Package 12

INSTRUCTION SHEET, DATA SHEET AND RESULTS REPORTING FORM FOR THE STEP 9 AUDIT

This package contains the following forms:

Instruction Sheet for the “end-to-end” dosimetric quality audit for IMRT dose delivery;

Data Sheet for the “end-to-end” dosimetric quality audit for IMRT dose delivery;

Certificate for the step 9 audit;

Phantom preparation, dosimeter and data analysis instructions for DANs;

Film handling instructions for DANs.

[DAN LETTERHEAD]

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

INSTRUCTION SHEET

Step 9: "End-to-end" dosimetric quality audit for IMRT including imaging, treatment planning and 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

1. Generate CT images of the IMRT QA phantom and transfer the image dataset to the TPS.
2. Generate all necessary contours, including the planning target volume (PTV), organ at risk (OAR) and TLDs.
3. Create an IMRT treatment plan (using static gantry or VMAT technique) for the photon beam on the accelerator used most often for IMRT patient treatments in your centre. The dose distribution should conform to the defined target prescription dose and the OAR dose constraint.
4. Transfer the treatment plan to the accelerator.
5. Position the IMRT QA phantom on the treatment couch aligning in accordance with the phantom marks.
6. Deliver the IMRT plan to the IMRT QA phantom.
7. Fill in the Data Sheet.
8. Return the Data Sheet and the phantom to the [DAN].
9. Submit the electronic treatment plan information to the [DAN].

Please complete the irradiation of this phantom timely and return all necessary equipment and data (including electronic data) within ONE WEEK after the irradiation.

If you have questions, please contact [DAN].

CONFIDENTIALITY

The 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. Anonymous results may be published; statistical distributions/aggregate results may be reported to the relevant authorities.

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

TECHNICAL INSTRUCTION

A. Aim of the end-to-end audit

The purpose of this audit is to verify the dose delivery for an 'end-to-end' clinical IMRT treatment executed with either a static gantry or VMAT technique. The extension of the [DAN] programme to an 'end-to-end' evaluation of advanced technology (IMRT) treatments provides an independent verification of the radiotherapy chain including imaging, dose calculation by the treatment planning system and the plan delivery.

B. Detailed instructions

B.1. Material included in the shipment box

1. A solid polystyrene phantom containing an IMRT QA insert preloaded with a radiochromic film and TLDs (see **Error! Reference source not found.**).

NOTE: Do not open or disassemble the phantom.

2. Pillbox (including two TLDs to be affixed to the outside of the phantom and a third TLD to measure background (see **Error! Reference source not found.**). *NOTE: Do not leave them in the treatment room during irradiation.*

FIG.1. Phantom containing IMRT QA insert loaded with film and TLDs and a pillbox with TLDs to be affixed to the outside of the phantom.

3. This Instruction Sheet.
4. Data Sheet (to be completed and returned to [DAN]).

B.2. Procedures

1. Remove the phantom from the box. Note the crosshair markings and labels: Anterior, Posterior, Superior and Inferior. The relevant crosshairs relate to the isocentre and the label markings help with the orientation of the phantom.
2. Tape the two TLD capsules from the pillbox onto the outside of the phantom at the locations labelled "TLD 1" and "TLD 2". The TLD will remain on for the imaging process, and then be removed before delivery of the IMRT treatment to determine the imaging dose for the therapy TLDs inside the phantom.
3. Affix radio-opaque markers to the phantom at the location of the marked isocentre. CT scan the phantom as you would a patient (i.e. use an appropriate CT scan protocol for head and neck including a relatively small slice thickness (≤ 3.0 mm)).
4. Ideally only one scan should be conducted to minimize the imaging dose to the dosimeters inside the phantom.
5. Remove the TLD capsules from the outside of the phantom. Place in the pillbox labelled "outside TLDs".
6. Export the CT scan data to the treatment planning system.

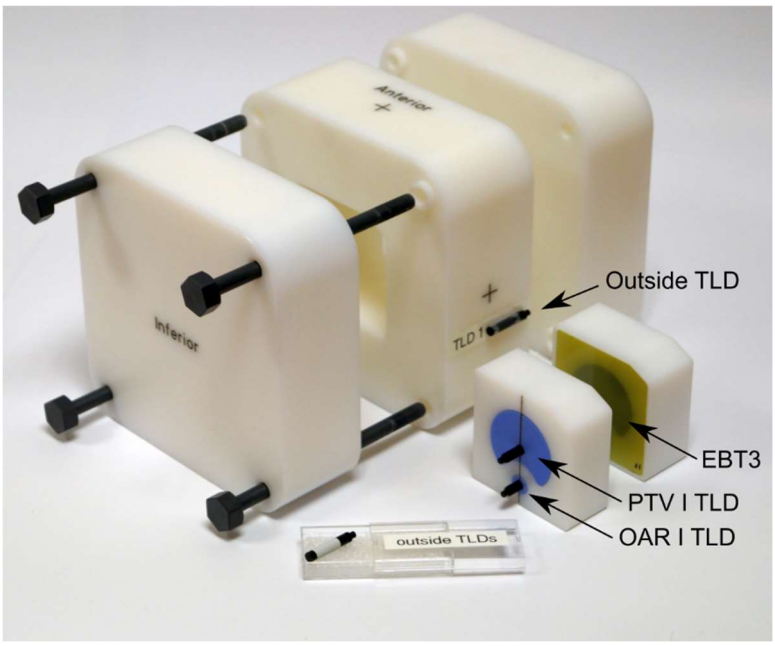

FIG.2. IMRT audit phantom and its insert for the film and TLDs.

7. Contour the phantom images. Include the PTV (the PTV should be taken as the visible target in the image). Also contour the OAR and the four TLDs. For the TLDs, only contour the powder (the dimensions of the TLD powder volume are approximately 20 mm long by 3 mm diameter; the outside dimensions of the TLD capsules are 28 mm long by 5 mm diameter. Both the capsules and the TLD powder will be visible on CT images). TLDs are in the locations shown in Fig. 2, superior and inferior to the axial film. Please use the following names for your contours:
   - PTV;
   - OAR;
   - PTV_S_TLD and PTV_I_TLD for the superior and inferior TLDs in the PTV;
   - OAR_S_TLD and OAR_I_TLD for the superior and inferior TLDs in the OAR.
8. Plan the treatment as specified in the dose prescription below. The planning processes and methods should be the same as would be used for a patient including clinical planning parameters (e.g., dose calculation grid, calculation algorithm, etc.). The plan should be generated to deliver **4 Gy to the PTV in 2 fractions**. The following target objectives and OAR constraints **per 2 Gy fraction** should be used:
   - PTV: 2.0 Gy prescription dose to at least 95% of the PTV volume and < 1% of the PTV is to receive < 93% of the prescription dose;
   - OAR: ≤ 1.4 Gy maximum dose;
   - Maximum dose anywhere in the plan: ≤ 2.2 Gy.
9. Perform your customary in-house patient-specific IMRT QA of the plan prior to irradiating the phantom.
10. Align the phantom on the treatment couch to the treatment isocentre; do not perform any alignment imaging so as not to contribute an additional dose to the dosimeters inside the phantom.
11. Treat the phantom with the developed plan as you would treat an actual patient (e.g. use your clinical record and verify system). Deliver two fractions of the treatment sequentially.
12. Complete the Data Sheet.
13. Return the following to [DAN]:
   - Phantom with the film and TLDs inside
   - Data Sheet
   - Pillbox with ‘outside TLDs’.
14. Submit to [DAN] the electronic treatment plan information (see below).

B.3. Necessary treatment plan information to be submitted to [DAN]:

1. Original hard copy isodose distributions in the axial and sagittal planes through the target volume, including the isocentre.
2. Plan summary page and field summary page from the treatment planning system.
3. A copy of the results of your in-house patient-specific IMRT QA measurements.
4. A copy of your most recent reference beam output calibration.
5. DICOM data – submit to [DAN] using Internet:
   - CT image set of the phantom;
   - DICOM RT dose file;
   - Separate DICOM RT dose distribution of **only the axial plane through isocentre**;
   - DICOM RT structure file.

[DAN LETTERHEAD]

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

DATA SHEET

Step 9: 'End-to-end' dosimetric quality audit
for IMRT including imaging, treatment planning and delivery

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*

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. CT-Scanner specification

The CT-scanner used for this audit is of the type

.....

manufacturer *model* *production year*

installed in the year .....

Slice thickness: ..... mm

Slice spacing: ..... mm

Imaging protocol..... kV..... mAs

$CTDI_{vol}$: …….. mGy

Total number of scans (not including scouts) used during simulation: …….

B. Specifications of the treatment unit

The treatment unit used for this audit is of the type

The treatment unit modelled by the TPS was

.....

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

installed in the year .....

The nominal beam energy is ..... MV

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: .....

The MLC used is of the type

.....

model *manufacturer* *#leaves* *leaf width at isocentre*

The treatment couch used is of the type:

.....

model *manufacturer* *model* *rails*

The reference absorbed dose to water per monitor unit which is used for treatment planning for patients in daily routine is: ..... Gy/MU.

It refers to a depth of .....cm in water for a ..... cm × ..... cm field size at:

SSD = ……cm		SDD = ……...cm
fixed source surface distance	**OR**	fixed source detector distance
SSD set-up		*Isocentric set-up*

Your most recent QC constancy check of the beam output showed a ratio of the measured/reference dose rate of .....

Date of this QC constancy check: .....

C. Treatment planning system (TPS) specification

Treatment Planning System used is: ..... Software version: .....

Dose calculation algorithm used is: ..... (version, if applicable).....

Calculation grid used is:.....

Original TPS commissioning date: ...../...../.....

Original software commissioning date: ...../...../.....

D. IMRT treatment technique

☐ Step-and-shoot
or ☐ Sliding Window
or ☐ VMAT.

E. Treatment plan parameters

1. Calculation grid size: ….. mm × ….. mm
2. Total plan MUs (per 2 Gy fraction) ……
3. Number of fields/arcs ……
4. Was any part of the treatment delivered through treatment couch rails? ☐ Y / ☐ N
5. Was any part of the treatment delivered through the treatment couch? ☐ Y / ☐ N
6. If yes, did you account for the treatment couch in this IMRT treatment plan ☐ Y / ☐ N

F. Treatment plan dose reporting 'per fraction'

Structure	Parameter	Dose (Gy)
PTV	$D_{98\%}$	
	$D_{2\%}$	
OAR	Maximum dose	
All tissue	Maximum dose	
PTV_S_TLD	Mean dose	
	Minimum dose	
	Maximum dose	
PTV_I_TLD	Mean dose	
	Minimum dose	
	Maximum dose	
OAR_S_TLD	Mean dose	
	Minimum dose	
	Maximum dose	
OAR_I_TLD	Mean dose	
	Minimum dose	
	Maximum dose	

G. Patient-specific IMRT QA for the treatment plan

Did the IMRT QA pass your institutional criteria? ☐ Y / ☐ N

Please briefly describe the patient-specific IMRT QA procedure and attach the results as appropriate:

.....
.....
.....
.....
.....

H. Treatment delivery

The phantom was irradiated on the following date:

|__|__| |__|__| |__|__|__|__|
day *month* *year*

Delivered MU (1st fraction) .....
Delivered MU (2nd fraction) .....

Any additional comments:

.....
.....
.....
.....
.....

[DAN LETTERHEAD]

RESTRICTED

STEP 9: 'END-TO-END' DOSIMETRIC QUALITY AUDIT FOR IMRT INCLUDING IMAGING, TREATMENT PLANNING AND DELIVERY RESULTS OF TLD MEASUREMENTS

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

Irradiation done by: *Family Name*
Date of irradiation: *yyyy-mm-dd*
TPS used: *TPS Model*
Evaluation: *yyyy-mm-dd*

Radiation unit	Beam	TPS	TLD set #	User stated (TPS) dose [Gy]	DAN (measured) dose [Gy]*	% deviation relative** to DAN mean dose	DAN mean dose / User stated dose
Name of the Radiation Unit	*6 MV*	*TPS Model*	*PTV_S*	*4.08*	*4.05*	*0.7*	*0.99*
			PTV_I	*4.07*	*4.00*	*1.6*	*0.98*
			OAR_S	*1.85*	*1.89*	*-1.9*	*1.02*
			OAR_I	*1.84*	*1.85*	*-0.6*	*1.01*

* The uncertainty in the TLD measurement of the dose is *x.x* % (1 standard deviation); this does not include the uncertainty intrinsic to the dosimetry protocol (see IAEA TRS-398).
** % deviation relative to DAN measured dose = 100 × (User stated dose – DAN mean measured dose)/ DAN mean measured dose.

Agreement within $\pm x$ % between the user stated dose and the DAN measured dose in the PTV is considered satisfactory. The OAR results are satisfactory if the TLD measured dose is below *x.x* Gy.

Date: .....
yyyy-mm-dd

…….
Signature

IMPORTANT NOTICE: This information is provided only as an independent verification of IMRT dose delivery. **IT DOES NOT CONSTITUTE A STATEMENT WITH REGARD TO THE QUALITY OF RADIOTHERAPY TREATMENTS.**

[DAN LETTERHEAD]

RESTRICTED

STEP 9: 'END-TO-END' DOSIMETR IC QUALITY AUDIT FOR IMRT INCLUDING IMAGING, TREATMENT PLANNING AND DELIVERY

Institution:	*Institution Name*	**Radiation unit:**	*Name of the Radiation Unit*	**Irradiation done by:**	*Family Name*
Address:	*Institution Address*	**Beam used:**	*xx MV*	**Date of irradiation:**	*yyyy-mm-dd*
Country:	*Country Name*	**MLC used:**	*MLC Model*	**Evaluation:**	*yyyy-mm-dd*
		TPS used:	*TPS Model*		

RESULTS OF FILM MEASUREMENTS

Gamma analysis was used to compare the TPS dose distributions and those from the irradiated film. The gamma analysis parameters can be seen in Table 1. ***[Film type]*** films were scanned with an ***[Scanner model]*** scanner and a ***[Software model]*** software was used for the analysis. The dose difference map and the isodose map can be seen in Figs 1 and 2. Rectangular gamma evaluation area was selected in the central part of the film to avoid pin marks and cut corner.

TABLE 1. THE PARAMETERS AND THE RESULTS OF THE GAMMA ANALYSIS.

Gamma Analysis	
Pass level criterion:	3%; 3 mm; global gamma
Threshold:	20%
Acceptance limit:	90%
Passing rate:	**100.0%**

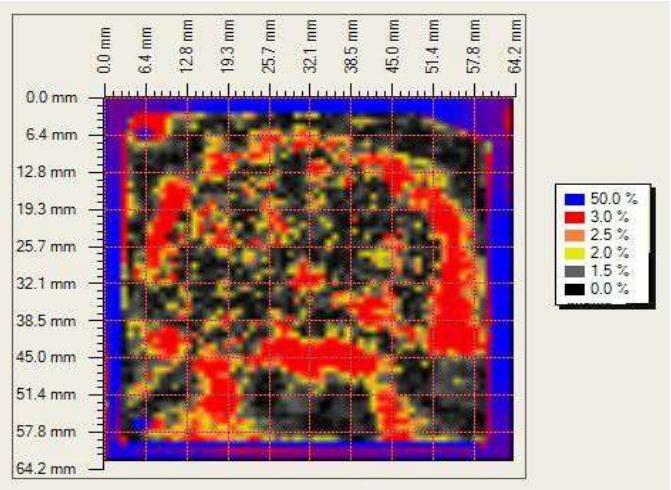

*Figure 1. Dose difference map between the TPS plan and the irradiated **[type of the film]** film. The blue colour refers to the areas outside the film and high difference areas such as pins and text markings.*

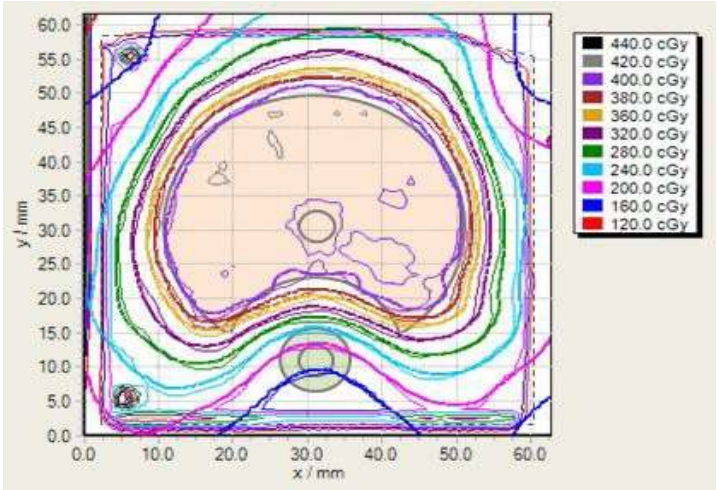

Figure 2. Isodose map with thick lines corresponding to TPS and thin lines to film measured isodoses. The background shows the phantom structures.

[DAN LETTERHEAD]

RESTRICTED

STEP 9: 'END-TO-END' DOSIMETRIC QUALITY AUDIT FOR IMRT INCLUDING IMAGING, TREATMENT PLANNING AND DELIVERY

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

Radiation unit: *Name of the Radiation Unit*
Beam used: *xx MV*
MLC used: *MLC Model*
TPS used: *TPS Model*

Irradiation done by: *Family Name*
Date of irradiation: *yyyy-mm-dd*
Evaluation: *yyyy-mm-dd*

RESULTS OF FILM MEASUREMENTS

Figure 3 shows the IMRT QA insert with the PTV and OAR regions and axes along which dose profiles were measured. The vertical and the horizontal dose profiles along the axes passing through the isocentre (A-A and B-B, respectively) and a horizontal profile passing through the OAR midpoint (C-C) are shown in Figs 4, 5 and 6. The agreement criteria between the relative dose points from the profiles is *x* % of the reference dose in the low dose gradient regions and ±*y* mm distance to agreement in the high dose gradient regions. The locations of TLDs marked on the profiles are only indicative. The lighter coloured areas in Figs 4, 5, 6 show the extent of the PTV and OAR in each cross-section, respectively.

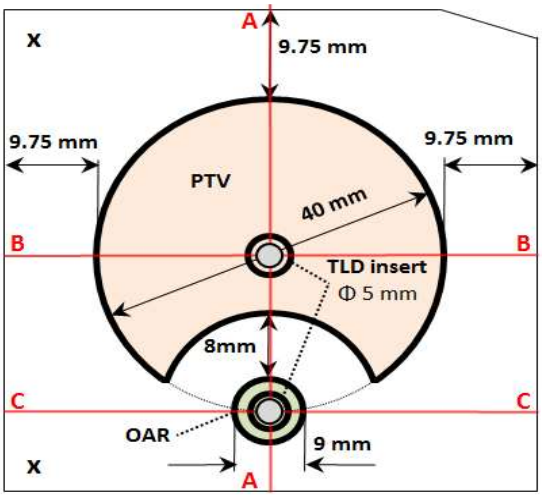

Figure 3. The IMRT QA insert with regions and cross-sections marked

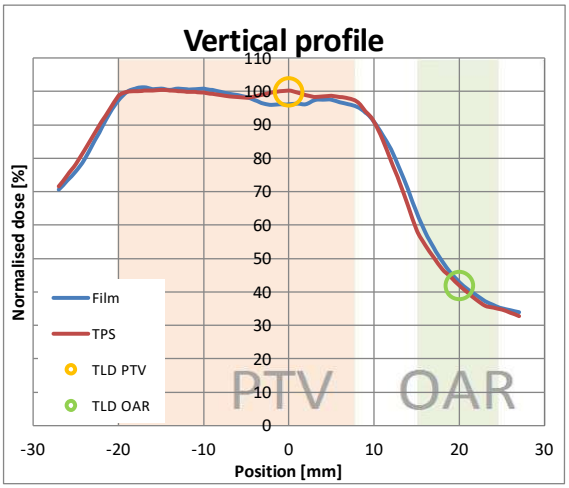

Figure 4. Vertical profile along the axis passing through the isocentre (A-A).

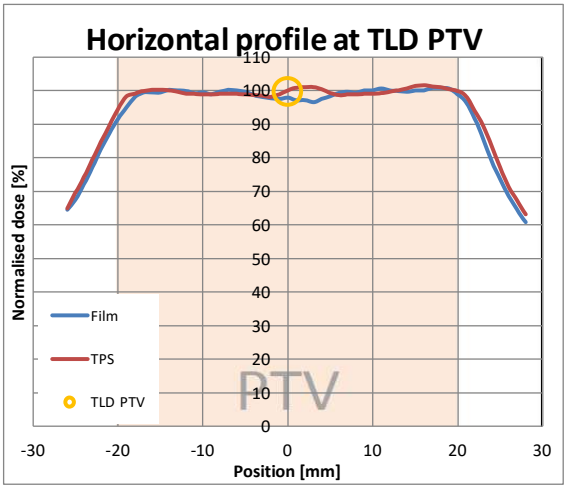

Figure 5. Horizontal profile along the axis passing through the isocenter (B-B).

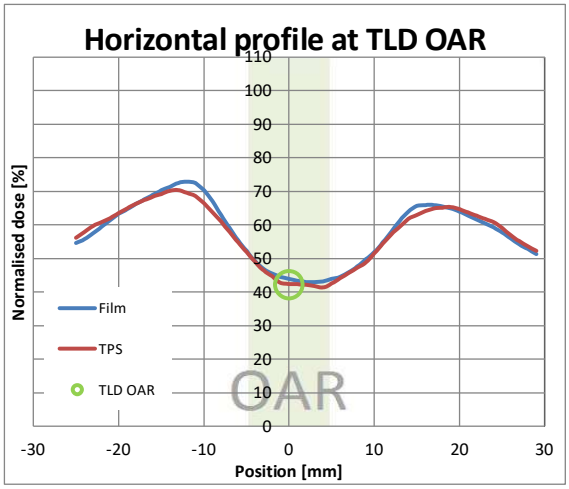

Figure 6. Horizontal profile along the axis passing through the OAR midpoint (C-C).

INSTRUCTIONS FOR DANS

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

PHANTOM PREPARATION AND DOSIMETER ANALYSIS

Step 9: 'End-to-end' dosimetric quality audit for IMRT including imaging, treatment planning and delivery

GENERAL INSTRUCTION

Before sending the phantom to a hospital

1. Confirm that a hospital is ready to receive the phantom.
2. Prepare the phantom for shipment.
3. Pack the phantom, the pillbox containing 'imaging TLDs' and a background TLD, a background film, as well as associated documents into the shipping box and send to the hospital.

Within the irradiation window

1. Irradiate calibration films as per "Film Handling Instructions" below.

Upon receipt of the phantom from a hospital

1. Unload film and TLDs. Be sure to keep track of TLD locations and the film orientation.
2. Read TLDs as per your TLD reading procedure established previously.
3. Scan the film as per "Film Handling Instructions".
4. Normalize the film dose to the treatment planning system dose at the isocentre.
5. Compare the film dose distribution to treatment planning system calculations.
6. Provide report to the hospital indicating the results of the TLD measured doses agreement with TPS doses and the planar film analysis.

TECHNICAL INSTRUCTIONS

Before sending the phantom to a hospital:

1. Load TLDs into the phantom (capsules' plugs should be positioned outwards and blue inserts should be positioned with the line outwards as shown in Fig. 1)

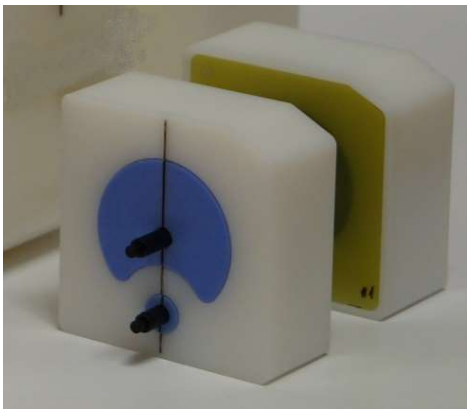

FIG. 1. IMRT QA insert with TLD capsules' plugs positioned outwards.

2. Cut film to fit IMRT QA insert (handling film as per "Film Handling Instructions")
   a). Verify film batch used in the phantom;
   b). Ensure orientation of the film (film notch should be in anterior-left direction).
3. Load film into phantom, ensure film is pressed into the pins.
4. Assemble IMRT QA insert and phantom.
5. Load the following into the shipping box
   a). Phantom (with its IMRT QA insert);
   b). A pillbox with 'imaging TLDs' and a background TLD;
   c). Background film (see "Film Handling Instructions");
   d). Hospital Instruction Sheet;
   e). Data Sheet;
   f). Return shipping label.
6. Send to hospital.

Within the irradiation window:

1. Irradiate calibration films as per "Film Handling Instructions".
2. Irradiate reference TLDs that will be used for the evaluation of the hospital TLDs.

Upon receipt of the phantom from a hospital:

1. Disassemble the phantom and unload TLDs and film from the phantom insert
   a). Be sure to keep track of film orientation.
   b). Be sure to keep track of the TLD positions in the phantom.
2. Read TLDs as per the previously established TLD reading procedure.
3. Compare the measured TLD dose from the TLD in the superior PTV with the reported mean dose to PTV_S_TLD.

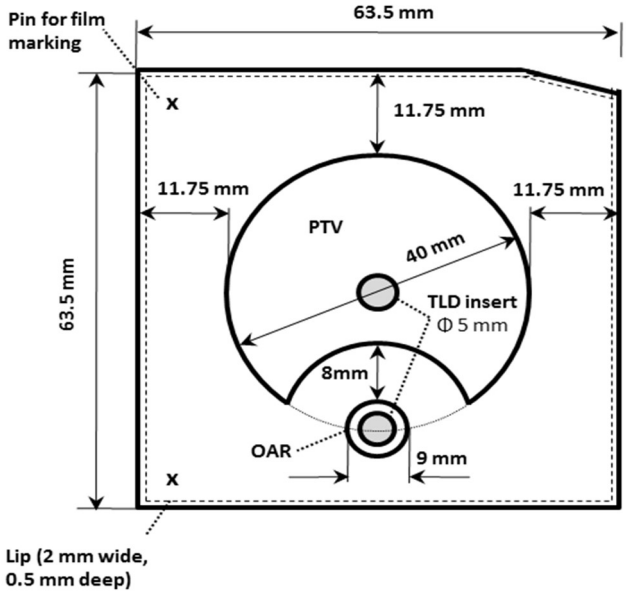

FIG. 2. IMRT QA Insert with positions of the pins marked.

4. Compare the measured TLD dose from the TLD in the inferior PTV with the reported mean dose to PTV_I_TLD.
5. Scan the hospital film1 as per "Film Handling Instructions".
6. Convert the film image to the dose map using the batch-specific calibration curve created by the DAN for film used in the IMRT QA phantom.
7. Load the treatment planning system dose calculations of the film plane into the gamma analysis software.
8. Register the measured and calculated dose distributions. The coordinates of the pin pricks relative to the isocentre are at (see Fig. 2):
   a). -2.5 cm, 2.5 cm
   b). -2.5 cm, -2.5 cm
9. Normalize the measured film distribution to the calculated dose distribution at the plan isocentre.
10. Perform gamma analysis on the dose distributions.
11. Evaluate the results considering the following:
    a). Printed dose distributions: Did the plan meet the criteria? Is the dose homogeneous in the PTV and across the TLD contours?
    b). Beam output (constancy check): Do not adjust for output but determine whether the beam output was substantially different in the constancy check.
    c). How many MUs were required for the treatment (more than 600 MU per fraction indicates a lot of modulation).
    d). Was the treatment delivered through the treatment couch without accounting for couch attenuation?
    e). Agreement of the dose in the superior and inferior TLD located in the PTV with the reported dose from the treatment planning system should be within 5%.
    f). What was the grid size for the dose calculation? Grid size greater than 3 mm may affect the TPS calculated doses to the TLDs.
    g). Dose to the TLD in the superior and inferior OAR each, should be below 2.8 Gy.

[1] Users of Film QA Pro may follow 'one scan protocol'.

h); Gamma analysis of the dose distribution (>90 % of pixels should pass a 3%/3mm, threshold 20%).

i). Profiles on the film passing through the isocentre along the two principle axes and through the organ at risk.

12. Evaluate the acceptability of the plan delivery based on the following criteria which must be met:

a). Agreement of the dose in the superior and inferior TLDs located in the PTV with the reported dose from the treatment planning system is within 5%;

b). The dose in the superior and inferior TLD located in the OAR is lower than 2.8 Gy;

c). Gamma analysis of the dose distribution: >90 % of pixels pass a 3%/3mm and 20% threshold.

13. Prepare the report for the hospital using the certificate template.

INSTRUCTIONS FOR DANS

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

FILM HANDLING INSTRUCTIONS

Step 9: 'End-to-end' dosimetric quality audit
for IMRT including imaging, treatment planning and delivery

GENERAL GUIDANCE

1. The DAN will store, prepare, load the phantom, ship, and receive the radiochromic films.
2. The DAN/FMC will scan and analyze the radiochromic films.
3. Radiochromic film and preloaded phantom inserts 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 cool and dark location, preferably in an envelope.
4. Radiochromic film must not be touched with bare hands. Cotton gloves must 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.
5. Further detailed information can be found in the AAPM's Task Group Report 55, 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 film needed for the IMRT QA phantom will be cut by the DAN from a full sheet of radiochromic film as shown in Fig. 1 for EBT3 film. The film must be cut to closely fit into the recessed area of the insert. The film can be cut with a very sharp pair of scissors or other sharp cutting device (a 1 mm strip along the cut line will not be usable for dosimetry purposes). Any person handling the film must wear cotton gloves.
3. Once the film has been cut it must be stored in a black envelope until it is used.
4. The radiochromic film will be positioned into the IMRT QA phantom on the superior portion of the IMRT QA insert, as shown in Fig. 2. The film will be placed in the position defined by the positioning lip and pressed onto the localization pins.

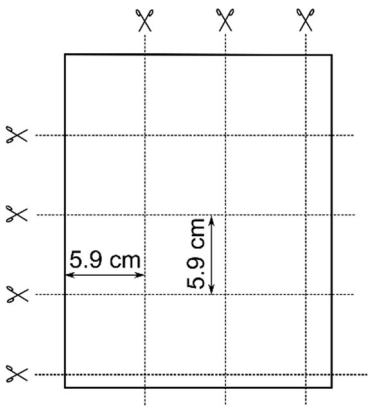

FIG. 1. The template and dimensions for cutting a full sheet of EBT3 radiochromic film.

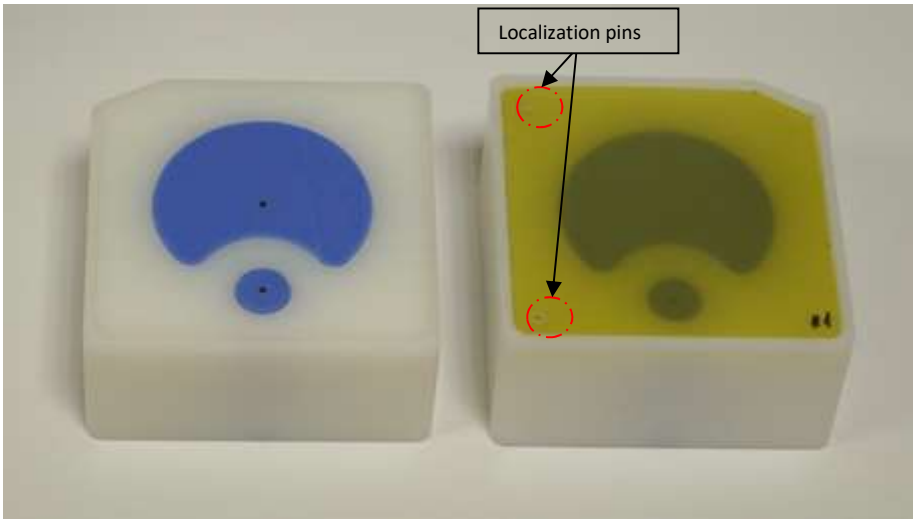

FIG. 2. The placement of the radiochromic film within the IMRT QA phantom insert.

5. The film will be held in its position by the positioning pins (shown in Fig. 2). The pin marks on the film will also serve to orient the film and locate the central axis on the film.
6. After inserting the TLDs into the IMRT QA phantom insert, secure both halves of the insert together and assemble the complete phantom. The phantom insert should be assembled such that the scribed lines on the insert align correctly.
7. When the phantom returns from the participating hospital, the film will be unloaded by the DAN, and handled and stored in the same manner indicated above until analysed by the FMC. The film storage envelopes must be labelled with hospital name, irradiation date and the film batch ID.

Film calibration:

1. Once for each batch of film, a film calibration curve must be generated. If film from a new batch is used in the phantom, a new calibration curve must be established and applied.
2. A new calibration curve should be generated (even within the same batch) at least regularly enough that the currently applied curve remains valid. 'One scan protocol' may be used instead.
3, The calibration curve should be generated according to the previously provided guidelines or software manufacturer's instructions over a dose range of 0–6 Gy using the beam energy appropriate to this audit (typically 6 MV).

Film scanning

A family of Epson scanners are generally recommended for radiochromic film reading. Scanner should operate in the positive transmission mode. The scanner software should allow for disabling image corrections in order to get the scan processed properly by the film evaluation software. The scanning parameters should be: 48 bit colour depth and 72 dpi scanning resolution. The film/-s should be positioned for scanning at the centre of the scanning area, along the central scanning axis. The scanner calibration area, marked on the scanner, should not be used. The orientation of films should be consistent between the calibration and readout of hospital films. Preferably, the film should be covered with a 3–5 mm thick glass plate to avoid Collier effect. The glass size should be sufficient to cover the whole scanning area, i.e. the scanner plate. The scanner should be turned on in advance to the scanning of films to allow proper warmup time. Three preview scans should be taken before the actual film scanning starts.

Once the films have been scanned, the images should be saved in a lossless format in order to avoid loss of information in the image, for example .tiff format would be adequate.

NOTE: 'One scan protocol', available in the Film QA Pro Software, can be used to correct for scanner fluctuations. For that, a blank film, a reference film, and a film under evaluation should be scanned together. The dose to the reference film should be above 20% of that of the maximum dose of the film under evaluation. For more information, the User's Manual of the Film QA Pro Software should be referred to.