

## GAFCHROMIC® EBT2 Dosimetry Film

Key technical features of EBT2 include:

- Measure with an economic flatbed color scanner
- Dose range 1cGy – 10Gy (measure in red color channel); up to 40Gy measured in green color channel
- Active layer incorporates a yellow dye
  - Reference baseline for film response
  - Decreases UV/light sensitivity by 10X
- Use the response in the blue color channel to adjust for small response differences over the area of a film
- Develops in real time. There is no post-exposure treatment
- Density changes stabilize rapidly after exposure
- Energy-dependence: <10% response difference from 60keV into the MV range
  - Minimizes concerns about the effects of scattered radiation
- Near tissue equivalent
- High spatial resolution – can resolve features to at least 100µm
- Handle in room light – eliminate the need for a darkroom
- Can be cut to any size and shaped to contours
- Water resistant
  - Can be immersed for hours in water phantoms
- Stable at temperatures up to 60°C
- GAFCHROMIC EBT2 is available in two formats:
  - EBT2 810: 8” x 10” in size, 25 sheets/box
  - EBT2 1417: 14” x 17” in size, 10 sheets/box

GAFCHROMIC EBT2 dosimetry film incorporates a number of features that are improvements over the original version, GAFCHROMIC EBT, but uses exactly the same active component. The new film incorporates a yellow marker dye that provides two benefits. Firstly, if EBT2 film is measured on a color scanner, the signal provided by the dye in the blue color channel can be used to improve dose accuracy by adjusting for small differences in response over the area of a film. Secondly, the yellow dye protects the active layer from exposure by UV and visible light, reducing effect from these sources by about 10X. Gelatin, a natural product, used as the binder component in the coated layers of the original product has been replaced with a synthetic polymer. This means that the composition and performance of EBT2 film can be more tightly controlled from lot-to-lot.

Use the GAFCHROMIC EBT2 dosimetry film as a drop-in replacement for EBT. Using the marker dye feature is not mandatory; it will only make things better. To benefit from the use of the marker dye ISP will soon introduce a software module to automatically calculate and apply any corrections. The process is explained in a posting titled “Correction Protocol EBT2” on the [www.gafchromic.com](http://www.gafchromic.com) web site. Interested users can learn about this feature and apply corrections by themselves until the software module is available.

Like the original film, EBT2 can be cut, immersed in water and cleaned with water or alcohol. Expose the film, digitize it with a color scanner and use the response in the red color channel for your dosimetry. Or you can use a Vidar Dosimetry Pro with red LED’s. The yellow marker dye will not interfere.

The structure of GAFCHROMIC EBT2 is shown in Figure 1. The active part of the film has been reduced to a single layer about 30µm thick and a thin topcoat applied to a clear, 175µm, polyester substrate. The coated layers are over-laminated with 50µm polyester and a pressure-sensitive adhesive.

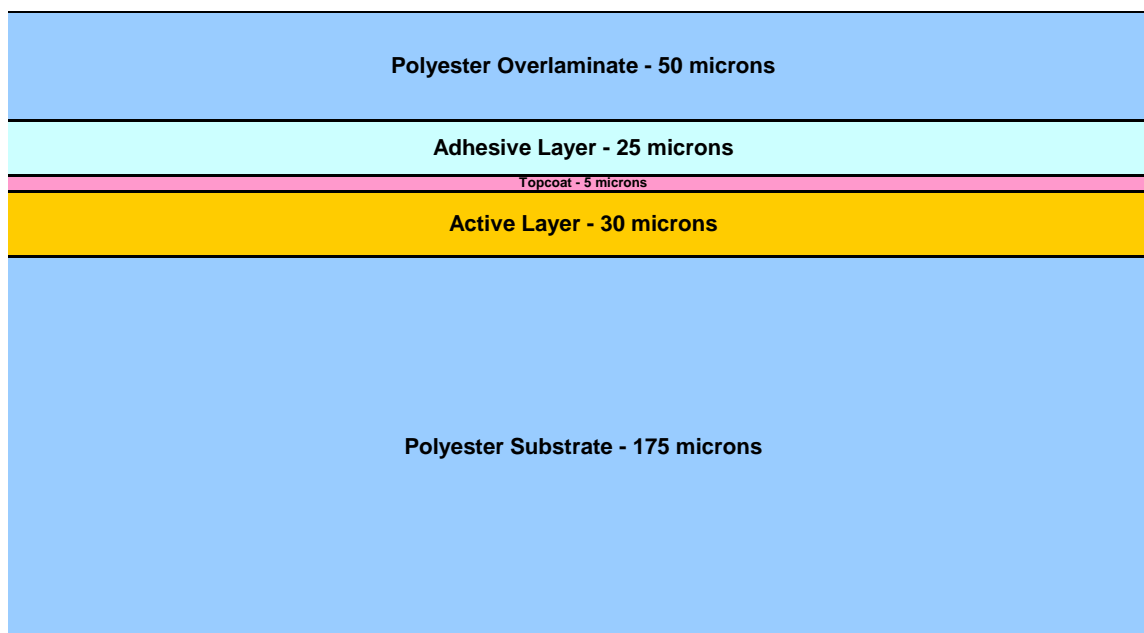


Figure 1: Configuration of GAFCHROMIC EBT2 Dosimetry Film

The atomic composition of the layers in the initial production batch of EBT2 with lot numbers beginning with the designation F020609 is given in the following Table 1. For the overall film the effective atomic number,  $Z_{\text{eff}}$ , is calculated as 6.84. Note that the composition is given in atom%, not weight %. The film has been formulated so that the response to photons is energy-independent between about 60keV and the MV region. Based on measurements of this lot of EBT2 film containing the designation F020609 the response to 60keV photons may be about 10% greater than the response to 6MV photons. If users evaluate energy dependence and report their findings to ISP the composition of future lots may be adjusted to optimize response and make the energy dependence closer to zero. Any adjustments made to the composition of future lots will be published on our web site, [www.gafchromic.com](http://www.gafchromic.com)

Layer	Thickness*** microns	Approximate density g/cm <sup>2</sup>	COMPOSITION (ATOM%)									
			H	Li	C	N	O	Na	S	Cl	K	Br
Polyester film base*	50	1.35	36.4%	0.0%	45.5%	0.0%	18.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Adhesive*	25	1.2	57.1%	0.0%	33.3%	0.0%	9.5%	0.0%	0.0%	0.0%	0.0%	0.0%
Surface layer (assumes 7.5% moisture)**	5	1.2	56.9%	0.9%	25.7%	0.0%	15.6%	0.0%	0.0%	0.9%	0.0%	0.0%
Active layer (assumes 7.5% moisture)**	30	1.2	58.3%	0.8%	29.6%	0.1%	10.7%	0.0%	0.0%	0.3%	0.1%	0.1%
Polyester film base*	175	1.35	36.4%	0.0%	45.5%	0.0%	18.2%	0.0%	0.0%	0.0%	0.0%	0.0%
Overall Composition			40.85%	0.10%	42.37%	0.01%	16.59%	0.00%	0.00%	0.04%	0.01%	0.01%

\* The composition of these layers is a good faith estimate based on the manufacturer's identification of the constituents. The composition should not be used as a specification.

\*\* The composition of these layers is a good faith estimate based on the proportion of the chemical constituents. The composition should not be used as a specification.

\*\*\* The thicknesses are approximate and are not specifications.

Table 1: Atomic Composition of GAFCHROMIC EBT2 with Lot Number F020609

The response of GAFCHROMIC EBT2 film is shown in Figure 2. This depicts the response of the film at doses up to 300cGy when measured in transmission using the red color channel of an Epson 10000XL scanner with transparency adapter. Like its predecessor, the response of EBT2 is dependent on orientation. Therefore all films must be scanned in the same orientation. We recommend scanning in

landscape orientation since this allows the flatness of the scanner response to be assessed by scanning an unexposed film. The image of the unexposed film can be normalized to the average value thus generating an image that can be used to correct images for scanner flatness. If film is cut into smaller pieces, it is very important to mark the film pieces so that their orientation is known with respect to the original film. This will help in assuring that all films are scanned in the same orientation.

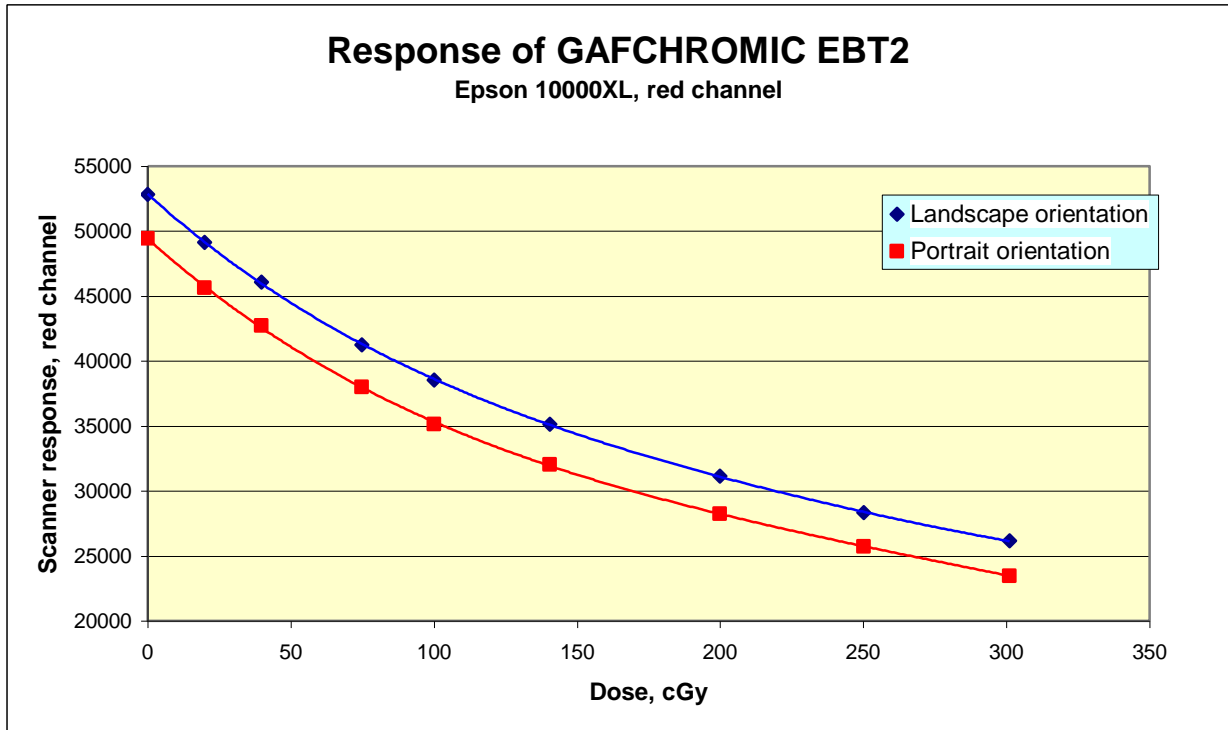


Figure 2: Response of GAFCHROMIC EBT2 Dosimetry Film

For more details on GAFCHROMIC EBT2 please obtain a copy of the EBT2 White Paper at posted on our web site at [www.gafchromic.com](http://www.gafchromic.com)