



SPECIFICATIONS

NUMBER JS-300
APRIL 1, 1974

GAMMACELL 220 IRRADIATION UNIT

A. GENERAL

The Gammacell 220 is a fully self-contained research irradiator designed to provide a field of high-intensity gamma irradiation. No additional shielding requirements are necessary to safely operate the unit. Exposure dose rates up to 2.0×10^6 roentgens per hour at the mid-point of the irradiation chamber can be provided with a nominal source loading of 23,000 curies of Cobalt-60. Based on the design specifications outlined herein, it has been determined by the Directorate of Licensing, United States Atomic Energy Commission, that the irradiator is acceptable for licensing in the United States.

B. COMPONENT PARTS

B.1 Radiation Shield- The radiation shield consists of a large steel-encased lead barrier with provision for housing the Cobalt source. Forming an integral part of the shield is a removable steel-encased lead plug, which permits the loading of the source at the centre of the shield. Mounted on the top of the main shield is an additional split lead collar which provides secondary shielding when the drawer is in motion.

B.2 Radioactive Source- The Cobalt-60 source consists of up to 48 linear source elements equally spaced in a stainless steel rack to form a radioactive cylindrical shell or annulus $8\frac{1}{4}$ in (20.9 cm) measured between the centres of opposing elements. Each linear element consists of a welded stainless steel pencil filled with Cobalt-60 in the form of metallic cobalt.

Internal dimensions of each pencil are 0.395 in (1 cm) diameter and 8 in (20.3 cm) length. The source is secured in the centre of the radiation shield.

B.3 Drawer- The drawer is centrally located in the radiation shield and is power-driven vertically through the centre of the source. Material to be irradiated is placed in the sample chamber, then lowered to the irradiation position, i.e. the sample chamber is then in the centre of the source.

The motor-driven drawer consists of four sections:- an access tube shielding plug, an upper shield, a sample chamber, and a lower shield, each as described below.

a) **Access Tube Shielding Plug-** A lead-filled steel cylinder which is hinged at the back of the drawer top. This plug prevents excess radiation leakage through the access tube when the sample chamber is in the irradiate position. An electrical interlock immobilizes the unit if the shielding plug is in the open position.

b) **Drawer - Upper Shield-** The upper shield consists of a steel-encased lead cylinder containing one straight access tube.

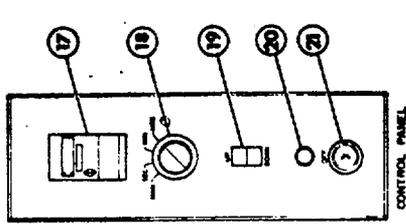
Access Tube Dimensions:-

Internal Diameter - 1-1/4 in (3.17 cm)

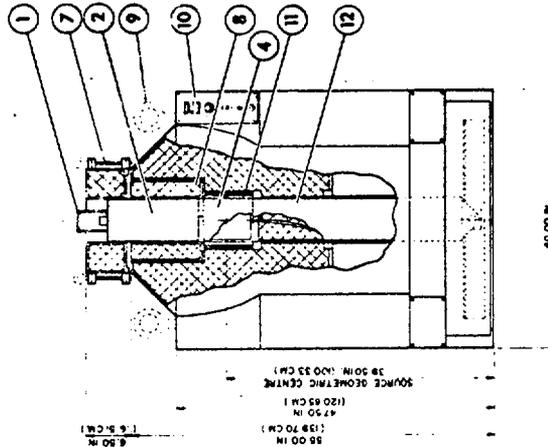
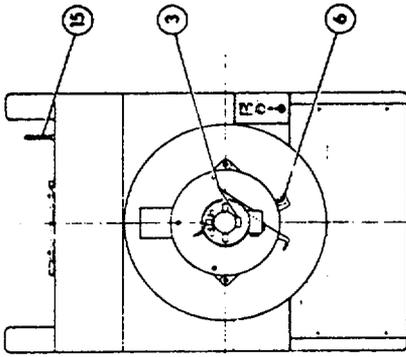
Thread at Top - 1-3/8 in - 12 TPI
American Standard Fine.

c) **Sample Chamber-** The sample chamber is a hollow, thin-walled, cylinder

A/4

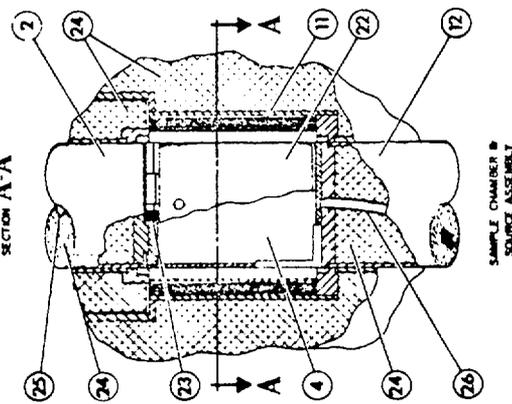
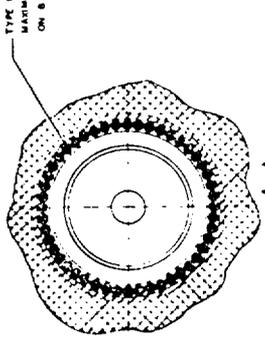
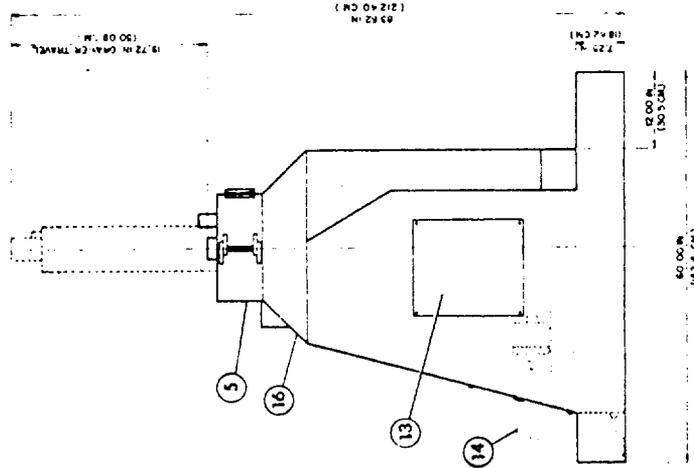


- 17 TOP SHIELD PLUG
- 18 DRAWER TOP
- 19 SAFETY INTERLOCK MECHANISMS
- 20 SAMPLE CHAMBER
- 21 SHIELD COLLAR
- 22 COLLAR DOOR HANDLE & LATCH
- 23 COLLAR DOOR HANDLE
- 24 WHEEL HEAD PLUG
- 25 REMOVABLE LIFTING LUMB
- 26 CONTROL PANEL (SEE DETAIL)
- 27 SOURCE PENCIL ASSEMBLY (SEE DETAIL)
- 28 DRAWER BOTTOM
- 29 ENCLOSED DRIVE MECHANISM
- 30 DRAWER MANUAL CRANK
- 31 ELECTRICAL CABLE
- 32 SHELLOW HEAD
- 33 DIGITAL TIMER
- 34 TIME MEDIA SELECTION SWITCH
- 35 DRAWER UP-DOWN SWITCH
- 36 FUSE
- 37 KEY SWITCH
- 38 SAMPLE CHAMBER DOOR
- 39 SLOWING DOOR LATCH
- 40 LEAD SHELLOW
- 41 ACCESS TUBE, STAINLESS STEEL, INTERNAL DIAMETER: 1.25 IN (31.75 MM)
- 42 SERIAL CRANK TUBE, STAINLESS STEEL, INTERNAL DIAMETER: 0.75 IN (19.05 MM)



TYPE C-185 OR C-186 CONSULT 50 PENCILS
 MAXIMUM OF 445 EACH 8.5 IN (21.5 CM) LONG
 ON 8.75 IN (22.25 CM) PITCH CIRCLE DIA.

NOTES
 1 - IRRADIATION CHAMBER INSIDE DIMENSIONS: 8.75 IN (22.25 CM) x 5.00 IN (12.70 CM) x 10.00 IN (25.40 CM)
 2 - DOOR APERTURE: 7.75 IN (19.65 CM) x 4.50 IN (11.43 CM) x 10.24 IN (26.02 CM) WIDE x
 3 - LIFT TRUCK CAVITY DIMENSIONS: 7.18 IN (18.24 CM) x 10.00 IN (25.40 CM) x 31.88 IN (80.98 CM)
 4 - IRRADIATION CLEARANCE: REAR - 24 IN (61 CM) SIDES - 30 IN (76 CM)



GAMMACELL "220" SPECIFICATIONS
 J 300-X-7

constructed of anodized aluminum. A removable door provides easy access. The door is locked by means of a chrome-plated, steel locking ring around the top of the chamber. Electrical interlocks are provided on both the door and locking ring to ensure their correct location before the machine will operate. A 1-3/8 in (3.5 cm) diameter hole in the roof of the chamber provides entry to the access tube in the Drawer Upper Shield. A hole in the bottom of the chamber provides access to the drain tube in the Drawer Lower Shield.

Sample Chamber Dimensions (internal):-

- Height:- 8-1/8 in (20.6 cm)
- Diameter:- 6 in. (15.2 cm)
- Volume:- 220 cu. in (3,610 cu. cm)
- Door Opening: 7.9 in (20 cm) high x
6.0 in (15.2 cm) wide.

d) **Drawer - Lower Shield-** The lower shield consists of a steel-encased lead cylinder with a 7/16 in (1.1 cm) inside diameter spiral stainless steel drainage tube passing through it from the bottom of the sample chamber to an outlet underneath the unit.

B.4 Main Frame- The radiation shield is mounted on a steel frame with an operator platform at the front of the unit. A cavity 7 in (17.8 cm) high and 32 in (81.3 cm) wide runs underneath the entire length of the unit and is used for movement of the unit with a lift truck.

C. CONTROLS

Control of the unit is from the central panel mounted on the front face of the unit. The control panel includes the following:-

- Drawer movement control switch for raising or lowering the sample drawer under manual control.

- Digital Timer with a range of 0.1-999.9 calibrated in hours, minutes, and seconds. Timer is automatically repetitive permitting continuous experiments of the same time interval to be completed by pressing reset button.
- Mode Selector Switch which enables operator to select time units desired, or manual control.
- Key operated Master Switch providing power supply to unit and control panel.
- Control Circuit Fuse.

The drawer can be operated manually by means of a crank in the event of power failure.

D. WEIGHTS & DIMENSIONS

Dimensions	Inches	Centimetres
Overall Width	40.0	101.6
Overall Length	60.0	152.4
Overall Height (drawer up)	83-5/8	212.4
Overall Height (drawer down)	62-1/8	157.8

Weight

- Total Weight:- 8,300 lb (3,765 kg)
- Floor Loading:- 498 lb/sq.ft. (2,430 kg/sq. m).

E. ELECTRICAL POWER REQUIREMENTS

220 Volts - 3 phase - 50 or 60 cycle - 0.75 kVA (1/2 H.P. motor).

F. SHIPPING

The Gammacell 220, complete with Cobalt-60 source, is shipped without additional

radiation shielding. Its design and construction comply with the Canadian and U.S.A. regulations covering transportation of radioactive material.

Crated Weight:- 8,500 lb. (3,856 kg)

Crated Dimensions:-

Height:- 69 in. (175.3 cm)
 Width:- 44½ in. (113.0 cm)
 Length:- 64 in. (162.6 cm)

G. CERTIFICATION & DOCUMENTATION

A set of isodose curves is supplied with each unit showing the distribution of the dose rate in the sample chamber.

Actual dose rate values are normally within 5% of those indicated by the isodose chart.

The dose rate at the mid-point of the sample chamber is measured by ferrous chemical dosimetry, the accuracy being ± 3.5%. A Certificate of Calibration is supplied with each unit.

The Cobalt pencils in the source are individually tested for leakage and contamination. A certificate describing the tests performed is supplied with each unit.

An Operation and Maintenance Manual is shipped with each unit.

**G A M M A C E L L 2 2 0
 A C C E S S O R Y E Q U I P M E N T**

(All accessories may be field installed with the exception of Dial-A-Dose (J-329))

A. FOOD & DRUG VIAL RACK (J-321)

Designed to hold up to 24 food or drug vials each 2-¾ in. (6.89 cm) long by 13/16 in. (2.06 cm) diameter. Rack locates vials in Gammacell 220 sample chamber at points of equivalent dose rate.

cylinder with external diameter of 5-15/16 in. (15.2 cm) and length of 7-7/8 in. (20.0 cm).

Attenuator Internal Diameter	% Central Dose Rate
4-29/32 in. (12.46 cm)	45
4-3/8 in. (11.11 cm)	30
2-25/32 in. (7.06 cm)	10

B. ATTENUATORS (J-325)

Set of three lead attenuators which when placed in the sample chamber serve to reduce the dose rate. All attenuators are constructed in the form of a hollow

Typical isodose curves are shown on drawings J300-x-2, J300-x-3, and J-300-x-4.

A tong-type removing tool is supplied with attenuators.

C. FIELD FLATTENER (J-348)

This contour-type attenuator provides greater dose rate uniformity, as shown on drawing J300-x-5. The central dose rate is 56% of that without attenuators. The internal diameter of this accessory is 4-15/16 in. (125 mm).

temperatures up to 1000°F (538°C). Usable irradiation space inside the High Temperature Chamber is 2-3/16 in. (5.56 cm) diameter by 3-1/2 in. (8.89 cm) high.

Accessory No. J-322 is required with the High Temperature Chamber.

***D. ACCESSORY TUBE INSERT (J-322)**

A bundle of stainless steel tubes specially constructed to fit within the access tube of the Gammacell 220 and permit easy passage of coolants, electrical wiring, etc., from a point exterior to the unit to accessories located in the sample chamber. A bundle consists of two tubes 5/16 in. (0.79 cm) O.D., two tubes 1/4 in. (0.635 cm) O.D., and one tube 3/16 in. (0.476 cm) O.D. All tubes have 0.028 in. (0.071 cm) wall thickness.

This accessory is required with Cat. Nos. J-323, J-324, and J-328.

***G. LOW TEMPERATURE CHAMBER (J-324)**

Specially constructed Dewar vessel fits inside the standard sample chamber of the Gammacell 220. Samples, during irradiation, may be maintained at temperatures down to that of liquid nitrogen at -319°F (-195°C) at an ambient temperature of 135°F (57°C). Coolants, other than liquid nitrogen, may be utilized to maintain intermediate low temperatures. A liquid level probe utilizing two solid state level sensors is provided for control of liquid nitrogen level in the coolant space. Usable irradiation space inside the Low Temperature Chamber is 2-3/4 in. (6.90 cm) diameter by 4.0 in. (10.16 cm) high.

Accessory No. J-322 is required with the Low Temperature Chamber.

***E. IRRADIATION HELIX (J-328)**

Stainless steel coil constructed of 5/16 in. (0.79 cm) O.D. tubing with 0.028 in. (0.071 cm) wall thickness which fits inside the sample chamber. Utilized for continuous circulation of fluids and gases during irradiation.

Accessory No. J-322 is required with the Irradiation Helix.

H. LIQUID NITROGEN LEVEL CONTROLLER (J-256)

Provides continuous control of liquid nitrogen level within the Low Temperature Chamber.

For complete control of the Low Temperature Chamber the customer must provide a storage dewar for liquid nitrogen and a discharge line for transferring the liquid nitrogen to the accessory tube which connects with the Low Temperature Chamber. The discharge line must have a suitable solenoid

***F. HIGH TEMPERATURE CHAMBER (J-323)**

Electrically heated and water cooled chamber fits inside the standard sample chamber of the Gammacell 220. Samples, during irradiation, may be maintained at

** Designed for use on all units above Serial No. 45 or on units fitted with a Drawer Top incorporating the straight access tube.*

valve which will be used to control the flow.

The controller provides power to the discharge line solenoid when the liquid level drops below the lower sensor in the cold chamber and maintains the power until the upper sensor is immersed in liquid nitrogen. Therefore, the liquid nitrogen level is maintained between the upper and lower sensors which are spaced 1/2 in. apart.

*I. MECHANICAL STIRRER (J-326)

Provides continuous stirring of liquids during irradiation. Mechanical Stirrer is recommended for materials of high viscosity. Stirrer is used with drive unit positioned external to the Gammacell and supplied as a separate item J-333.

*J. MAGNETIC STIRRER (J-327)

Provides continuous stirring of materials which must be irradiated in a sealed container. Stirrer is used with a drive unit positioned external to the Gammacell and supplied as a separate item J-333.

*K. MOTOR DRIVE UNIT (J-333)

This unit is required for use with both stirrer accessories J-326 and J-327.

The drive unit consists of the following components:-

- a) A small 115-volt electric motor and speed reducer supported on an adjustable mounting bracket.
- b) A variable speed selector coupled into the motor circuit to control motor

revolutions and accessory rotation speed.

- c) A flexible drive shaft to conduct motive power from the speed reducer to sample chamber equipment.

The Accessory Drive Unit is suspended from the mounting bracket on a vertical post screwed into the unit drawer top. The flexible drive cable is coupled to the reducer socket and travels through the drawer top access tube to the unit sample chamber.

L. DIAL-A-DOSE (J-329)

This accessory permits the operator to select either the exposure time or the total dose to be received by a sample. The Dial-A-Dose incorporates the digital timer supplied with all Gammacell 220's, and, in addition, an ionization chamber encased in polystyrene (0.866 in. diam. by 1.130 in. long) converts radiation energy to electrical energy. The ionization chamber is placed close to the sample being irradiated to monitor radiation dosage. Total time or total dose for the irradiation is set on the control panel, and when the time has expired or the total dose delivered, the sample chamber automatically returns from the "irradiate" to "load" position.

A range selector switch located on the Gammacell 220 control panel permits choice of the following ranges:-

- 0.1 - 999.9 x 10^3 rads
- 0.1 - 999.9 x 10^5 rads
- 0.1 - 999.9 x seconds
- 0.1 - 999.9 x minutes
- 0.1 - 999.9 x hours

A position for manual operation is also

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provided.

The accuracy of the Dial-A-Dose for dose ranges is $\pm 4\% + .2$ units of the indicated reading, and for time ranges is $\pm 2\% + .2$ units of indicated reading.

This accessory must be installed on the Gammacell 220 prior to shipment.

M. ADDITIONAL DRAWER TOP (J-339)

Drawer Top complete with straight access tube of 1-1/4 in. (3.27 cm) internal diameter. This drawer top incorporating the straight access tube is standard equipment on all units above Serial No. 45. It can be readily installed on units Serial Nos. 1-45, if it is desired, to utilize accessories J-322, J-323, J-324, J-326, J-327, or J-328.

The specifications contained herein were in effect at the time of printing. Atomic Energy of Canada Limited reserves the right to discontinue models at any time or change specifications or design without notice and without incurring obligation.

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