FLAMELITE (S) PTE LTD
29 MANDAI INDUSTRIAL ESTATE
#01-05 INNOVATION PLACE, TOWER 3
SINGAPORE 729932
TEL: 6468 3166 FAX: 6468 7266
GST Registration No.: M2-0109914-5
Email Address: flameliteG@flamelite.com.sg
Website: www.flamelite.com.sg

CIDB Registered Contractor
Grade: L3 Type: CR 16

Co. Reg. No. 199205533 R
GST Reg. No. M2-0109914-5

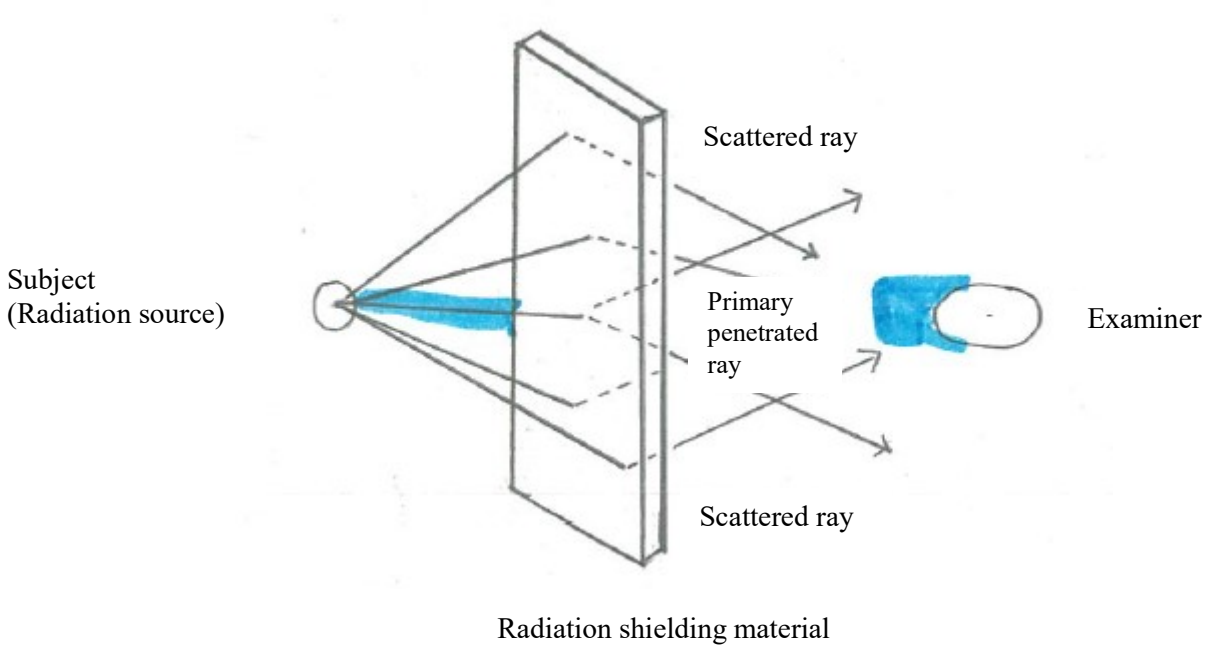
ISOTOPE-LITE G

Flamelite (S) Pte Ltd has developed the Isotope-Lite G for shielding against gamma rays in PET treatment. Isotope-Lite G is made of glass materials having a lead oxide content rate of roughly 70% that is equivalent to ultra-high lead content block glass for nuclear power facilities.

We have calculated the effective dose transmission factor of 0.511 MeV gamma ray through our Isotope-Lite G lead glass taking into account the build-up factor so that Isotope-Lite G lead glass can be used safety and appropriately as shielding glass in PET treatment facilities.

Primary Penetrated Rays and Scattered Rays

As shown in the figure below, gamma rays are radiated in all directions from a subject dosed with medicine in PET treatment, and some of those gamma rays pass through radiation shielding materials (e.g. lead, lead glass, concrete) as primary penetrate rays that go straight through the radiation shielding material or as scattered rays that come out after being scattered and their direction changed inside the radiation shielding materials. As PET uses radiation of such a relatively high energy as 0.511 MeV, the amount of scattered rays is comparatively large.



FLAMELITE (S) PTE LTD
29 MANDAI INDUSTRIAL ESTATE
#01-05 INNOVATION PLACE, TOWER 3
SINGAPORE 729932
TEL: 6468 3166 FAX: 6468 7266
GST Registration No.: M2-0109914-5
Email Address: flameliteG@flamelite.com.sg
Website: www.flamelite.com.sg

CIDB Registered Contractor
Grade: L3 Type: CR 16

Co. Reg. No. 199205533 R
GST Reg. No. M2-0109914-5

Build-up Factor

For this reason, in designing radiation protection with a radiation shielding material, it is not sufficient to calculate only the primary penetrate rays in formula (1) below. The effective dose transmission factor must be calculated taking the scattered rays into account in formula (2) below.

Formula (1): Formula for calculating the primary penetrate ray dose rate

$$I = I_0 \times e^{-\mu x}$$

I : Dose rate after penetration μ : Linear attenuation coefficient
I_0 : Dose rate at incidence x : Thickness of radiation shielding material

Formula (2): Formula for calculating the effective dose transmission factor with scattered rays' factor in

$$I = B \times I_0 \times e^{-\mu x}$$

B : Build-up factor

In formula (2), build-up factor (B) expresses the increase in dose caused by scattered rays. B is always bugger than 1, and its value tends to be bigger, the lower the density of the radiation shielding material is or thicker radiation shielding material is. The build-up factor varies depending on the radiation source, and properties, density and thickness of the radiation shielding material. In making a shielding calculation for gamma rays using lead glass the build-up factor specific to the lead glass to use must be figure out depending on the radiation source to shield.

Shielding Performance of 'Isotope-Lite G' against Gamma Rays

In calculating the shielding performance of '**Isotope-Lite G'** lead glass against 0.511 MeV gamma rays, we adopted Monte Carlo simulation to calculate the build-up factor of each respective glass, and calculated the effective dose transmission factor in accordance with the "Manual for shielding Calculating of Radiation Facilities, 2000" (issued by the nuclear Safety Technology Centre). In calculating the lead equivalent of "**Isotope-Lite G"**, we designed the thickness of the glass, so that the effective dose transmission factor of lead calculated taking the build-up factor into account as shown on the following table.

FLAMELITE (S) PTE LTD

29 MANDAI INDUSTRIAL ESTATE
#01-05 INNOVATION PLACE, TOWER 3
SINGAPORE 729932
TEL: 6468 3166 FAX: 6468 7266
GST Registration No.: M2-0109914-5
Email Address: flameliteG@flamelite.com.sg
Website: www.flamelite.com.sg

CIDB Registered Contractor
Grade: L3 Type: CR 16

Co. Reg. No. 199205533 R
GST Reg. No. M2-0109914-5

Effective Dose Transmission Factor of Lead for 0.511 MeV Gamma Rays, and Thickness of 'Isotope-Lite G' Corresponding to Each Thickness of Lead

Lead		Isotope-Lite G	
Lead thickness (mm)	**Effective dose transmission factor (%)**	**Glass thickness (mm) corresponding to effective dose transmission factor of lead on left**	**Recommended Isotope-Lite G**
5.00 [1.21]	**52.60**	**14.20 [1.33]**	**14.70 mm**
7.50 [1.25]	**36.00**	**21.30 [1.45]**	**21.80 mm**

Isotope-Lite G

- **Maximum Size : 1000mm x 1500mm (ht)**
- **Specific gravity : Minimum 5.20**
- **Visible light transmission : 83%**

"Seeds" or minute air bubbles exist inside 'Isotope-Lite G' as it is made of glass materials. This, however, does not adversely affect its radiation shield performance.

Preference	Effective Dose Transmission Factor of X Rays
In the case of 0.2 MeV rays, the effective dose transmission factor of lead of thickness 2mm, 3mm, 5mm and 7.5mm is 11.8%, 4.1%. 0.48% and 0.033% respectively.	

FLAMELITE (S) PTE LTD

29 MANDAI INDUSTRIAL ESTATE
#01-05 INNOVATION PLACE, TOWER 3
SINGAPORE 729932
TEL: 6468 3166 FAX: 6468 7266
GST Registration No.: M2-0109914-5
Email Address: flameliteG@flamelite.com.sg
Website: www.flamelite.com.sg

CIDB Registered Contractor
Grade: L3 Type: CR 16

Co. Reg. No. 199205533 R
GST Reg. No. M2-0109914-5

New Isotope-Lite Gamma Ray Shielding Glass

Shielding Performance of 'Isotope-Lite G' against Gamma Rays ~ With regard to gamma rays of 01511 MeV used for PET~