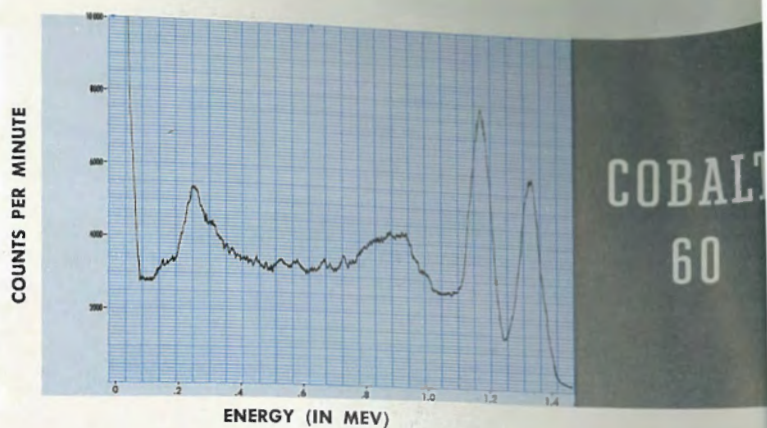
The motor-driven base level control is a ten-turn 0.1% precision potentiometer to assure that the energy scale as represented by chart distance is linear. The standard drive motor provides a scan time of 30 minutes for a complete scan from full scale on the potentiometer (1000) to zero. Motors providing total scan times of 15 or 60 minutes are available.

The recorder supplied with the 1820 has a chart width of 11 inches and a full scale deflection speed of 2 to 3 seconds (with one second available on special order). The chart length for a 30 minute scan is variable from 1.5 inches to 30 inches.

general—The "window" is constant within 1% over the scan time and over the range of the energy scale. Channel width change is less than 0.1% after warm up. The amplifier is capable of counting at high rates without overloading. Maximum amplifier integral counting rate for best resolution is in excess of 3×10^6 counts-per-minute. Window rates of 100,000 cpm with window widths of less than 1 volt can be measured. The overall system linearity at base level settings from 5 to 100 volts (50 to 1000 on the dial) is ± 1 percent. A chassis switch is provided to decrease window range from 0 to 10 volts to 0 to 5 volts.

Cabinet dimensions are 38" x 21 $\frac{3}{4}$ " x 18". Overall weight—185 lbs. Power requirements—250 watts, 115 volts, 60 cycles. Available for 230 volt and/or 50 cycle operation on request. Shipped ready-to-use with recorder, ratemeter, Radiation Analyzer, scan control chassis, chart paper, pen set, RT2 source.

Typical curves made with the Model 1820 Recording Spectrometer. Note the excellent resolution and detail which normally can be obtained only with much more complex and higher priced instruments. All curves shown were made with a standard Model DS5-3P scintillation detector. The window width was $\frac{3}{4}$ volt during all four scans.





- portable Geiger counter
- three ranges to 20 mr/hr
- choice of probes
- 250 hour battery life

Model 2612 is a portable battery operated Geiger-Muller survey meter for measuring alpha, beta, and gamma radiation of low and medium intensities. It uses a proven, reliable electronic circuit which is housed in a weatherproof aluminum case to assure dependable operation under all conditions.

The instrument is available with choice of probes utilizing either a Model D50 thin glass wall Geiger counter for measuring both beta and gamma radiation with energies over 0.2 mev, or a Model D35 thin mica end window counter for measuring alphas and soft betas in addition to harder radiations.

This versatile, precise count rate instrument is widely used in checking for radioactive contamination or spills in radioisotope laboratories, determining necessary shielding, monitoring x-radiation, locating leaks in piping systems, prospecting for uranium ores, etc.

operation—A single range switch located directly beneath the handle turns the instrument on and selects the desired range. The meter scale is direct reading in terms of milli-

roentgens per hour and counts per minute. Three ranges cover radiation intensities of 0.2, 2, and 20 mr/hr, full scale corresponding to 600, 6000, and 60,000 counts per minute. Health tolerance level (7.5 mr/hr for a 40 hour week) is slightly under half scale on the 20 mr/hr range.

The probe mounts in the handle by a simple friction fit and can be used in that position or may be easily removed for surveying benchtops, radioactive spills, hands, clothing, rock crevices, etc. A 40-inch coiled cable connects the probe to a connector on the panel.

The time constants of the Model 2612 are automatically changed to the fastest possible response time consistent with statistical fluctuations. Special circuit design assures no zero drift. A compensating circuit minimizes coincidence losses at high counting rates. The supply voltage for the ratemeter circuit is regulated to keep the calibration constant.

The Model P16 probe (shown in position in the handle of the unit) is used with Model D35 mica end window counter and is provided with a probe cap which permits gamma surveying only. Removing the cap from the end of the probe

METER

exposes a 1.4 mg/cm² window and permits monitoring alpha and beta radiation with energies as low as 40 kev.

The Model P15 probe (shown next to the unit) holds the Model D50 glass wall counter and has a revolving beta shield which exposes a 180° angle. When closed, the shield effectively cuts out beta radiation.

The two probes are interchangeable. The radium calibration source mounted on the case may be used in recalibrating the instrument should the probes be interchanged in the field.

calibration—The instrument is carefully calibrated at the factory in terms of gamma rays from Cesium-137 which is radium equivalent for this instrument. A calibrated radiation source is mounted at one end of the case and may be removed and placed next to the Geiger tube for checking calibration at any time. If necessary, the instrument can be easily recalibrated by means of a screwdriver adjustment beneath a sealed jack on the panel. Accuracy of the Model 2612 is better than $\pm 10\%$ of full scale on all ranges.

circuit—The circuit uses two hearing aid type tubes, a 25 microampere meter, crystal earphones, and a 900 volt stabilized audio oscillator high voltage supply for the Geiger tube. The low-drain circuit makes possible an extremely long battery life of over 250 hours for continuous operation or a battery life equal to shelf life when operated two hours per day. An on-off pilot light is mounted on the front panel. Its failure provides a visual indication of battery failure.

construction—The internal layout of the instrument has been designed for easy servicing when required. Electronic components are located in the cover of the unit and are mounted on a hinged shelf. The instrument is easily opened for access to all parts. The two portions of the case are held together by screws and pressed against twin rubber gaskets in a chromium joining strip to insure weatherproof construction. All other external parts, including the meter, are firmly mounted in rubber to prevent water leakage.

Strap holders are provided. A sealed earphone jack and earphones are provided for aural monitoring. The instrument is lightweight for easy portability.

Model 2612 is suitable for measuring alpha and soft beta surface contamination when used with the D35 thin window counter.

SPECIFICATIONS

ranges—0.2, 2.0, and 20 mr/hr and 600, 6,000, and 60,000 counts per minute full scale.

circuit—Time constants are automatically changed by the range selector switch to the fastest response time consistent with statistical fluctuations. Absolutely no zero drift.

probe and detector—Available with Model P16 probe and D35 mica end window counter as Model 2612P which should be ordered when it is desired to count soft radiation from carbon-14, sulfur-35, etc. Available with Model P15 probe and D50 glass wall counter as Model 2612M which should be ordered by those working with iodine-131, phosphorous-32, prospectors, and all those desiring to monitor higher energy beta or gamma radiation.

controls—Range switch operable by hand carrying the instrument. Off position and three scale ranges are provided. A sealed earphone jack and a set of double earphones are provided for aural monitoring.

calibration—Instrument is carefully calibrated at the factory in terms of gamma rays from a cesium-137 source, which is radium equivalent for this instrument. A calibrated reference source is mounted on the instrument case.

accuracy—Better than $\pm 10\%$ on all ranges.

power—Uses 900 volt stabilized flyback-oscillator high voltage supply for the Geiger tube. Two 67½ volt and two 1½ volt batteries. Battery life is 250 hours continuous operation or equal to shelf life when operated 2 hours per day.

meter—3" meter with counts-per-minute and mr/hr scales.

case dimensions—10" x 4¾" x 5¾".

weight—10 lbs., shipping weight 15 lbs.

supplied with batteries, double earphones, calibration source, probe and detector as specified, and instruction manual.

models available—Model 2612 M for general beta-gamma survey work and prospecting. Model 2612P for monitoring alphas and soft betas as well as harder radiations.





- portable beta-gamma ionization chamber survey meter
- three ranges
- choice of medium range (2.5 r/hr) or high range (250 r/hr) ion chambers
- chamber removable — may be connected to cable for remote monitoring
- thin window permits measurement of low energy beta radiation
- window shield provided to permit gamma monitoring only

The Nuclear-Chicago "Cutie Pie" is a battery operated, portable gun-type survey meter for measurement of beta and gamma radiation where fairly high field intensities may be encountered. The instrument is available with a choice of ion chambers for medium range or high range measurements. Model 2586 is supplied with a 500 cc. cylindrical ionization chamber for measuring beta or gamma radiation up to 2500 mr/hr (2.5 r/hr). Model 2586-P is supplied with a 5 cc. ionization chamber for measuring high intensity radiation up to 250 r/hr. The higher range ion chamber is shown next to the standard unit in the illustration above. It is available separately if desired and is completely interchangeable with the lower range chamber. When using the high range chamber, the user merely multiplies the meter readings by 100.

The Cutie Pie is convenient for determining the amount of radiation which laboratory workers are receiving from experimental work with radioisotopes, to monitor shipping containers for excess radiation, for remote monitoring purposes, for civil defense use, industrial radiography uses and for decontamination and clean-up purposes.

operation—A single range switch at the top of the instrument turns the unit on, checks the battery supply, checks meter zero, and offers three range positions. In the medium range Model 2586, these ranges are 0-25, 0-250 and 0-2500 *milliroentgens per hour*. For the high range Model 2586-P they are 0-2.5, 0-25, and 0-250 *roentgens per hour*. The accepted tolerance level (6.25 mr/hr for a 48 hour week) is one-quarter scale on the 0-25 mr/hr range, and is indicated by a mark on the meter.

In the "battery check" position of the range switch, the meter needle gives an indication of correct battery voltage or the need for battery replacement. The "set" position of the range switch permits zero setting of the meter even in the presence of ionizing radiation. Circuit design is such that adjustment of meter zero for different ranges is unnecessary. A coarse zero control is provided beneath a snap plug on the side of the instrument.

In normal use the ion chamber is connected to the body of the instrument. If desired, the chamber may be remotely positioned by means of a cable. This exclusive feature permits location of the chamber up to 100 feet from the operator.

Model 2586 is illustrated in use with the Model PC43 rigid extension arm for determining the intensity of a strong gamma source.

and allows continuous monitoring of areas of high radiation intensity without personnel exposure. A 10-ft. cable for remote operation may be ordered separately at nominal charge as Model PC33, and a 6-ft. rigid aluminum tube with a handle and connectors at both ends may be ordered separately as Model PC43.

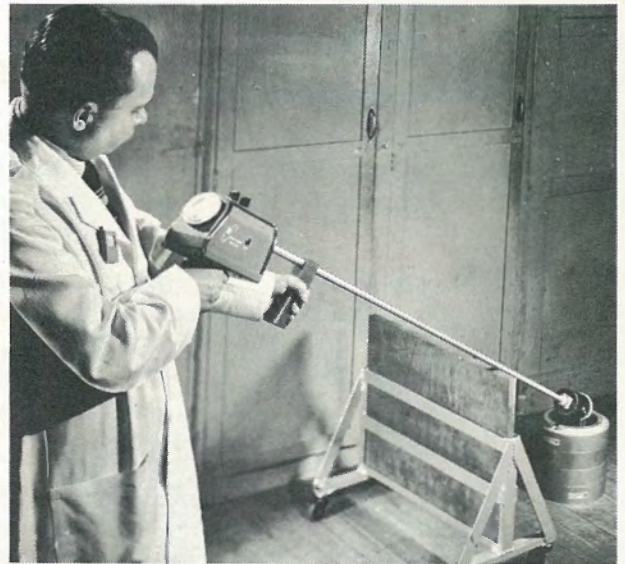
A 0.7 mg/cm² rubber hydrochloride window covers one end of the ionization chambers and permits entry of beta radiation with energies as low as 40 kev. When the one gram/cm² beta shield supplied with the chambers is placed over the thin window the Cutie Pie reads only gamma radiation, excluding all beta rays. With the beta shield removed, the instrument is suitable for measuring roentgen dosage rates from x-rays with energies as low as 50 kev.

calibration—The instrument is carefully calibrated at the factory in terms of gamma rays from a radium-equivalent Cesium-137 source. Calibration will remain constant throughout the life of the batteries and is accurate to $\pm 10\%$ of full scale at normal air density and room temperature.

A beta radiation source is included with the low range chamber to enable the user to check calibration at any time. The source fits into a well on the inside of the plastic beta shield supplied with the ion chamber and may be stored in the beta shield with its back facing the window. In this position the source will not affect the meter reading. Turning the source so that it faces the rubber hydrochloride window will cause the meter to read approximately 2/3 scale on the low range. The meter reading in mr/hr is marked on the source itself. A calibration control is located beneath a snap plug on the side of the instrument.

circuit—The "Cutie Pie" utilizes a three-tube electrometer circuit employing both positive and negative feedback. The time constant is less than two seconds on all ranges. All critical components are hermetically sealed to provide freedom from humidity effects. Zero drift with good batteries is less than 5% of full scale for 8 hours of operation. The ion chamber collector is supported by a polystyrene insulator mounted in a volumetric guard ring.

general—The instrument is provided with an exclusive "sled-runner" stand which provides exceptional stability. The stand may be flipped up when the instrument is hand-held. The attractiveness, light-weight, compactness, and unmatched versatility of this instrument combined with its high reliability and accuracy make it an outstanding addition to any laboratory where medium range beta, gamma, or x-ray measurements are made.



SPECIFICATIONS

range—Three linear ranges. Model 2586 ranges are 0-25, 0-250, and 0-2500 milliroentgens per hour. Model 2586-P ranges are 0-2.5, 0-25, and 0-250 roentgens per hour.

calibration accuracy— $\pm 10\%$ of full scale on all ranges.

calibration—Calibrated at the factory in terms of gamma rays from a Cesium-137 source which is radium equivalent for this instrument. Calibration remains constant throughout battery life. Screwdriver calibration control on side of case. Calibration source fits into a well in the low range chamber beta shield and may be used to check calibration at any time. The axial beta geometry is within 20% of the gamma geometry, thus giving a rep calibration factor of 80%.

time constant—Less than two seconds on all ranges.

gamma ray energy dependence—Linear within $\pm 10\%$ from 50 kev to 2 mev.

ionization chamber—500 cc. cylinder supplied with 2586, 5 cc. cylinder supplied with 2586-P. Aquadag inner coating. A 0.7 mg/cm² rubber hydrochloride window at one end of the chamber permits entry of low energy beta radiation. Window is normally covered with the 1 gram/cm² beta shield when measuring gamma radiation. Chamber may be remotely operated up to 100 ft. from the body of the instrument by cable connection.

zero drift—Less than 5% of full scale for 8 hours of operation.

warm-up—Instrument reads within 2% of equilibrium value on most sensitive range within one minute after warm-up.

panel meter—2 1/2 inch panel meter with 2 3/8 inch scale length. 6.25 mr/hr tolerance rate and battery check points marked.

stand—An exclusive sled-runner stand may be flipped down to support the instrument for stationary measurements or for upright storage. Unit is well balanced for easy handling.

power supply—Uses four 30-volt (BA-030), two 15-volt (BA-016) and four 1.3-volt (BA-026) batteries. Battery life is 350 hours continuous operation or 400 hours at two hours per day.

electronic circuit—Three-tube electrometer circuit employing both positive and negative feedback.

controls—Single range switch selects meter zero, battery supply or selects one of three ranges. Meter zero control located at top of instrument case. Coarse meter zero control and calibration control are screwdriver adjustments located beneath snap plugs on sides of instrument case.

dimensions—3 1/2" x 8" x 12 1/2".

weight—4 lbs., shipping weight 6 lbs.

supplied with complete set of batteries, R5 calibration source with 2586, and instruction manual. 10 ft. cable is available for remote operation as Model PC33 at extra charge. Extra length cables are available on special order, prices on request. 6-ft. rigid tube containing cable and connectors at each end is available as Model PC43.

MODELS: **2112-P** ALPHA SURVEY METER
2112-N NEUTRON SURVEY METER



2112 UNIT

DN3 PROBE

AP4 PROBE

- interchangeable probes for alpha or neutron detection
- high sensitivity, suitable for health monitoring
- long, economical battery life
- transistorized amplifier and high voltage supply
- light-weight, rugged

Model 2112 is a new, exclusive, battery operated survey meter available with a choice of transistorized probes for alpha or neutron measurement. The instrument, an outstanding addition to our line of portable survey meters, is a redesigned version of the reliable Model 2612 (page 26) with time constants changed for optimum performance and a new transistorized high voltage supply (using economical, easily obtained batteries) for the interchangeable alpha and neutron probes. Either the alpha or neutron probes may be connected without any internal changes to the 2112.

model AP4 alpha probe—The 2112 is available with the new AP4 unsealed air proportional alpha probe as Model 2112-P. The counting chamber has an active area of 75 sq. centimeters and a window thickness of approximately 0.8 mg/cm². With its use, the 2112 will measure alpha contamination from a minimum of 2 alphas per cm²/minute to 2000 alphas per cm²/minute.

The probe is light-weight, non-microphonic, rugged, easily decontaminated, and extremely stable in calibration reproducibility. It has more than twice the sensitivity with no decrease in beta-gamma discrimination of any previously available Nuclear-Chicago alpha probe.

A removable transistor amplifier is mounted on the back of the counting chamber to raise the signal from approximately 2.5 millivolts to the 0.25 volt level required to trigger the 2112 unit. Since the pulse is carried to the count rate unit at a 0.25 volt level instead of at a millivolt level, cable difficulties are eliminated. The amplifier housing serves as a convenient hand grip for the probe. It is sealed to the ion chamber to exclude contamination and moisture from the circuitry. It has been carefully engineered to minimize size, weight, and power consumption. Total alpha background of the unit is less than 2 counts per minute.

The neon lamp on the 2112 indicates when power is applied. At low count rates the lamp will blink, permitting an estimate of alpha contamination below useable meter readings. Earphones are also provided to provide aural indication.

A deposited uranium alpha source is supplied to enable the user to check quickly the proper calibration of the instrument. Recalibration is accomplished by adjusting the high voltage to the correct operating point by means of the Calibrate control located beneath a sealed jack on the 2112 panel. The high voltage may be varied from 1500 to 2300 volts to accommodate different chambers and atmospheric pressures. The negative temperature coefficient of the high voltage sup-

ply helps balance the positive temperature coefficient of the air proportional chamber and makes the instrument almost completely independent of temperature changes over the range of 40° F. to 110° F.

model DN3 neutron probe—The 2112 is available with the new DN3 neutron probe as Model 2112-N. The probe contains an enriched BF₃ proportional counter and the same transistor amplifier used in the AP4 Alpha Probe. A single flexible cable connects the DN3 probe to the 2112.

The neutron probe is supplied with a removable paraffin-Cadmium moderator for fast neutrons and a hollow shield for thermal neutrons. With the moderator shield in place, the probe is sensitive only to fast neutrons with energies above the Cadmium resonance of 0.176 electron volts. With the hollow shield in place, the probe is primarily sensitive

to thermal neutrons. It is insensitive to gamma radiation up to 1r/hr with either shield in place.

A calibration curve with correction factors for different neutron energies from 0.25 mev to 14 mev is provided. Calibration is made with a Radium-Beryllium neutron source and is accurate to within $\pm 15\%$.

The high voltage for the BF₃ detector is obtained from a plug-in potted transistor high voltage supply which is powered by a long-lived mercury battery. The correct operating voltage for the counter is adjusted at the factory but can be easily readjusted in the field.

general—The Models AP4 Alpha Probe and DN3 Neutron Probe are ideally suited for use with standard quarter-volt scalars or ratemeters without modification, and may be ordered separately for this purpose if desired.

SPECIFICATIONS

2112 Unit

input sensitivity—0.25 volt for 10 microsecond negative pulses.

ranges—Three ranges of 0-150, 0-1500, and 0-15,000 counts per minute full scale. Internal calibration permits ratemeter accuracy for evenly spaced pulses of $\pm 3\%$ of full scale.

time constants—10 seconds on 0-150 CPM range; 2 seconds on other ranges. Compromise between accuracy and speed.

zero drift—There is no zero drift. With no input pulses the meter will always read zero.

regulator—The neon lamp visible on the 2112 serves to indicate when power is applied. At low count rates this lamp will blink. This can be used to estimate alpha contamination or neutron fluxes below useable meter readings. The regulating action of this lamp helps keep the 2112 calibration independent of B+ battery voltage.

high voltage supply—The high voltage is supplied from a separate potted transistor high voltage supply. When used with the AP4 Probe an adjustment range from 1500-2300 volts is provided to accommodate different chambers and atmospheric pressures. The output voltage is regulated by a very long lived 2.7 volt mercury battery input power supply. When the DN3 Probe is used, the proper high voltage for the BF₃ neutron detector is automatically obtained by a switched position at one end of the calibrate control. No false counts due to high voltage noise.

dimensions—Case size 10" x 4 $\frac{3}{4}$ " x 5 $\frac{3}{4}$ ".

controls—Four position range switch, HV Calibrate control, input connector, phone jack.

weight—Complete with batteries, 7 $\frac{3}{4}$ pounds.

AP4 Alpha Probe

sensitive window area—75 sq. cm. (1 $\frac{3}{4}$ " x 7"). Removable chrome plated protective grill with 80% open area. Sensitivity of point source at any outer grill square averages 50%. All inner squares 90% or better.

window—Rubber hydrochloride, aquadag coated.

sensitive volume—Uses 4 one-half mil wires spaced $\frac{3}{8}$ " on insulators. Each anode wire spring loaded to absorb shock and microphonics. Chamber depth $\frac{1}{2}$ ".

efficiency—20-25 percent for 5 mev alphas from RA D+E and from U₃O₈, for 2 pi geometry.

amplifier gain—Voltage gain is 100 \pm 10%.

feedback—Effective negative feedback factor of 10 minimizes dependence on transistor characteristics, temperature and operating voltage.

rise time—Approx. 1 μ sec. for pulse generator measurement.

temperature characteristics—Gain is constant to within 5% from 0°-45° Centigrade.

power supply—8 volts at 1.2 milliamperes. Supplied by two Mercury batteries TR-133R with rated life of 800 hours. Switch on preamplifier to turn off when not in use.

high voltage—Normally adjustable from 1500-2300 volts at the 2112. This allows for chamber and altitude variations. Allows optimum setting for each chamber and location. Normal operating voltage at sea level is 2000-2150 volts.

dimensions—Housing is 6" x 1 $\frac{3}{4}$ " x 1 $\frac{1}{8}$ ". Chrome plated steel. Easily removable from counter for decontamination.

weight—complete with batteries and attached cable; 0.75 lbs.

DN3 Neutron Probe

transistor amplifier—Identical with that used in the AP4 probe (see detailed specifications above). Removable handle permits servicing and battery change.

detector—Brass wall BF₃ counter, $\frac{5}{8}$ " d., 3.5" active volume.

shield—Removable shield of 1" high temperature paraffin and a cadmium liner. With moderator shield in place, detector responds to fast neutrons. An additional shield for the BF₃ tube without moderator or cadmium liner is supplied for thermal or slow neutron measurements.

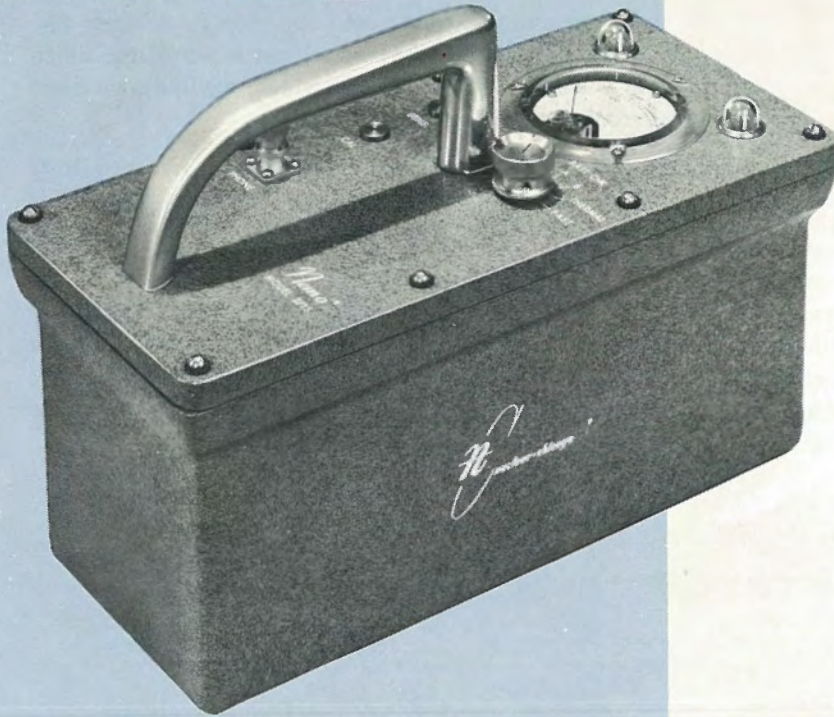
calibration—Calibration is made with a standard Ra-Be neutron source. Calibration accuracy $\pm 15\%$. A separate calibration curve to convert meter reading to neutrons/cm²/sec. is provided. Independent of gamma flux to 1 r/hour. A calibration correction curve is supplied for neutrons with energies from 0.25 mev to 14 mev.

dimensions—Probe including handle and shield is 13 $\frac{1}{2}$ " long, 2 $\frac{3}{4}$ " in diameter, four ft. cable attached.

weight—Complete with shield; 2.5 lbs.

PORTABLES

MODEL: 2715 NEMO[®]



- portable survey meter for separate measurement of thermal and fast neutrons

SPECIFICATIONS

range—10 to 10^4 neutrons per cm^2 per second for thermal and fast neutrons.

circuit—Four tube degenerative amplifier with exceptional high frequency response. Mid-frequency amplifier gain is adjustable from approximately 600 to 5000. Its response is down 3 db at approximately 200 kc. Input sensitivity is from 1.2 to 10 mv. and is normally set at 2 millivolts. Pulse operated high voltage supplies 1500 volts to proportional counters. Special logarithmic rate circuit is independent of tube characteristics.

controls—"Off, Fil, B+, Thermal, Fast" radial switch. Screwdriver sensitivity and calibrate controls.

detectors— BF_3 proportional counters, $\frac{5}{8}$ " in diameter, 4" long with enriched BF_3 to a pressure of 20 cm of Hg. One detector is enclosed in a $4\frac{1}{2}$ " x $4\frac{1}{2}$ " x $2\frac{1}{2}$ " wax block which is surrounded by a cadmium shield thick enough to absorb all the thermal neutrons, so that this counter responds only to fast neutrons. The other counter responds to thermal neutrons.

calibration—Calibration is made with a radium-beryllium neutron source having a maximum number of emitted neutrons at approximately 3 mev, an average energy of 4 mev, and a minimum energy of 13 mev. The meter calibration accuracy for this source is within $\pm 15\%$ for neutrons. Counter efficiency is approximately 10%. Calibration is constant throughout battery life.

scale of two—Provides a pulse of constant average duty cycle for the operation of the voltmeter circuit over the entire range of frequencies to be encountered. Neon lights on panel are connected to this circuit.

limiter—Pulse from scale of two is brought to a constant amplitude by the limiter circuit to drive the voltmeter circuit.

battery supply—Instrument uses five 45 volt batteries (two BA-029, three BA-032), four mercury cells (three BA-021, one BA-033). Battery life is 40 hours continuous or more than 150 hours at two hours per day.

dimensions—6" x 6" x $12\frac{3}{4}$ " exclusive of handle.

weight—16 $\frac{1}{2}$ lbs., shipping weight 20 lbs.

supplied with batteries, earphones and instruction manual.

Nuclear Chicago's Model 2715 "Nemo" is a unique portable battery operated survey meter for the separate measurement of thermal or fast neutron fluxes from 10 to 10^4 neutrons/ cm^2 /second. The instrument contains two enriched BF_3 proportional counters, precision electronic circuitry, a high voltage supply, and batteries.

One of the proportional counters measures thermal neutrons, and is mounted directly on the circuit board. The other measures fast neutrons only, and is in a wax block which is surrounded by a cadmium shield. It is sensitive only to neutrons whose energy is above the cadmium resonance at 0.176 electron volts. The neutron response is not affected by gamma background up to one r/hr. A calibration curve is furnished which supplies the proper meter correction factor for neutron energies from 20 kev to 12 mev.

The selector switch has five positions marked Off, Fil, B+, Thermal, and Fast. The selector switch is the only control used in normal operation. The Fil and B+ positions are used to check battery life, and battery check points are indicated by a mark on the meter scale. Screwdriver Calibration and Sensitivity controls are provided.

Headphones may be plugged into a jack on the panel if aural monitoring is desired. A pair of neon lights which are alternately lit with each detected neutron provide an indication of proper operation and permit fluxes of less than 10 neutrons/ cm^2 /second to be estimated. The meter scale is logarithmic and covers a range from 10 to 10^4 neutrons/ cm^2 /second.



Laboratory cabinets courtesy of Chicago Apparatus Company

complete new instrumentation for nuclear research in industry

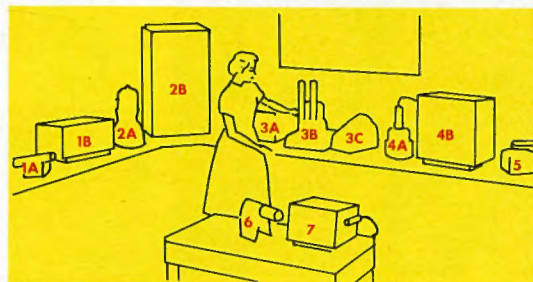
The variety of research and manufacturing problems encountered in the modern industrial nucleonic laboratory requires the broadest range instrumentation, including counting systems for alpha, beta and gamma determinations. The new Nuclear-Chicago detection and recording equipment illustrated in the model industrial radioisotope laboratory above have been se-

lected to handle a wide diversity of laboratory and plant problems and provide the ultimate in automatic sample-handling, recording and read-out convenience. Costly technical time is minimized in this model laboratory by automatic systems which collect precise data "around the clock". Your inquiries for specific recommendations will receive prompt attention.

1A Model DS5-3P Scintillation Detector with exposed 2" x 2" sodium iodide crystal and **1B** Model 132 Analyzer Computer for precision gamma-ray measurements using pulse-height discrimination techniques.

2A Model DS5-5 Scintillation Well Counter with exclusive "scaler-spectrometer" circuit and **2B** Model 1820 Recording Spectrometer for automatic quantitative energy separation of gamma-ray spectra.

3A Model 183B Count-O-Matic Binary Scaler, **3B** Model C110B Automatic Sample Changer with Model D47 Gas Flow Counter, and **3C** Model C111B Printing Timer for completely automatic changing, counting, and recording of as many as 35 soft beta emitting radioactive samples.



4A Model 3054 Manual Sample Changer with Model DS5 Scintillation Detector which features interchangeable alpha, beta, or gamma sensitive crystals connected to Nuclear-Chicago's finest scaler, the **4B** Model 192A Ultrascaler. Model 192A features decade scale of 10,000, one millivolt sensitivity, and precision automatic circuitry.

5 Model 2612P Portable Survey Meter contains a 1.4 mg/cm² thin window G-M tube for surveying for alpha, beta, or gamma contamination up to 20 milliroentgens per hour.

6 Model 2586 "Cutie Pie" features interchangeable ionization chambers for measuring beta, gamma, or x-radiation up to 250 roentgens per hour.

7 Model 1620A-S Analytical Count Rate Meter offers a wide choice of full scale ranges, four time constants, wide range high voltage supply. It is shown with a Model D34 thin window G-M tube and P11 probe for continuous monitoring or analytical radioactivity determinations.

Radioisotopes are creating new frontiers in medicine

NEW NUCLEAR INSTRUMENTS FOR MEDICAL USE



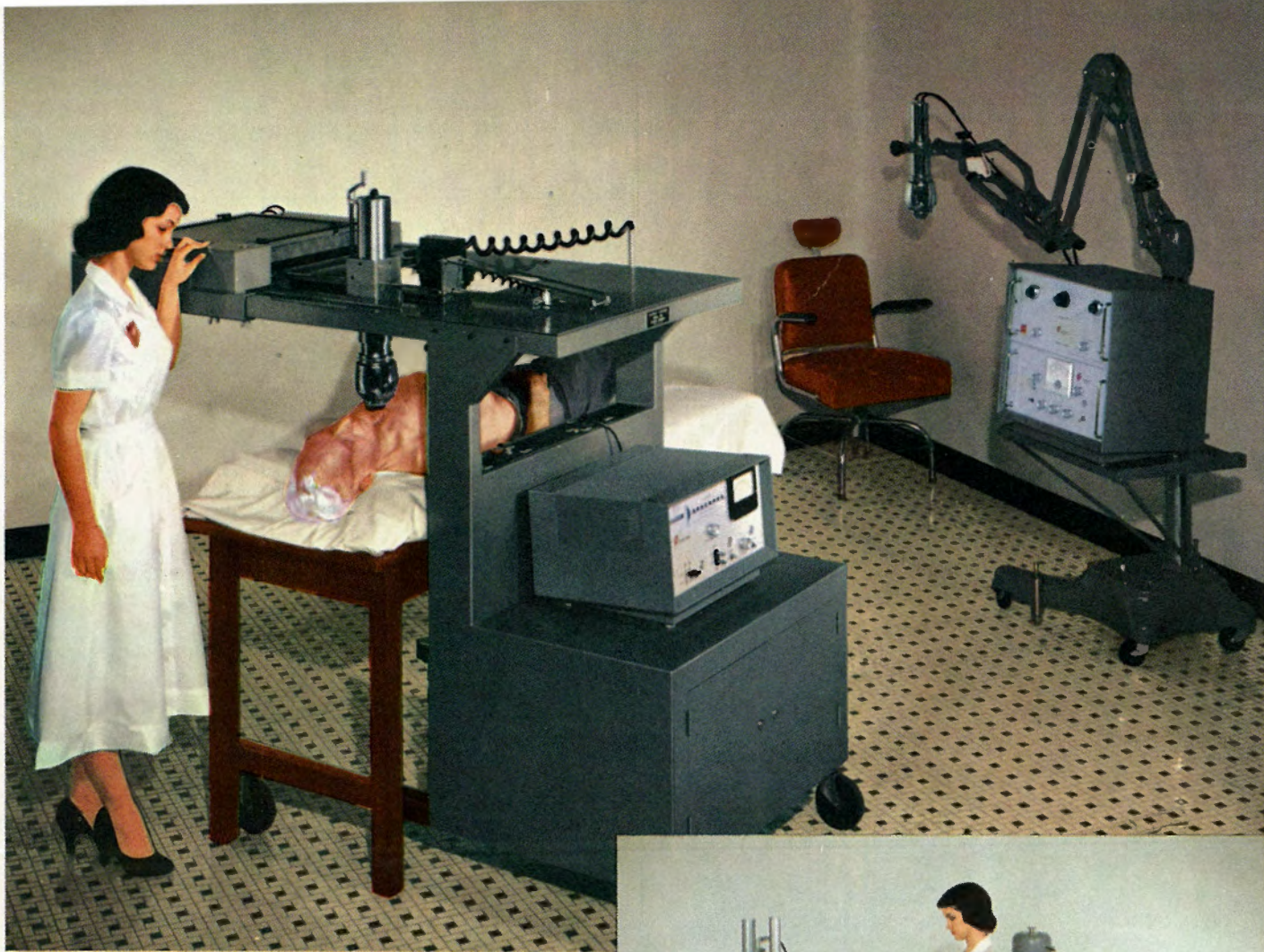
Radioisotope techniques are playing increasingly important roles in modern medicine. New applications have introduced diagnostic and therapeutic uses of radioactivity into every specialty and broadened the field to the point where every hospital, clinic and private physician should investigate the merits of an isotope program.

Nuclear-Chicago has been the leader in developing complete and versatile nuclear instrumentation for medical use. A typical, inexpensive system for measuring thyroid function, still the most widely used radioisotope technique, is illustrated at the left. The simple scaler, stand and directional scintillation detector may also be used in brain tumor localization, liver and gall bladder function studies, and in other clinical procedures involving external counting.

Addition of a scintillation well counter (below to the same scaler widens the range of techniques which may be carried out to include determination of plasma volume, red cell mass, red cell survival and absorption of vitamin B₁₂. Any application requiring measurement of gamma emitting radioisotopes in liquid or solid form can be performed with these instruments.

(Above) New Nuclear-Chicago equipment being used includes 161A Binary Scaler, T1 Timer, DS5-2 Directional Scintillation Detector, and SA1-A Detector Stand. (At right) Same 161A Scaler is used with DS5-5 Scintillation Well Counter for radioactive sample counting.





Nuclear-Chicago can provide instrumentation for the most elaborate medical facility carrying out both research and routine diagnostic and therapeutic applications of radioisotopes. In the typical diagnostic center above, an automatic scintillation scanning system with the newly developed photo-recording attachment is being used to obtain an exact picture of the radioisotope distribution in a patient's thyroid gland. The same instruments are useful in outlining radioactivity concentrations in other parts of the body.

The precision external counting system in the background combines a gamma-ray spectrometer with a rate-meter and highly sensitive scintillation detector. This versatile equipment can be used for all the procedures outlined for the simpler system illustrated on the opposite page and in addition is ideal for cardiac output measurements, kidney function studies, and other uses where a rapid response to changes in concentration of radioactivity must be obtained.

The more elaborate clinical counting room at the right permits measurement of carbon-14 and sulfur-35 radiations with an automatic sample changer system and precision measurement of one or more gamma-emitting isotopes present in the same sample with a scintillation well counter and combination scaler-spectrometer unit. The beta-gamma survey meter is used for locating contamination in areas where radioisotopes are used.

Nuclear-Chicago's wide experience is available to anyone establishing or enlarging a radioisotope program.



(At top) Nuclear-Chicago equipment being used includes 1700 Isotope Scanner, 1700-P Photo-Recording Attachment, DS5-1 Scintillation Detector and 161A Scaler. In background, SA2 Stand, DS5-1P Scintillation Detector, 1620A Ratemeter and 1810 Radiation Analyzer in double cabinet. (Below) C110B Automatic Sample Changing system using D47 Gas Flow Counter, DS5-5 Well Counter, 132 Analyzer Computer, and 2612M Portable Survey Meter. Note that the equipment shown in the simple laboratories on the opposite page has been incorporated into these more elaborate installations.


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Laboratory cabinets courtesy of Chicago Apparatus Company

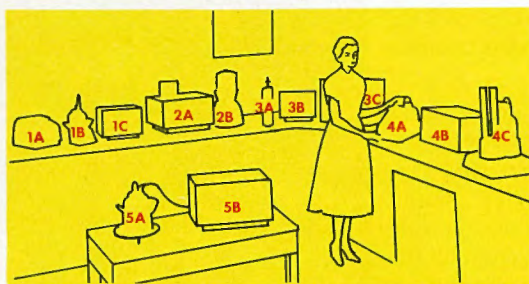
complete new instrumentation for biochemical research with radioisotopes

The modern laboratory illustrated above is the most complete and versatile ever assembled for nuclear biological research. Separate Nuclear-Chicago instruments have been combined into specialized counting and recording systems for scanning paper radiochromatograms, for assay of liquid or solid gamma emitting samples, for low level counting of carbon-14 and tri-

tium, for automatic sample handling and counting. Each of these systems offers the maximum in accuracy and automaticity, is designed for integration with other biological techniques, and is built to maintain the traditional high standards of quality and reliability of all Nuclear-Chicago products. Our representatives will be happy to discuss your particular needs with you.

1A Rectilinear Recorder, **1B** Model C100A "Actigraph" with sensitive D47 Gas Flow Counter with exclusive "Micromil" window, and **1C** Model 1620A-S Analytical Count Rate Meter for automatic scanning and recording of the radioactivity on paper strip chromatograms.

2A Model 181A Royal Scaler and Model T1 timer are shown with **2B** Model DS5-5 Scintillation Well Counter for precision measurement of gamma emitting liquid or solid radioactive samples. Well counter contains a full 2" of lead shielding.



3A "Dynacon" Converter with 500 ml. ion chamber, **3B** "Dynacon" amplifier, and **3C** Recorder for high efficiency measurement of radioactive carbon-14, tritium, and other low level samples in the gas phase.

4A Printing Timer, **4B** Model 161A Basic Binary Scaler, and **4C** Model C110B Automatic Sample Changer for automatic handling, measuring, and recording of the radioactivity of as many as 35 samples. Thin window or gas flow detectors may be used with the sample changing system.

5A Model M5 Semi-automatic Sample Changer with Model D47 Gas Flow Counter connected to **5B** Model 186 Imperial Scaler. The 186 may be used with all G-M, scintillation or proportional detectors, features one millivolt to one volt input sensitivity.

MODEL: 1500 HAND AND FOOT COUNTER

MONITORS

- *completely automatic monitoring of beta-gamma contamination on personnel hands and shoes*

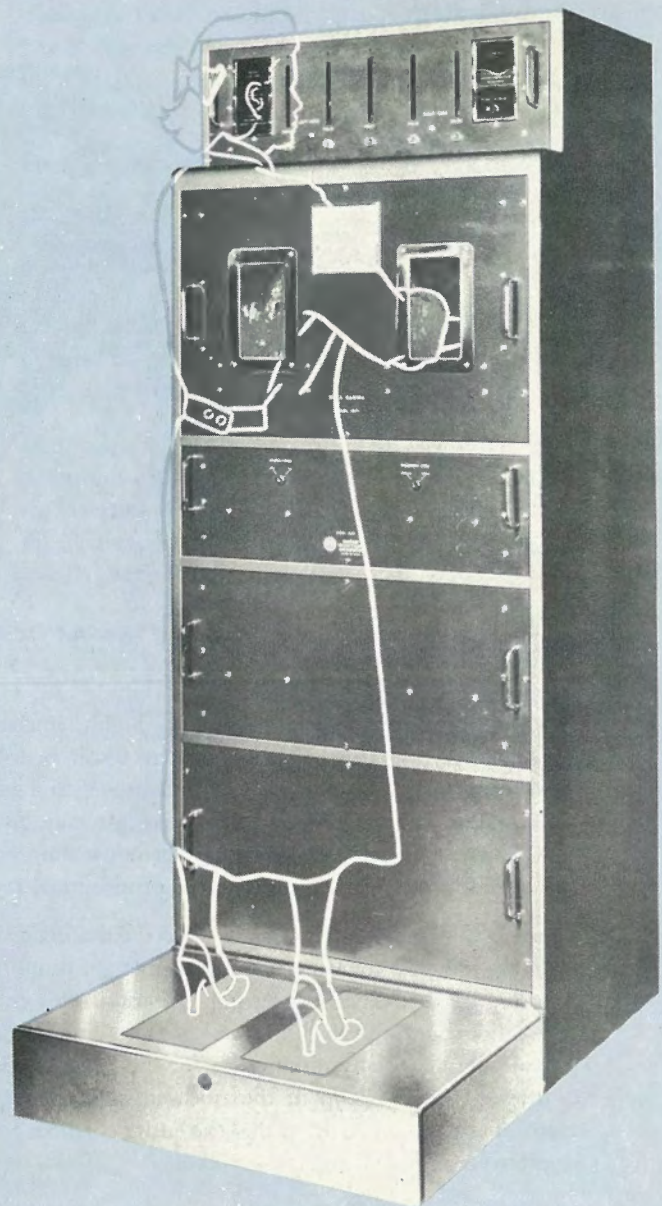
Model 1500 "Hand and Foot Counter" provides automatic monitoring of beta-gamma contamination on the hands and feet of radiolaboratory technicians. It consists of a five channel scaler and power supply with automatic controls to time the counting operation in proper sequence. One scaling channel is provided for each side of each hand, and one for the soles of both shoes.

Typical operation finds the green "Ready to Use" sign lighted when the user steps up to be tested. The counting process is started and maintained by pressure of the finger tips at the rear of the hand pockets. During the test, the user sees five banks of decade indicators at eye level. Each of these decade indicators will present a single number to indicate the degree of contamination of hand and foot surfaces. After the preset time, the timer will shut off the scalars. If the number of counts in any channel exceeds the scaling factor in that channel, the "Decontamination Required" sign will light. If it does not, the "Check OK" sign will light.

If the hands are removed before the complete counting time has elapsed, "Check Incomplete—Reset and Repeat" will light. In ordinary operation, the user simply steps down from the counter after his check, and the unit automatically resets itself after a preset length of time. Time intervals are variable from six to sixty seconds.

Each hand channel is operated by two long-life Halogen quenched thinwall counting tubes which are individually shielded to provide low background. The foot channel is operated by eight shielded counting tubes, four to each shoe. Scaling factors are 100 for the hand channels and 200 for the foot channel.

The unit is made with all controls locked inside to discourage tampering, or injury to casual personnel. When a chassis is pulled out, interlock switches disconnect the power for the entire unit. B+ and HV primary circuits are fused, and if the counter voltage falls below a predetermined value, the "Ready for Use" legend will be shut off automatically. The design of this instrument provides safe and foolproof operation and permits its use by untrained personnel.

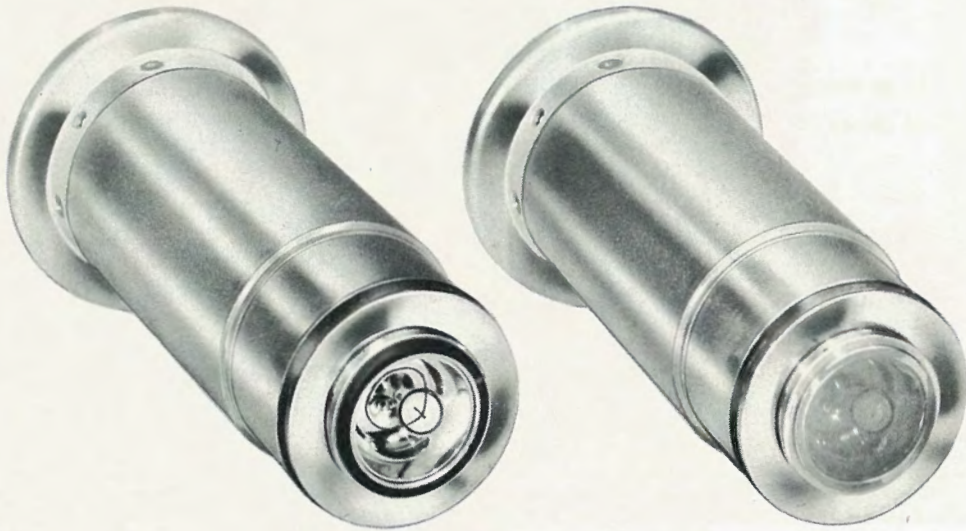


SPECIFICATIONS

- detectors**—16 thinwall (35 —40 mg/cm²) stainless steel halogen type G-M counters.
- sensitivity**—Minimum beta energy 200 kev.
- high voltage**—600 to 3000 volts continuously adjustable. Voltmeter is mounted on chassis. Well stabilized—less than 0.05% change in high voltage for line voltage change over 100 to 130 volt range.
- tolerance**—10 cpm to 1200 cpm for the hand channels. 10 cpm to 2400 cpm for the feet channel.
- power requirements**—Approximately 325 watts, 115 volts, 60 cycles. Available for 220 volts and/or 50 cycle operation on request.
- dimensions**—76" high, 32" wide, 24" deep without platform, 49" deep with platform.
- weight**—440 lbs. without platform, 565 lbs. with platform.
- supplied with** all necessary interconnecting cables and instruction manual.

DETECTORS

MODEL: D47 GAS FLOW COUNTER



- high efficiency for C-14, S-35, tritium beta radiations
- windowless or ultra-thin Micromil® window operation
- geiger or proportional operation by merely changing counting gas
- unparalleled versatility

WINDOWLESS OR WITH THE EXCLUSIVE MICROMIL WINDOW

The Nuclear-Chicago Model D47 is a highly efficient gas flow counter primarily designed to detect soft beta radiations from isotopes such as carbon-14, sulfur-35 and tritium. This unique and versatile radiation detector may be operated either as an ultra-thin Micromil® window counter or as a windowless counter in the Geiger or proportional regions.

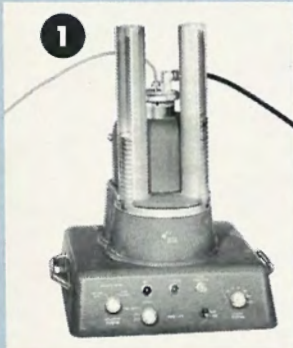
Model D47 contains a trochoidally shaped counting chamber through which a constant flow of Geiger or proportional counting gas is maintained during operation. This constant renewal of counting gas eliminates counter aging effects and provides an essentially infinite life for the detector. A concentric anode wire loop in the trochoid maintains a symmetrical electrostatic field so that the entire chamber volume is effective for counting.

micromil® window operation — An outstanding and unique feature of the Model D47 is its removable "Micromil" window. This strong, ultra-thin plastic membrane has a density of less than 150 micrograms/cm² including its metallic coating and is mounted on a metal ring which can be placed quickly on the end of the counter chamber.

The extreme thinness of the "Micromil" window allows measurement of soft beta radiations with little loss in detection sensitivity. Total absorption loss of the window and of the normal air layer between the window and the sample is less than 30% for carbon-14 beta particles. This slight loss in counting efficiency is compensated for by the greatly increased reliability and versatility of window operation. Chamber contamination, electrostatic charge effects, vapor

THE MODEL D47 GAS FLOW COUNTER MAY BE USED WITH THE:

C110B Automatic Sample Changer



C100A Actigraph



M5 Semi-Automatic Changer



3054 Manual Sample Changer



or with its own base p



transmission from liquid or moist samples, and other common faults associated with windowless counters are completely eliminated by the use of the Nuclear-Chicago exclusive "Micromil" window.

windowless operation—When the greatest sensitivity is desired, or when extremely soft radiations from isotopes such as tritium, nickel-63, etc. are to be counted, the D47 may be used as a windowless counter. The design of the instrument is such that usual windowless counter faults are reduced to a minimum consistent with high detection efficiency. Radioactive samples are positioned so that their holders make a tight seal with a rubber "O" ring mounted on the end of the counting chamber. The unit then operates as a 2π counter with the maximum geometry obtainable using a flat sample.

operation as a geiger counter—The Model D47 is operated most simply as a Geiger counter with Nuclear-Chicago patented "Q-Gas", and any standard Nuclear-Chicago scaler or ratemeter. The signal from the D47 may be fed directly into the scaler or ratemeter without any preamplification.

operation as a proportional counter—The D47 may be used as a proportional counter when operated with a scaler having one millivolt sensitivity such as the Nuclear-Chicago Models 186 or 192A. When operated with "PR-Gas" in the proportional region it is possible to discriminate between different beta energies, and to count alpha radiation in the presence of other radiations. Since the "dead-time" of the detector is extremely short when operated as a proportional counter, very high counting rates can be measured without appreciable coincidence loss.

Operation as a proportional counter is particularly useful in detecting alpha radiation since the pulse height obtained from the alpha particles is considerably higher than that from any beta, gamma, or meson radiation.

The D47 Gas Flow Counter is unique in that the change from Geiger to proportional operation is accomplished by merely changing the counting gas. There is no need to substitute center wires or make other mechanical or electrical changes to the detector.

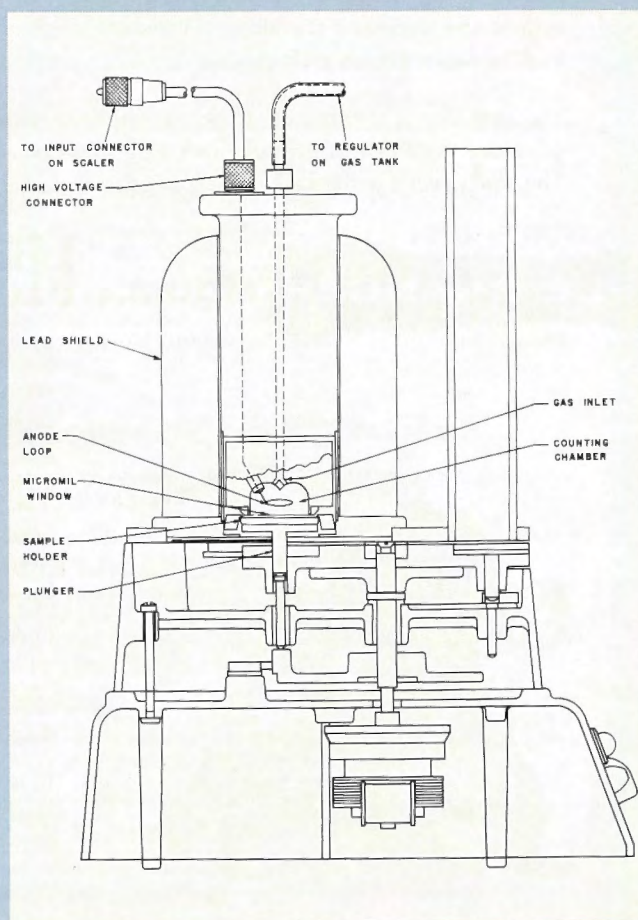
gas system—The gas system of the Model D47 is of extremely simple design in order to keep the gas free of contamination from water vapor, organic solvents, dust, etc. and to eliminate all critical adjustments. Counting gas flows from the supply tank through a two stage pressure regulator and then through a length of polyethylene tubing which contains a small-bore glass capillary which determines the gas flow. Gas flows through the tubing directly to an inlet at the top of the D47 counter or to the T3 automatic valve and then to the D47 counter.

Gas enters the counting chamber through four equispaced orifices at its top. The smooth contour of the chamber assures a uniform flow of gas, and helps prevent the accumulation of impurities. In operation, the counting chamber is maintained slightly above atmospheric pressure. Final gas exhaust passes through holes in the "Micromil" window ring or through holes in the sample pan holders during windowless operation.

background considerations—To achieve maximum sensitivity, the Model D47 flow counter was designed to provide the lowest possible background. Ambient and cosmic ray background is minimized by designing the counter with the smallest possible size consistent with the samples with which it is used. The counting chamber of the D47 is surrounded by a heavy iron shield. In addition, the 2" lead shield normally used with the detector materially decreases background.

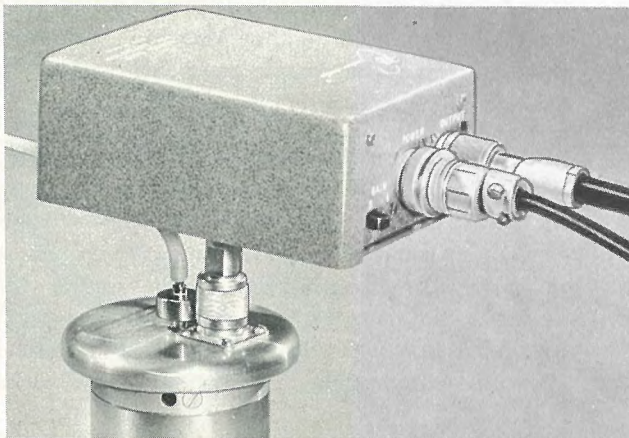
general—The Model D47 Gas Flow Counter is the result of careful design and precision manufacture. Every counter is inspected, operated and carefully adjusted before leaving the factory. Wide field experience has shown it to be unusually precise and trouble-free in all its modes of operation.

Simplified cross-section drawing of the Model D47 Gas Flow Counter mounted in a lead shield on the C110B Automatic Sample Changer.



ACCESSORIES

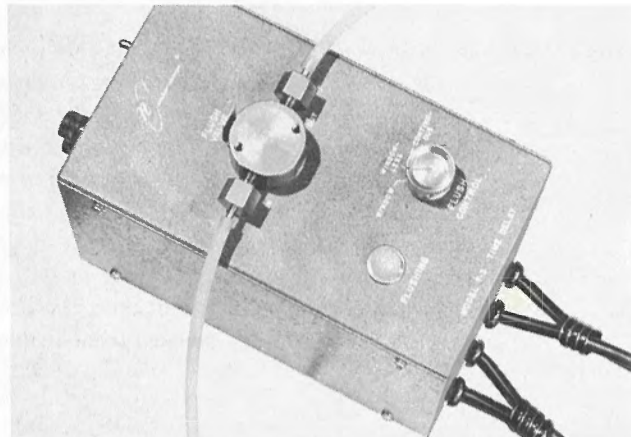
FOR MODEL D47 GAS FLOW COUNTER



MODEL D47 PREAMPLIFIER

D47-P preamplifier—The use of the Model D47-P Preamplifier is recommended when the D47 Gas Flow Counter is used as a proportional detector with either Models 192A or 186 scalers. The Model D47-P provides better plateau characteristics and permits the use of long cables between the counter and scaling unit. By keeping the input capacity small it lowers the plateau starting voltage, increases plateau length, and decreases the slope. The short shielded input lead minimizes noise pickup.

The amplifier is a two-stage feedback amplifier with plate-to-cathode feedback. A gain of either 1 or 5 may be selected. The unit attaches to the D47 input connector as shown above.



MODEL T3 TIME DELAY VALVE

T3 automatic valve—In windowless operation *with the C110B Automatic Sample Changer* the use of the Model T3 Automatic Valve is recommended. The T3 valve is used to conserve counting gas and to prevent the scaler from counting during flushing of the detector. The regulated gas pressure at the supply tank is set high enough to cause flushing. During the sample changing portion of the cycle and for 55 seconds after the chamber is sealed, the T3 remains open. Thus, air is automatically flushed out of the counting chamber after being unavoidably introduced into the windowless chamber during sample changing. After the 55 second flush, the T3 automatically throttles the gas flow to a lower rate, and simultaneously activates the scaler for counting.

SAMPLE CHANGER MODEL: M5 SEMI-AUTOMATIC SAMPLE CHANGER



Model M5 is used with the D47 and 3037B lead shield (optional) for fast, accurate sample counting. They make a complete system for Geiger or proportional counting of alpha or soft beta emitters and permit windowless or "Micro-mil" window operation.

The Model M5 changer features a rotating lower table with three recesses containing stainless steel adapters for holding sample pans. While sample #1 is being measured, sample #2 is automatically preflushed and sample #3 may be inserted. When the count is completed on sample #1 the index handle is operated to rotate the table 120° and advance all samples one position. Sample #1 may then be replaced at the open station by a new sample or recycled for another count. By this simple semi-automatic scheme, a long series of samples may be counted or recounted without lost time and motion between counts.

In normal operation, the counting gas flows through the sample chamber and is then directed through a flexible polyethylene connector to the preflush chamber. The gas then flows through a bubbler for observation of its flow rate.

Order Model M5 Changer, Model 3037B lead shield, D47 Gas Flow Counter, gas regulator, gas tank and scaler for complete system.

SPECIFICATIONS

MODELS: D47, T3, D47-P, Counting Gas, M5

MODEL D47 GAS FLOW COUNTER

counting chamber— $1\frac{7}{16}$ " I.D. with trochoidal profile.

anode—Loop of 0.002" diameter wire.

"micromil" window—Total density less than 150 micrograms per square centimeter including metallic coating.

connections on D47—Gas and high voltage connectors at top.

approximate operating potentials—Geiger, 1250 volts; beta proportional, 2200 volts; alpha proportional, 1200 volts with PR-gas, with pure methane 2300 volts.

plateau length—200 volts in Geiger region. 400 volts in proportional region using Model D47P preamplifier.

plateau slope—2% per 100 volts in Geiger region. 0.5% per 100 volts in proportional region using Model D47P.

scaler sensitivity required—Geiger operation, 0.25 volts. Proportional operation, 1 millivolt.

sample size—When used with M5 or C110B the D47 will accept samples $\frac{3}{32}$ " by $1\frac{1}{4}$ " dia. or $\frac{3}{16}$ " x 1" dia.

air layer between window and sample—Variable from a minimum of 0.5 mm (60 micrograms/cm²) to a maximum of 8.8 mm (1 milligram/cm²).

background (approx.)—Alpha proportional—8 counts/hr.*

Geiger and beta proportional—16 counts/minute.*

*At 600 ft. above sea level using $1\frac{1}{2}$ " of lead.

resolving time—100 microseconds with Geiger operation. 6 microseconds with proportional operation.

dimensions—Body diameter, 3". Total height, $9\frac{1}{8}$ ".

weight—14 lbs., shipping weight 26 lbs.

supplied with—3 "Micromil" windows, sealing rings, ring weights, base plate, Allen wrench with "T" handle for adjusting height of detector over sample, counter servicing bracket, $\frac{1}{4}$ oz. silicone vacuum grease, 3 ft. polyethylene tubing with glass capillary inserted, instruction manual.

MODEL T3 AUTOMATIC VALVE

Note that the use of the Model T3 is not necessary for any method of operation *except* windowless operation with the C110B Automatic Sample Changer.

flushing time—Adjusted at the factory to approximately 55 seconds. Time can be adjusted inside the unit down to a minimum of 10 seconds.

three position flush control—

1. *Continuous*—Provides continuous flushing with the scaler activated for counting.
2. *Windowless*—Provides flushing during sample changing and for approximately 55 seconds after the D47 chamber is sealed. The T3 then automatically reduces gas flow and automatically activates the scaler.
3. *Window*—Provides a reduced continuous gas flow for "Micromil" window use of the D47 counter. Note that the use of the T3 is not necessary for window operation, but may be left connected for convenience.

D47-P PREAMPLIFIER

circuit—Two stage amplifier consisting of one 6BQ7A twin triode with negative feedback from output plate to cathode of input section.

circuit characteristics—

Gain—1 or 5 (both $\pm 20\%$) as determined by GAIN switch.

Rise and Decay Time—Approximately 0.2 microsecond.

Frequency Response—Within 3 db from 1 kc to 2 mc.

Feedback Factor—20 decibels.

Input Capacity—Approximately 20 micro-microfarads.

Output Impedance—Approximately 100 ohms.

Maximum Linear Output—Approximately 15 volts.

Pulse Overshoot—Less than 5%.

Output Noise Level—Peak-to-peak random noise, approximately 0.1 millivolt. Peak-to-peak 60 cycle hum approximately 1 millivolt.

Power Requirements—6.3 volts a.c. at 0.5 ampere, and 150 150 volts d.c. at 10 milliamperes.

High Voltage Limit—5000 volts, as determined by noise generation rather than voltage ratings of capacitors.

dimensions— $2\frac{5}{8}$ " x $4\frac{1}{4}$ " x 6"; weight—2 lbs.

COUNTING GAS

geiger "Q-Gas"—98.7% helium, 1.3% butane.

proportional "PR-Gas"—90% argon, 10% methane.

Gas is available in steel cylinders with 855 cubic inch capacity filled to approximately 1500 pounds pressure. A tag on each capillary supplied with the D47 flow counter shows the regulated pressure required to give a proper gas flow.

life—Gas life is approximately 460 hours of operation under any method of "Micromil" window operation. When the D47 is used as a windowless counter with the M5 manual sample changer, life is approximately 360 hours. When used as a windowless counter with the C110B automatic sample changer and T3 automatic valve, life is approximately 115 hours.

M5 SEMI-AUTOMATIC SAMPLE CHANGER

material—Base plate and table are solid bronze. Exposed top surfaces have a protective finish.

lubrication—Silicone grease between base and table to insure perfect gas seal and smooth rotation.

sample positions—"loading", "preflush" and "counting" positions. Adapters accept $\frac{3}{32}$ " x $1\frac{1}{4}$ " d. or $\frac{5}{16}$ " x 1" d. sample pans. A special adapter for use with plastic sample pans can be supplied.

shield—Table designed to hold Model 3037B lead shield containing the Model D47 Gas Flow Counter over "counting" position. Unit may be used with the D47 by itself without the 3037B if desired.

dimensions—Table is 10" in diameter.

weight—23 lbs., shipping weight 29 lbs.

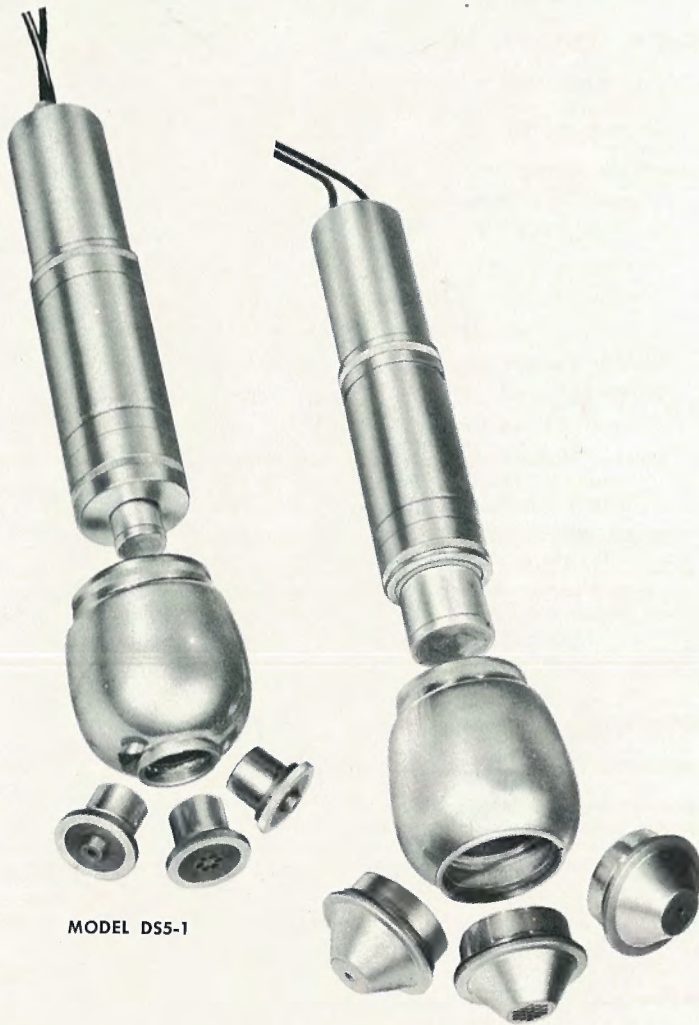
supplied with 3 numbered sample adapters, polyethylene tubing with glass capillary, and instruction manual.

order model 3037B separately.

SCINTILLATION DETECTORS

MODELS: DS5-1, DS5-1P

- versatile gamma-sensitive scintillation detectors with interchangeable collimators for medical use



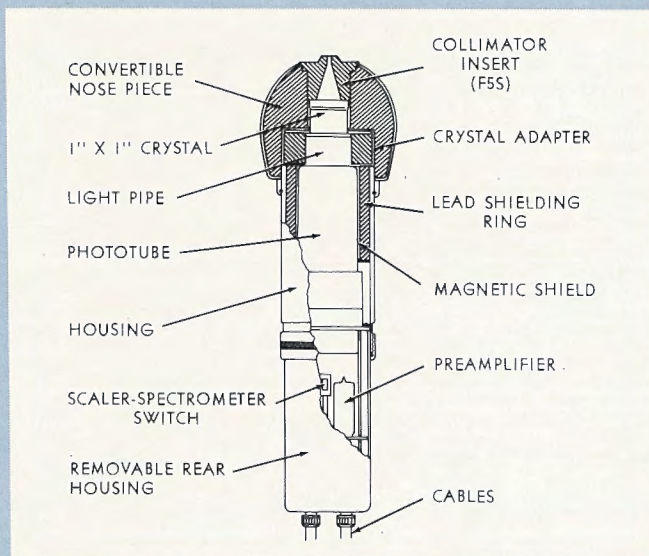
MODEL DS5-1

MODEL DS5-1P

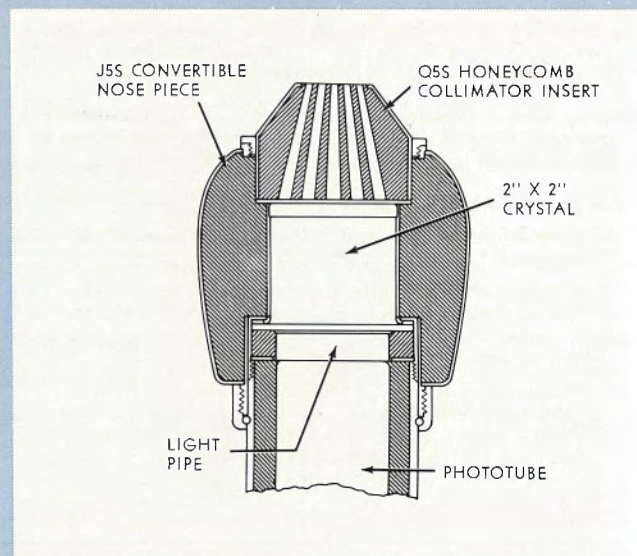
On the following six pages of this catalog are illustrated the most versatile and modern scintillation counters available today. Each of these precision detectors is made from a basic probe (part No. DS5) to which is added interchangeable accessories and a wide variety of crystals and phosphors to provide for every research, medical or industrial application. Models DS5-1 and DS5-1P are gamma-sensitive detectors particularly recommended for medical applications. Both detectors are supplied with three special collimator inserts, are easily converted to any other DS5 scintillation detector (alpha, beta, or gamma-well type), and can be used with scalers, ratemeters, or gamma-ray spectrometer systems.

MODEL DS5-1

Model DS5-1 Multi-Purpose Scintillation Detector, equally suitable for large area source measurements, uptake studies "pin-point" resolution or three dimensional body scanning is recommended for medium or small size hospitals and clinics, and is outstanding in a physician's private office.



MODEL DS5-1



MODEL DS5-1P

This precision detector consists of the DS5 basic probe, a crystal adapter and light-pipe, a 1" x 1" sodium iodide crystal, a removable convertible nose piece providing exceptional crystal side shielding, and three versatile collimator inserts. Although it may be used with the convertible nose piece by itself for measurement of large areas, the detector is most often used with one of the threaded collimator inserts.

the 20° flat field collimator contains a cone shaped hole which tapers to 3/4" diameter at the crystal. Its use is recommended for thyroid uptake studies, gross organ scanning, cardiac output determinations, and other measurements in which a 20° response angle is required. A detector using this insert will "see" a circular area with a diameter of approximately 5" at 30 cm.

the straight bore collimator contains one straight hole 7/32" in diameter. Collimation is such that at 5 cm. the detector will see an area with a diameter of only 1/2". This insert is employed for fine resolution measurements and is most often used with the Model 1700 Isotope Scanner.

the focusing collimator permits three-dimensional radiation measurements. It contains six tapered holes the axes of which meet at a point 1 3/4" from the face of the collimator. Sensitivity is extremely high at this point and falls rapidly as the distance in any direction from the focal point increases. The focusing collimator is particularly useful for determining *the depth as well as the lateral position* of a radioactive "hot" spot or a radioactive "void" in an organ.

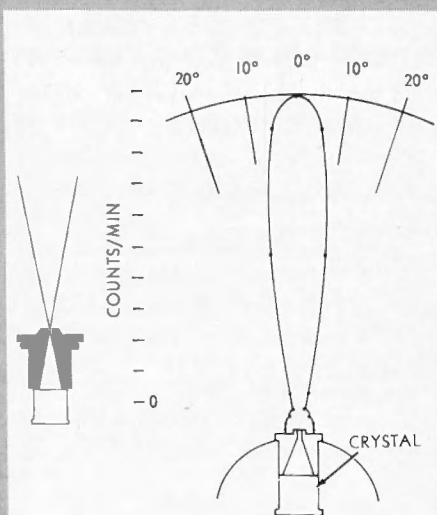
Three-dimensional mapping is most conveniently carried out by mounting the detector on the Model 1700 Isotope Scanner and making several scans at different depths.

MODEL DS5-1P

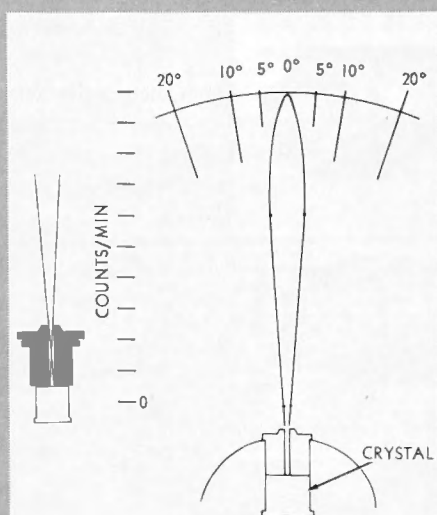
The Model DS5-1P Scintillation Detector is similar to the DS5-1 except that it is provided with a 2" x 2" sodium iodide crystal, a larger nose piece with a minimum of 1" of lead for shielding, and three collimator inserts designed for the larger crystal. These inserts (a straight bore collimator, a 20° flat field collimator, and a unique focused honeycomb collimator) have been improved mechanically by housing the lead shielding in brass spinings.

The focused honeycomb collimator insert supplied with the DS5-1P contains *nineteen tapered hexagonal holes* which provide maximum sensitivity at a point approximately 2" from the face of the insert. Although the response curve for this insert is similar to the response curve for the DS5-1 focusing collimator insert, the increase in counting rate due to the larger combined aperture area and crystal size is significant. At the focus point, the count rate obtained with the DS5-1P is approximately 100% greater than that obtained with the DS5-1 focusing collimator. Thus, the more elaborate DS5-1P permits more rapid measurements and enables the user to administer smaller tracer doses for clinical measurements.

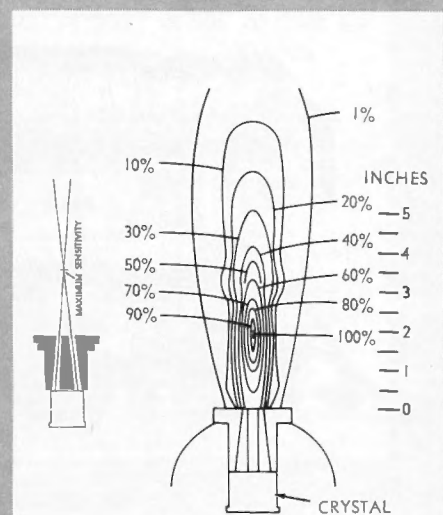
The Model DS5-1P Scintillation Detector is our finest medical gamma ray detector. Maximum sensitivity is provided through the use of the large 2" x 2" sodium iodide crystal. It offers maximum versatility by its ease of conversion to any application requiring different types of collimation. It may be quickly converted to an alpha or beta detector or to a gamma-sensitive well counter by merely changing crystals and adapters.



THE 20° FLAT FIELD COLLIMATOR



THE STRAIGHT BORE COLLIMATOR

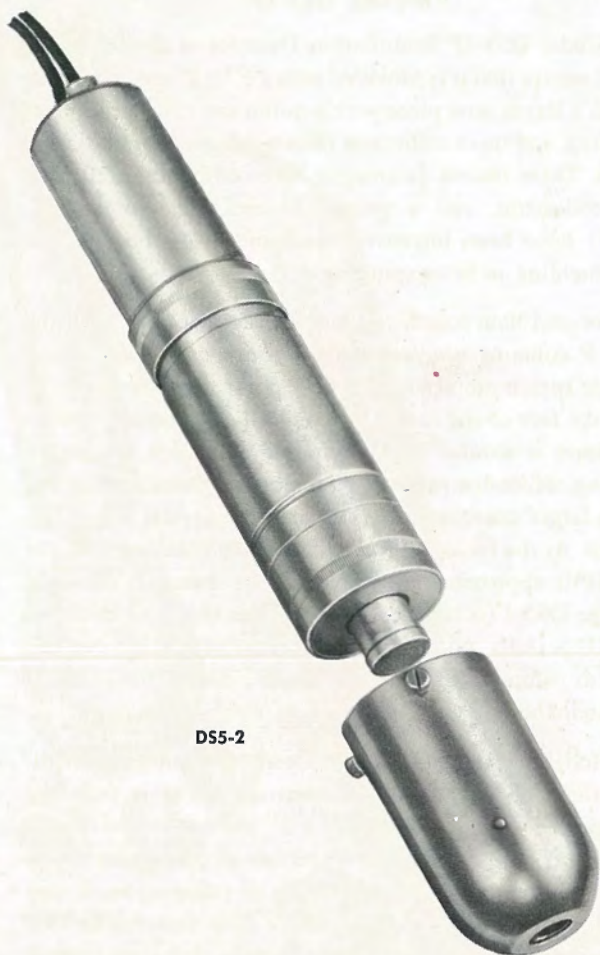


THE FOCUSING COLLIMATOR

DETECTORS

MODEL: DS5-2

BASIC MEDICAL SCINTILLATION DETECTOR



DS5-2

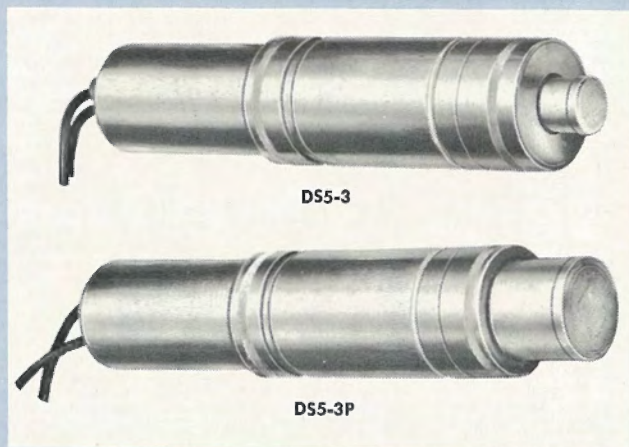
The Model DS5-2 Basic Medical Probe, shown at left, is identical with the DS5-1 Multi-purpose Scintillation Detector shown on the previous pages except that it is offered with a simplified nose piece instead of the convertible nose piece and collimator inserts.

This detector, which may be easily converted to the more elaborate Models DS5-1 or DS5-1P at any time by the addition of the convertible nose pieces and inserts, is recommended as an inexpensive directional counter for routine medical diagnostic studies such as thyroid uptake measurements and gross body scannings. The lead nose piece provides approximately 1" of lead shielding around the side of the exposed 1" x 1" crystal and extends 1 $\frac{5}{8}$ " beyond the end of the crystal.

A slightly tapered one inch diameter hole through the nose piece provides directional shielding. At a distance of 30 cm., the detector equipped with this nose will "see" a circle with a diameter of approximately 7 inches.

The Model DS5-2 Basic Medical Probe is recommended for laboratories where present applications are well defined and restricted to thyroid work, organ scanning, etc., and where fine resolution and focusing features are not needed. Although requiring only a modest capital investment, the instrument can be broadened in application at any future date by the addition of the convertible nose piece and collimator inserts.

MODELS: DS5-3, DS5-3P EXPOSED CRYSTAL PROBES



DS5-3

DS5-3P

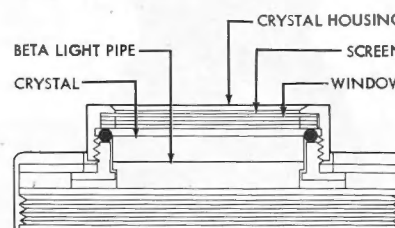
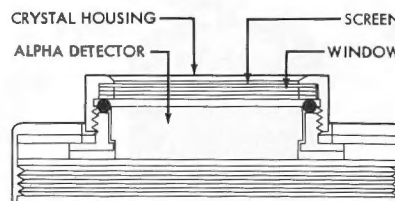
The Models DS5-3 and DS5-3P scintillation detectors are identical with the DS5-1 and DS5-1P detectors shown on the previous page except that they are provided without the nose pieces or collimator inserts. The DS5-3 is supplied with a 1" x 1" crystal, while the DS5-3P is furnished with a 2" x 2" crystal. The exposed crystals provide maximum signal response and minimum scatter.

The DS5-3 and DS5-3P probes are ideal for gamma ray spectrometry measurements (see scans on page 25). They may be used with the 3054 lead shield or with the C110B Automatic Sample Changer.

Probes with $\frac{3}{4}$ " x $\frac{3}{4}$ " and $\frac{1}{2}$ " x $\frac{1}{2}$ " crystals are available on special order. Prices on request.

MODELS: **DS5-6** ALPHA SCINTILLATION DETECTOR
DS5-7 BETA SCINTILLATION DETECTOR

DETECTORS



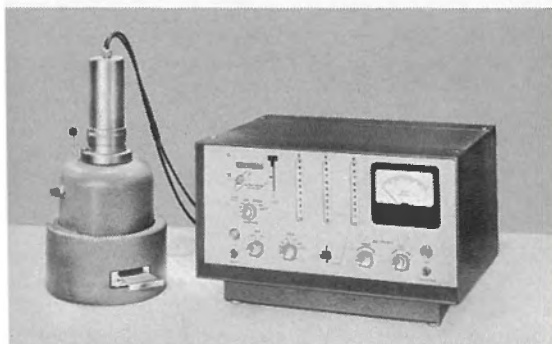
The Models DS5-6 Alpha and DS5-7 Beta Scintillation Detectors consist of the DS5 basic probe, the AX7S adapter, and either an alpha phosphor or beta crystal. Both detectors may be used with all Nuclear-Chicago scalers except Model 2800, and can be mounted in the Model 3054 shield for manual sample changing or in the Model 3052 shield for use with the C110B Automatic Sample Changer.

model DS5-6 alpha scintillation detector—The XTA Alpha crystal consists of a tightly packed, carefully prepared layer of alpha sensitive ZnS-Ag phosphors approximately 5 mg/cm² thick mounted on a lucite disc and covered by a light-tight double aluminized Mylar film with a density of 0.9 mg/cm². The disc is mounted in an aluminum housing with an open end area of 10.4 cm² containing a removable protection grid.

The Model DS5-6 may be used in full illumination, and is completely insensitive to beta or gamma radiation. The over-

all alpha efficiency of the detector is 32% with the protective grid and 50% with the grid removed. Collection efficiency, compensating for geometry and absorption, is greater than 95%. Background count is only a few counts per hour. The plateau is 250 volts with a slope of less than 2% per 100 volts.

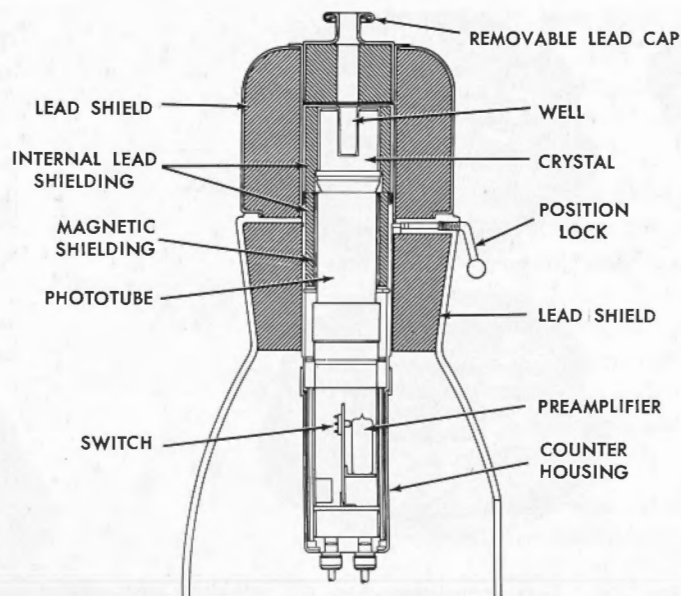
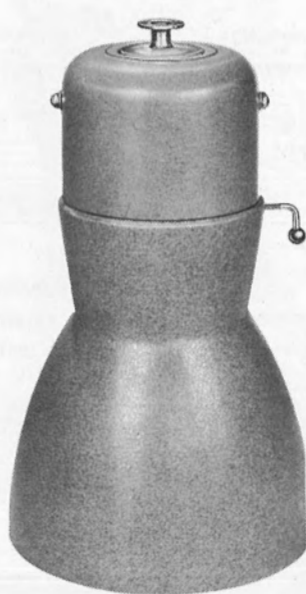
model DS5-7 beta scintillation detector—The XTB beta crystal consists of a $\frac{3}{16}$ " x 1½" dia. anthracene crystal optically coupled to a thin lucite support and mounted in a housing assembly similar to that used with the phosphor. It is sensitive to beta radiations with energies as low as 60 kev. Counting efficiency is virtually 100% for betas which penetrate the thin foil. The unit is insensitive to alpha radiation, and has a gamma efficiency of less than 5% when used with a quarter-volt scaler or ratemeter. Background is approximately 150 counts per minute unshielded and 50 cpm when used in the Models 3052 or 3054 shields. Average plateau is 150 volts with less than 5% slope per 100 volts.



Models DS5-6 and DS5-7 detectors may be used in the Model 3054 Manual Sample Changer (at left) or in the Model 3052 shield for use with the C110B Automatic Sample Changer (at right).



SCINTILLATION WELL COUNTER



- high efficiency gamma ray detector for measuring liquid or solid radioactive samples

The Model DS5-5 Scintillation Well Counter is designed for extremely efficient measurement of low-level gamma-emitting samples in liquid or solid form. It may be used with all Nuclear-Chicago scalars (except Model 2800), with the Model 1620A Ratemeter, and with Models 132, 1810, or 1820 gamma-ray spectrometers.

The large sodium iodide crystal supplied with the DS5-5 contains a well which accommodates a test tube or centrifuge tube containing the sample. Extremely high overall efficiency is achieved because a sample inserted into the well is almost completely surrounded by the crystal. The excellent counting geometry makes measurements of very weak sources practical and permits high statistical counting accuracy in short periods of time.

More than 2" of lead shielding extends above and below the crystal, providing an exceptionally good ratio of source to background counts. The generous amount of shielding combined with the tremendous sensitivity of the well crystal permits accurate measurement of gamma sources with activities as low as 10^{-5} microcuries.

Medical studies most easily accomplished with the DS5-5 Scintillation Well Counter include measurement of protein-bound I-131 and urinary I-131 content in thyroid function studies, radioactive iodinated serum albumin in the estimation of plasma volume, chromium-51 in the measurement of red cell mass and red cell survival, iron-59 in studies of

red cell production and survival, and cobalt-60 labelled vitamin B₁₂ in pernicious anemia diagnosis.

Since the DS5-5 uses the same DS5 basic probe as all other previously described Nuclear-Chicago scintillation detectors, it may be easily converted to a probe-type detector by substitution of crystal and crystal adapter. The detector may be quickly removed from its lead shielding by loosening a single handle-lock at the side. The handle may be used to lock the detector at any height in the shield. This feature is particularly useful in measuring large liquid volumes (such as urine) since the detector may be raised so that its crystal is flush with the top of the upper shield. Beakers containing the radioactive liquid may then be placed directly on the upper shield and crystal to obtain maximum geometry.

Overall sensitivity of the Model DS5-5 is approximately 50%. Background counting rate when used with a scalar or ratemeter is approximately 300 counts per minute. When used with the Models 132, 1810 or 1820 gamma-ray spectrometers background is normally only 20-30 counts/minute. Count rate is independent of sample volume up to 5 ml.

The Model DS5-5 is supplied complete as pictured above with necessary cables, photomultiplier tube, sodium iodide crystal, electronic circuitry, base, lead shielding, and removable lead cap. One dozen plastic test tubes, 1/2" d. by 5/8" long, suitable for use in the well are also supplied. Additional test tubes may be ordered by specifying Model TT-1.

DS5 SERIES SPECIFICATIONS

Model No. **Consists of** **Description**

DS5-1P DS5 AX8S XT200 J5S K5S L5S Q5S

The finest and most versatile directional scintillation probe available. 2" x 2" crystal provides exceptional sensitivity, removable nose and three collimator inserts provide the greatest flexibility in directional applications. This detector is recommended for the large or medium size hospital where all types of scintillation counting problems arise.

DS5-1 DS5 AX5S XT100 C5S F5S G5S H5S

Medium priced directional scintillation probe identical to DS5-1P except for a 1" x 1" crystal and directional nose piece and collimator inserts designed for use with this smaller crystal. This detector provides all the sensitivity required for most medical applications and is recommended for the private physician, clinic, small or medium sized hospital.

DS5-2 DS5 AX5S XT100 N5S

Low cost directional scintillation probe for small clinical laboratory or private physician. Excellent for simple diagnostic procedures such as thyroid uptake measurements. Easily converted to the more versatile DS5-1P or DS5-1.

DS5-3 DS5 AX5S XT100

Scintillation probe with 1" x 1" exposed crystal. Identical to above detectors except no nose piece or collimators are provided.

DS5-3P DS5 AX8S XT200

Identical with DS5-3 except with 2" x 2" crystal.

DS5-4 DS5 AX6S XT2W0

Well-type scintillation detector providing maximum sensitivity for gamma emitting samples in solid or liquid form. Base, lead shielding and lead plug not included.

DS5-5 DS5 AX6S XT2W0 3055

Same as above except base, shielding, lead cap, and one dozen plastic test tubes are included.

DS5-6 DS5 AX7S XTA

Alpha sensitive scintillation detector supplied with ZnS-Ag phosphor.

DS5-7 DS5 AX7S XTB

Beta sensitive scintillation detector supplied with anthracene crystal.

OPTIONAL EQUIPMENT

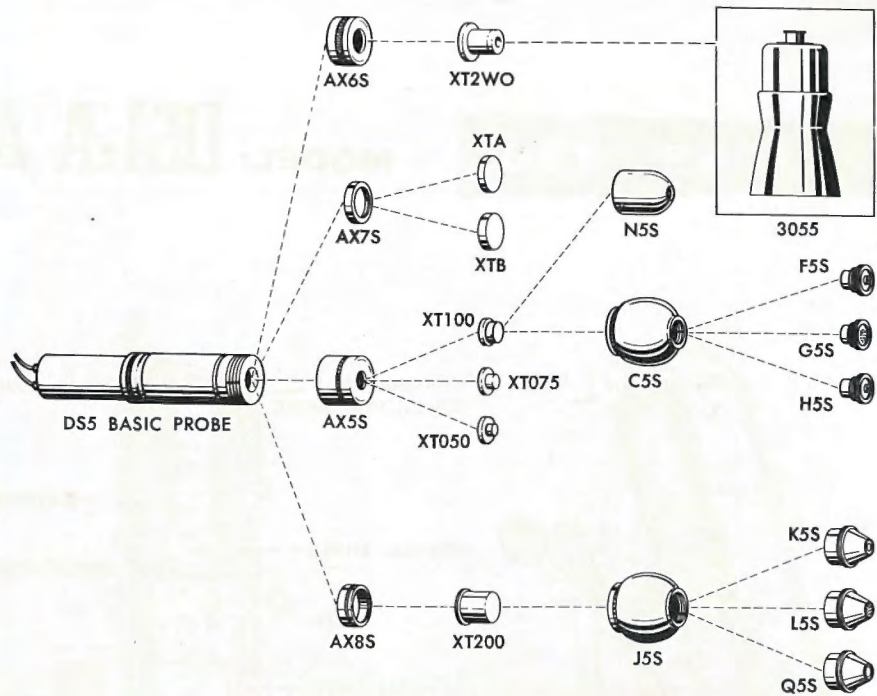
Part No. **Description**

XT050 1/2" x 1/2" sodium iodide crystal. Interchangeable with 1" x 1" crystal supplied with probe type DS5 detectors. Flange is provided for exact positioning in AX5S.

XT075 Identical to XT050 except 3/4" x 3/4".

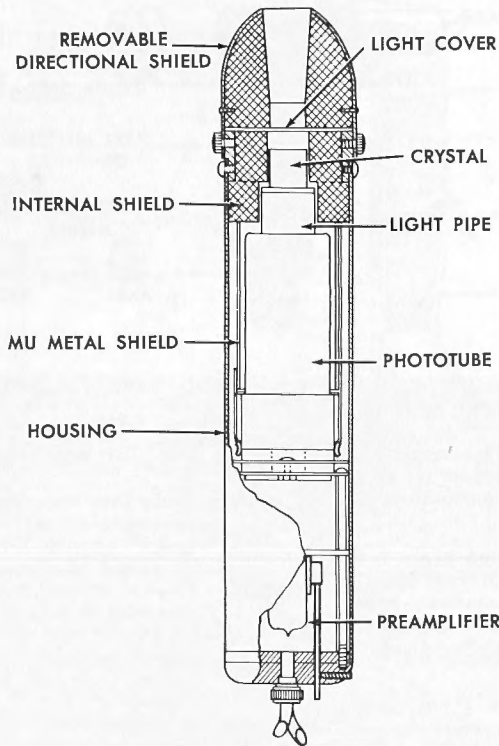
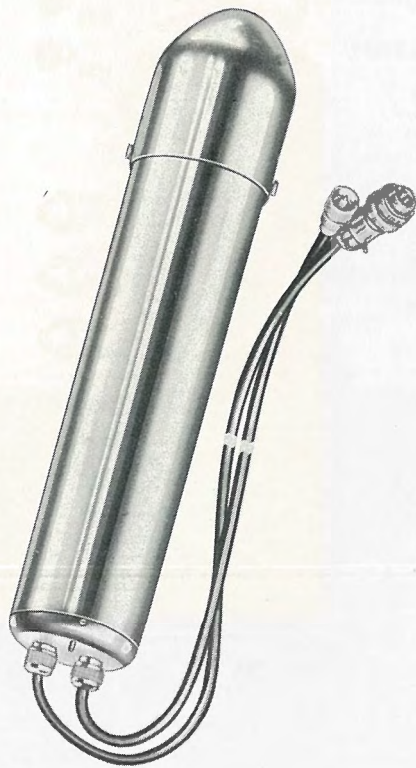
AX6S and XT2W0 Adapter and well-type crystal for converting DS5 probe-type detectors into a scintillation well counter.

3055 Base, shielding, and lead cap for use with DS5-4 scintillation well counter.



DESCRIPTION OF PARTS

Part No.	Description
DS5	Basic Detector consisting of attached cables, housing, preamplifier circuit with internal "spectrometer-scaler" switch, DuMont 6292 photomultiplier tube protected by a magnetic shield, inner lead shielding.
AX5S	Crystal Adapter for holding flat-type scintillation crystals such as XT100. Consists of housing which screws on to DS5 basic detector, internal lead shielding ring, gaskets, and lucite light pipe.
AX6S	Crystal Adapter for holding well-type scintillation crystal.
AX7S	Crystal Adapter for holding XTA or XTB crystals.
AX8S	Crystal Adapter for holding 2" x 2" solid crystal.
XT200	2" x 2" sodium iodide, thallium activated crystal, hermetically sealed in 1/32" spun aluminum can with a glass window. Entire crystal projects beyond probe when adapter is screwed to DS5.
XT100	Identical to above crystal except 1" x 1".
XT2W0	Well-Type Crystal. Sodium iodide, thallium activated. Dimensions: 1 7/8" in diameter by 2 1/4"; well is 2 1/32" in diameter, 1 1/2" deep.
XTA	Alpha sensitive ZnS-Ag phosphor.
XTB	Beta sensitive anthracene crystal.
N5S	Small Nose Piece. Attaches to basic detector, provides approximately 1" lead shielding around side of exposed crystal. Hole in nose is 1" in diameter at the crystal, 7/8" diameter at the face, 2 5/8" long.
C5S	Convertible Nose Piece. Provides approximately 1 1/2" lead shielding around side of exposed 1" x 1" crystal. May be used by itself or accepts F5S, G5S, or H5S special purpose collimators.
J5S	Similar to C5S except is used with 2" x 2" crystal. Accepts K5S, L5S, or Q5S special purpose collimators.
F5S	Flat Field Collimator for use with C5S convertible nose piece.
G5S	Focusing Collimator for use with C5S convertible nose piece.
H5S	Straight Bore Collimator for use with C5S convertible nose piece.
K5S	Flat Field Collimator for use with J5S convertible nose piece.
L5S	Honeycomb Collimator for use with J5S convertible nose piece.
Q5S	Straight Bore Collimator for use with the J5S convertible nose piece.
3055	Base, lead shielding, lead cap for use with DS5-4 scintillation well counters. Supplied with DS5-5 scintillation well counter.



- *high sensitivity to gamma radiation*
- *economical, trouble-free operation*
- *new preamplifier circuit permits use with all scalers, ratemeters or gamma-ray spectrometer systems*
- *directional nose piece collimator provided for clinical studies*
- *nose piece removable for large area measurements*

SPECIFICATIONS

crystal—Sodium iodide, thallium activated, 3/4" x 3/4" in diameter. Crystal is hermetically sealed in spun aluminum case with a glass window. Lucite light pipe between crystal and phototube. DC200 optical coupling fluid used on all contacting surfaces.

phototube—DuMont 6292 photomultiplier tube protected by a magnetic shield.

preamplifier—One-tube feedback amplifier utilizing 6BQ7A tube provides gain of 10 with negative output for normal use; gain of two and cathode follower positive output for spectrometer use. Band width is sufficient for 1 microsecond resolution. Provides pulse height limiting for spectrometer use. A set screw in the side of the housing permits quick change from "scaler" to "spectrometer" output.

plateau—Production tolerance requires plateau length of 250 volts and a slope not exceeding 5% per 100 volts over that range using cobalt-60 as a radiation source.

power requirements—Unit operates at high voltage between 900 and 1500 volts. 20 microampere drain at 900 volts. Preamplifier draws 6.3 volts at 0.4 amperes; 150 volts at 8 milliamperes.

background—Less than 200 counts per minute.

dimensions—16" long with directional shield; 3" in diameter. Cable length 6 ft.

finish—Housing and removable directional shield are chrome plated brass.

weight—18 lbs., shipping weight 22 lbs.

shipped with removable directional shield, instruction manual.

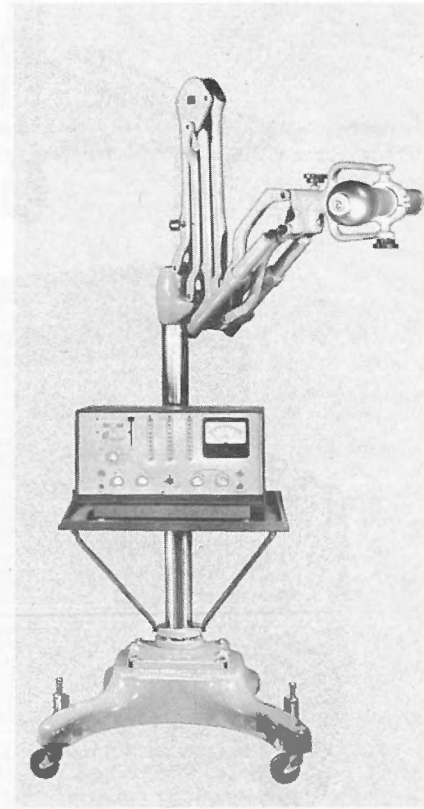
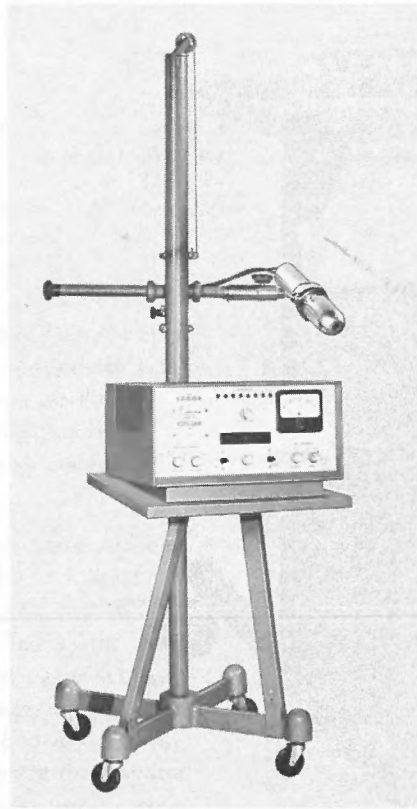
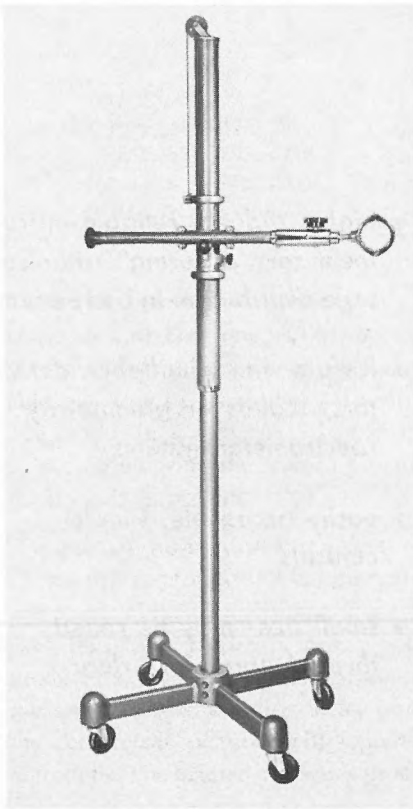
The Model DS1-A is an improved version of our older Model DS-1 directional scintillation detector, widely used for its high reliability and simplicity of operation. Designed primarily for basic clinical diagnostic applications such as thyroid uptake studies or body scanning operations, the new DS1-A incorporates the exclusive "scaler-spectrometer" preamplifier which permits its use with all scalers, ratemeters, or gamma-ray spectrometer systems. Recommended for laboratories or physician's offices where the work program is well defined, the DS1-A is Nuclear-Chicago's most economical gamma sensitive scintillation detector.

A removable directional shield discriminates sharply against activity more than 15° off the axis of the probe, enabling the detector to be used for accurate localization of concentrations of radioactivity. With the directional shield removed, the detector serves to measure activities from larger areas.

The DS1-A is most conveniently used for medical applications when mounted on any one of the detector stands shown on the following page.

MODELS: SA1, SA1-A, SA2

DETECTOR STANDS



- sturdy, mobile stands for holding and positioning Nuclear-Chicago scintillation detectors

Three new detector stands are available from Nuclear-Chicago which simplify exact positioning of 3" diameter scintillation detectors around a patient's head or body.

model SA1 is an inexpensive counter-balanced stand with ball-bearing adjustments. The four-legged base affords excellent stability and large easy-rolling casters provide easy mobility. A 30 lb. counter-weight in the vertical column permits raising or lowering the scintillation counter with a finger tip. Bakelite knobs may be used to lock the counter in both the vertical and horizontal positions. Ball bearing, rotating cross arm permits horizontal adjustment over a range of 25 inches. Vertical adjustment is 27 inches. A special clamp at the end of the cross arm holds any 3" diameter detector or a smaller detector or shield with a suitable adapter. Overall height is 75". Weight 110 lbs., shipping weight 130 lbs.

model SA1-A is identical to the SA1 except that it is provided with a shelf to hold a scaler or ratemeter. It is shown with the 183B scaler and DS5-2 Scintillation Detector.

model SA2 detector stand is a precision built, extremely versatile stand with a flexible extension arm mounted on a chrome post which is in turn bolted directly to the mobile base. The arm is of rugged construction, using aluminum and bronze, and designed to support up to a fifty pound weight in a suitable manner. The arm consists of six bar-links with interconnecting castings and balancing mechanism. The detector may be supported in any position without the use of locks, although they are provided. The scaler shelf may be rotated around the mast.

The heavy base provides positive stability at all times. Floor locks and four ball-bearing swivel casters with 3" hard durable wheels are provided. All metal parts are either chrome plated or covered with a carefully applied seven-coat baked-on, synthetic enamel finish, hand rubbed between coats for permanence and lustre. The unit is pictured above with Model 181A Scaler and Model DS5-1 scintillation detector. Overall height — 74". Weight 265 lbs., shipping weight 310 lbs.



- *highly rugged, reliable instrument for "picturing" radioisotope distribution in body areas*
- *for use with scintillation detectors, scalers or gamma-ray spectrometer systems*
- *easily accessible, simple controls*
- *small size—may be rolled through three-foot door*

The Model 1700 Isotope Scanner is a highly reliable, precision instrument for scanning body areas for concentrations of radioactive isotopes, while simultaneously producing a "picture" of the radioisotope distribution. Most commonly used to chart radioiodine distribution in the thyroid gland, the Isotope Scanner may be used for delineating any part of the body in which a radioactive isotope is localized.

The Model 1700 consists of a holder for a directional scintillation detector, a motor-driven mechanical scanning system which moves the detector back and forth and step-wise over the body, and a sturdy, attractive stand which holds a scaler or scaler-spectrometer combination, supports the mechanical scanning system over the hospital bed, and provides a printing surface for the "picture".

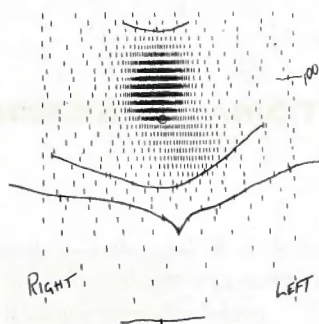
The Isotope Scanner is designed to operate without modification with the DS1-A, DS5-1, or DS5-1P scintillation detectors, and with the 192A, 186, 181A, 183B, or 161A scalers by themselves or in combination with the Model 1810 Radiation Analyzer. Use of a binary scaler is recommended because of the wide choice of scaling factors it offers, while a

gamma-ray spectrometer provides the only really reliable and scientific method of reducing background and scatter radiation. A particularly elegant and versatile system consists of the Isotope Scanner, Model DS5-1P scintillation detector, and Model 132 Analyzer Computer (see photo above).

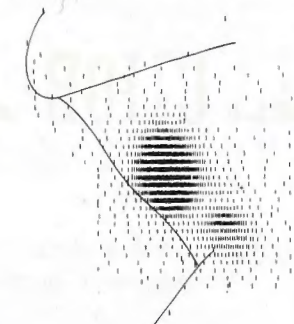
The system, which graphically depicts the actual size and shape of the radioactive distribution, is frequently used in diagnosing a pathological condition, planning for surgery, or determining organ bulk in order to calculate a proper size of therapeutic dose. The unit may also be used for routine radioiodine uptake studies by removing the collimator and permitting the counter to "see" the entire thyroid gland.

The instrument may be set to scan an area as large as 14" x 17". The scanning limits are established by moving four spacing knobs to the desired positions. The scintillation detector is easily positioned at the desired distance above the patient by a simple turn-screw mechanism. The detector holder may be quickly disengaged from its drive screws by simply loosening two locking levers. The detector may then be moved about by hand anywhere within the scan area.

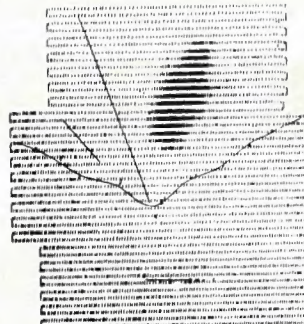
ACTUAL SCANS MADE WITH MODEL 1700 ISOTOPE SCANNER



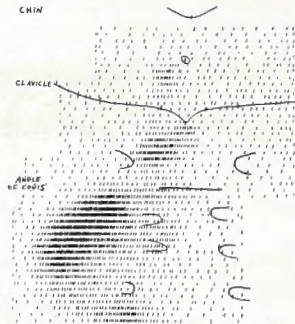
Thyroidectomy in 1928. Thyrotoxic symptoms without palpable thyroid in 1956. Scan shows recurrence in pyramidal region.



Same patient as in figure at left. Left lateral view. 610 microcuries of iodine-131 in lesion. Model 1810 Radiation Analyzer used.



Scan showing residual thyroid area following surgery and node dissection.



Intrathoracic recurrence 20 years after surgery. 300 microcuries iodine-131 retained. Pulse height analyzer used.

The sweep speed of the detector over the scan area is continuously variable from zero to approximately 10 inches per minute. Spacing between sweep lines is continuously variable, and may be set so that adjacent sweeps are flush with one another or as far apart as $\frac{1}{4}$ inch. Spacing may be varied at any time during the scan to provide better resolution or to speed the procedure.

The unit's printing device is a relay operated solenoid mechanically coupled to the detector such that it follows the movement of the scintillation counter during the scan. Whenever the scaler reaches a preset scaling factor, the relay produces a $\frac{5}{64}$ " line on the carbon-backed paper. Thus, if the scaler is set to a scaling factor of 16, every short line on the completed "picture" will represent 16 detected disintegrations. The printed surface is in full view of the operator during the whole scanning period and up to seven carbon copies of the pattern may be obtained.

The Isotope Scanner stand is constructed of welded steel tubing. The entire unit occupies a maximum floor area of 34" x 44" and can be easily rolled through a door 3-ft. in width. Foot operated brakes are provided.

SPECIFICATIONS

- printer**—Solenoid produces $\frac{5}{64}$ " line on carbon-backed paper in full view of operator. Printing speed in excess of 15/sec.
- scan area**—Unit may be set to scan any sized area up to 14" x 17".
- scan spacing**—Continuously variable with single turn control. Spacing may be set so that adjacent scans are flush with one another or as far apart as $\frac{1}{4}$ ".
- index switch**—Determines the direction the detector will move or index between sweep lines.
- spacing knob**—Determines the spacing between sweep lines.
- marker**—Push-button switch to energize the printer to produce a single mark at any time.
- speed control**—Determines the speed of the sweep motor (DC).
- dimensions**—Printing table and large frame holding scintillation counter are 58 inches above floor level. Entire instrument occupies maximum floor area of 34" x 44" and can be easily rolled through three ft. wide door opening.
- shipping weight**—600 lbs., including wooden packing case.
- power requirements**—115 volts, 50-60 cycles. Available for 220 volt operation on request.
- accessories supplied**—Fuses, tracing paper, drafting tape, 3 lead collimating noses and Allen wrench set, instruction manual.

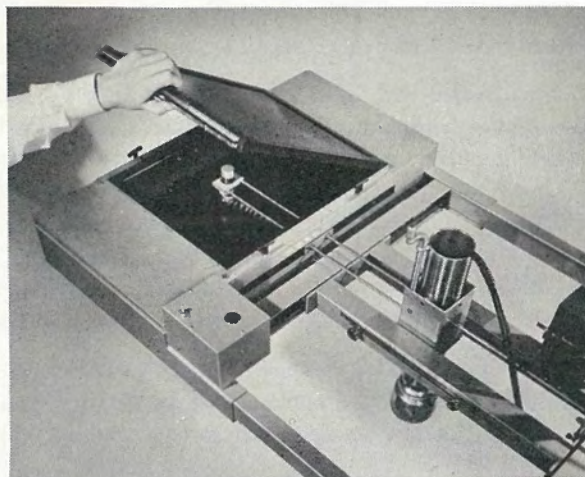
MODEL: 1700-P PHOTO-RECORDING ATTACHMENT

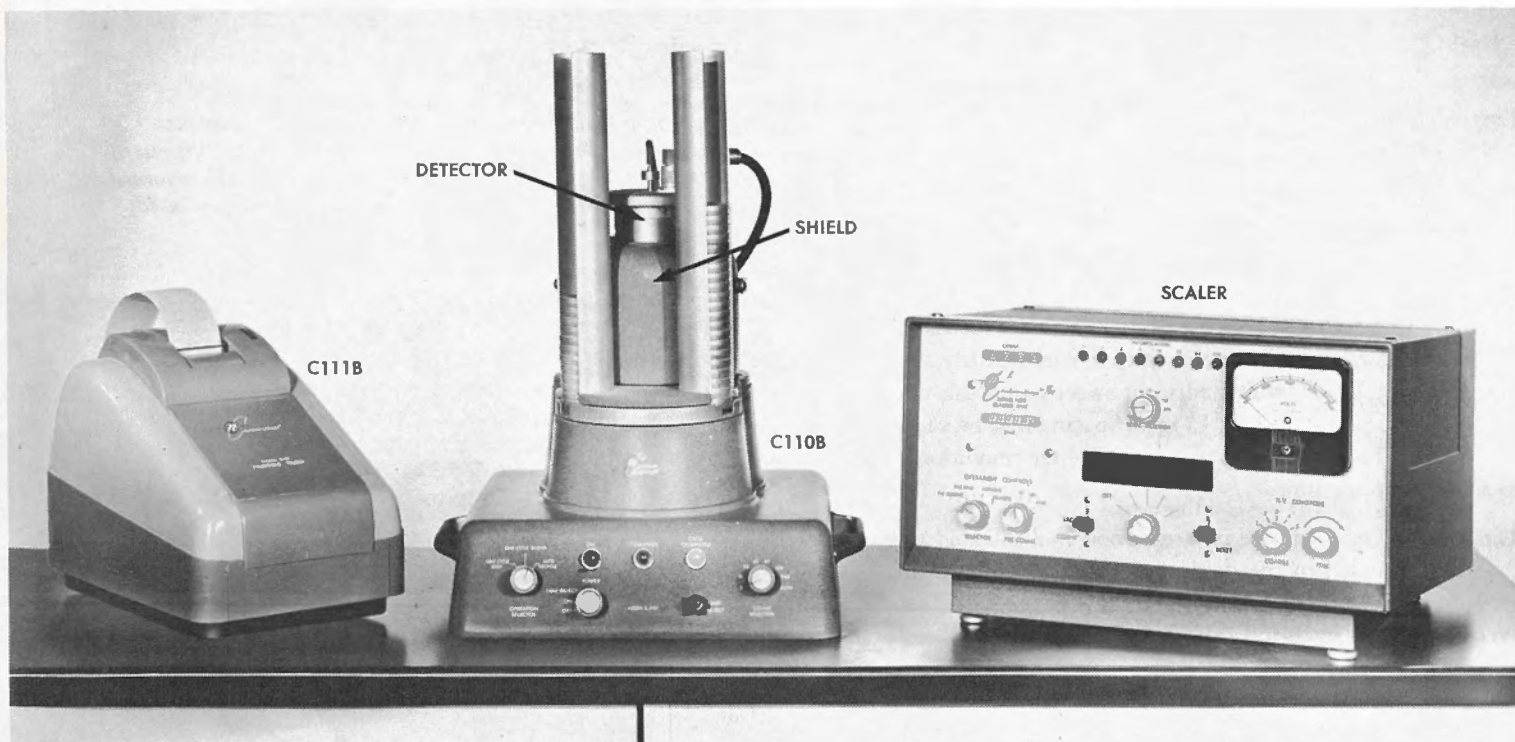
Model 1700-P is a new photo-recording attachment for Model 1700 Isotope Scanner consisting of a camera box containing a glow modulator tube mechanically coupled to the scintillation detector, a film cassette which uses standard 14" x 17" x-ray film, and electronic circuitry.

The glow tube produces separate flashes of light on the film which vary in frequency and pulse brightness with count rate. The attachment may be operated simultaneously with the printer and provides contrast enhancement, variability of contrast, background suppression, and accurate anatomical localization. The developed film may be superimposed on appropriate roentgenograms to give a clear presentation of isotope distribution. Shipped complete, ready to attach to Model 1700.

Reference:

A High-Contrast Photographic Recorder for Scintillation Counter Scanning, Radiology, Pgs. 730-739, May, 1956.





The Nuclear-Chicago Model C110B Automatic Sample Changer was designed to meet the need for automatic handling and counting of radioactive samples in laboratories where a large number of samples are measured routinely. The complete system consists of the C110B Automatic Sample Changer which holds the radiation detector and lead shield, a scaler, and a printing-timer. Widely used in biological and other radiochemical research laboratories, the system makes possible substantial savings in the number of technicians required for radioassay work. In addition, it provides accurate, more reproducible results than can be obtained through manual counting techniques.

Normally used with the Model D47 Gas Flow Counter for counting soft beta-emitting samples, the system also is designed to operate with thin window or scintillation detectors. Tedious and time-consuming manual sample changing is completely eliminated since as many as 35 samples may be counted without attention. Each sample is measured for a preset number of counts. The printing-timer then records the length of time required for each sample to reach the predetermined count.

features—Radioactive samples may be prepared in $1\frac{1}{4}$ " x $\frac{1}{8}$ " or 1" x $\frac{5}{16}$ " sample plans which fit into the thirty-

five numbered 2" sample adapter rings furnished with the instrument. The adapter rings are inserted (lowest number first) into the right-hand loading magazine from which they automatically will be moved under the detector.

The number of counts which will be accumulated on each sample is determined by the settings of the *count selector switch* and the preset scaling factor on the scaler. When the unit is used with a binary scaler having a scaling factor variable from 4 to 256, the lowest possible predetermined count is 20 and the highest is 25,600, with many possible combinations between these figures. Changing the scaling factor on the scaler or the setting of the count selector switch on the changer will increase or decrease the total number of counts taken on each sample and thus increase or decrease the statistical error. The user will strike his own compromise between the percentage of accuracy desired and the length of time available to accumulate the necessary counts.

The *operation selector switch* provides three types of operation: (1) in *one-cycle-stop* each sample is counted once and then the unit stops; (2) in *normal* position the changer goes through one complete cycle and then automatically takes background counts until the instrument is shut off; (3) in *auto-recycle* the unit will restack the samples in proper se-

SPECIFICATIONS

MODEL C110B AUTOMATIC SAMPLE CHANGER

capacity—Up to 35 samples. Samples may be prepared in $1\frac{1}{4}$ " x $\frac{1}{8}$ " or 1" x $\frac{3}{16}$ " sample pans which fit into the 35 two-inch sample adapter rings furnished. 35 AC-12 sample pans furnished.

cycle time—15 seconds for changing on each sample.

operation selector—Selects complete cycle and stop, continuous cycling in proper order, or count with background. Separate start-reject switch interrupts or starts operation.

count selector—Presets 5, 10, 20, 40, 80, or 100 times scaling factor.

index reset (at rear)—Resets the index number on the C111B to zero whenever desired.

scaler reset—Prevents the register on the scaler from electrically resetting on automatic operation.

timer reject—Allows preset times to reject dead samples.

connectors—Nine-pin to scaler, nine-pin to printing timer, two PC28 cables furnished.

power—Always obtains power from scaler. Separately fused.

dimensions— $14\frac{1}{4}$ " x 15" x $18\frac{1}{2}$ " high.

weight—50 lbs., shipping weight 60 lbs.

MODEL C111B PRINTING TIMER

capacity—99 samples to 999.99 minutes each.

record—Prints time in minutes and hundredths with sample identification number on paper tape.

dimensions—9" x 14" x 12".

weight—32 lbs., shipping weight 35 lbs.

LEAD SHIELDS

order model 3050 lead shield for use with Model D47 Gas Flow counter.

order model 3051 lead shield for use with Model D34 or similar mica-end window counters.

order model 3052 lead shield for use with Model DS5 series or similar scintillation counters.

CHANGER

quence at the end of each complete cycle and then automatically recount the samples repeating this sequence indefinitely until shut down.

Under each mode of operation, the Model C111B printer automatically prints the length of time required for each sample and each background count to reach the preset number of counts. This length of time, together with the sample number, is recorded on a paper tape in minutes and hundredths of a minute to 999.99 minutes maximum. Background counts may be taken at any point in the cycle by leaving one or more of the adaptor rings empty.

The Model C111B printer in addition to new mechanical design features an exclusive "time-reject" circuit which is particularly useful to prevent a very weak sample from unnecessarily delaying the measurement of a large group of samples. The time-reject feature is selected by the control switch on the C110B. This switch activates a circuit which will reject a sample after one hour even though the total preset count has not been reached.

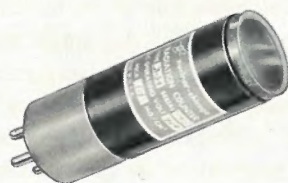
operation—The radiation detector is inserted into the appropriate lead shield and connected to the scaler in the regular manner. The changer is attached to the printer and the scaler by means of two nine-conductor cables. The radioactive samples to be counted are then loaded into the right hand vertical tubular magazine.

The *operation selector* switch is placed in the desired position, the scaler is turned on, the high voltage set at the proper level for the detector, and the stop-count switch is thrown to the *count* position. To start the operation, the *start* button on the sample changer is depressed momentarily.

When the preselected count on a sample has been accumulated, the counting will stop, the printer will record the length of time which was required to reach the count, and a new sample will be raised into the counting position within the lead shield. Samples being counted are fully surrounded by lead and are elevated to the exact position each time, thus assuring precise geometrical reproducibility.

The complete sample changer system is the product of constant research and development, and incorporates the finest mechanical and electrical workmanship. Its compactness and versatility makes this instrument an excellent choice for any laboratory counting a large number of samples.

Order—Model C110B, C111B, detector, scaler, and appropriate lead shield for complete system. All Nuclear-Chicago scalers except Models 151, 2800, or 132 may be used.



D34 thin window Geiger-Muller tubes.



D47 Gas Flow Counter (windowless or with "Micromil" window).

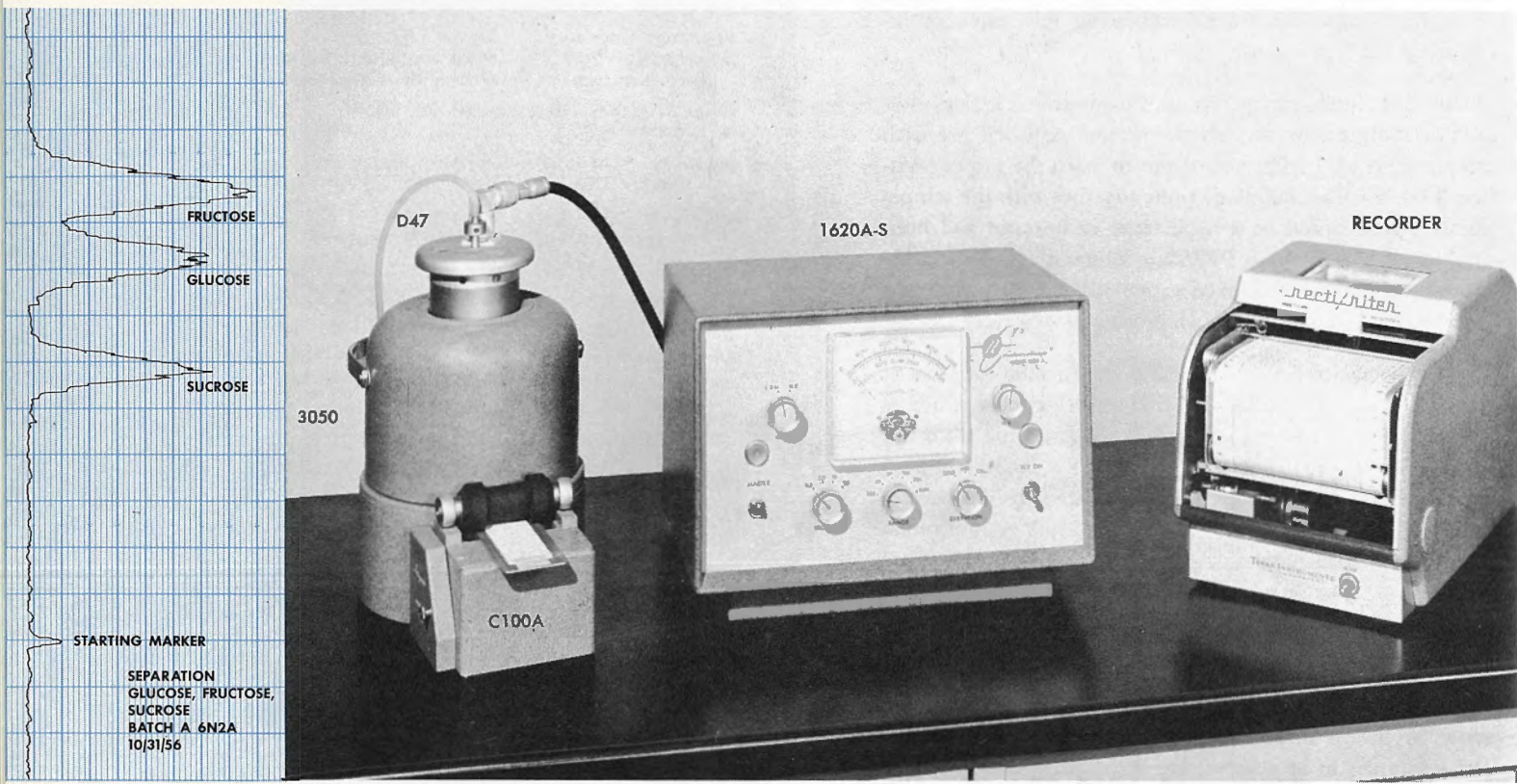


DS1A or DS5-3 Gamma sensitive scintillation detectors.



DS5-6 or DS5-7 Alpha or beta scintillation detectors.

Typical detectors used with the C110B System.



The Model C100A Actigraph is part of a complete system designed to scan automatically a strip chromatogram in order to obtain a permanent graphic recording of the radioactivity distributed along its length. Use of the Actigraph not only permits location of the separated radioactive components but also gives quantitative estimate of the total activity. Since the technique permits the separation and detection of as little as one microgram of material, it has been widely used for testing chemical radiopurities, in biological applications, and in other uses where chemical analyses of very small samples is desired.

The complete Actigraph laboratory consists of the Model C100A strip feeder, a suitable thin-window radiation detector such as the Model D47 Gas Flow Counter mounted in a lead shield which rests on the strip feeder, a Model 1620A (or similar) count rate meter, and a chart recorder. The recorder shown in the illustration above is recommended for this application, not only because of its high reliability, but because it presents a rectilinear record of the radioactivity (see actual scan above showing separation of glucose, sucrose, and fructose).

operation—Radiolabeled strip chromatograms are taped to the mounting strip, passed through the lead shield holding the radiation detector, and through the rubber rollers of the strip feeder. The recorder's chart drive motor is matched and synchronized with a motor in the Actigraph which drives the rubber rollers. As the recorder chart advances, the rubber rollers of the Actigraph move the mounting strip carrying the chromatogram past the thin window of the detector. Since the movement of the paper strip is synchronized with the movement of the recording chart, close correspondence is assured between the linear distribution of radioactivity as it exists on the strip and as it is indicated on the chart.

The Actigraph is designed to provide constant geometry, suitable collimation, and an appropriate and constant scanning speed during the entire scanning operation.

Constant geometry is assured by the fixed distance maintained between the window of the detector mounted within the lead shield and the strip table which is drawn through the strip guide in the lead shield.

While imposition of a collimating slit between the radio-

STRIP FEEDER

chromatogram and the detector window reduces the total recorded count rate, such "focusing" is frequently necessary in order to resolve two closely-spaced radioactive zones. Four collimating slits, $\frac{1}{4}$, $\frac{1}{8}$, $\frac{1}{16}$, and $\frac{1}{32}$ inches in width are provided for this purpose. They are of an improved design which maximizes the sensitivity of detection at any slit widths selected by the operator.

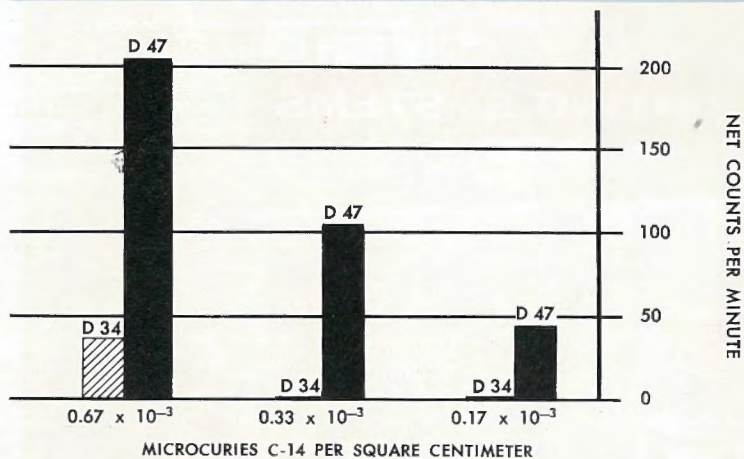
Since the rate of response of the count rate meter as well as the accuracy of its readings depend upon the number of radioactive events detected per unit time, low activities require a slower scanning rate than high activities in order to obtain the same statistical accuracy. If only a qualitative indication of the activity distribution on a highly radioactive chromatogram will suffice, fast rates of scanning are convenient.

Three pairs of easily-changed color-coded gears provided with the Actigraph and with the chart recorder afford a choice of ten different scanning speeds ranging from $\frac{3}{4}$ " to 12" per minute. By use of a gear shift, speeds from $\frac{3}{4}$ " to 12" per hour may be selected. When the scanning of a strip is completed, a contact switch in the Actigraph strip feeder automatically stops the chart drive and the strip table.

choice of detectors—The choice of detectors will be determined by the degree of sensitivity desired. The Model D34 thin mica window counter will detect carbon-14 on a strip chromatogram in concentrations of 0.67×10^{-3} microcuries per square centimeter. The Model D47 Gas Flow Counter using the exclusive Micromil® window will detect 0.17×10^{-3} microcuries per square centimeter. Thus, the use of the Model D47 increases the dilution of activity permissible in a given experiment or will permit an increase in scanning speed without loss of statistical accuracy.

resolving power—Resolution of the Actigraph system is extremely fine, permitting separate measurements of radioactive zones separated by small distances. Resolution is measured by taking the ratio of the average heights of the "peaks" to the "valleys" traced on the recorder chart. Excellent resolution is achieved for spots spaced as closely together as $\frac{1}{5}$ " using the $\frac{1}{16}$ " collimating slit.

Order the Models C100A strip feeder, 1620A or 1620A-S count rate meter, a suitable detector with its appropriate lead shield, and the Houston Technical Laboratories chart recorder for the complete Actigraph system. See "specifications" for detailed ordering information.



Relative sensitivities of various detectors used with the Actigraph system. The D47 was used with its Micromil window. Net counts per minute=observed counts per minute less background.

SPECIFICATIONS

STRIP FEEDER

model C100A strip feeder—Includes a flat plate with rubber rollers in a metal frame. A microswitch and cable assembly (PC27) are permanently attached. Drive stops when end of table is reached. Shipped with strip feeder are: strip table, minute and hour motors, speed gears, guide table with four collimating slits.

dimensions—Feeder is 10" long by $6\frac{1}{2}$ " wide by 6" high. Strip table is 36" long.

weight—10 lbs., shipping weight 14 lbs.

shipped with instruction manual, items listed above.

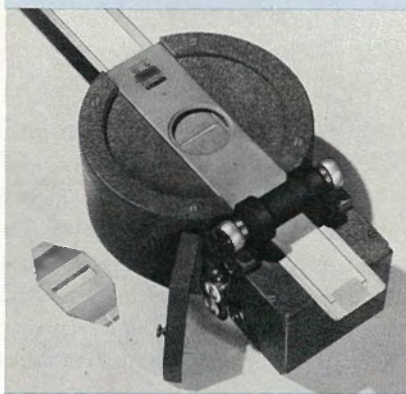
COUNT RATE METER AND RECORDER

Either Model 1620A Analytical Count Rate Meter or Model 1619 Labitron may be used with the Houston Technical Laboratories recorder and the C100A.

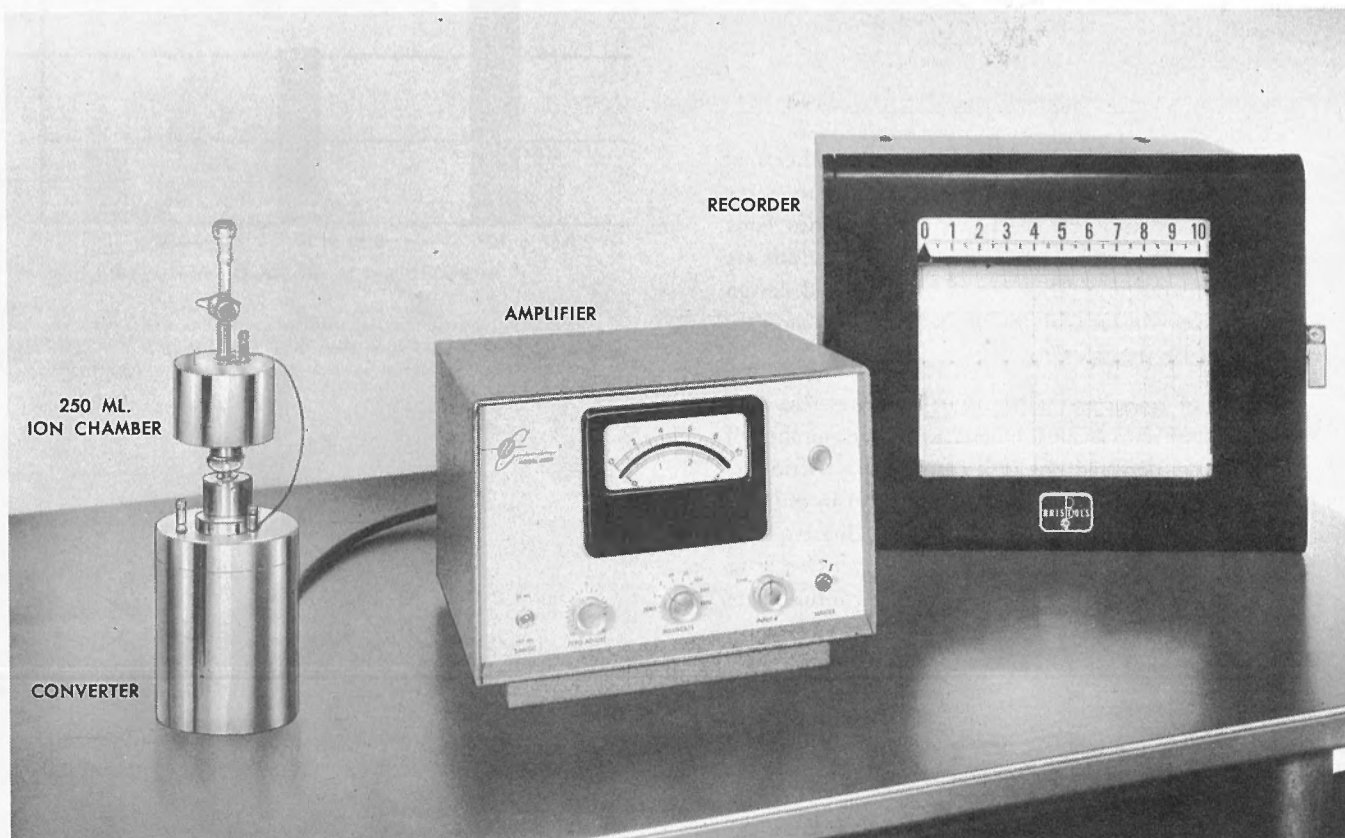
LEAD SHIELD AND DETECTOR

Model D34 thin window counter is used with Model 3051 lead shield and with either the Model 1620A Analytical Count Rate Meter or Model 1619 Labitron.

Model D47 gas flow counter is used with Model 3050 lead shield and with the Model 1620A Analytical Count Rate Meter only.



Model C100A strip feeder. Strip table, rollers, speed gears, gear shift, and collimating slits are shown.



The new Model 6000 Dynacon is a low-level radioactivity measuring instrument based on the principle of the dynamic condenser electrometer. The Dynacon, consisting of the converter and amplifier shown above, has its greatest utility in the measurement of soft-beta emitters such as carbon-14 and tritium but is readily adaptable to a wide variety of radioactivity measurements. Offering particular ease of operation in the measurement of the radioactivity in dynamic systems e.g. the radioactivity associated with an evolved gas or a flowing liquid, the Dynacon may be used in the measurement of radioactive gas, solid, or liquid samples with ease, precision and unusually high sensitivity. The Dynacon is the nearest known approach to the "one-instrument" radioactivity laboratory.

When a radioactive sample is enclosed in an ion chamber and a potential of 50-300 volts is impressed on the electrodes, a small direct "ion current" is produced which is strictly proportional to the radioactivity of the sample. The Dynacon amplifies the ion current by means of an unusual electromechanical converter which produces an a.c. signal exactly proportional to the original "ion current". This a.c. signal is amplified and rectified for display on a meter or recorder.

Ion currents may be measured with high precision in either of two ways. If the instrument is switched to insert a calibrated high-valued resistor into the d.c. circuit, the impressed voltage, which is strictly proportional to the sample radioactivity, may be read directly from the meter or recorder. For ion currents of less than 10^{-14} amperes, no resistor is used. Instead, the rate of drift of charge on the input capacitance is used and the time measured in which this charge is collected.

In either case, the system may be directly calibrated with a known source of radioactivity so that the sample may be read directly in radioactivity units, e.g. microcuries, or disintegrations per second.

The extreme sensitivity of the Dynacon is illustrated by its detection of as little as 10^{-14} curies of radioactive carbon-14 dioxide in a 250 ml. ion chamber. Since organic and biological samples are readily converted to carbon dioxide by wet combustion, a whole new low-level operating range is made available in chemical, biological, and medical research.

By proper selection of the panel-mounted switch positions, samples varying in radioactivity by a factor greater than 10^6

The Model 6000 Dynacon is shown being used to record the uptake of radioactive carbon dioxide by plants in a growth chamber.

may be quickly and conveniently measured. The difficulties of attempting to prepare all samples to approximately the same radioactivity level are completely eliminated.

By oxidizing all organic and biological samples to gaseous carbon dioxide measured in an ionization chamber, maximum geometry is realized and losses due to self-absorption, and window and air absorption are completely eliminated. Since most of the error in the counting of solid samples is due to variations in sample arrangement and density and to scattering errors and since these ambiguities are completely eliminated in the Dynacon gas-counting method, the precision is vastly improved. Considerations of coincidence corrections, register losses, geometry and sample absorption corrections are completely absent.

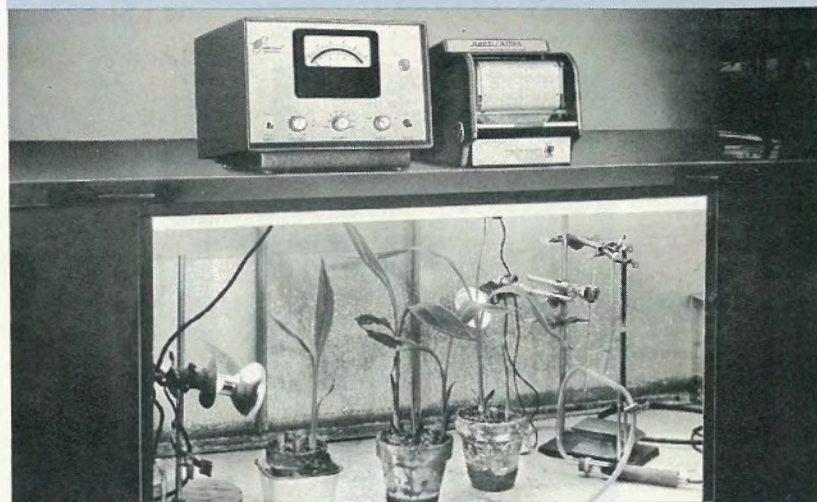
Background corrections if required are easily made by determining the ion current produced in an ion chamber containing no radioactivity.

Although the standard Model DC250 250 ml. ion chamber is preferred for most gas sample measurements, smaller and larger chambers are available. A special slide-type chamber, Model DCL is also available for continuous measurements in dynamic systems. Since the 250-ml. ion chamber contains approximately 10 millimoles of carbon dioxide at normal room temperature and pressure, the measurement of materials of extremely low specific activity is possible. Lower specific activities may be measured with the larger chambers.

By use of the ion chamber technique with the Dynacon, the measurement of tritium can be made with facility and with greater precision than with any other known method. Tritated samples may be conveniently converted to gaseous form by any one of several methods. The tritium gas is expanded into an ion chamber and measured as described above for carbon dioxide.

For measurement of solid and liquid samples, the Model DCL slide chamber is used which provides for the insertion of such samples directly into an air-filled chamber. The radioactivity of each sample may be read directly as described above and may be related to the gas equivalent value by a simple calibration procedure. The geometry, and therefore the sensitivity, of the solid and liquid sample measurement is approximately equal to that of windowless gas-flow counters with the advantage that ambiguities due to charge effect and coincidence loss are eliminated, the gas supply is unnecessary, and the operating range is vastly increased.

The Dynacon with slide chamber is also particularly convenient for measurement of radioisotopes of short half-life since samples varying in activity by orders of magnitude may be easily measured by adjustment of the range control and without chemical dilution or the use of absorbers.



SPECIFICATIONS

converter frequency—240 cycles using positive locked line frequency doubling.

construction—Hermetically sealed plug-in construction. Built-in air coupling capacitor.

input resistance—Approximately 10^{17} ohms in converter proper. Input open circuit time constant greater than 1000 seconds.

shorted input circuit characteristics—

a. ± 0.1 millivolt average zero drift in 24 hours at 70°F.

b. Less than 0.03 millivolt rms short term noise fluctuations.

open circuit characteristics—

a. Less than 2×10^{-16} coulombs rms short period noise.

b. Average input background current is approximately 5×10^{-17} amperes without shielding.

input capacity—Maximum of 2.5×10^{-12} farads on 1 millivolt range, and approximately 0.5×10^{-12} farad on ranges of 30 millivolts or more. Critical damping compensation adds approximately 1 micro-micro farad to these values.

ranges—An open circuit, short circuit and two high megohm input resistors are provided. Ranges are switched at the instrument panel. Resistors are normally 10^9 and 10^{11} ohms. Other values to 10^{12} available on request. Resistor values and input capacity can be calibrated to a known accuracy for absolute measurements on request. Response times and damping characteristics for all Nuclear ion chambers are supplied in instruction manual. Range switch has 1, 3, 10, 30, 100, 300 or 1000 millivolt positions. Voltage sensitivity and range calibration accurate to ± 1 percent on ranges above 10 millivolts. Provision for use of external potentiometer.

response time—

a. Basic instrument step function response corresponds to a time constant of 0.1 seconds.

b. Panel meter time constant approximately 0.5 seconds.

panel meter—1 percent full scale accuracy. Two scales correspond to range switch using decimal multipliers.

external recorder—Can be used with Houston, Esterline-Angus, Bristol, or Honeywell recorders.

chamber polarizing potential—

a. 0 to 200 volts available from control unit.

b. External battery pack necessary for some modes of chamber operation.

chamber sizes—100, 250, 500, 1000 ml. capacity are standard sizes. Stainless steel construction, rugged, guarded insulator.

dimensions—Amplifier $13'' \times 10'' \times 11''$; converter $6\frac{1}{2}'' \times 4''$.

weight—32 lbs., shipping weight 39 lbs.

panel controls—

a. Zero Adjust Range Switch—Either ± 5 mv or ± 50 mv.

b. Zero Adjust—Ten turn linear precision potentiometer.

c. Millivolts—Selects full scale range.

d. Input Selector—Zero, two resistor values, open circuit.

power requirements—105-125 volts 60 cycles 35 watts. Available for 230 volts and/or 50 cycles on request.

supplied with—Model 6000 Dynacon consists of detector head, amplifier unit, connecting cable and instruction manual. All accessories listed separately.

Write for more detailed specifications on complete instrument.



The Model 1613A "Classmaster" Radioactivity Demonstrator is a simple radioactivity monitor complete with all accessories to make it outstanding for lecture or demonstration use, or for a complete course in elementary nucleonics. Properties such as absorption, scattering, coincidence loss, detector efficiency, and health protection are easily and clearly demonstrated. It also can be used for tracer study demonstrations in biological classes. The "Classmaster" includes, in addition to the electronic unit, a Model D51 Geiger tube in a separate probe, a calibrated mounting board, radioactive sources, a set of absorbers, and a complete manual of instructions and experiments.

The count rate unit provides triple indication of radioactivity. A neon light flashes and a built-in speaker clicks for each disintegration detected.

SPECIFICATIONS

- range**—Two ranges, 0 to 1500 and 0 to 15,000 counts per minute indicated on panel mounted meter.
- controls**—Front panel volume control for loud speaker. High voltage—on-off control, operation selector switch with three positions: volts, cpm x 1, and cpm x 10.
- high voltage**—Continuously variable from 500 to 1200 volts by means of front panel control. Operation selector switch switches meter to read in volts instead of counts per minute.
- power requirements**—60 watts, 100 to 130 volts, 60 cycles.
- dimensions**—Cabinet 10" x 14" x 9½". Calibrated board 3⅞" x 25⅞" x 1".
- weight**—24½ lbs., shipping weight 32 lbs.
- equipment supplied**—One electronic demonstrator with extendable probe, one calibrated mounting board, two radium beta-gamma sources, one Model D51 Geiger counter, 14 flat aluminum absorbers, 20 flat cardboard absorbers, 10 flat lead absorbers, one aluminum cylinder, one cardboard cylinder, one lead cylinder, and instruction and experiment manual.

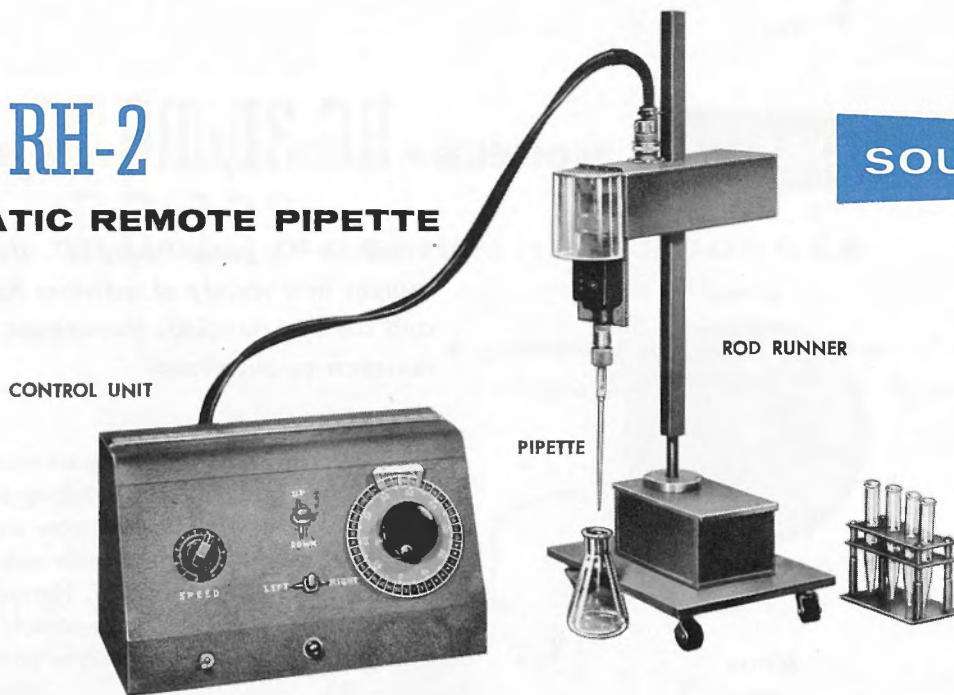
MODEL: 1413 CLOUDMASTER®

The Model 1413 "Cloudmaster" is a continuous cloud chamber to provide a spectacular display of "tracks" caused by alpha, beta, gamma, and meson radiation. These vapor "tracks" occur in a sensitive layer about three-quarters of an inch thick near the floor of the chamber. The sharp change in temperature necessary for the creation of the supersaturated "sensitive" layer is produced by easily-obtainable isopropyl alcohol and dry ice. 110-volt ac operated unit provides necessary spot light and a 1200 volt dc "sweep voltage" to the cloud chamber. Radiation source provided.



MODEL: RH-2
AUTOMATIC REMOTE PIPETTE

SOURCE HANDLING



Model RH-2 Automatic Remote Pipette is a necessity in any radioisotope laboratory in which one to 2000 millicurie amounts of hard beta or gamma emitting isotopic solutions are handled. Filling a need between the simple hand-held pipette devices and elaborate and costly manipulation machines, the Model RH-2 permits the precise measurement, dilution, and dispensing of hazardous amounts of radioactive solutions. It permits completely remote operation with greatly decreased risk of exposure or radioactive spillage.

Model RH-2 consists of two sections, (1) the remote pipette stand, and (2) the control unit, the two being interconnected by 15 ft. of cable. The pipette stand, designed to fit within a standard laboratory hood, consists of a pipette assembly which can be motor-driven vertically through a

12" movement on the up-right rod-runner and separately motor-driven through a 360° rotation.

The pipette is a Gilmont micro-pipette with plunger-type control actuated by a selsyn motor. The three-digit position indicator permits reading to 1 part in 10,000. Thus for a buret of one ml. capacity, each of the smallest divisions represents 0.0002 ml. of contained solution.

The control unit has two lever-type switches which provide vertical and rotational movement, a large wheel for precise selsyn control of the pipette plunger and a speed control for the two modes of motion.

Model RH-2 is shipped complete with connecting cable and test-tube rack. Power requirements—115 volts, 50-60 cycles. Available for 220 volt operation on request.

CALIBRATION SOURCES



RT-1



RT-2

model RT-1 is an individually calibrated gamma source containing approximately 0.02 microcuries of cesium-137 in a plastic tube 1/2" by 2". It is useful for checking well counter systems since the tube may be inserted directly into the crystal "well".

model RT-2 is identical with the RT-1 except that it contains approximately 0.10 microcuries of activity for checking DS1-A, DS5-1, and DS5-3 scintillation detectors.

model R2 is an uncalibrated source containing 2 to 3 micrograms of radium in a plastic cylinder 1" dia. by 1/2" for day



R2



R20

to day checking of G-M tubes, scintillation detectors, etc. One end gives approximately 10 times the radiation of the other end.

model R20 is a carbon-14 source emitting approximately 12,000 disintegrations per minute. Housed in 1" by 1/8" plastic disk, it can be used in a sample pan with manual sample changers or the C110B for checking D47, D34, or D37 detectors.

model R5 is similar to the R20 and is supplied with the Model 2586 Cutie Pie.

BETA RAY SOURCES

MODELS: RG-31, RG-32, RG-33

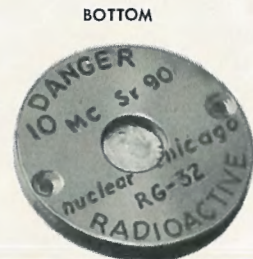
- strontium-90, promethium-147, thallium-204 sources in a variety of activities for thickness and density gauging, therapeutic and research applications



RG-31



RG-32



RG-33



ORDERING INFORMATION

The RG-31, RG-32, RG-33, and the RR-60 and RR-137 sources shown on the following page have type approval from the Atomic Energy Commission. In making application for a license, no source description other than the model number is necessary.

The purchaser must make application to the U. S. Atomic Energy Commission to receive an AEC Byproduct Material License necessary to possess any of these sources. Application is easily made by completing AEC forms 313 and 313b, available from the AEC, P.O. Box E, Oak Ridge, Tennessee, or from any Nuclear-Chicago Corporation branch office.

High intensity beta radiation sources are widely used in thickness and density gauging, therapeutic applications, and research projects. Three standard sources are available from Nuclear-Chicago which are suitable for most applications requiring high intensity beta radiation. Normally supplied with the isotope strontium-90, all three sources are available in a variety of sizes using the isotopes promethium-147 or thallium-204.

RG-31—The RG-31 is a thin, flat, practically indestructible source. A single mica window $\frac{1}{2}$ " in diameter with a density of 7 mg/cm^2 covers the activity which is incorporated in a melt of glass and fused to the stainless steel container. The activity is in close contact only with materials of low average atomic number resulting in low x-ray production and low self-absorption losses. Geometry is 1.6π radians.

RG-32—Model RG-32 is a balanced source containing a $\frac{1}{4}$ " diameter, 12 mg/cm^2 double mica window which permits the activity to be detected by two chambers on either side of it. The radiation field at either side of the source is identical. The activity is mounted on a mica window, delineated by a washer of mica and covered with mica. This assembly is bonded with glass and then sealed into a stainless steel frame. The source is so designed that an infinite thickness of mica separates it from the steel frame resulting in a five-fold reduction in source originated bremsstrahlung. The geometry is 1.9π radians (0.95π per side).

RG-33—The Model RG-33 Source is similar to the RG-32 design except that the radiation is emitted thru mica windows $\frac{1}{2}$ " in diameter. The mica density is 50 mg/cm^2 on one side, 12 mg/cm^2 on the other. A removable aluminum backing covers the thicker window to absorb the beta radiation without producing hard x-rays. The backing is an integral part of the source so that the sturdiness of the RG-31 design is retained. Geometry is 1.6π radians.

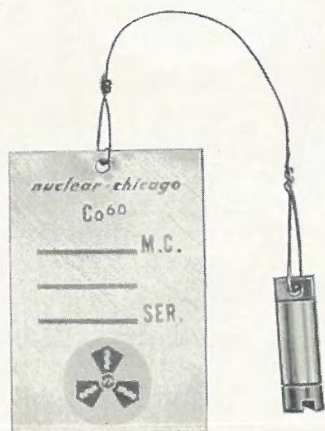
special beta ray sources—Nuclear-Chicago is prepared to make a wide variety of custom sources for special applications. Line sources, flat sources up to three inches in diameter, and other specially fabricated sources are easily adaptable to the RG-31 method of manufacture. Quotations on special sources are available on request.

MODELS: **RR-60** COBALT-60

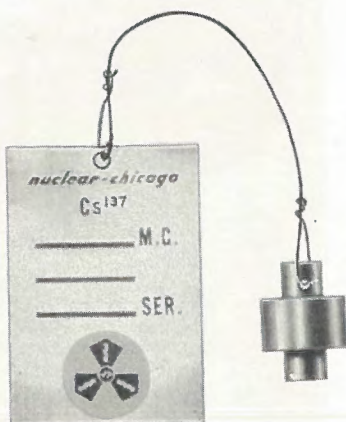
RR-137 CESIUM-137 SOURCES

GAMMA RAY SOURCES

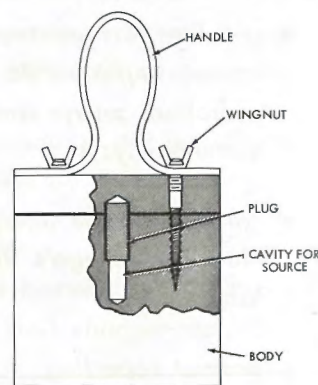
- gamma-ray sources in a variety of activities for industrial radiography, reference standards, research applications



RR-60
ACTUAL SIZE



RR-137
ACTUAL SIZE



SH-602

model RR-60 cobalt-60 source provides a high intensity source of gamma radiation useful for many years. It has a half-life of 5.3 years and produces gamma radiation of two energies, 1.17 mev and 1.33 mev. The RR-60 source is widely employed in inspecting steel and other materials from 1" to 6" thick. RR-60 sources are available in activities from 1 to 2000 millicuries.

The activity is contained in a brass holder approximately 1/4" in diameter by 3/8" long to which a magnetic stainless steel cap is hermetically sealed with silver solder.

model RR-137 cesium-137 source has a half-life of 37 years and produces gamma rays of 664 kev. It is widely used in checking and calibrating radiation measuring instruments and is employed in non-destructive testing of thin sections of steel or of materials of lower density.

The radiocesium is dispersed in a radiation resistant material which is fused to the capsule. The capsule is secured by a screw cup whose threads are sealed hermetically. RR-137 sources are available from 1 to 1000 millicuries.

testing—RR-60 and RR-137 sources are thoroughly leak-tested in the AEC-approved manner before shipment. The activity in each source is determined with an ionization chamber previously calibrated with a source of known strength. Individual calibration is to within $\pm 10\%$ of stated

value. Sources are guaranteed to be free of external contamination.

shipping—One and five millicurie sources are shipped in disposable cans. Sources with activities from 10 to 100 millicuries are shipped in Model SH-602 source holder (see drawing above) which provides 1 3/8" of lead shielding. 100 to 500 mc sources are shipped similarly in Model SH-603 shield which provides 3" of lead. 500 to 2000 mc sources are shipped in the Model SH-604 shield which provides 4" of lead. Full purchase price of the lead shield will be refunded if returned prepaid in good condition within one year.

Special gamma ray sources will be fabricated to customer specifications. Prices on request.

Models RR-60, RR-137 Sources Millicuries	Shield Supplied*	Shipping Weight (Lbs.)	Models RR-60, RR-137 Sources Millicuries	Shield Supplied*	Shipping Weight (Lbs.)
1	---	5	200	SH-603	70
5	---	5	300	SH-603	70
10	SH-602	21	400	SH-603	70
20	SH-602	21	500	SH-604	165
25	SH-602	21	1000	SH-604	165
50	SH-602	21	1500**	SH-604	165
100	SH-603	70	2000**	SH-604	165

*Shields are invoiced separately at time of shipment and may be returned for credit.
**RR-60 Sources only.

- *low cost, practical protection for employee and employer*
- *provides written record of personnel exposure to hard beta radiation, x-rays and gamma rays*
- *careful, precise interpretation at Nuclear-Chicago's film badge laboratory*
- *prompt reporting*



All persons exposed to hazardous external radiation from x-rays or radioactive materials should make use of a reliable method of determining to what extent exposure has taken place. The Nuclear-Chicago "Nuclibadge" service is a practical and economical means of providing routine personnel monitoring for x-ray and radioisotope laboratories, doctors' and dentists' offices.

A Nuclibadge is furnished each user regularly. The badge number and the date the badge is to be worn are clearly printed at the window. These data are also marked on the film emulsion for permanent identification. Accompanying the badges (if there are three or more) is a control badge to monitor radiation accumulated in transit and off hours.

The badges are worn for the desired time and then returned to our film badge department for processing and interpretation. A new set, which arrives several days ahead of time, is then put into use. When the badges are received at Nuclear-Chicago, they are promptly developed and evaluated by interpretation of the blackening of the film in terms of standard films which have been exposed to a known radiation dosage. A complete set of calibrated films of the same film lot are processed with each group of films. The user receives a complete exposure report. Nuclear-Chicago keeps the films and a copy of the report on file.

The Nuclibadge utilizes a special multiple filter system and two different films; one low range, the other high range. A carefully tested method of interpretation makes possible the evaluation of a wide range of ionizing radiations, including hard beta radiation and x-rays and gamma rays from 25 kev to 5 mev. In addition, it makes possible the evaluation of mixed exposure from any combination of x-rays and gamma radiations within this range. Nuclibadges contain a high range film for measuring roentgen exposures from 50 mr to 300,000 mr (300r).

Regular Nuclibadges may be fastened to any garment by a convenient fastener on the back of the badge. Wrist badges are also available and contain the same film packet as regular Nuclibadges. When a customer subscribes to the regular service, the entire badge (holder and film packet) are returned for evaluation. When wrist badges are ordered, the customer returns only the film packet.

ordering information—Please provide name, address, number of badges per shipment, identification desired on the badge (maximum of 12 characters and spaces), frequency of shipments (weekly, bi-weekly, or monthly), and number of shipments desired. Also state desired starting date and whether you wish to be notified by collect wire of exposures greater than 300 mr per week.

POCKET CHAMBERS, CHARGERS, AND CHARGER-READERS

PERSONNEL PROTECTION



Pocket ionization chambers are compact detecting instruments to indicate accumulated radiation exposure. They may be conveniently carried in a pocket and consist of a chamber which is charged to a specific voltage by a suitable charger. Ionization produced by any incident radiation then partially discharges the chamber, and the resultant change in charge is measured to indicate radiation dosage.

model L50 is a direct reading pocket chamber complete with optical system which permits frequent personal checks on exposure. The unit contains a small quartz fiber voltmeter which is charged so that the image of the fiber falls on the zero mark of the reticle within the unit. When x-rays or gamma rays pass through the chamber, the voltmeter is partially discharged. The accumulated dose is indicated directly in milliroentgens by the new position of the image on the reticle. When completely discharged, the unit reads 200 mr. The instrument is easily read at any time by pointing it at a source of light. Calibration error is less than 5% of full scale for the gamma rays of cobalt or radium. 1/2" dia. by 4" long; weight 1/3 oz.

model L24K is a battery operated instrument used to charge the L50 pocket chamber. It is contained in a sturdy grey

leatherette covered case 6" x 8" x 3" high. The only control is the potentiometer which "zeros" the chamber. A single size D cell provides 200 volts to the potentiometer for charging, and also provides current for the socket lamp. Clips for holding four chambers are mounted in a recessed area at the other end of the case.

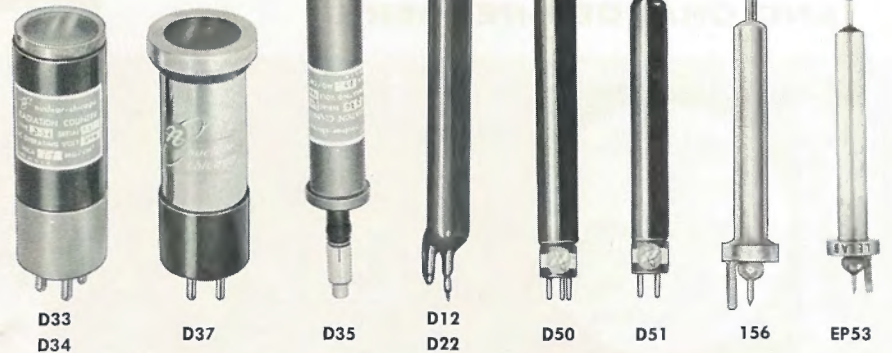
model L65 pocket chamber differs from the Model L50 in that it has no self-contained quartz fiber voltmeter. It must, therefore, be not only charged *but read* on an auxiliary device known as a charger-reader. Full scale range is 200 milliroentgens. The unit may be read as often as desired when a charger-reader is available. Calibration is exceptionally independent of x or gamma ray energy and is uniform to within $\pm 6\%$ from 1.4 mev to 30 kev. 3 1/2" long, 1/2" d.

model L60 Charger-Reader is a battery operated instrument used to charge and read the L65 pocket chamber. It may also be used to charge the L50 pocket chamber. Model L60 uses six extremely long-lived 22 1/2 volt batteries and a D size cell which provides power for the flash lamp. The scale is linear and divided and marked 0 to 200 milliroentgens. The unit is furnished complete with a sturdy gray leatherette carrying case with clips to hold six chambers.

- self-reading pocket chambers for use by trained personnel permit frequent checks on exposure
- non-self-reading pocket chambers for use by untrained personnel
- long-lived battery operated chargers and charger-readers

DETECTORS

- thin window Geiger tubes
- miscellaneous Geiger tubes
- special medical probes



thin window—Models D33, D34 and D35 are rugged halogen quenched detectors with practically infinite life, and great resistance to damage by overvoltage or high counting rates. Model D37 is an organic-quenched detector featuring high efficiency, long, flat voltage plateau and good hysteresis characteristics. Models D34, D35 and D37 have thin mica windows of approximately 1.4 mg/cm² which will pass beta particles of energies greater than 25 kev and present a stopping power equivalent to one cm. of air to alpha particles. They are widely used for soft betas such as carbon-14, sulfur-35 and calcium-45.

Models D33, D34, and D37 may be used with the 3053 manual sample changer, C110B Automatic Sample Changer, C110A "Actigraph", or with the P10 or P11 probes and a ratemeter. Model D35 is used with the P16 probe, and is supplied with the Model 2612P portable survey meter.

miscellaneous G-M tubes—Self-quenching Geiger counters are available in several types and dimensions. Model D22 is useful for gamma detection only. Models D12, D50 and D51 detect both beta and gamma radiation of over 0.2 mev. All tubes have glass envelopes with carbon cathodes. Special tubes, including dip counters, are available.

special medical G-M probes—The 156 brain probe and EP53 eye probe, originally designed for tumor location, are extremely small volume beta detectors which are uniquely suited for small area measurement or high resolution scanning. Of only 2 mm. diameter, the 156 and EP53 have sensitive volumes starting at 3 mm. and 5 mm. respectively from the needle tip and extending to 16 mm. and 15 mm. respectively. They may be sterilized in germicide and have been autoclaved. The probes are connected to a scaler or ratemeter with Model PC44 cable.

SPECIFICATIONS		D33	D34	D37	D35	D12	D22	D50	D51	156	EP53	
	Window Thickness (mg/cm ²)	3-4	1.4-2	1.4-2	1.4-2	—	—	—	—	—	—	—
	Wall Thickness (mg/cm ²)	—	—	—	—	35	300	35	35	.004" Stainless Steel	.004" Stainless Steel	
	Operating Voltage	900	900	1250	900	970	970	925	925	1100	1000	
	Plateau Length (volts)	200	200	250	180	150	150	150	150	75	75	
	Plateau Slope (%100v)	5-10	5-10	1	10	3	3	3	3	10	10	
	Cathode Material	Stainless Steel	Stainless Steel	Special Metal	Stainless Steel	Carbon	Carbon	Carbon	Carbon	Stainless Steel	Stainless Steel	
	Counting Life (counts)	5x10 ¹⁰	5x10 ¹⁰	5x10 ⁸	5x10 ¹⁰	10 ⁸	10 ⁸	10 ⁸	10 ⁸	5x10 ⁷	5x10 ⁷	
	Effective Diameter of Mica Window (inches)	1 ³ / ₃₂	1 ³ / ₃₂	1 ¹ / ₈	2 ⁵ / ₃₂	—	—	—	—	—	—	
	Background (CPM) Shielded with 2" Lead	50	50	50	75	50	50	50	50	negligible	negligible	
	Maximum Diameter (inches)	1 ³ / ₈	1 ³ / ₈	1 ¹ / ₈	1	1 ³ / ₁₆	1 ³ / ₁₆	3/4	2 ¹ / ₃₂	needle 2mm	needle 2mm	
	Overall Length including Base (inches)	4 ¹¹ / ₃₂	4 ¹¹ / ₃₂	4 ¹¹ / ₃₂	6	8 ¹ / ₄	8 ¹ / ₄	6	5 ¹ / ₄	needle 3 ¹ / ₂ overall 9	needle 2 ¹ / ₂ overall 7 ¹ / ₂	
Base (type)	4 Pin	4 Pin	4 Pin	Min'ture Cap	None	None	3 Pin	3 Pin	Special	Special		
Operating Temperature Range (Centigrade)	-55° to +75°	-55° to +75°	+15° to +50°	-55° to +75°	-40° to +55°	-40° to +55°	-40° to +55°	-40° to +55°	+15° to +45°	+15° to +45°		

LEAD SHIELDING

- lead shields and manual sample changers
- mounts
- lead bricks
- accessory lead shields

Models 3053 and 3054 Manual Sample Changers incorporate the finest components and precision machining. Two interchangeable aluminum trays are provided for the two sample slides in the base. One tray contains a removable adapter which accepts sample pans 1 1/4" d. by 1/8" deep or 1" d. by 5/16" deep. The other tray accepts C101 absorbers.

model 3053 is designed for use with Models D33, D34, or D37 end window counters. Two inches of lead shielding and 1/2" of iron shielding are provided. Geometry is controlled by a calibrated, precision-ground screw-type mechanism which makes six complete revolutions, each revolution raising or lowering the G-M tube 8 mm. A spring detent stop and an engraved number (1 to 6) appearing on the exposed screw indicate the precise geometry. Weight 165 lbs.

model 3054 is used with Models DS5-3 gamma, DS5-6 alpha, and DS5-7 beta scintillation detectors, and with the D47 Gas Flow Counter. Precise counting geometry is fixed by means of a clamp-cam which holds the detector at any desired distance above the sample. The design of the shield permits either "Micromil" window or windowless operation of the D47. When samples are changed during windowless operation, the cam is depressed, raising the D47 slightly so that the sample may be withdrawn. Weight 155 lbs.

model 3050 is identical with the upper portion of the Model 3054, is used with the D47 and C110B or C100A.

model 3051 consists of the whole upper section of the 3053 (including the screw mechanism) with a spacer, is used with D34 or D37 G-M tubes and C110B or C100A.

model 3052 is used with the DS5-3, DS5-6 or DS5-7 scintillation detectors and the C110B Automatic Sample Changer. It is identical with the upper shield section of the 3054.

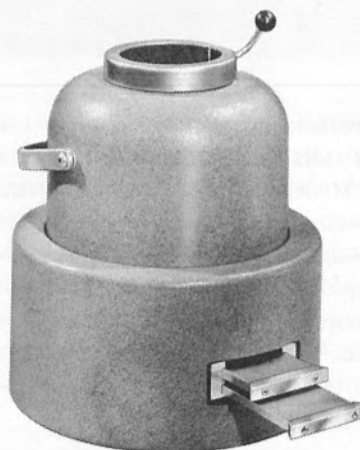
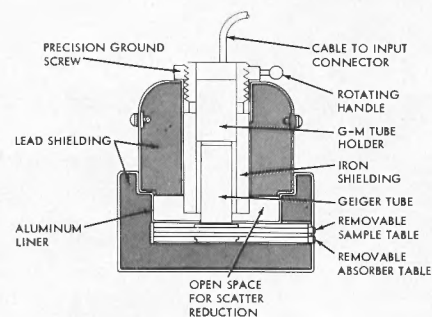
model M2 mount is an economical cast aluminum mount for end-window counters. Three sample slides are provided. Supplied with holder for 1 3/4" sample pans and three adapters. 8" high, shipping weight 8 lbs.

models 3040A and 3040B are conventional flat-side lead bricks available in two sizes: Model 3040A is 2" x 4" x 8", weighs 26 lbs., Model 3040B is 2" x 3" x 6", weighs 20 lbs.

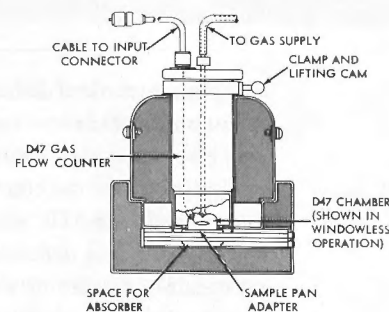
model LC-2 is suitable for carrying and storing small amounts of radioactive material. Storage area is 1 3/4" d. by 3" high and is surrounded by 1" of lead. Weight 22 lbs.



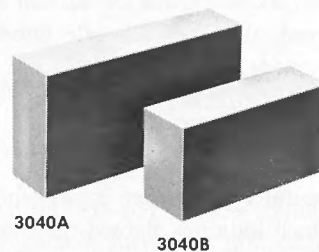
MODEL 3053



MODEL 3054

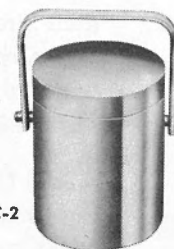


MODEL M-2



3040A

3040B



MODEL LC-2

ACCESSORIES

CHART RECORDER

TIMERS

SAMPLE SPINNER

LINE FILTER

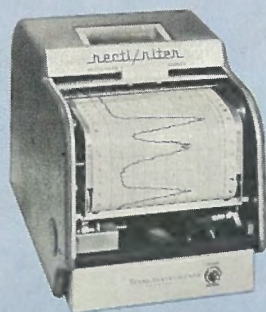
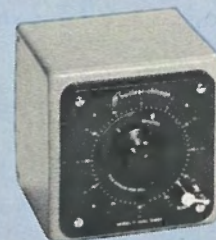


CHART RECORDER



T 101



T 1



PM 1-2-3



PS 7

houston technical laboratories chart recorder gives a continuous chart record of radiation count rate vs. time and may be connected to either Models 1619 or 1620A ratemeters. A duplication of the count rate as indicated by the ratemeter is provided, full-scale reading on the ratemeter corresponding to full swing deflection of the recording pen. The most outstanding feature of this precision instrument is its true straight line motion which inscribes the signal in its true shape on a rectilinear chart—in a form that can be measured with a ruler.

The transparent access door slides up easily into the case, permitting chart notations directly on the "writing desk" area. Input current: 1 ma full scale ($4\frac{1}{2}$ " deflection). Pen speed: 0.35 sec full scale (under critical damping). Accuracy (dc): $\pm 1\%$ of full scale. Chart speeds: 0.75, 1.5, 3, 6, and 12 in/min or in/hr. Power terminals at rear. Weight 27 lbs., shipping weight 33 lbs.

model T-101 timer is a reliable five digit drum type timer which indicates elapsed time in minutes and hundredths of minutes. Operates with any Nuclear-Chicago scaler, or by itself directly from 110 volt 60 cycle line. Convenient push button on-off switch mounted in base. Complete with six foot cord and plug. Weight $2\frac{1}{2}$ lbs., shipping weight 4 lbs. Dimensions $5'' \times 3\frac{1}{2}'' \times 4\frac{1}{4}''$ high.

model T1 dual timer provides either preset time or elapsed time from two seconds to 60 minutes with $\frac{1}{2}$ second increments, when used with Nuclear-Chicago Models 186, 183B,

181A, 161A, and 151 scaling units. Uses 110 volt 60 cycle supply from auxiliary connector on scaler (50 cycle model available). Incorporates own switch for other control purposes. With connecting cable (specify scaler Model number) and instructions. Dimensions: $4\frac{3}{4}'' \times 4\frac{1}{2}'' \times 4\frac{1}{2}''$. Shipping weight 6 lbs.

model PM-1 sample spinner is designed to simplify the problem of sample preparation. It consists of a constant speed turntable rotating the sample pan. Hand may be rested on top surface as sample material is spread on the rotating pan. An air-blower unit, Model PM-2, to aid in drying homogenous solutions evenly, and Model PM-3, consisting of an upright, clamp, and socket to hold an infrared bulb (not supplied) should also be specified for a complete unit. Turntable speed is 20 rpm. Any sample size up to 2" may be accommodated. Connectors: inlet for compressed air, nitrogen, etc. for PM-2 air blower unit, line cord, two female plugs for powering other instruments. On-off switch provided. Power — 95 to 130 volts, 60 cycles. Base is $8\frac{1}{2}'' \times 6\frac{1}{4}'' \times 2''$. Weight 9 lbs., shipping weight 15 lbs.

model PS7 line noise filter is particularly designed for nuclear counting applications. Has extremely high attenuation from 10 kc to more than 10 megacycles. The unit will effectively eliminate line noise counts due to electric typewriters, motors, and most diathermy machines. It is a balanced pi-section filter rated 115 volts at 3 amperes. Dimensions: $4\frac{1}{4}'' \times 4\frac{1}{4}'' \times 2\frac{1}{2}''$. Weight 2 lbs., shipping weight 4 lbs.

ACCESSORIES



FK 1



SAMPLE PANS



C 101



P 15



P 16



P 10



P 11

FAN KIT

SAMPLE PANS

ABSORBERS

PROBES

model FK-1 fan kit is offered as an accessory item for use with Nuclear-Chicago scalers where high ambient temperatures tend to cause overheating. The fan kit is supplied with a 115 volts, 60 cycle synchronous motor which plugs into the a-c outlet on the back of any one of our scalers. Four lugs allow quick connection of the fan to four holes at the rear of the scaling units. The fan is able to move 30 cubic feet of air per minute, guaranteeing sufficient flow to keep tube and component temperatures far below the safe operating level. The kit is supplied with a metal screen.

sample pans—Model AF-12 is a flat aluminum pan 1¼" dia.; AC-12 is a cupped aluminum pan 1¼" dia. by ⅜" deep; SC-12 is a cupped stainless steel pan 1¼" dia. by ⅜" deep; PC-12 is a cupped clear plastic pan 1¼" dia. by ⅜" deep; SS-10 is a cupped stainless steel pan 1" dia. by ⅝" deep. AC-12, SC-12, and PC-12 pans are supplied in a plastic tube, 100 to a tube. AF-12 pans are supplied 500 to a tube.

note—PC-12 pans may be used in the C110B Automatic Sample Changer and 3053 and 3054 changers but are too deep for use in the M5 Semi-Automatic Sample Changer. Special adapters are required for the M5 when used with PC-12 pans. Details on request.

model C-101 absorber set provides a range of aluminum and lead absorbers from 1.7 to 6700 mg. per sq. cm. They may be used to determine the energies of photons and beta radiations, check isotope purity, identify radioactive species, to count one isotope in the presence of another, etc. The

set consists of 23 calibrated discs mounted in uniform plastic rings. An additional empty ring is provided for zero absorption. The set is constructed for rugged, long-term duty and is housed in a handsome walnut case. The absorbers may be used on the top shelf of the Models 3053 or 3054 Manual Sample Changers or Model M2 mount. Each absorber is 1⅞" diameter x ⅜". Seventeen aluminum absorbers range from 1.7 mg/cm² to 1670 mg/cm²; six lead absorbers range from 401 mg/cm² to 6700 mg/cm². Case dimensions 7" x 10" x 2½". Weight 2 lbs., shipping weight 5 lbs.

geiger probes are available for use with scalers or rate-meters. Model P15 and P16 are chrome plated brass; P10 and P11 are finished in blue-grey paint. All probes are furnished with cable and connector.

model P15 probe accepts Model D50 counter, has revolving shield which exposes a 180° angle to permit entry of beta radiation. 40" coiled cable. Shipping weight 3 lbs.

model P16 probe accepts Model D35 end window counter, has cap at end of probe for gamma surveying. 40" coiled cord cable. Shipping weight 3 lbs.

model P10 probe incorporates a preamplifier and ten-foot cable, accepts four-pin end window counters (such as Model D34). Has built-in magnet for positioning on any ferromagnetic material. Shipping weight 6 lbs.

model P11 probe is similar to P10 except it has a 3 ft. cable and no preamplifier. Shipping weight 3 lbs.

Nuclear-Chicago warrants its manufactured equipment to be free from defects in workmanship or materials under normal use for one year. If any part of such equipment, with the exception of vacuum tubes, fuses, and batteries, proves to be defective within one year after original date of shipment, it will be repaired or replaced without charge.

warranty

Geiger tubes are guaranteed for 90 days against defects in material and workmanship.

All repairs or replacements under the above warranties are f.o.b. company's factory, or company's authorized service representative. If any question arises within these warranty periods, contact the company or its nearest Branch Office for assistance or instructions. No liability shall attach to us, however, for damages or delays caused by defects, beyond making such repairs or furnishing duplicate parts, nor shall we be liable for any defective material repaired or replaced without our consent.

terms of warranty

The company is not responsible for instrument damage which occurs during shipment, but it is our practice to make every effort to obtain restitution from the carrier. If you receive an instrument which is damaged in any respect, an immediate inspection by the carrier should be requested. We will make arrangements for repair or replacement of the equipment upon receipt of the carrier's inspection report.

shipping damage

Our Customer Service Department, with headquarters in Chicago, has established authorized service representatives at many points throughout the U. S. and Canada. For information about service representatives in your area, contact our nearest Branch Office. Where necessary, our factory in Chicago is ready to make repairs promptly. No charge will be made on repairs within warranty, but on other repairs it will be necessary to issue an invoice against your purchase authority.

service information

When submitting an order or a request for a quotation, please supply the following information:

1. Model number. When ordering accessories please give the model and serial number of the instrument with which the accessories are to be used so we can furnish proper cable or connectors or adapters.
2. Desired f.o.b. point (our published prices are all f.o.b. Chicago except where noted).
3. Desired delivery date.
4. Full information concerning shipping and billing addresses.
5. Method of shipment—all shipments will be Railway Express collect unless otherwise specified.

suggestions for ordering

Nuclear-Chicago products are in use throughout the world and we are pleased to supply equipment to customers abroad. Orders and correspondence from countries outside the U. S. should be directed to our Export Department at 223 W. Erie Street, Chicago 10, Illinois.

export orders



nuclear - chicago
CORPORATION

223 WEST ERIE STREET, CHICAGO 10, ILLINOIS, DELaware 7-3060 • Cable: NUCLEAR