dosimetry solutions

Product Specifications and Usage Information

P1060

10 MeV E-Beam Phantom

DESCRIPTION

A fixture which is used for the arrangement of discs containing alanine transfer dosimeters, and pouches of B3 film dosimeters, in proper geometry, to ensure that the dosimeters receive the same absorbed dose when irradiated.

APPLICATION(S)

Used when performing in-plant batch calibration of dosimeters in electron beam irradiation facilities. This phantom has been designed and built to provide a consistent method of presenting dosimeters to the beam as detailed in the two references listed near the end of this document. The P1060 is designed for 10 MeV nominal surface energy of the electrons from the ebeam but it may also be useful for energies down to 7.5 MeV.

SPECIFICATIONS

Product Dimensions:	Product Weight	Packaging Dimensions:	Packaged Weight:
41cm (L) x 20cm (W) x 18mm (H) (16.1” x 7.9” x 0.7”)	3.3 lbs.	19.0” x 9.0” x 2.0”	3.8 lbs.

Material:	High-Impact Polystyrene (HIPS)
Color:	White
Alanine Cutout Dimensions:	(Dia.) 1.024” ±0.005” x (H) 0.236” ± 0.005”
Film Dosimeter Cutout Dimensions:	(L) 12.6” ±0.125” x (W) 4.3” ±0.125” x (H) 0.132” ± 0.005”
Film Dosimeter Cover Plate Dimensions:	(L) 12.6” ±0.125” x (W) 4.3” ±0.125” x (H) 0.115” ± 0.005”
Printing:	Serial number engraved in upper right-hand corner
Packaging:	Cardboard box

Storage:

Under any relative humidity conditions at less than 50°C.

Shelf Life:

HIPS is radiation tolerant to many thousands of kilogray (kGy). It is typical that the material will be sufficient for normal usage up to at least 5000 kGy with no significant change in the material density or molecular properties that would cause significant change in the dose to dosimeters placed in the device.

PRODUCT PHOTO

USAGE

Prerequisite: The phantom design alone cannot ensure that the dosimeters receive the same dose. Installation qualification (IQ) of the electron beam should be completed before the phantom is irradiated for dosimeter calibration; the user should confirm that the dose distribution over the area of the phantom is uniform, and should select an optimal arrangement of the phantom in the irradiation zone to maintain this uniformity. Refer to the 'Precautions' Section below for additional suggestions.

1. Place the film dosimeter samples into the large well of the phantom. The pouches may be placed edge to edge or slightly overlapped, but should never cover the dosimeter in the pouch that it overlaps. See Figures 1 and 2.

FIGURE 1: B3 dosimeters spaced edge to edge

FIGURE 2: B3 dosimeters overlapping edges (with alanine dosimeter)

2. Secure the dosimeters and the cover plate into position with masking tape. The cover plate should be flush. The pouches may stick out of one side and should be taped flat and securely.
3. Place an alanine transfer dosimeter and secure into place with masking tape. If a well is not used, then insert and secure the dummy plug with masking tape. Do not leave the circular well open, if possible.
4. It is essential to measure the maximum temperature during irradiation as accurately as possible when calibrating dosimeters using Alanine Transfer-Standard Dosimeters for in-plant calibration. The calibration laboratory will correct the alanine for the temperature effect on the response of the alanine using this data.

Two methods of measuring maximum temperature are acceptable when using this phantom:

a. *Temperature label* – Using masking tape, secure an irreversible temperature label (GEX Part No. P8003 or equivalent) to the body of the phantom, away from, and not covering any dosimeter.

b. *Calorimeter* – Alternatively, use GEX Part No. B6001 or B6002 Risø Polystyrene Calorimeter to determine the maximum irradiation temperature. This method will very closely approximate the temperature to the dosimeters, and is as good as, or better than the temperature labels.

5. All materials should be secure with no possibility of movement during irradiation. See Figure 3 below.

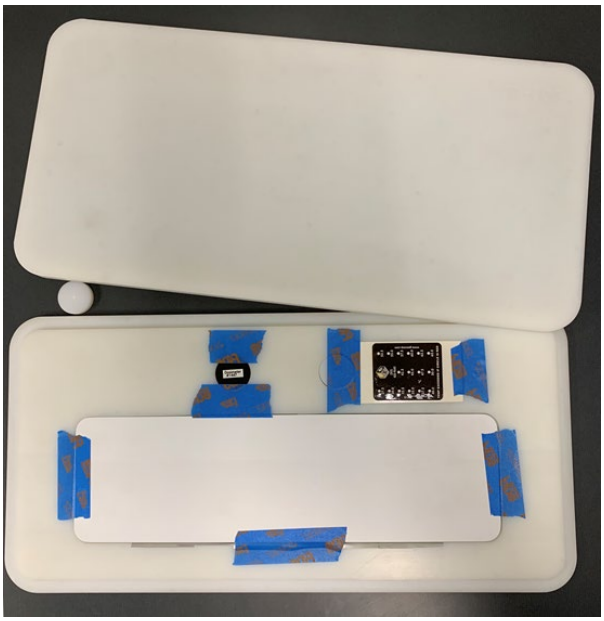

FIGURE 3

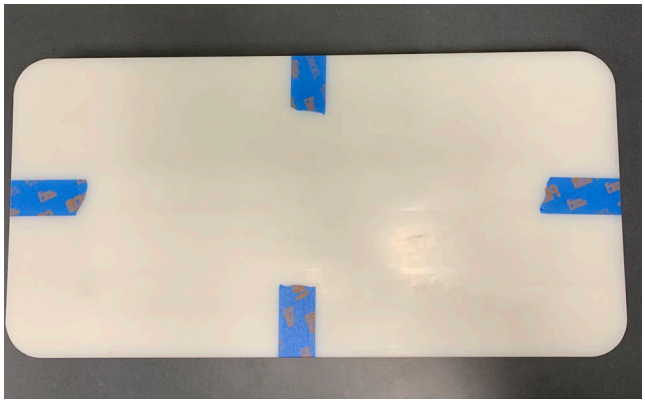

FIGURE 4

6. Place the top half of the phantom over the bottom half, and secure with tape. See Figure 4 above. The phantom is now ready to be placed for irradiation.

7. Irradiation Instructions:

7.1. The phantom geometry is identical from either side. See Figure 5 below. Irradiate the phantom from either side or dual-sided. Ensure that the phantom is placed perpendicular to the scan horn of the accelerator and irradiate to the desired dose. If the accelerator is mounted horizontally rotate the figure 90°.

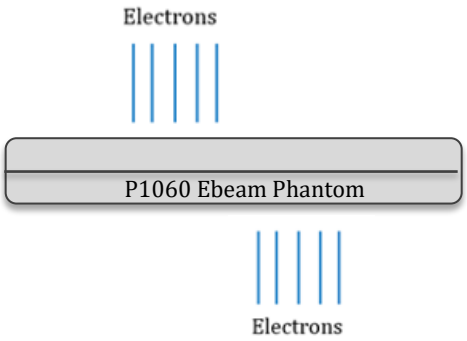

FIGURE 5

7.2. If using a tote, cart, carrier, etc. ensure that the phantom is secure from movement on the carrier/tote/cart.

7.3. If using a rolling conveyor that moves the products into the irradiator, ensure that the phantom will complete the entire conveyance. The phantom is small and lightweight and must not get stuck at any point in the process. If necessary, the

phantom may be placed inside a box or on a piece of foam, metal, or plastic to aid in successful conveyance. However, avoid any material between the phantom and the electron beam during irradiation whenever possible.

8. Consider the 'Precautions' Section below and develop a reproducible procedure for the handling and irradiation of the phantom in the specific ebeam design in which the dosimeters will be calibrated.

   Note: No detail is too small to document in a procedure for using these phantoms. Most users will execute calibration no more than twice per year. Having a very detailed procedure to ensure it is always executed in identical fashion is paramount to the long-term stability of the dosimetry system.

ACCESSORIES

GEX Part No.	Description	Purpose
P8003	Irreversible Temperature Label	Measurement of the maximum irradiation temperature.

PRECAUTIONS

1. Failure to adhere to the preparation or irradiation instructions could result in different attenuation to alanine and film dosimeters creating a bias in any resulting calibration that could be detrimental to the user's process or quality for which the results are intended. The user should take care to ensure proper setup of the phantom and irradiation in accordance with the instructions herein each time the product is used.
2. Do not use overly aggressive or permanent adhesive tapes, as the adhesives may leave a residue on the phantom.
3. Do not attach GEX Part No. P8003 Irreversible Temperature Labels directly to the phantom; the adhesive is permanent!
4. Do not place the phantom directly on a metal carrier, cart, or rolling conveyor system. A material of some type must be placed between the phantom and the conveyor/carrier to prevent rapid heat exchange that may not simulate routine use or create an unknown bias; It is recommended to use a piece of polystyrene or polyethylene foam or a couple of layers of cardboard to insulate the phantom from any metal that it may rest on during irradiation to prevent high rates of heat exchange.
5. The maximum temperature during irradiation should not exceed 65°C. Temperatures greater than this are not understood and may cause permanent damage to the phantom. Do no overheat. For irradiation of higher doses, the user must fractionate the dose to keep temperatures below the threshold. For example, 80 kGy = 50 kGy + 30 kGy (always with the highest dose first).
6. Allow to cool completely to room temperature before using again. The temperature must be stable at the time the phantom is placed onto the beam conveyor and not continuing to cool down. This includes when using fractionation; use a second phantom and move the dosimeters and temperature label to a new phantom between fractions.

REFERENCES

1) ISO/ASTM 51261 – Practice for Calibration of Routine Dosimetry Systems for Radiation Processing
2) NPL Report CIRM 29; Guidelines for the Calibration of Routine Dosimetry Systems for Use in Radiation Processing

RELATED DOCUMENTS

- GEX Doc# 100-170, P1050 Ebeam Phantom 5 MeV – Product Specification and Usage
- GEX Doc# 100-203, Dosimetry System Calibration – Technical Information Report
- GEX Doc# 100-263, Performing a Dosimeter Batch Calibration – Procedure Template

REVISION HISTORY

DATE	CHANGE DESCRIPTION	REVISION
03/27/2019	Initial release.	A
08/25/2020	Harmonized with 100-108 and 100-170. Rewrote description and application sections, revised specification section to include more information. Expanded on usage. Added accessories. ECO 70527	B
10/12/2023	Changed Product Dimension Height to 18mm (2.36"). ECO 70655	C