Hopewell Designs, Inc.

Model BX1 Box Calibrator

BX1 Features

- Self-contained shielded exposure chamber
- Large viewing window
- 0 -600X Attenuator set
- Front opening door gives easy access
- Single or Dual Source, 10mCi to **50 Ci**
- Dual axis positioning track
- Fully automated or manual operation
- Door & source interlocked for safety
- Compact size
- Ports for teletectors & extendable probes

The Model BX1 Box Calibrator produces a beam of gamma radiation of varying strenths for calibrating survey meters inside a fully shielded enclosure. The irradiator consists of a shielded exposure chamber, one or two source, shielding, a safety interlock system and a control panel.

MODEL BX1 BOX CALIBRATOR

SOURCES

The BX1 can be provided with 1 or 2 sources. The range of available sources is from 10mCi to 50 Ci. Typical sources and their corresponding exposure rates are:

Source & Size	Maximum Exposure Rate	Minimum Exposure Rate*
50 Ci of Cs^{137}	375 R/hr	55 mR/hr
10 Ci of Cs^{137}	75 R/hr	11 mR/hr
5 Ci of Cs^{137}	37 R/hr	5.5 mR/hr
1 Ci of Cs^{137}	7.5 R/hr	1 mR/hr
0.5 Ci of Cs^{137}	3.7 R/hr	0.5 mR/hr
0.1 Ci of Cs^{137}	750 mR/hr	0.1 mR/hr
0.05 Ci of Cs^{137}	370 mR/hr	0.5 mR/hr
0.01 Ci of Cs^{137}	75 mR/hr	0.01 mR/hr

* Minimum exposure rate based on full 600x attenuation and tract at maximum distance (80cm) from source.

The sources are doubly encapsulated, hermetically sealed, special form sources. The source capsule is fabricated of stainless steel. Sources are supplied with certificates for source activity, exposure rates, and leak tests. The source(s) are loaded in a rod made primarily of tungsten. The cavity that holds the radioactive source is made from stainless steel to limit the amount of attenuation.Tungsten is placed both above and below the source to limit radiation levels and crosstalk between the sources. Brass guide bushings are attached to the top and bottom of the source rod.

SHIELDING

The irradiator consists of 2 shields, one for storing the radiation sources, and the second for housing the exposure chamber.

The shield for the sources is a steel-encased lead cylinder approximately 10 ¾” in diameter and 19" tall (24” tall for dual source). The weight is 800 lbs. The source rod moves up inside a thin walled stainless tube to the exposed position. It is permanently embedded in the shield and can not be removed. A conical, rectangular beam port extends out the side of the shield to the exposure chamber.

The exposure chamber shield is shaped as a box and is approximately 15" deep x 21” tall x 32 ¾” long. The weight is 1,200 lbs. The interior size is 12” deep x 18” tall x 26” long. A lockable latch can hold the front door closed. In addition, a safety interlock holds the door closed during an exposure. A 2” diameter port in the side of the chamber allows extendable probes such as teletectors to be calibrated. It is located close to the source shield to provide maximum exposure rates.

Lead provides sufficient shielding to limit the radiation level to ≤ 0.5mR/h at 12" from the surface of the shield. All lead is totally encased in steel.

VIEWING WINDOW

A leaded glass viewing window in the top of the shield allows the instrument to be read during an exposure. The 12” x 18” window allows the instrument to be read over the full range of travel of the positioning track.

ATTENUTORS

A set of 3 attenuators, X3, X10, and X20 provide 8 different exposure rates from 1 to X600. Slide handles on the exterior of the exposure chamber allow the attenuators to be positioned during an exposure. The attenuators can be moved out of the way so that instruments can be placed next to the beam port to achieve the highest possible exposure rate.

POSITIONING TRACK

A manual positioning track allows instruments to be moved over a range of 30 cm to change exposure rates by a factor of 20. This distance change, in combination with the attenuator set provides a large dynamic range for each source. An adjustable vertical axis provides 12 cm of adjustment to align instruments in the beam centerline. Scales on each show platform position. The 20 cm x 20 cm platform has a grid of lines at 1 cm spacing, and tapped holes on a 10 cm spacing to allow instruments to be accurately positioned.

Jigs are available for a wide assortment of instruments.

SOURCE HANDLING SYSTEM

The source is moved between the shielded position and exposed position by hand or by pneumatic cylinder depending on the control system. In the storage position, the source rod is locked in place by a solenoid and will not allow the operator to expose the source until is safe to do so.

SAFETY INTERLOCK SYSTEM

The irradiator system is designed to be a safe system to operate. "Fail Safe" design constraints have been applied to all components that involve source exposure. A safety interlock system is an integral part of the design to prevent inadvertent exposure to staff. A door interlock is provided for the exposure chamber door. When the door is open, power to the source solenoid is broken, preventing source exposure. When an exposure is in progress, the door is locked and cannot be opened.

A red warning light is mounted above the source tower, and is on whenever the source is not fully shielded. A green light is on when the source is fully shielded.

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MANUAL CONTROL PANEL

The manual control panel has a keyed power switch, a timer, and a series of handles for moving the source rod and the attenuator, an expose button, and a timer. The key for the power switch is captured in the ON position. With the system interlock satisfied, the operator lifts the source handle to the desired position. When the source handle is placed in either exposed position. A reset button zeros the timer.

SPECIFICATIONS

Physical Size: 43” wide x 15” deep x 42” tall.
Top of exposure chamber is at 28” from floor.
Recommended working space: 3 ft. x 6 ft.
Weight: 3000 Lbs.
Viewing Window: 18” x 12”
Power Requirements: 120 VAC, 1 Amp.
Compressed Air: 80 PSI, < 1SCFM
(for systems with electronic controllers only)

OPTIONAL ELECTRONIC CONTROLLER

The electronic controller adds the ability to do timed exposures. An electronic controller has a digital display for exposure time, and a keypad for time entry. A pneumatic air cylinder is connected to the source rod and moves the source between the shielded and exposed position(s). Exposure begins when the operator presses the expose button, and returns when preset time is reached or when the return button is pressed. Operator can select desired source when the dual source system is supplied. All safety interlocks are still incorporated into the control system: the door must be closed before an exposure can occur; and when the source is exposed, the door is locked.

OPTIONAL COMPUTER CONTROLLER

- Calculates Exposure rate & Decay Correction
- Automatic Set-Up of Irradiator
- Automated Calibration of Irradiator

The BX1 can be supplied with a computer based control system. This approach offers several advantages: calculation of exposure rate via polynomial equation, automatic set up of irradiator, automated calibration of irradiator, and enhanced ease of use. The computer screen shows controls and indicators for interlock status, expose/shielded state, preset and elapsed time, preset and actual positions for track, source and attenuator selection, and automatic set up procedure and step. The automated controller uses the latest model of computer and includes circuit boards for interfacing to the inputs and outputs, the linear positioning track, and the electrometer.

With the power of the computer available for calculations, the irradiator control system can calculate the track’s X-axis distance based on a desired exposure rate. This calculation includes decay correction and is based on a polynomial equation that precisely matches the measurement data collected for that source/attenuator/position combination. When distance is changed, the exposure rate for that position is calculated. The same arrangement holds for time and exposure – when one is changed, the other is calculated and displayed.

The automatic set up routine speeds up instrument calibration and increases accuracy by quickly configuring the irradiator to match the instrument’s calibration procedure. With the change of one button, this routine configures source, attenuator, track position or exposure rate, and time or exposure. These configurations are arranged in procedures and steps that the user defines. Whenever the operator changes a step, the irradiator is reconfigured to match that step.

The irradiator calibration requires that hundreds of data points be collected to determine exposure rates for distances along the positioning track. This data must be collected for each source and each attenuator. With the computer control system, this process is automated allowing the pc to communicate with the electrometer to collect calibration data. The irradiator control system presents a set up screen that allows the operator to specify distances, exposure time, and number of exposures at each position. Once the operator starts the exposure, the control system performs the exposures at each position, collects the exposure rate from the electrometer and saves it to a spreadsheet file. The automated sequence continues until all data is collected. An equation curve fit program is used to fit the data to a polynomial equation. This equation is then coded into the software control program.

The computer based control system enhances ease-of-use by automating and simplifying many steps of the calibration process. It handles the mundane, repetitive tasks and lets the operator concentrate on the calibration procedure.

This option includes the following enhancements:

- Computer control system with touch screen
- Irradiator control software
- Pneumatic operation of source rod, controlled via computer
- Pneumatic operation of attenuators, controlled via computer
- X-axis stepper motor for linear positioning track

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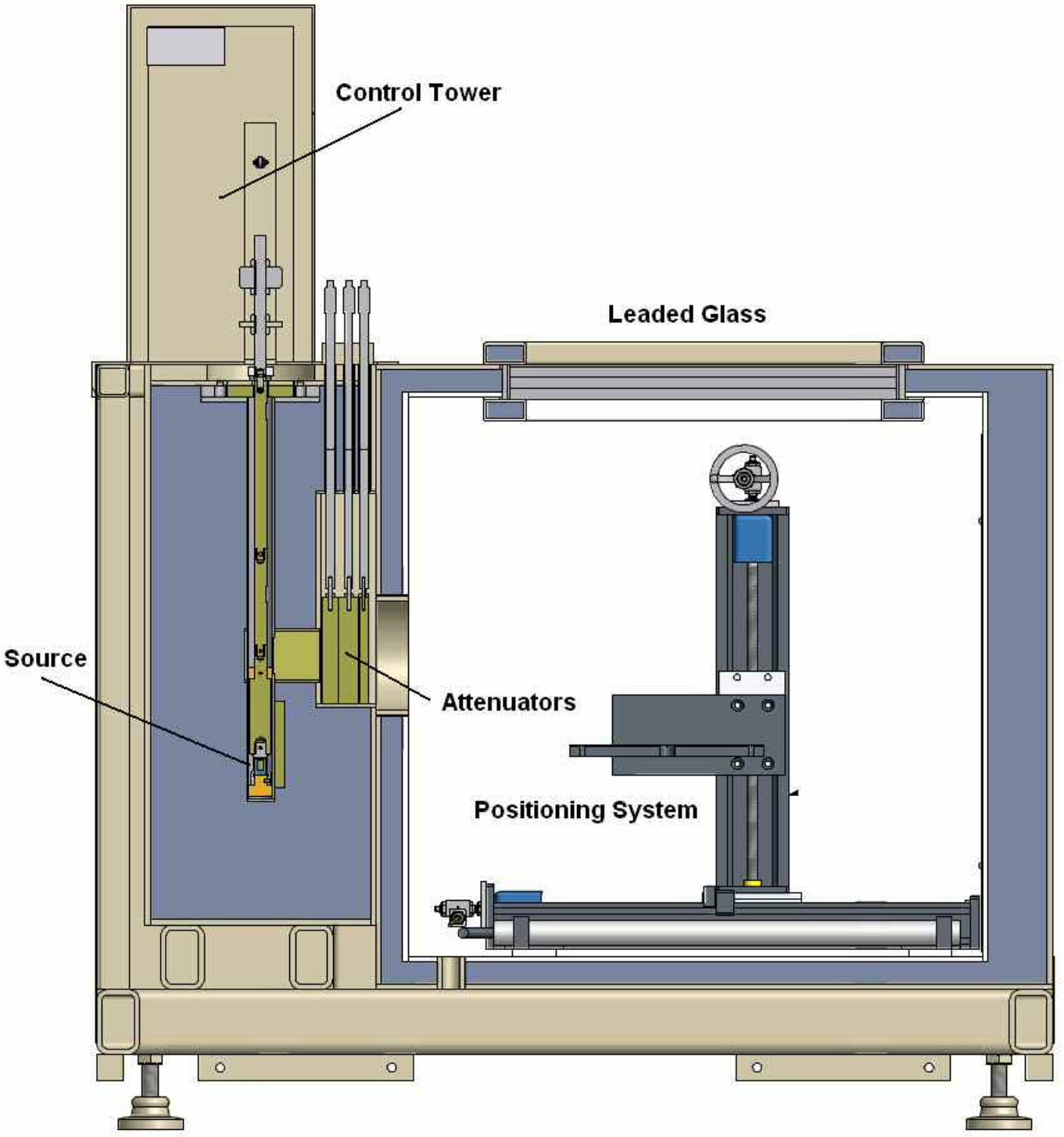
Model BX1 Box Calibrator

Cross-section



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