Protocol for OrthoChromic Film and OrthoChrome Pro Software

1. OrthoChrome OC-1 Basic Properties

OrthoChromic film was designed to be the most robust and user friendly dosimetry tool. The special single layer coating is water proof and can be safely immersed into water - see structure in Figure 1. OC-1 film is opaque (see Figure 4) and its reflective nature is designed to eliminate most of the interfaces that can create artifacts during scanning process with commonly used flatbed scanner.

Active Coating ~30 micron
White Polyester Base ~125 micron

Figure 1: Structure of OrthoChromic Film OC-1

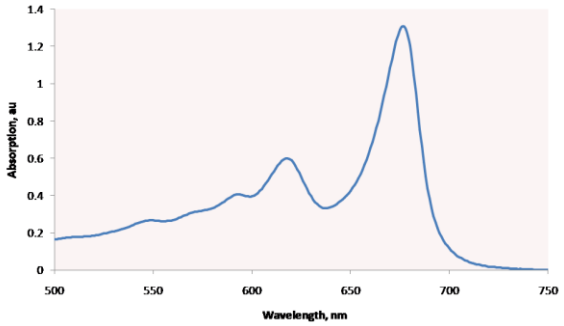

Figure 2: Absorption Spectrum of the OrthoChrome Film

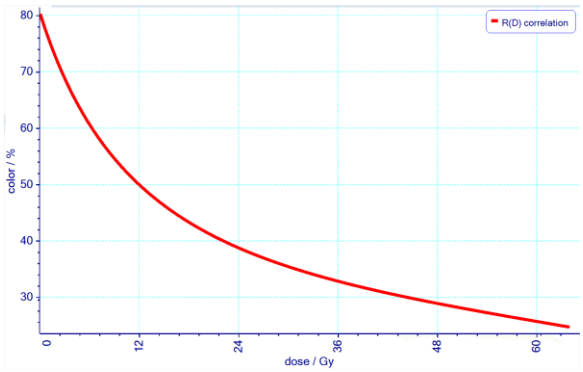

Figure 3: Color Density Response Curve of OC-1 Film

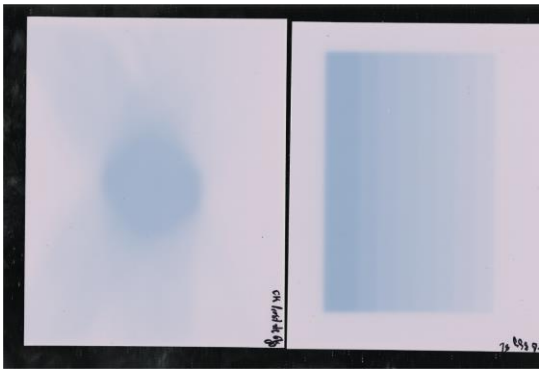

Figure 4: Exposed OC-1 Film scanned from left to right, Calibration field (right), Treatment Field (left)

The flexible nature of the film also enables the use of the film in phantoms of all shapes and curvatures.The active component has an absorption peak at 670 nm (Figure 2). OC-1 film has an extremely wide usable dynamic range as shown in Figure 3, the usable dose range extends from 10 cGy to 100 Gy.

2. Dosimetry Equipment and Materials

- OrthoChromic OC-1 film,
- 48-bit flatbed scanner with 64-bit Twain driver, recommended is Epson 12000XL-GA (transparency adapter is Not needed),
- OrthoChrome Pro software,
- Glass plate 5 - 10 mm thick and size of the scan area 31.5 x 44.5 cm to flatten film at scanner platen, preferred opaque glass (mirror or one side painted black),
- Optional scissors or paper trimmer to cut film,
- Recommended use of powder free rubber gloves to avoid marks on films.

3. OrthoChrome OC-1 Film Handling

- **Storing**: OrthoChrome OC-1 film is delivered in a re-sealable plastic bag packed in a black, light safe box. Leave the film in the bag and box until use. The film can be stored at ambient temperature and non-condensing humidity.
- **Light**: The film darkens very slowly when exposed to indoor ambient light – i.e. multiple scanning or indoor working with the film causes little to no additional darkening. Do Not expose it to direct sun light. Do not leave films outside for any unnecessary period.. Keep the film dark when Not in use.
- **Surface**: Soiling and smudging of the active film side must be avoided. Do Not touch the active side with your bare hands. , Wearing powder free gloves is recommended. Dusts can be cleaned with a soft cloth using water only. Solvents such as alcohol will damage the film surface! When cleaning the scanner platen with solvent, one should ensure that the scanning surface is completely dry before putting the film on the scanner. Permanent marker can be used to mark or write on the film.
- **Cutting**: When film cutting is necessary use a pair of sharp scissors or paper cutter without damaging or smearing the active side of the film. The ~5 mm along the cutting edge will have some degree of degradation in terms of measurement accuracy.
- **Scanning**: After exposure, the optical density of the film will grow slowly over time. The OrthoChromic protocol compensates this effect by using only a single scan for the measurement evaluation and involves only two pieces of films – one for calibration and one for the treatment field. Scan the films after a minimum four times the time difference between first and second exposure. To achieve best accuracy, scan the film no later than 48 hours after exposure.

4. Scanner Setup

Install your scanner by following the instructions of the manufacture – make sure the **64-bit Twain** driver is installed. Test the scanner using the native software supplied with the scanner.

The OC-1 film dosimetry was validated using Epson 10000XL, 11000XL and 12000XL scanners. The later uses LED light source and delivered the most stable results.

Select your scanner at the Twain 'Select Source' panel as shown in Figure 7 – the selection can be done either using the scanners native software of via OC Pro software.

Note: Twain might have both 32 and 64 bit driver versions - make sure the 64-bit selection is used.

The OrthoChromic protocol allows a wide range of scan resolution, most common are

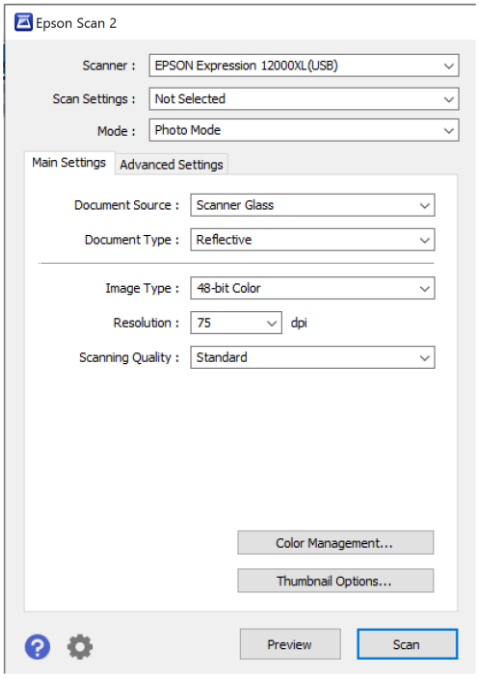

Figure 5: Epson Scan 'Main Settings'.

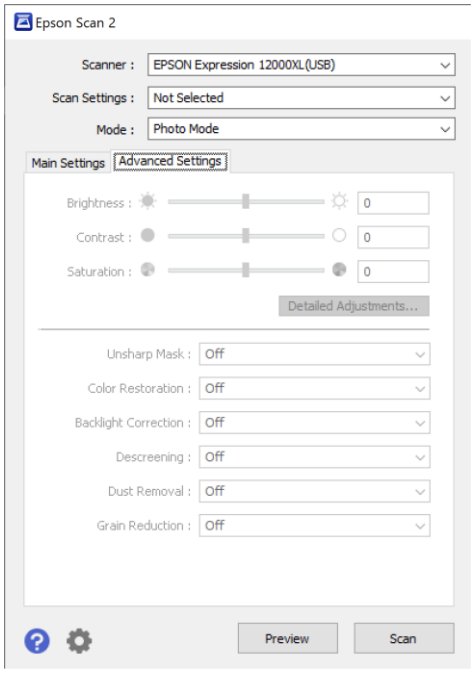

Figure 6: Epson Scan 'Advanced Settings'.

70 – 150 dpi (recommended 75 dpi). For the Epson 12000XL select the 'Main Settings' and the 'Advanced Settings' as shown in Figure 5 and 6.

From the 'Main Settings' the 'Color Management' panel shown in Figure 7 can be reached to turn Off the color management.

Note: The Twain driver can only be accessed by one application at the time, i.e. close any native scanner software before accessing the Twain driver using OC Pro.

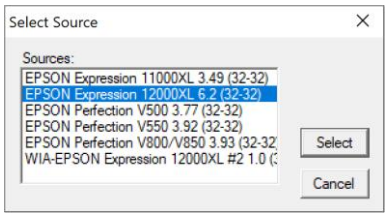

Figure 7: Twain 'Select Source' panel choose Epson Expression 12000XL.

- In contrast to other radiochromic films, OrthoChromic film suppresses any systematic lateral artifact when scanned. Note: OC Pro software provides per scanner sensor calibration that allows to eliminate sensor to sensor variations.
- Figure 9 shows the RGB profiles of three pieces of OC-1 film exposed together to a 10 x 10 cm flat field at 10 Gy. All three profiles are free of any lateral artifact. Furthermore the profiles taken at several scan locations are matching perfectly.

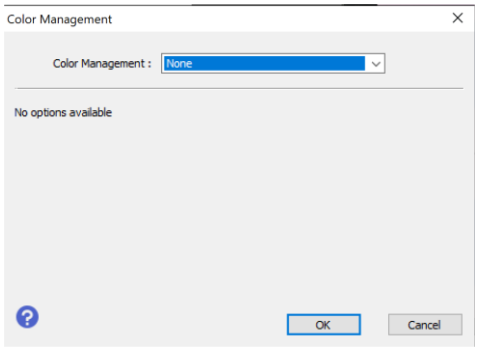

Figure 8: Epson Scan 'Color Management'.

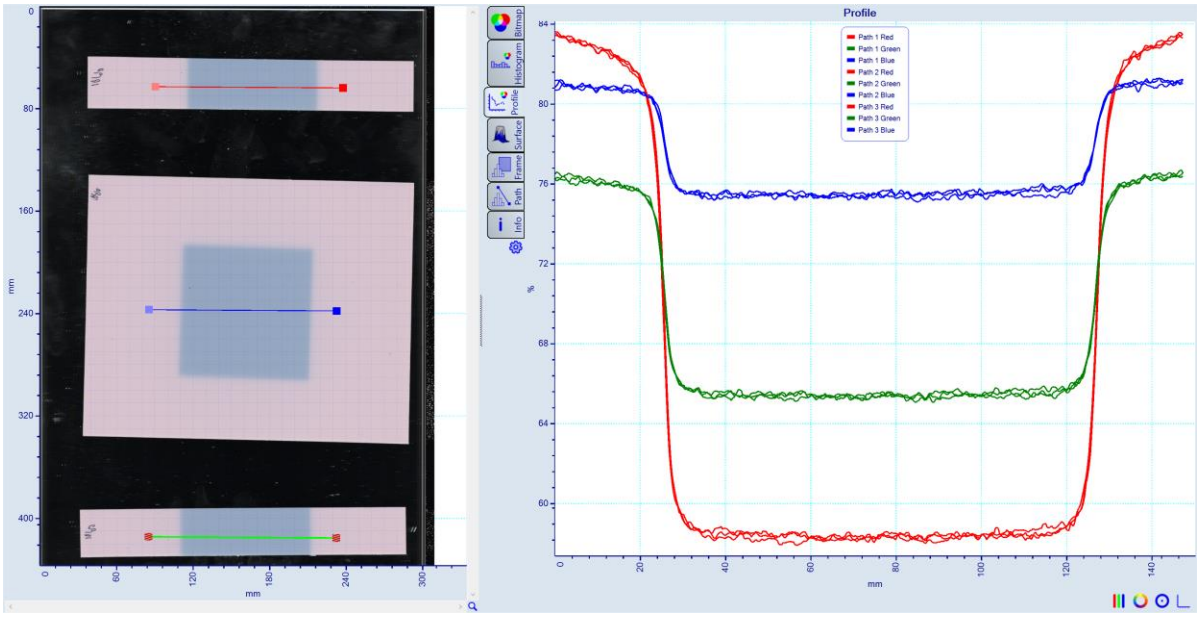

Figure 9: RGB profiles of OC-1 film with 10 x 10 cm flat field exposures at 10 Gy without any lateral artifact.

5. OrthoChrome Pro Software

OC Pro implements the OrthoChromic Protocol and allows reliable and accurate verification of any IMRT plans:

- Calibration is based on single exposure dose field, usually a step wedge generated by overlaid flat fields. As shown in Figure 10 calibration was done with a wide 4 level wedge to calibration each scanner pixel lane separately compensating scanners sensor to sensor variations.
- Entire analysis requires only 2 pieces of OC-1 film and the entire analysis involves merely a single scanned image

- Calibration, dose map calculation and plan comparison are carried in one simple step and all data are presented simultaneously on screen (see Figure 10).
- Entire analysis requires three simple steps:
  1. Scan films with treatment and calibration fields.
  2. Assign calibration plan to calibration field area (auto registration).
  3. Assign treatment plan to treatment field area (auto registration).
- Data evaluation is using an automated all on one screen analysis as shown in Figure 10. The multi-threaded 64-bit architecture of OrthoChrome Pro ensures enough resources to handle even high resolution analysis with ease.

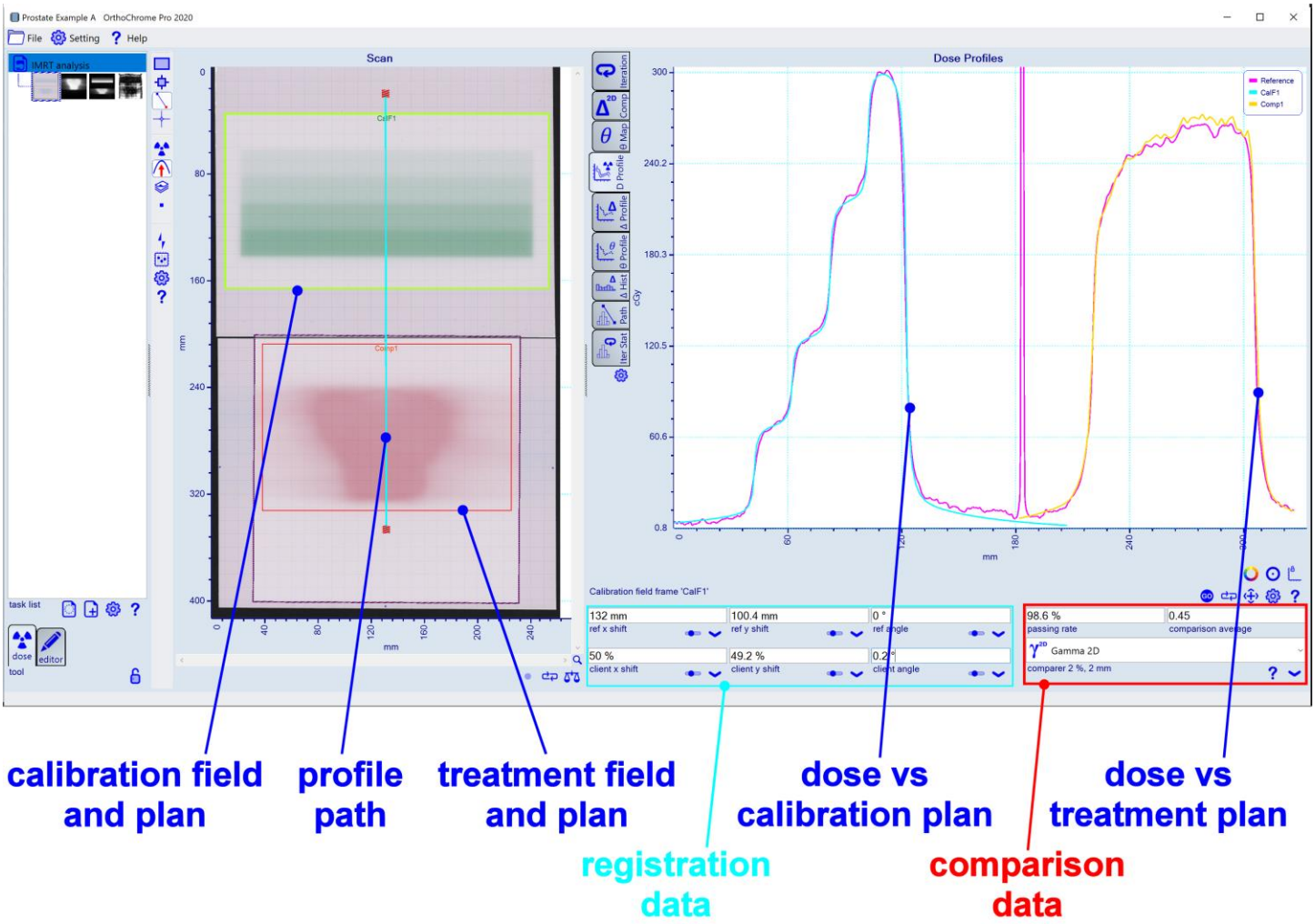

Figure 10: OrthoChrome Pro allowsautomated Calibration, Dose map generation and Treatment plan comparison all in one panel.

- Download OrthoChrome Pro at http://www.orthochromic.com/OC/installation.html for a free trial.

OrthoChrome Dosimetry System offers the best tools for today's radiation therapy environments: Same robust and uniform film for all applications, a reliable and simple work flow of software and most importantly our superior products are accompanied by superior service!