

$\gamma$  constant Co-60  $\approx 14.4$  R/hr/curie/1ft.

$$\frac{I}{I_0} = \left(\frac{d_0}{d}\right)^2 ; \frac{I}{14.4} = \left(\frac{1}{3.25}\right)^2 = \frac{I}{14.4} = \frac{1}{10.56} =$$

$$10.56(I) = 14.4$$

$$I = \frac{14.4}{10.56}$$

$$I = 1.4 \text{ R/hr/ci/m}$$

$$1000 \text{ Ci (Co-60)} \approx 1.4 \text{ R/hr/ci/m} \times 1000 \approx 1400 \text{ RHm} \checkmark$$

$$\frac{I}{I_0} = \left(\frac{d_0}{d}\right)^2 ; \frac{I}{1400} = \left(\frac{1 \text{ m}}{1.82 \text{ m}}\right)^2 = 3.3 \text{ m}(I) = 1400 \text{ RHm}$$

$$I = \frac{1400 \text{ RHm}}{3.3} = 424.2 \text{ R/hr.} \checkmark$$

$$\text{Co-60} = 1.33 \text{ mev}$$

mass attenuation coefficient for concrete : 1.0 mev = .0637  
1.5 mev = .0519

$$1.0 = .0637$$

$$1.33 = .0560 \checkmark$$

$$1.5 = .0519$$

$$\text{Density} = 2.30 \text{ g/cm}^3 \checkmark$$

$$\text{ave} = 2.35 \text{ g/cm}^3$$

$$\text{HVL (concrete)} = \frac{.693}{\mu} = \frac{.693}{.1288} = 5.38 \checkmark$$

REGISTRY OF RADIOACTIVE SEALED SOURCES AND DEVICES  
SAFETY EVALUATION OF SEALED SOURCE

NO.: NR628S141U

DATE: March 1978

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SEALED SOURCE TYPE: Radiograph Sources

MODEL: A453-5, A453-6

MANUFACTURER/DISTRIBUTOR: Technical Operations  
Radiation Products Division  
40 North Avenue  
Burlington, MA 01803

MANUFACTURER/DISTRIBUTOR:

ISOTOPE: Cobalt-60 A453-6  
Cobalt-60 A453-5

MAXIMUM ACTIVITY: 1100 curies  
550 curies

LEAK TEST FREQUENCY:

PRINCIPAL USE: Industrial Radiography

CUSTOM SOURCE: No

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SEALED SOURCE TYPE: Radiograph Sources

DESCRIPTION:

The sources are designed for use in Technical Operations Model 520 radiography projectors. Model A453-6 is designed to contain up to 1100 curies of cobalt-60 whereas A453-5 contains up to 550 curies of cobalt-60. The cobalt is contained in a capsule of stainless steel which is sealed by heliarc welding. The capsule is swaged to the flexible control cable. Model A453-5 has an outer diameter of 0.350 inches whereas the Model A453-6 has an outer diameter of 0.476 inches. The capsules are not labeled since they are used in a radiography exposure device. The sources may be singly or doubly encapsulated. The doubly encapsulated sources are identified by the addition of a prefix "D" to the source serial number.

QUALITY ASSURANCE AND CONTROL:

Each sealed source is subjected to a quality control program to assure design specifications which are established through prototype testing (drop, percussion, heating and immersion).

ISSUING AGENCY:

U.S. Nuclear Regulatory Commission

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SAFETY EVALUATION OF SEALED SOURCE

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SEALED SOURCE TYPE: Radiography Source Assembly

MODEL: A-11-T

MANUFACTURER/DISTRIBUTOR: Gamma Industries, Inc.  
P.O.Box 2543  
Baton Rouge, LA 70821

MANUFACTURER/DISTRIBUTOR:

ISOTOPE: Cobalt-60

MAXIMUM ACTIVITY: 1000 curies

LEAK TEST FREQUENCY:

PRINCIPAL USE: Industrial Radiography

CUSTOM SOURCE: ☐ YES ☒ NO

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SEALED SOURCE TYPE: Radiography Source Assembly

DESCRIPTION:

The Gamma Industries Model A-11-T source assembly is an exception to the nomenclature, concerning the "A" series source assemblies, and therefore, a separate sheet has been issued.

The Model A-11-T source assembly is designed for use in the Gamma Industries Model 180 exposure device. The source is doubly encapsulated using heliarc (TIG) welding. Capsules are fabricated from type 304 or 316 stainless steel. The capsule wall thickness is maintained at a minimum of 0.030 of an inch. Teleflex cable is inserted into the capsule and connector at least 5/16 of an inch.

A 1/4-28 threaded connector is used which, after attaching to the drive mechanism, is drilled and pinned in place.

PROTOTYPE TESTING:

The manufacturer states that prototype sources have met the criteria specified in ANSI publication N5.10-1968 and are classified as E32515.

QUALITY ASSURANCE AND CONTROL:

Each pigtail assembly is subjected to a 150 lb. pull test prior to radioactive material insertion, and is subjected to a wipe test after the material is sealed in the capsule. If the results of the wipe test are doubtful, then a hot water bubble test is performed. No source shall be shipped if removable contamination exceeds 0.005 microcurie.

ISSUING AGENCY:

Louisiana Nuclear Energy Division.

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SAFETY EVALUATION OF DEVICE

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DEVICE TYPE: Radiographic Exposure Device

MODEL: 180

MANUFACTURER/DISTRIBUTOR: Gamma Industries, Inc.  
P.O. Box 2543  
Baton Rouge, LA 70821

MANUFACTURER/DISTRIBUTOR:

SEALED SOURCE MODEL DESIGNATION: Gamma Ind. A-11-T

ISOTOPE: Cobalt-60

MAXIMUM ACTIVITY: 1000 curies

LEAK TEST FREQUENCY:

PRINCIPAL USE: Industrial Radiography

CUSTOM DEVICE: ☐ YES ☒ NO

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DEVICE TYPE: Radiographic Exposure Device

DESCRIPTION:

The device consists of a lead shield enclosed in a 1/4" steel case in the form of a right circular cylinder with 1/4" steel end plates. It has a collimation port at the center bottom and another collimation port on the side. These collimation ports are enclosed with 1/4" plates for the side port and a 1/4" steel machined cone for the bottom port. The source never leaves this device. It is moved by means of a pigtail assembly from the shielded position to a collimation port.

The outside dimensions of the device are 21" in diameter by 25-3/4" in height. Approximate weight is 3,647 pounds.

A stainless steel source tube extends through the shielding mass. At the safe position, the tube is reduced in diameter so that the source is blocked from further passage in the tube. At the exposed position of the source, the tube is blocked with a threaded plug, removable for source exchange, which also serves to center the source in the tube. The collimation port at the bottom center of the device is a 45 degree cone. The side collimation port projects a beam of radiation that extends horizontally at the bottom and diagonally upwards to the degree necessary for customer use. The side collimation port extends from 180 degrees to a maximum of 300 degrees. The circumferential and vertical angles are determined by suspending lead blocks in the side collimation port. These blocks are designed to prevent "streaming".

At the top of the device, the source pigtail assembly extends from the source tube and is attached to a spring loaded air cylinder. The air cylinder has a 1-1/8" diameter bore and a 13" stroke. Pressure will cause the spring to retract the source to the safe position and will not expose the source again until the air and electrical supply is regained and positive action is initiated. The air cylinder is held in place by a T-shaped support 52-1/2" long. This support may be placed in either a horizontal or vertical position. The pigtail which protrudes from the air cylinder is supported through a 9/16" diameter stainless steel tube attached to the cylinder by screws. Two (2) micro-switches are also attached to the support arm to give indication to the control panel of safe and exposed position of the source.

This device is supported on a base assembly whose dimensions vary according to the foundation supplied by the customer.

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DEVICE TYPE: Radiographic Exposure Device

LABELING:

The device bears the manufacturer's label which specifies the isotope, activity, date of source calibration, model and serial numbers of the device, model and serial numbers of the source and states that the device is manufactured by Gamma Industries, a Division of Nuclear Systems, Inc., Baton Rouge, Louisiana. Three "Caution, Radioactive Material" labels are also attached to the device.

EXTERNAL RADIATION LEVELS:

The manufacturer supplied a detailed radiation profile of the device which indicated the maximum exposure at any surface was 150 mr/hr. This was found on contact with the bottom center collimation port which will be inaccessible after the device is installed. The highest exposure rate noted at any accessible surface of the exposure device was 100 mr/hr in the throat of the side collimation port. This throat has a PVC spacer installed which prevents an individual from actually being able to come in contact with the source tube. However, if this spacer were removed, the exposure rate would then be 240 mr/hr on contact with the source tube. The exposure rate on contact with the rest of the surface of the device ranged from less than 1 mr/hr to 17 mr/hr. The exposure rate at 39" (1 meter) from any accessible portion of the surface of the exposure device was less than 1 mr/hr. These measurements were confirmed by the Division, using a Ludlum Model 3 G-M survey meter.

LIMITATIONS AND/OR OTHER CONSIDERATIONS OF USE:

The manufacturer furnishes operating instructions and a copy of a recommended preventive maintenance program. The operating instructions supplied by the manufacturer are not complete for each facility since each is a custom installation and the control circuitry and interlock system will vary according to the customer. Therefore, the licensing agency should review the licensee's operating and emergency procedures and ensure that all interlock systems are designed in such a manner that, after an automatic retreat of the source, the system must be reactivated by the system start switch, a direct operator action. The system start switch should be key controlled so the system may be locked by the operator. The licensing agency should also ensure that the entire control circuitry, including any radiation alarms, doors, interlocks, emergency retreat, etc., operate from the same 115 volt electrical supply. This caution is made to the customer in the operating procedures supplied by the manufacturer.