Package 10

INSTRUCTION SHEET, DATA SHEET AND RESULTS REPORTING FORM FOR THE STEP 7B AUDIT

This package contains the following forms:

Instruction Sheet for film quality audit of MLC performance for IMRT dose delivery;

Data Sheet for film quality audit of MLC performance for IMRT dose delivery;

Certificate for the step 7b audit;

Film handling instructions for DANs.

[DAN LETTERHEAD]

ADVANCED TECHNOLOGY IN RADIOTHERAPY DOSE DELIVERY
QUALIT AUDIT FOR X RAY BEAMS

INSTRUCTION SHEET

Step 7b: Film quality audit of MLC performance for IMRT dose delivery

Please irradiate the TLDs during the period:

_____

_____

and return the package to the address given in the covering letter. Timely response will improve the accuracy of your results.

GENERAL INSTRUCTIONS

A radiochromic film is supplied for irradiation.

1. It is advisable to use the same treatment unit as in step 7a and the photon beam energy most often used clinically for IMRT treatments.
2. Create an MLC picket fence pattern with five strips, each of which should be separated by 3 cm.
   a) For Varian machines, the central strip is defined by the secondary jaws, while the outer strips are defined by the MLC.
   b). For Elekta and Siemens machines, each strip is defined by the MLC (which are the secondary jaws).
3. Prepare institution's solid phantom (typically, 30 cm × 30 cm× 30 cm).
4. Irradiate a 'picket fence' pattern (Fig. 1) onto a sheet of radiochromic film placed between the phantom slabs (Fig. 2).
5. Fill in the Data Sheet. An evaluation of the film results is only possible if this form is complete.
6. Return the irradiated radiochromic film to the [DAN] for analysis within ONE WEEK after the irradiation.

SPECIAL NOTE

The radiochromic film should be kept in sealed envelope to avoid excessive exposure to UV light. Please protect the film from accidental irradiation, heat and excessive humidity during storage. Do not store film in a place where accidental exposure to radiation could occur.

CONFIDENTIALITY

The audit results of individual centres are kept confidential by the [DAN] staff and will not be disseminated without the written permission of the participating radiotherapy centre. The statistical distribution of the results may be reported anonymously to the relevant authorities or published.

The radiochromic film sent to you represents a significant investment in cost, time and effort to the [DAN]. Failure to return the film may be reported to your local authorities.

TECHNICAL INSTRUCTIONS

A. Aim of the film quality audit of MLC performance for IMRT dose delivery

The purpose of this film audit is to check the performance of an accelerator's MLC by verifying the positioning accuracy of the individual MLC leaves and their combined position relative to the secondary jaws for Varian machines. Increasingly advanced technology treatments such as intensity modulated radiation therapy (IMRT) require steeper dose gradients between treatment targets and adjacent organs at risk that require not only the magnitude of the dose be accurate but the shape, position and edges of the field sizes as defined by accurate positioning of the MLCs be correct. An independent experimental verification of the MLC positioning accuracy using film dosimetry is an important step in the improvement of quality assurance in radiotherapy and therefore an important extension of the [DAN] programme.

A five strip 'picket fence' pattern will be created using an accelerator's MLC. Radiochromic film, sandwiched between solid slabs as shown in Fig. 2, will be irradiated with the "picket fence" pattern. The film plane should be located near d_{max}, at 100 cm SAD.

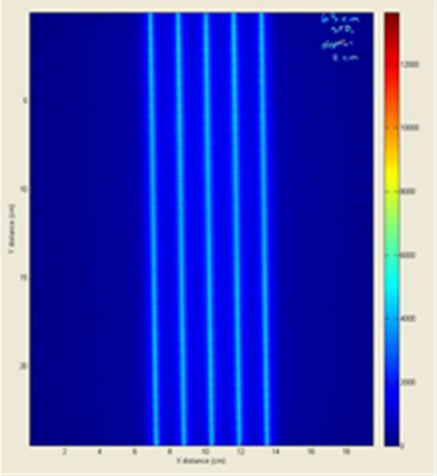


FIG. 1. An example of analysis of a scanned piece of radiochromic film irradiated with a picket fence pattern.

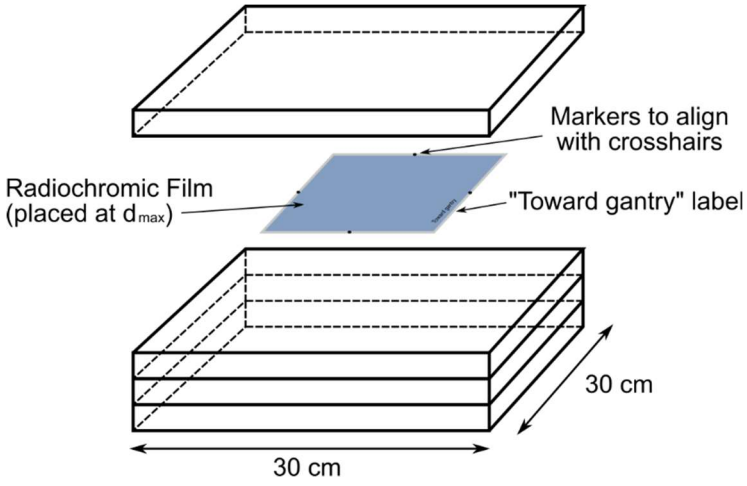


FIG. 2. Placement of the radiochromic film within the slab phantom.

B. Irradiation of radiochromic film with the picket fence pattern

1. Assemble the solid phantom configuration such that the film plane is near d_{max} for the photon beam energy used clinically most often for IMRT treatments.
2. Take the film from the envelope, place it on the phantom and align the beam central axis with the crosshairs inscribed on the film ensuring the orientation of the film is such that the "toward gantry" label is on the top of the film and closest to the gantry.
3. Add build-up phantom slabs to place the film plane near d_{max} and set 100 cm SAD to the film plane.
4. The secondary jaws in the in-plane direction should be opened to the maximum field size. For Elekta machines the backup jaws in the cross-plane direction should be retracted completely. For Varian machines the secondary jaws in the cross-plane direction should be retracted so as not to obscure the MLC field.
5. Irradiate radiochromic film using the picket fence pattern created using 250 MU per strip. Each of five MLC strips, each with a minimum achievable width at your institution (no less than 5 mm), the centre of which shall be separated by 3 cm (e.g. MLC strip positions at -6 cm, -3 cm, 0 cm, 3 cm, and 6 cm relative to the central axis). For Varian machines, the central strip is defined by the secondary jaws, while the outer strips are defined by the MLC.
6. Put the irradiated radiochromic film back into the envelope and return it to the [DAN].

[DAN LETTERHEAD]

ADVANCED TECHNOLOGY IN RADIOTHERAPY DOSE DELIVERY
QUALITY AUDIT FOR X RAY BEAMS

DATA SHEET

Step 7b: Film quality audit of MLC performance for IMRT dose delivery

It is of a great importance for the TLD evaluation that the information requested below be completed. Please complete Part II, if additional absorbed dose to water determination was made by ionization chamber measurements.

Individuals responsible

Radiation oncologist .....
name *position*

Medical physicist .....
name *position*

Name of institution .....
.....

Address .....
.....

Telephone number .....

Fax number ..... :

E-mail .....

Form completed by

Name .....

Position ☐ Medical physicist ☐ Radiation oncologist ☐ Technician
Other: .....

On the day |__|__| |__|__| |__|__|__|__|
day *month* *year*

TLD irradiation performed by

Name .....

Position ☐ Medical physicist ☐ Radiation oncologist ☐ Technician
Other: .....

Previous participation in an external audit or inter-institution comparison for this beam

No ☐
Yes ☐ Date .....

Please also give information on participation in any other audit .....

FOR HOSPITAL STAFF (physicist, oncologist, technician)

A. Specifications of the treatment unit

The treatment unit used for this audit is of the type

.....

model *manufacturer* *serial number* *production year*

installed in the year .....

The manufacturer's stated beam energy is.....

The beam is ☐ with ☐ without the flattening filter and is commissioned as ☐ standard ☐ SRS ☐ SRT beam.

The beam quality is characterized by one of the following:

☐ D_{20}/D_{10} = ... (10 cm × 10 cm at SSD = 1 m)

☐ TPR $^{20}/_{10}$ = ... (10 cm × 10 cm at a constant source detector distance of ..... cm)

other ..... conditions: .....

MLC model (including number of leaves and their width) .....

B. Irradiation of the picket fence pattern on the film

The film was irradiated on the following date:

|__|__| |__|__| |__|__|__|__|

day *month* *year*

The planned width of the MLC shaped strip was: .....

and the picket fence pattern delivery was:

☐ static

or

☐ dynamic

Any additional comments:

.....

.....

.....

.....

.....

[DAN LETTERHEAD]

RESTRICTED

FILM QUALITY AUDIT OF MLC PERFORMANCE FOR IMRT DOSE DELIVERY

Institution: *Institution Name*
Address: *Institution Address*
Country: *Country Name*

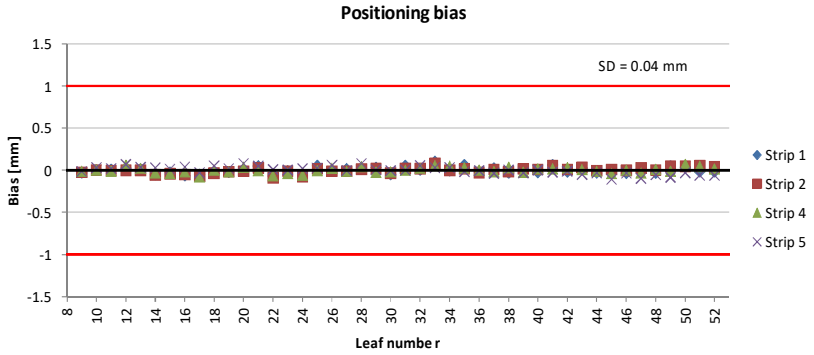
Irradiation done by: *Family Name*
Radiation unit and beam used: *Radiation Unit*
MLC used: *MLC Model*
Evaluation: *yyyy-mm-dd*

RESULTS OF PICKET FENCE TEST

Metric 1: Mean deviation of a strip position. Tolerance limit: 0.5 mm

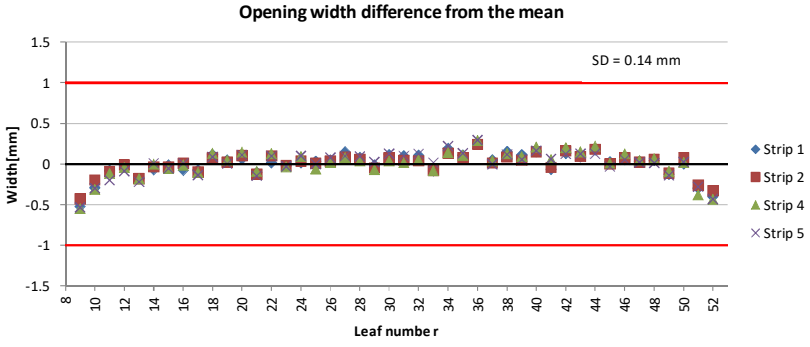
	Strip 1	Strip 2	Strip 3	Strip 4	Strip 5
Mean strip position [mm]	60.4	30.2	-0.5	-30.2	-60.3
Planned strip position [mm]	60	30	0	-30	-60
Deviation [mm]	0.4	0.2	-0.5	-0.2	-0.3

Metric 2: Strip positioning bias from a strip average for a leaf pair. Tolerance limit: 1.0 mm
Metric 3: Standard deviation of strip positioning bias of all leaf pairs for all strips. Tolerance limit: 0.25 mm



Note: The analysis was performed for all leaves visible on the film.

Metric 4: Difference between the opening width of a leaf pair and the strip average opening. Tolerance: 1 mm.
Metric 5: Standard deviation of the opening width of all leaf pairs for all strips. Tolerance: 0.5 mm
Note: The opening width was calculated from FWHM, and on average this was 1 mm greater than



the planned width. The analysis was performed for all leaves visible on the film.

Date: ....
yyyy-mm-dd *Signature*

INSTRUCTIONS FOR DANs

ADVANCED TECHNOLOGY IN RADIOTHERAPY DOSE DELIVERY
QUALITY AUDIT FOR X RAY BEAMS

FILM HANDLING INSTRUCTIONS

Step 7b: Film quality audit of MLC performance for IMRT dose delivery

GENERAL GUIDANCE

1. Radiochromic film will be needed to execute this audit step by the DAN's Film Measurement Centre (FMC). The [DAN] will store, prepare, send, receive and analyse the radiochromic films.
2. Radiochromic film should be stored in such a manner as to avoid accidental irradiation, heat (e.g. sunshine), exposure to UV light and excessive humidity. The film should be kept in a dark location.
3. Radiochromic film should not be handled with bare hands. Cotton gloves should be worn when touching the film. In addition, the film should not be folded or damaged mechanically, as that will cause artefacts to appear when scanning irradiated films.
4. Further detailed information can be found in the AAPM's Task Group No. 55 Report No. 63[1], entitled "Radiochromic Film Dosimetry".

TECHNICAL GUIDANCE

Radiochromic film preparation procedures:

1. The [DAN] should note the batch of the film being used and not mix batches.
2. The entire 20 cm × 25 cm film sheet will be needed for the quality audit for MLC performance for IMRT dose delivery. Mark the radiochromic film with a label "toward gantry' in the top right hand corner which will indicate the correct orientation of the film in the phantom, also add four orthogonal pinpricks on the edges of the film that will correspond to the crosshair location and will serve to locate the central axis on the film.
3. The sheet of radiochromic film, quality audit instructions and data sheet will be sent to the participating hospital.
4. When the films return from the participating hospital, they will be handled and stored in the same manner indicated above until they are analysed. The film storage envelopes must be labelled accordingly.
5. The radiochromic films should be labelled with:

   a). Radiotherapy machine name or serial number

   b). Initials of the person irradiating film

(NOTE. Keep writing away from strips on the film).

[1] AAPM Radiation Therapy Committee Task Group No. 55, AAPM Report No. 63, Radiochromic Film Dosimetry, December 1998