Package 5

INSTRUCTION SHEET, DATA SHEET AND RESULTS REPORTING FORM FOR THE STEP 3 AUDIT

This package contains the following forms:

Instruction Sheet for TLD postal dose quality audit for Co-60 γ-beams and megavoltage X-ray beams for the reference and non-reference conditions off-axis; Part 1: Symmetric fields;

Data Sheet for TLD postal dose quality audit for Co-60 γ-beams for the reference and non-reference conditions off-axis; Part 1: Symmetric fields;

Data Sheet for TLD postal dose quality audit for megavoltage X-ray beams for the reference and non-reference conditions off-axis; Part 1: Symmetric fields;

Instruction Sheet for TLD postal dose quality audit for Co-60 γ-beams and megavoltage X-ray beams for the reference and non-reference conditions off-axis; Part 2: Asymmetric fields;

Data Sheet for TLD postal dose quality audit for Co-60 γ-beams for the reference and non-reference conditions off-axis; Part 2: Asymmetric fields;

Data Sheet for TLD postal dose quality audit for megavoltage X-ray beams for the reference and non-reference conditions off-axis; Part 2: Asymmetric fields;

Certificate for the step 3 audit.

[DAN LETTERHEAD]

TLD POSTAL DOSE QUALITY AUDIT FOR Co-60 γ-BEAMS AND MEGAVOLTAGE X RAY BEAMS

INSTRUCTION SHEET

Step 3: Reference and non-reference conditions off-axis

PART 1. SYMMETRIC FIELDS

Please irradiate the TLDs during the period:

_____

_____

and return them to the address given in the covering letter. Timely response will improve the accuracy of your results. Should the TLDs arrive late, please irradiate them as soon as possible but no later than one month after their receipt. If you are unable to carry out the irradiation, please **RETURN** the TLD set, marking it '**UNEXPOSED**'.

GENERAL INSTRUCTIONS

The 12 TLD capsules for this audit are stored in 4 different boxes.

Box 'R' (reference measurements): 2 TLDs are for irradiation. The third TLD, with a white mark, ***must not be irradiated***; it is used to record environmental influences during transport and storage.

Box 'O1' (open field – first profile): 3 TLDs are for irradiation. These are coded by colour (blue, red, green) so that the individual TLD put in each position can be easily identified.

Box 'O2' (open field – second profile): 3 TLDs are for irradiation. These are coded by colour (blue, red, green) so that the individual TLD put in each position can be easily identified.

Box 'W' (wedge field): 3 TLDs are for irradiation. These are coded by colour (blue, red, green) so that the individual TLD put in each position can be easily identified.

1. Irradiate the TLDs as instructed in the Technical Instruction (parts B–E). Ensure that the treatment unit is functioning properly and is being used clinically or is ready for clinical use.
2. After the TLD irradiation, if possible, measure the dose delivered to the reference TLDs (part F).
3. Fill in the Data Sheet.
4. Return the TLDs and the Data Sheet within **ONE WEEK** after the irradiation.

SPECIAL NOTE

After each irradiation, replace carefully the TLDs in the original position in the storage boxes. Please protect the TLD capsules from accidental irradiation, heat (e.g. sunshine) and excessive humidity during storage.

CONFIDENTIALITY

The results of this TLD audit will be kept confidential by [DAN] and will not be disseminated without the written permission of the participating radiotherapy centre.

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 for HOSPITAL STAFF
(physicists, oncologists, technicians)

A. Aim of the TLD audit

The purpose of this TLD audit is to check the dose delivered by the radiotherapy unit. It will include measurements on the beam axis and two positions off the beam axis, ±5 cm, with and without wedges, at 10 cm depth in water, and the source-to-surface (SSD) or source-to-axis (SAD) distance used by the hospital. The measured fields are listed below.

- Reference measurements: 10 cm × 10 cm.
- Open field: 20 cm × 20 cm.
- Wedged field: for the most commonly used wedge, 20 cm × 20 cm for accelerators and the largest field covered by the wedge for cobalt units.

B. Preparation of the holder, water phantom and therapy unit for reference TLD measurement

1. Assemble the TLD holder, with the lead weight, as in Fig.1.
2. Place the holder in a water tank on the treatment table (Fig. 2). If needed, cut the red holder legs (Fig. 1) to fit the holder into the tank. (*Note that if you have no access to a dosimetry water phantom you can still use a large plastic container*).
3. Set your therapy unit for a vertical beam, with a 10 cm × 10 cm field size (Fig. 2).
4. Adjust the water level by filling the water tank **exactly** to the level of the top of the holder (Fig. 2).
5. Adjust the table height so that the water surface is at the proper distance to the source, according to the set-up selected (SSD or isocentric, see Fig. 2).

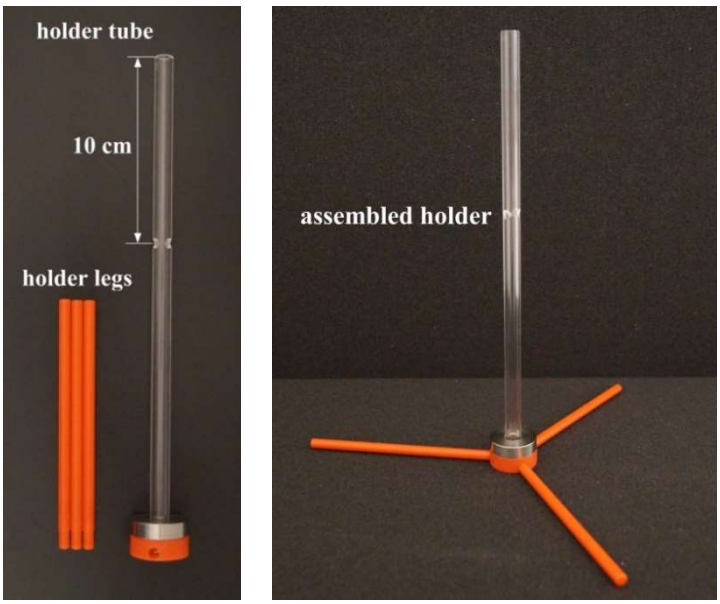


FIG. 1. Assembling the IAEA standard holder for the TLD irradiations in reference conditions.

SSD set-up
The TLD capsule is at a 10 cm depth; the SSD is set to your normal value

OR

Isocentric set-up
The TLD capsule is positioned at your usual SAD and also at 10 cm depth.

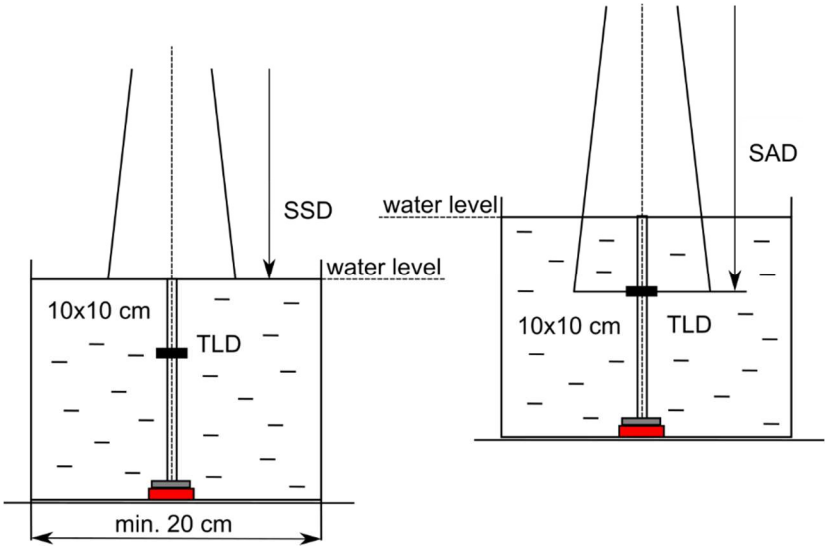


FIG. 2. Two alternative geometry set-ups for the TLD irradiation/

C. Irradiation of the TLD capsules for the reference measurement

NOTE: *The capsule with a white mark must not be irradiated; it is used to record environmental influences during transport and storage.*

1. Calculate the irradiation time or monitor units to deliver 2 Gy (200 cGy) to the TLD capsule as you would do for a 'tumour' whose centre would be at 10 cm depth, for a 10 cm × 10 cm field, as for example for cranial irradiation. The delivered dose is not a 'given dose' at the depth of maximum dose, but a dose at 10 cm depth (Fig. 3).
2. Choose Box 'R'R.
3. Insert the first capsule into the hole of the holder (Fig. 4).
4. Position the holder with the TLD in water making sure that the tube of the holder is completely filled with water (no air bubbles).
5. Align the holder tube with the central axis of the beam (Fig. 2).
6. Before irradiation recheck whether the alignment, field size, water level and distance are correct (Fig. 2).
7. Irradiate the first capsule with the time or the number of monitor units as calculated above.

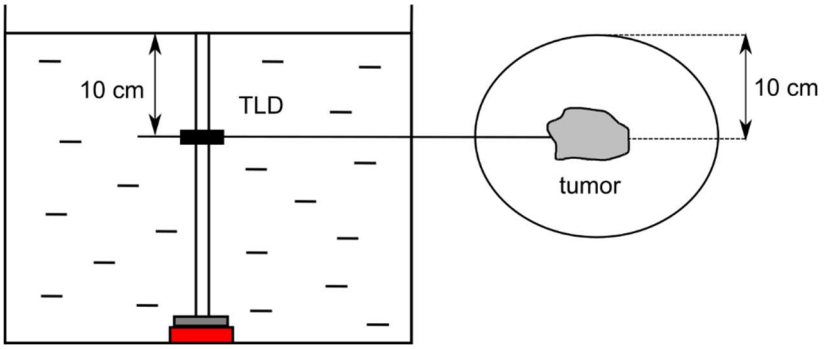


FIG. 3. Irradiation geometry for the TLD and for a brain tumour.

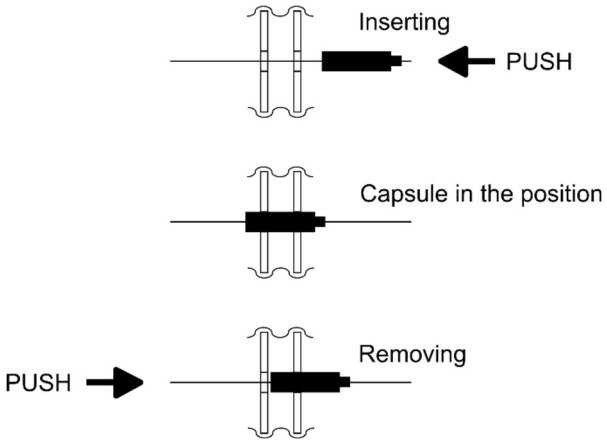


FIG. 4. Inserting, positioning and removing the TLD capsule.

8. Remove the capsule from the holder (Fig. 4) and wipe it dry.
9. Repeat the procedure, steps 3 to 8, for the second capsule (2 TLD capsules per beam for the reference measurements).
10. Make sure that both capsules are safely stored back in Box 'R'.

D. Preparation of the holder, water phantom and therapy unit for the profile TLD measurements

1. Assemble the TLD holder (see Fig.5).
2. Place the holder in a water tank on the treatment table (see Fig. 6).
3. Set your therapy unit for a vertical beam, with a 20 cm × 20 cm field size and a collimator rotation of 0 degree.
4. Adjust the water level by filling the water tank **exactly** to the level of the top of the holder (see Fig.6).
5. Adjust the table height so that the water surface is at the appropriate distance to the source, according to the set-up selected (SSD or isocentric, see Fig. 6).

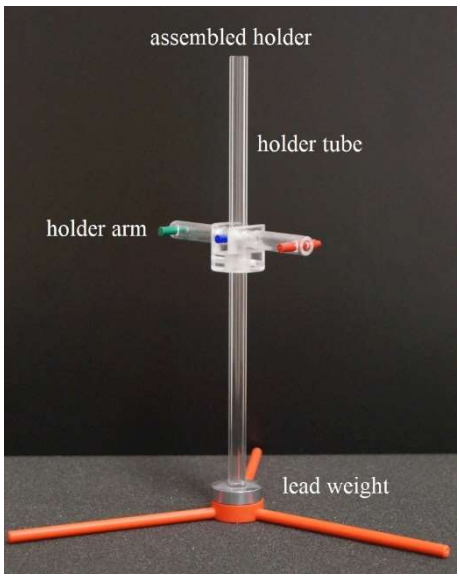


FIG. 5. Assembling the IAEA standard holder for the TLD irradiations.

SSD set-up
The TLD capsule is at a 10 cm depth; the SSD is set to your normal value

OR

Isocentric set-up
The TLD capsule is positioned at your usual SAD and also at 10 cm depth.

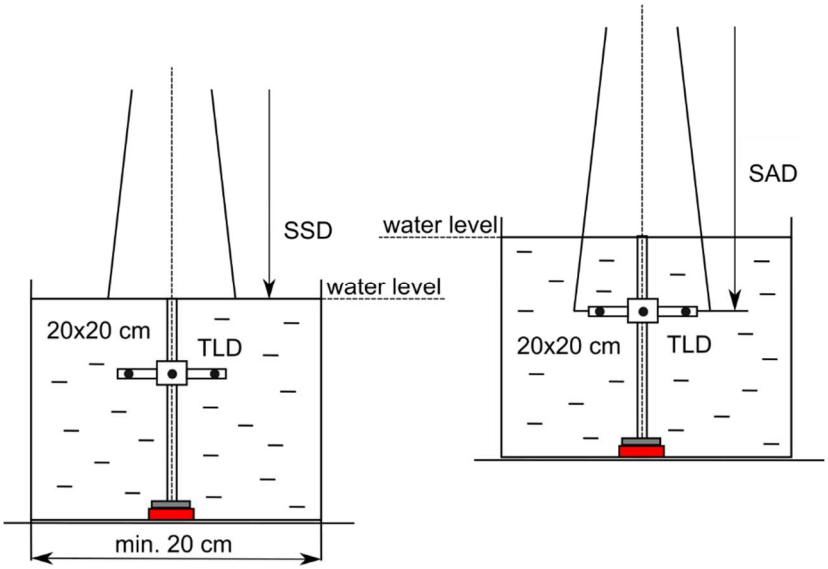


FIG. 6. Two alternative geometry set-ups for the TLD irradiation.

E. Irradiation of the TLD capsules for the profile measurements

E.1. Open field profiles

Calculate the irradiation time or monitor units to deliver 2 Gy (200 cGy) to the TLD capsule on the central axis at 10 cm depth, for a 20 cm × 20 cm open field.

1. Choose Box ‘O1’.
2. Insert the three TLD capsules from this box into the three holes of the holder, i.e. the red coded one on the central axis, and the blue and the green in the two points along the arms.
3. Position the holder, with the TLDs, in water, making sure that the tube of the holder and the arm are completely filled with water (no air bubbles).
4. Align the holder tube with the central axis of the beam and align the arm along one of the major axes of the field following Fig. 7.
5. Before irradiation, recheck whether the setup is correct (see Fig. 7).

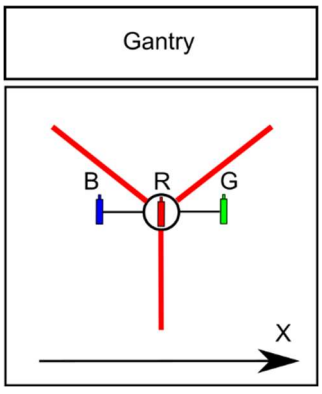


FIG. 7. Alignment of the holder tube viewed from above the phantom for measurements of the beam profile ‘O1’; B – blue, R – red, G – green

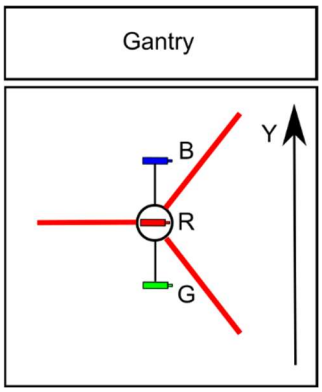


FIG. 8. Alignment of the holder tube viewed from above the phantom for measurements of the beam profile 'O2'; B – blue, R – red, G – green.

6. Irradiate the TLD capsules with the time or the number of monitor units as calculated above to deliver 2 Gy to the red coded capsule on the central axis.
7. Remove the capsules from the holder, wipe them dry and replace back in Box 'O1'.
8. Choose Box 'O2'.
9. Repeat the procedure, steps 1 to 3, with the TLDs from this box.
10. Align the holder rotated through 90° such that the TLDs off-axis are positioned along the other major field axis, aligning the holder tube with the central axis of the beam, see Fig. 8.
11. Before irradiation, recheck whether the setup is correct (see Fig. 8).
12. Irradiate the TLD capsules with the time or the number of monitor units as calculated above to deliver 2 Gy to the red coded capsule on the central axis.
13. Remove the capsules from the holder, wipe them dry and replace back in Box 'O2'.

E.2. Wedge field profile

Calculate the irradiation time or monitor units to deliver 2 Gy (200 cGy) to the TLD capsule on the central axis at 10 cm depth, for a 20 cm × 20 cm wedged field.

1. Select the wedge which is most commonly used in your department for this treatment unit. For an accelerator, retain the field size of 20 cm × 20 cm. For a cobalt unit, set the field size to be the largest field covered by the selected wedge in the direction of the wedge and keep the field size in the other direction as 20 cm. Keep the collimator rotation at 0 degrees.
2. Select Box 'W'.
3. Insert the three TLD capsules from this box into the three holes of the holder, i.e. the red coded one on the central axis, and the blue and the green in the two points along the arms.
4. Position the holder with the TLDs in water making sure that the tube of the holder and the arm are completely filled with water (no air bubbles).
5. Align the holder tube with the central axis of the beam and align the arm such that it lies along the direction of the wedge slope, see Fig. 9.
6. Be sure that the collimator rotation is kept at 0 degrees. Record the geometry of irradiation relative to the holder arm as requested in the data sheet, see section I.4.2.
7. Before irradiation recheck whether the set-up is correct
8. Irradiate the TLD capsules with the time or the number of monitor units as calculated above to deliver 2 Gy to the red coded capsule on the central axis.
9. Remove the capsules from the holder (Fig. 4.), wipe them dry and replace them in Box 'W'.

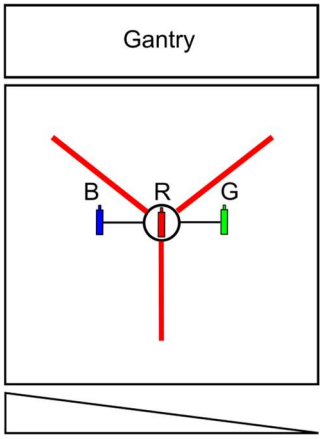


FIG. 9. Alignment of the holder tube viewed from side of the phantom for measurements of the wedged beam profile 'W'; B– blue, R–red, G–green

F. Absorbed dose measurements with an ionization chamber (additional request for medical physicists)

Determine experimentally the absorbed dose to water in the beam for the reference measurements (field size 10 cm × 10 cm) according to your usual dosimetry protocol and complete the data sheet.

[DAN LETTERHEAD]

TLD POSTAL DOSE QUALITY AUDIT FOR Co-60 γ BEAMS

DATA SHEET

Step 3: Reference and non-reference conditions off-axis

PART 1. SYMMETRIC FIELDS

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

Has Step 2, TLD audit for photon beams in reference and non-reference conditions on the beam axis, been successfully completed?

No ☐

Yes ☐ Date .....

FOR HOSPITAL STAFF (physicist, oncologist, technician)

A. Specifications of the treatment unit

The Co-60 treatment unit used for this audit is of the type

.....

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

installed in the year .....

and the date of the last source replacement is .....

B. Irradiation of the TLD capsules for the reference measurement

(see Sections B and C of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

day *month* *year*

The TLD capsules were irradiated at 10 cm depth in water using a 10 cm × 10 cm field at a distance

SSD = ……cm		SAD = ……...cm
fixed source skin distance	**OR**	fixed source axis distance
SSD set-up		*Isocentric set-up*

For the different TLD capsules, the irradiation time (in minutes) and the dose delivered[1] (in grays) were:

TLD 1	t = ... min	D = ...Gy
TLD 2	t = ... min	D = ...Gy

C. Calculation of time setting for the reference measurement

Provide the data used for calculation of time setting for the TLD irradiation.

Please give detailed explanation of your procedure for the above time and dose calculation. Please provide all factors (beam output, any conversion or correction factors, etc.) you have used:

.....

.....

.....

.....

.....

Beam output (*units*) as stated for your clinical data: ..... [.....] |__|__| |__|__| |__|__|__|__|

day *month* *year*

Please explain in detail the irradiation conditions for which this clinical beam output applies (e.g. in-air or depth in water, SAD or SSD, field size):

.....

.....

.....

.....

[1] Please adjust your irradiation time to get the absorbed dose as close as possible to 2 Gy (200 cGy).

D. Irradiation of the TLD capsules for the profile measurements

D.1. Open field profiles

(see Sections D and E.1 of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

The TLD capsules were irradiated at 10 cm depth in water using a 20 cm × 20 cm field at a distance

SSD = ……cm
fixed source skin distance
SSD set-up

OR

SAD = ……...cm
fixed source axis distance
Isocentric set-up

For these TLD capsules the irradiation time is required to deliver 2 Gy to the red coded capsule on the central axis.

Open field profile 1 t =..... min
'Red' capsule on axis D =..... Gy
'Blue' capsule off axis D =..... Gy
'Green' capsule off axis D =..... Gy

Open field profile 2 t =..... min
'Red' capsule on axis D =..... Gy
'Blue' capsule off axis D =..... Gy
'Green' capsule off axis D =..... Gy

D.2. Wedge field profile

(see Sections D and E.2 of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

The TLD capsules were irradiated at a 10 cm depth in water using the largest field covering the wedge field at a distance:

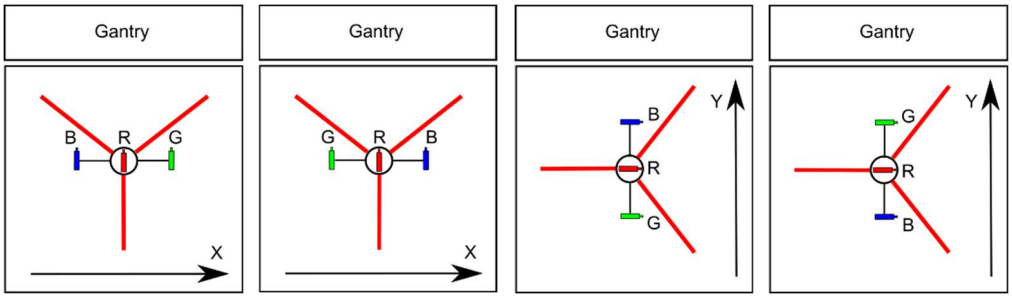
SSD = ……cm
fixed source skin distance
SSD set-up

OR

SAD = ……...cm
fixed source axis distance
Isocentric set-up

Field size: .....cm × ..... cm
Nominal wedge angle: ..... degrees

Please mark the diagram (below) which is appropriate for your geometry of irradiation, as viewed from above the phantom:



For these TLD capsules the irradiation time is required to deliver 2 Gy to the red coded capsule on the central axis.

Wedge field profile	t = ... min
‘Red’ capsule on axis	D = ... Gy
‘Blue’ capsule off axis (thick part of the wedge)	D = ... Gy
‘Green’ capsule off axis (thin part of the wedge)	D = ... Gy

E. Calculation of doses for the profile measurements

Provide the data used for calculation of the irradiation time and doses on and off-axis for the TLD irradiations.

Please give a detailed explanation of your procedure for the above calculations. Please provide data from the TPS or factors (relative beam output, off-axis ratios, wedge factor, etc.), you have used in the manual calculation:

Open field profiles:

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

Wedged field profile:

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

ADDITIONAL REQUEST FOR MEDICAL PHYSICISTS

Determination of the absorbed dose to water by ionization chamber in the reference conditions

Measurements were performed by

.....

name *position*

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

The absorbed dose rate to water in this beam was determined by using a dosimeter system composed of an ionization chamber .....
manufacturer *model*

and an electrometer.....
manufacturer *model*

The calibration factor of the dosimeter system (**ionization chamber TOGETHER with electrometer**) was:
..... R/scale unit (exposure calibration factor N_X)
or ..... Gy/scale unit (air kerma calibration factor N_K)
or ..... Gy/scale unit (absorbed dose to water calibration factor $N_{D,w}$).

The above stated calibration factor was determined by the following laboratory/ manufacturer..... on the following date ..... and refers to a temperature of .....°C and a pressure [*units*] of..... [.....].

The absorbed dose to water in this beam was measured under the following conditions:
☐ water phantom ☐ plastic phantom – *please specify material* .....
field size: ..... cm × ..... cm
distance:
SSD = ……
SSD set-up

The depth of ☐ the geometrical centre **or** ☐ the P_{eff} of the ionization chamber in phantom was ……. cm.

Please give your reading results:
Average reading ..... [*scale units*]
Measurement performed during ..... min
Temperature.....°c
Pressure [*units*] ..... [.....]
Electrometer scale .....
Polarizing voltage .....

The absorbed dose rate to water in this beam was determined using the following code of practice (dosimetry protocol):
.....
.....
.....
.....
.....
.....

Please give a detailed explanation of your procedure to determine the dose at the position of the centre of the TLD capsule based on the measurement described above. Please provide all factors you have used:
.....
.....
.....

.....
.....
.....
.....
.....
.....
and, if any, the shutter correction (timer error) applied was .....

[DAN LETTERHEAD]

TLD POSTAL DOSE QUALITY AUDIT FOR MEGAVOLTAGE X RAY BEAMS

DATA SHEET

Step 3: Reference and non-reference conditions off-axis

Part 1. SYMMETRIC FIELDS

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

Has Step 2, TLD audit for photon beams in reference and non-reference conditions on the beam axis, been successfully completed.

No ☐

Yes ☐ Date .....

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: .....

B. Irradiation of the TLD capsules for the reference measurement

The TLD capsules were irradiated on the following date :

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

day *month* *year*

The TLD capsules were irradiated at 10 cm depth in water using a 10 cm × 10 cm field at a distance

SSD = ……cm	**OR**	SAD = ……...cm
fixed source skin distance		fixed source axis distance
SSD set-up		*Isocentric set-up*

For the different TLD capsules, the monitor setting (in MU) and the dose delivered[2] (in grays) were:

TLD 1: ..... MU D = ... Gy

TLD 2: ..... MU D = ... Gy

C. Calculation of monitor setting for reference measurements

Provide the data used for calculation of monitor unit (MU) setting for the TLD irradiation.

Please give a detailed explanation of your procedure for the above MU and dose calculation. Please provide all factors (beam output, any conversion or correction factors, etc.) you have used:

.....

.....

.....

.....

.....

Beam output as stated for your clinical data: ..... [.....] |__|__| |__|__| |__|__|__|__|

day *month* *year*

Please explain in detail the irradiation conditions for which this clinical beam output applies (e.g. depth in water, SAD or SSD, field size):

.....

.....

.....

.....

.....

[2] Please adjust your monitor unit (MU) setting to get the absorbed dose to the TLD capsule as close as possible to 2 Gy (200 cGy).

D. Irradiation of the TLD capsules for the profile measurements

D1. Open field profiles

(see sections D and E.1 of the Instruction Sheet)

The TLD capsules were irradiated on the following date: |__|__| |__|__| |__|__|__|__|
day *month* *year*

The TLD capsules were irradiated at 10 cm depth in water using a 20 cm × 20 cm field at a distance

SSD = ……cm
fixed source skin distance
SSD set-up

OR

SAD = ……...cm
fixed source axis distance
Isocentric set-up

For these TLD capsules, the monitor setting (in MU) as calculated to deliver 2 Gy to the red coded capsule on the central beam axis is:

Open field profile 1 ..... MU
'Red' capsule on axis D =..... Gy
'Blue' capsule off axis D =..... Gy
'Green' capsule off axis D =..... Gy

Open field profile 2 ..... MU
'Red' capsule on axis D =..... Gy
'Blue' capsule off axis D =..... Gy
'Green' capsule off axis D =..... Gy

D.2. Wedge field profile

(see Sections D and E.2 of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

The TLD capsules were irradiated at 10 cm depth in water using a 20 cm × 20 cm field at a distance

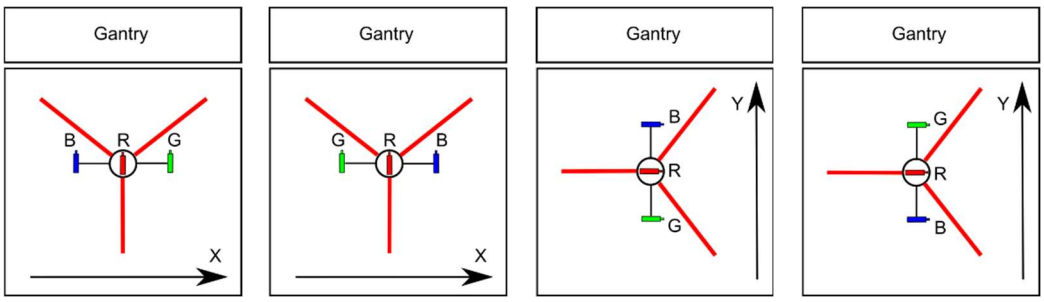
SSD = ……cm
fixed source skin distance
SSD set-up

OR

SAD = ……...cm
fixed source axis distance
Isocentric set-up

Nominal wedge angle: .....degrees
Type of wedge (fixed, motorised, dynamic, etc.): .....

Please mark the diagram (below) which is appropriate for your geometry of irradiation, as viewed from above the phantom:



For these TLD capsules, the monitor setting (in MU) is required to deliver 2 Gy to the red coded capsule on the central axis.

Wedge field profile	..... MU
‘Red’ capsule on axis	D =..... Gy
‘Blue’ capsule off axis (thick part of the wedge)	D =..... Gy
‘Green’ capsule off axis (thick part of the wedge)	D =..... Gy

E. Calculation of doses for the profile measurements

Provide the data used for calculation of MU and doses on- and off-axis for the TLD irradiations.

Please give a detailed explanation of your procedure for the above calculations. Please provide data from the TPS or factors (relative beam output, off-axis ratios, wedge factor, etc.), you have used in the manual calculation:

Open field profiles:

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

Wedged field profile:

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

ADDITIONAL REQUEST FOR MEDICAL PHYSICISTS

Determination of the absorbed dose to water by ionization chamber in reference conditions

Measurements were performed by

.....

name *position*

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

The absorbed dose rate to water in this beam was determined by using a dosimeter system composed of an ionization chamber .....
manufacturer *model*

and an electrometer.....
manufacturer *model*

The Co-60 calibration factor of the dosimeter system (**ionization chamber TOGETHER with electrometer**) was:

..... R/scale unit (exposure calibration factor N_X)

or ..... Gy/scale unit (air kerma calibration factor N_K)

or ..... Gy/scale unit (absorbed dose to water calibration factor $N_{D,w}$).

If any other calibration factor is used please specify:

.....

The above stated calibration factor was determined by the following laboratory/ manufacturer..... on the following date ..... and refers to a temperature of .....°C and a pressure [*units*] of..... [.....].

The absorbed dose to water in this beam was measured under the following conditions:

☐ water ☐ plastic – *please specify material* .....

field size: ..... cm × ..... cm

distance:

SSD = …… **OR** SAD = ……...

SSD set-up *Isocentric set-up*

The depth of ☐ the geometrical centre **or** ☐ the P_{eff} of the ionization chamber in phantom was ……. cm.

Please give your reading results:

Average reading ..... [*scale units*]

Measurement performed during..... mu

Temperature.....°c

Pressure [*units*]..... [.....]

Electrometer scale.....

Electrometer voltage .....

The absorbed dose to water per MU in this beam was determined by the following code of practice (dosimetry protocol):

.....

.....

.....

.....

.....

.....

Please give detailed explanation of your procedure to determine the dose at the position of the centre of the TLD capsule based on the measurement described above. Please provide all factors you have used:

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

[DAN LETTERHEAD]

TLD POSTAL DOSE QUALITY AUDIT FOR Co-60 γ BEAMS

INSTRUCTION SHEET

Step 3: Reference and non-reference conditions off-axis

PART 2. ASYMMETRIC FIELDS

Please irradiate the TLDs during the period:

_____

_____

and return them to the address given in the covering letter. Timely response will improve the accuracy of your results. Should the TLDs arrive late, please irradiate them as soon as possible but no later than one month after their receipt. If you are unable to carry out the irradiation, please **RETURN** the TLD set, marking it '**UNEXPOSED'**.

GENERAL INSTRUCTIONS

Nine TLD capsules for this audit are stored in four different boxes.

Box "REF" (reference measurements): two TLDs are for irradiation. The third TLD, with a white mark, ***must not be irradiated***; it is used to record environmental influences during transport and storage.

Box "AO" (asymmetric open field): two TLDs are for irradiation. These are coloured blue and red so that the individual TLD put in each position can be easily identified.

Box "AW" (asymmetric wedged field): two TLDs are for irradiation. These are coloured blue and red so that the individual TLD put in each position can be easily identified.

Box "HBB" (half-beam blocked field): two TLDs are for irradiation. One TLD (coloured green) is for the open field and the other TLD (coloured blue) is for the wedged field.

1. Irradiate the TLDs as instructed in the Technical Instruction (parts B-G). Ensure that the treatment unit is functioning properly and is one that is being used clinically or is ready for clinical use.
2. After the TLD irradiation, if possible, measure the dose delivered to the reference TLDs (part H) using local ionization chamber dosimetry procedures.
3. Fill in the Data Sheet.
4. Return the TLDs and the Data Sheet within **ONE WEEK** after the irradiation.

SPECIAL NOTE

After each irradiation, carefully replace the TLD in its original position in the storage box. Please protect TLD capsules from accidental irradiation, heat (e.g. sunshine) and excessive humidity during storage.

CONFIDENTIALITY

The results of this TLD audit will be kept confidential by [DAN] and will not be disseminated without the written permission of the participating radiotherapy centre.

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 INSTRUCTIONS FOR HOSPITAL STAFF
(physicists, oncologists, technicians)

A. Aim of the TLD audit

The purpose of this TLD audit is to check the dose delivered by the radiotherapy unit for asymmetric open and wedged fields. It includes measurements on the central (collimator) axis and one position 5 cm off the axis, with and without wedges, at 10 cm depth in water, at your usual source-to-surface (SSD) or source-to-axis (SAD) distance. The measured fields are listed below.

- Reference field: symmetric 10 cm × 10 cm.
- Asymmetric open field: 10 cm × 10 cm, with its centre lying at 2.5 cm from the central (collimator) axis
- Asymmetric wedged field: 10 cm × 10 cm, with its centre lying at 2.5 cm from the central (collimator) axis, for the most commonly used wedge.
  (Note: If no wedge completely covers this asymmetric field in the direction of the slope of the wedge, then this particular test cannot be carried out and it should be ignored.)
- Half-beam blocked fields: 10 cm × 10 cm, with centres lying at 5 cm from the central (collimator) axis:
  - half-beam blocked open field
  - half-beam blocked wedged field (*Note: This test is for linear accelerators only.*).

Note: *for all the asymmetric and half-beam blocked fields, the data evaluation process requires that all measurements are along the same major axis across the field and with the individual collimator jaws in the same positions relative to the field and also to the TLD positions. Therefore, the geometry of the machine (collimator angle setting and wedge orientation) and the TLD holder and its arm alignment must be the same throughout. Specific recommendations cannot be given, as different treatment units may have different wedge orientations relative to collimator angles. Therefore, before any irradiation, including open field ones, careful consideration needs to be given to the positions required for the wedged beams (see section E.2) and then these settings and TLD holder alignments must be used for all fields, including the open ones. An example is given in Fig. 1.*

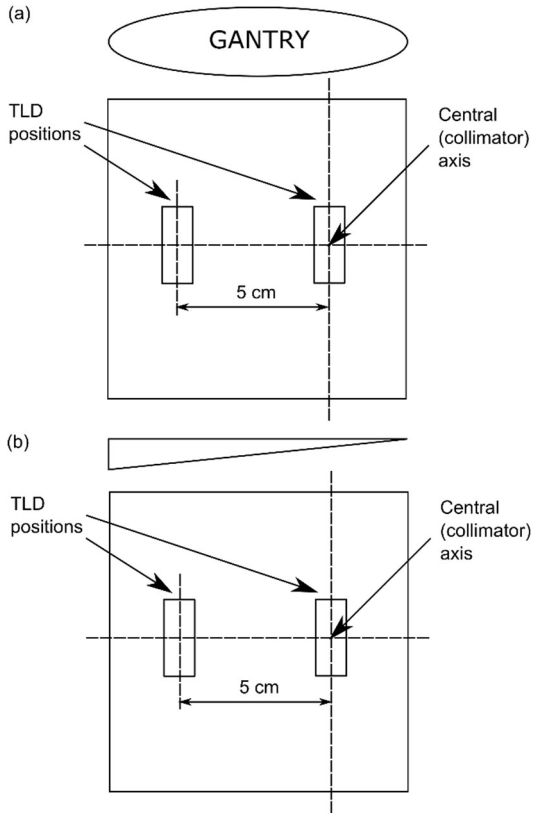


FIG. 1. Schematic illustration of the set-up for (a) asymmetric open and (b) wedged fields (beam view), keeping the same collimator rotation angle.

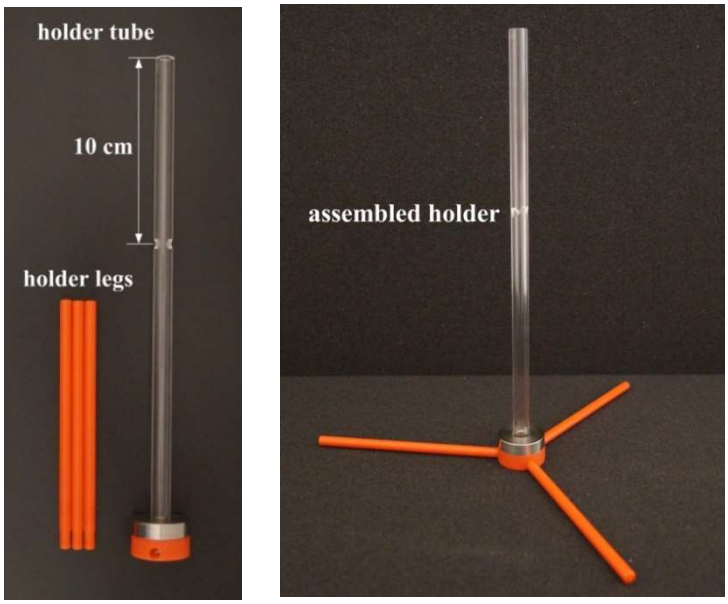


FIG. 2. Assembling the IAEA standard holder for the TLD irradiations in the reference conditions.

B. Preparation of the holder, water phantom and therapy unit for the reference TLD measurement

1. Assemble the TLD holder, with the lead weight, as shown in Fig.2.
2. Place the holder in a water tank on the treatment table (Fig. 3). If needed, cut the red holder legs (Fig. 2) to fit the holder into the tank. (*Note: that if you have no access to a dosimetry water phantom you can still use a large plastic container*).
3. Set your therapy unit for a vertical beam, with a 10 cm × 10 cm field size (Fig. 3).
4. Adjust the water level by filling the water tank **exactly** to the level of the top of the holder (Fig. 3).
5. Adjust the table height so that the water surface is at the standard distance to the source, according to the set-up selected (SSD or isocentric, see Fig. 3).

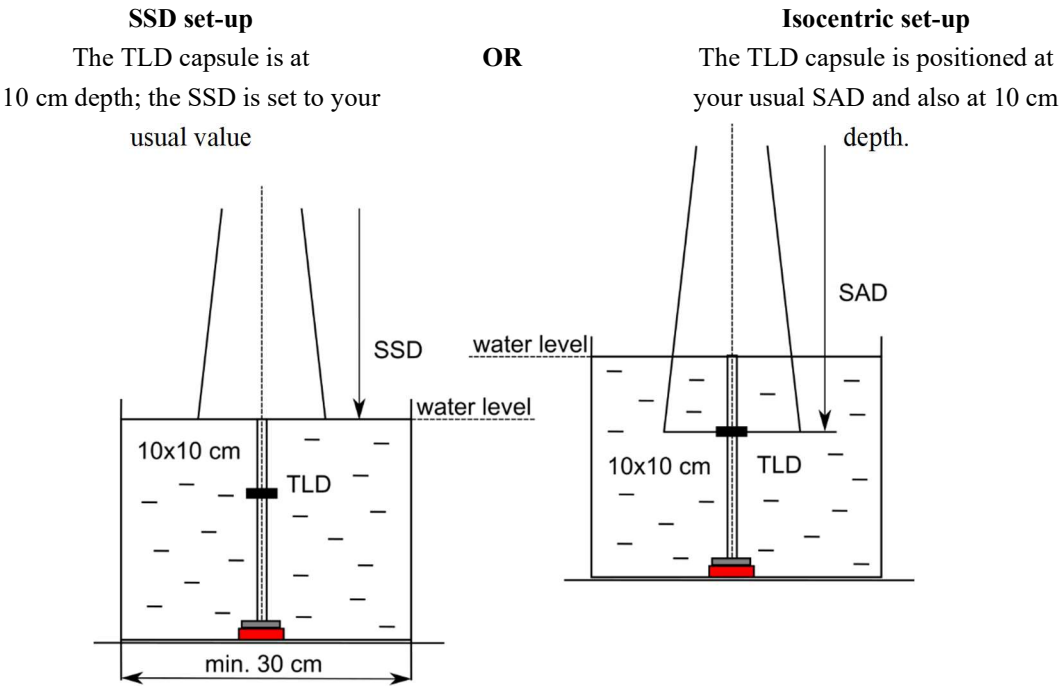


FIG. 3. Two alternative geometry set-ups for the TLD irradiation in reference conditions.

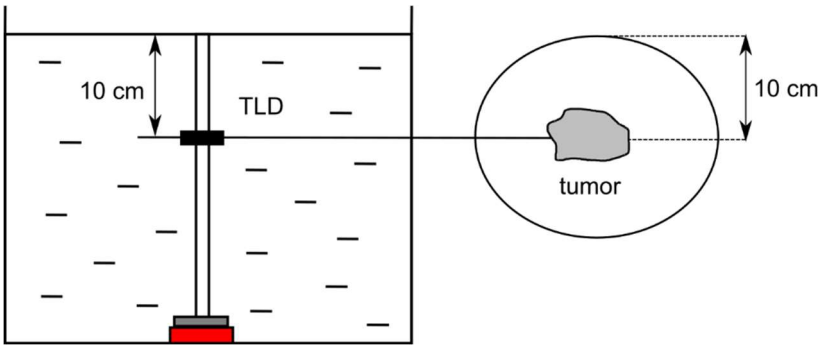


FIG. 4. Irradiation geometry for the TLD.

C. Irradiation of the TLD capsules for the reference measurement

Note: *The capsule with a white mark* ***must not*** *be irradiated; it is used to record environmental influences during transport and storage.*

1. Calculate the irradiation time or monitor units to deliver 2 Gy (200 cGy) to the TLD capsule as you would do for a 'tumour' whose centre would be at 10 cm depth, for a 10 cm × 10 cm field. The delivered dose is not a 'given dose' at the depth of maximum dose, but a dose at 10 cm depth (Fig. 4).
2. Choose Box 'REF'.
3. Insert the first capsule into the hole of the holder (Fig. 5).
4. Position the holder, with the TLD, in water, making sure that the tube of the holder is completely filled with water (no air bubbles).
5. Align the holder tube with the central (collimator) axis (Fig. 3).
6. Before irradiation, recheck that the alignment, field size, water level and distance are correct (Fig. 3).
7. Irradiate the first capsule with the time or the number of monitor units as calculated above.
8. Remove the capsule from the holder (Fig. 5), wipe it dry.
9. Repeat the procedure, steps 3 to 8, for the second TLD capsule.
10. Make sure that both capsules are safely stored back in Box 'REF'.

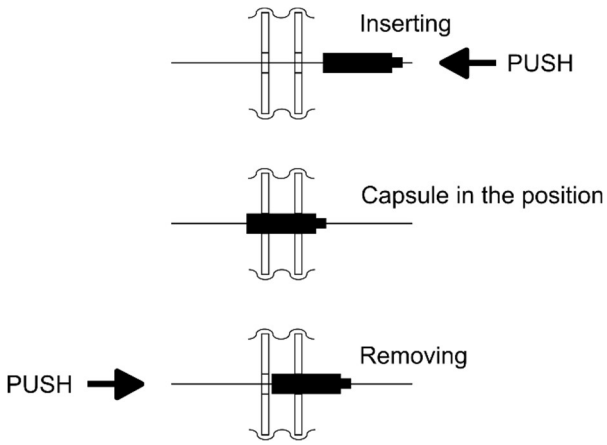


FIG. 5. Inserting, positioning and removing the TLD capsule.

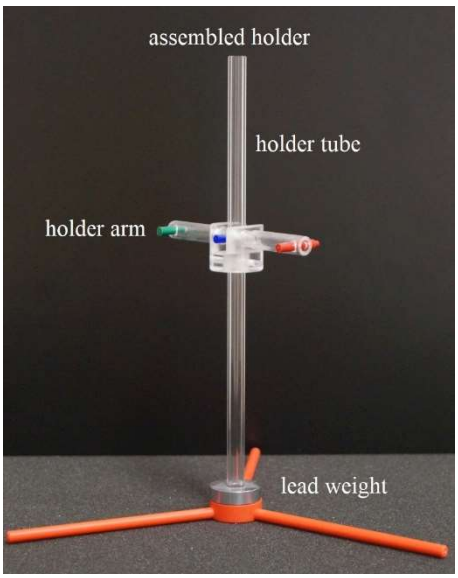


FIG. 6. Assembling the IAEA holder for the TLD irradiations in non-reference conditions.

D. Preparation of the holder, water phantom and therapy unit for the asymmetric field TLD measurements

1. Assemble the TLD holder (see Fig.6).
2. Place the holder in a water tank on the treatment table (see Fig. 7).
3. Set your therapy unit for a vertical beam, with a collimator rotation selected as discussed in Section A, and set-up a field:

SSD set-up
The TLD capsules are at 10 cm depth; the SSD is set to your usual value

OR

Isocentric set-up
The TLD capsules are positioned at your usual SAD and also at 10 cm depth.

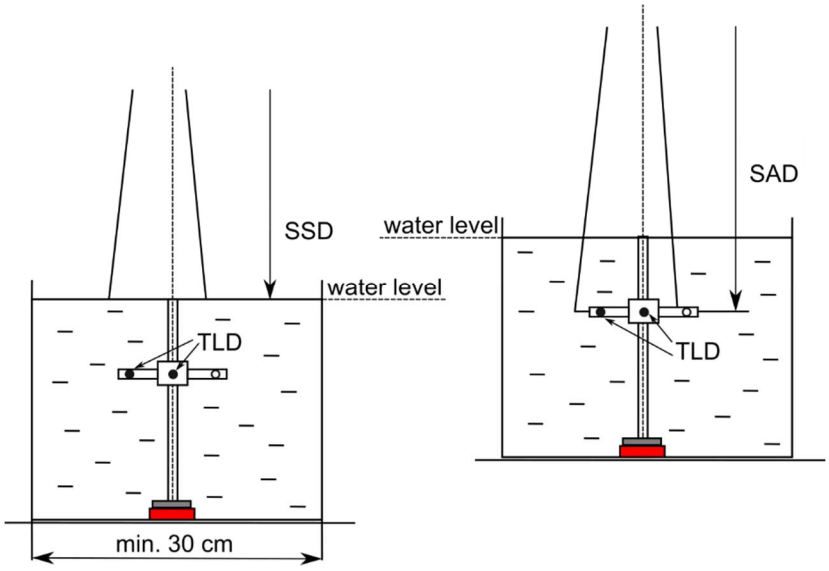


FIG. 7. Two alternative geometry set-ups for the TLD irradiation in non-reference conditions.

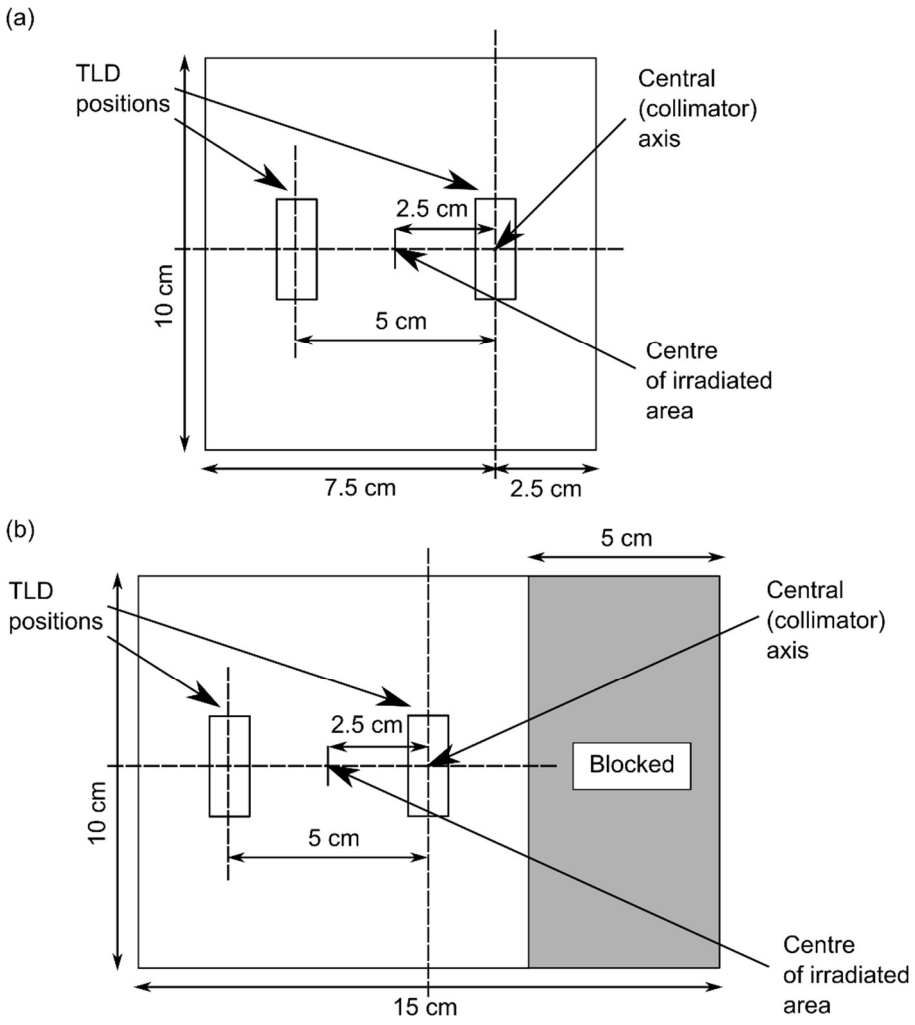


FIG. 8. Set-up for asymmetric open field: (a) where asymmetric collimators are available (beam view; (b) where asymmetric collimators are NOT available, and blocking is used (beam view).

a) For treatment machines which allow asymmetric (independent) collimator positioning: one asymmetric collimator jaw should be positioned at 7.5 cm from the central (collimator) axis and the opposite one should be positioned at 2.5 cm at the other side of the central (collimator) axis. The collimators in the other direction should be set to a symmetric 10 cm size (Fig. 8a).

b) For treatment machines which do not allow asymmetric collimator positioning: a symmetric field size of 15 cm × 10 cm and a block positioned to shield 5 cm from one edge of the 15 cm dimension (Fig. 8b) should be used.

In both cases, the result is an irradiated area of 10 × 10 cm^2, with its centre lying at 2.5 cm from the central (collimator) axis; the other field dimension is symmetric.

4. Adjust the water level by filling the water tank **exactly** to the level of the top of the holder (see Fig.7).

5. Adjust the table height so that the water surface is at the usual distance to the source, according to the set-up selected (SSD or isocentric, see Fig. 7).

E. Irradiation of the TLD capsules for the asymmetric field measurements

E.1. Open asymmetric field measurements

Calculate the irradiation time or monitor units to deliver 2 Gy (200 cGy) to the TLD capsule on the central (collimator) axis at 10 cm depth, for the asymmetric field used (Fig. 8a or 8b).

1. Choose Box ‘AO’.
2. Insert the two TLD capsules from this box into the two appropriate holes of the holder, i.e. the red one on the central (collimator) axis, and the blue one in the point along the arm in the field (Fig. 8a or 8b).
3. Position the holder with the TLDs inserted in the water, making sure that the tube of the holder and the arm are completely filled with water (no air bubbles).
4. Align the vertical holder tube with the central (collimator) axis and align the arm along the major axis of the asymmetric field such that the TLDs are positioned as in Fig. 8a or 8b.
5. Before irradiation, recheck that the alignment, field size, water level and the distance are correct (see Fig. 8a or 8b).
6. Irradiate the TLD capsules with the time or the number of monitor units as calculated above to deliver 2 Gy to the red capsule on the central (collimator) axis.
7. Remove the capsules from the holder, wipe them dry and replace them in Box ‘AO’.

E.2. Wedged asymmetric field measurements

The wedged asymmetric field size is the same as the open asymmetric field as used in Section E.1, with a wedge applied such that the thick wedge end covers the 7.5 cm width of the asymmetric field and the thin end covers the 2.5 cm width (see Fig. 9a and 9b). Keep the collimator rotation at the value selected in Section E1.

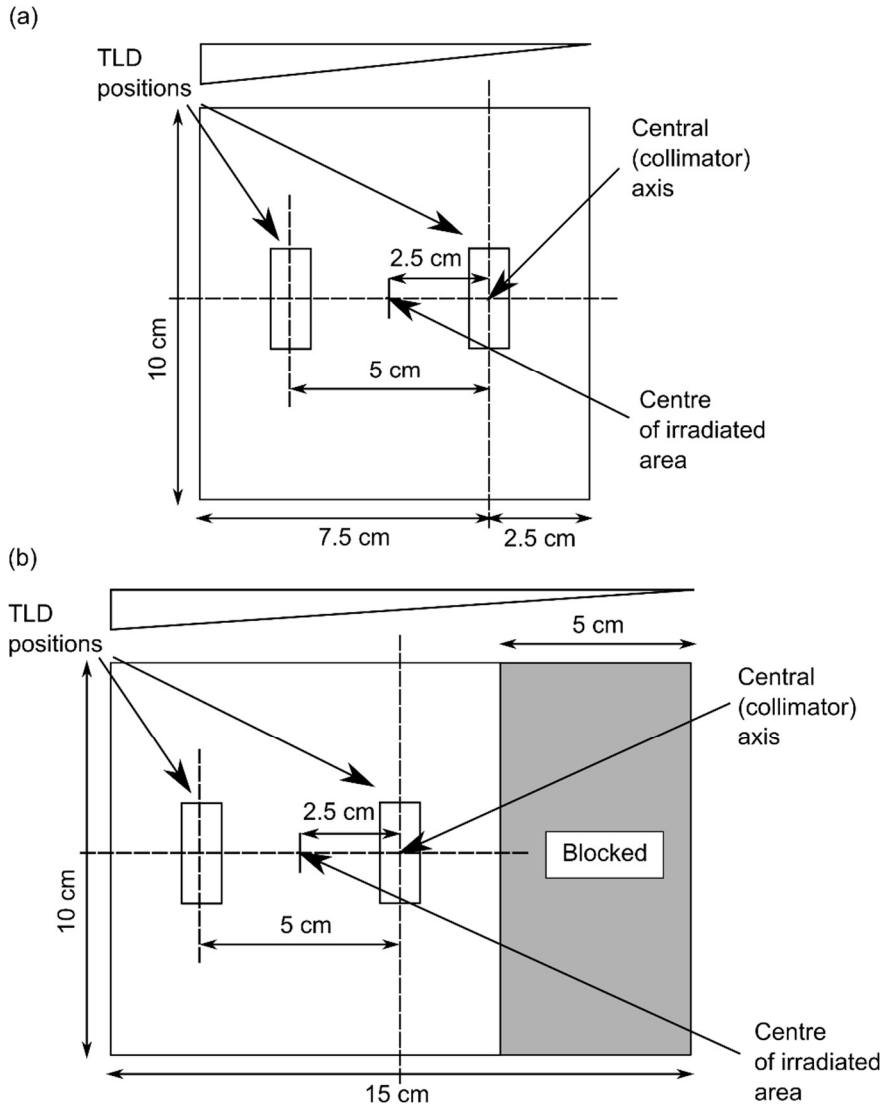


FIG. 9. Set-up for asymmetric wedged field: (a) where asymmetric collimators are available (beam view); (b) where asymmetric collimators are NOT available and blocking is used (beam view).

1. Select the wedge which is most commonly used in your department for this treatment unit and ensure that the alignment with the asymmetric field is as required.

Note for Co-60 units: *If no wedge completely covers a 15 cm field size in the direction of the slope of the wedge, then this particular test cannot be carried out and it should be ignored.*

2. Calculate the irradiation time or monitor units to deliver 2 Gy (200 cGy) to the TLD capsule on the central (collimator) axis at 10 cm depth, for the asymmetric field used and the wedge selected.
3. Select Box 'AW'.
4. Insert two TLD capsules from this box into two appropriate holes of the holder, i.e. the red capsule on the central (collimator) axis, and the blue one in the hole along the arm in the field (Fig. 9a or 9b).
5. Position the holder with the TLDs inserted in the water, making sure that the tube of the holder and the arm are completely filled with water (no air bubbles).
6. Align the holder tube with the central (collimator) axis and align the arm along the major axis of the asymmetric field following Fig. 9a or 9b.
7. Before irradiation, recheck that the alignment, field size, water level and distance are correct (Fig. 9a or 9b).
8. Irradiate the TLD capsules with the time or the number of monitor units as calculated above, to deliver 2 Gy to the red capsule on the central (collimator) axis.
9. Remove the capsules from the holder, wipe them dry and replace them in Box 'AW'.

F. Preparation of the holder, water phantom and therapy unit for the half-beam blocked field TLD measurements

1. Assemble the TLD holder (see Fig.10).
2. Place the holder in a water tank on the treatment table (see Fig. 11).

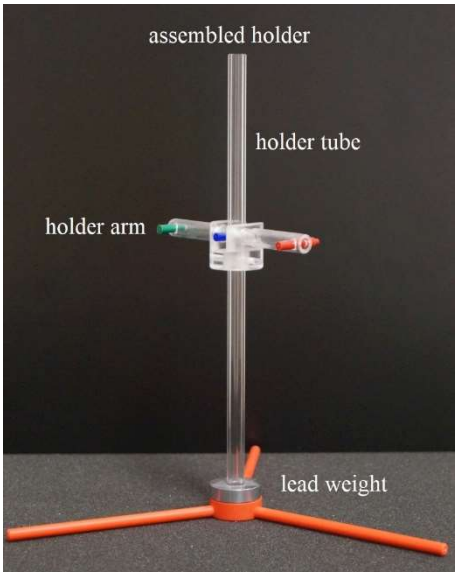


FIG. 10. Assembling the IAEA holder for the TLD irradiations in non-reference conditions.

SSD set-up

The TLD capsules are at 10 cm depth; the SSD is set to your usual value

OR

Isocentric set-up

The TLD capsules are positioned at your usual SAD and also at 10 cm depth.

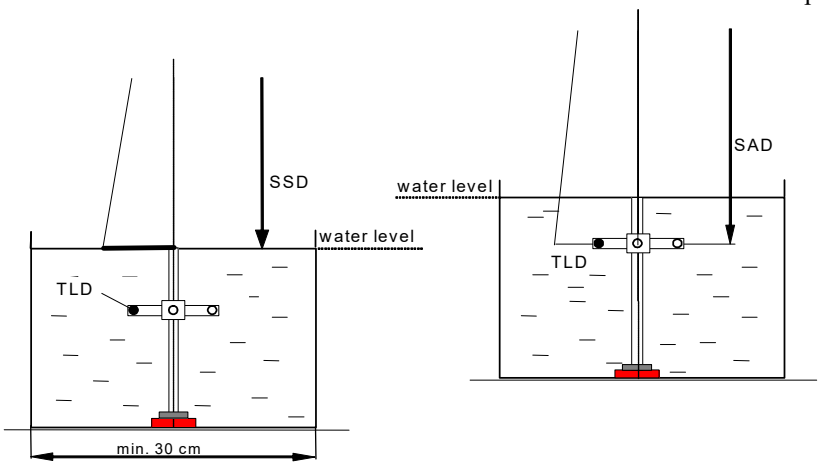


FIG. 11. Two alternative geometry set-ups for the TLD irradiation in non-reference conditions.

3. Set your therapy unit for a vertical beam, with a collimator rotation selected as discussed in Section A, and set-up a field:

   a) For treatment machines which allow asymmetric (independent) collimator positioning: one asymmetric collimator jaw should be positioned at 10 cm from the central (collimator) axis and the opposite one should be positioned at 0 cm at the other side of the central (collimator) axis. The collimators in the other direction should be set to a symmetric 10 cm size (Fig. 12).

   b) For treatment machines which do not allow asymmetric collimator positioning: symmetric field size of 20 cm × 10 cm and a block positioned to shield 10 cm from one edge of the 20 cm dimension (Fig. 13) should be used.

In both cases, the result is an irradiated area of 10 × 10 cm^2, with its centre lying at 5 cm from the central (collimator) axis; the other field dimension is symmetric.

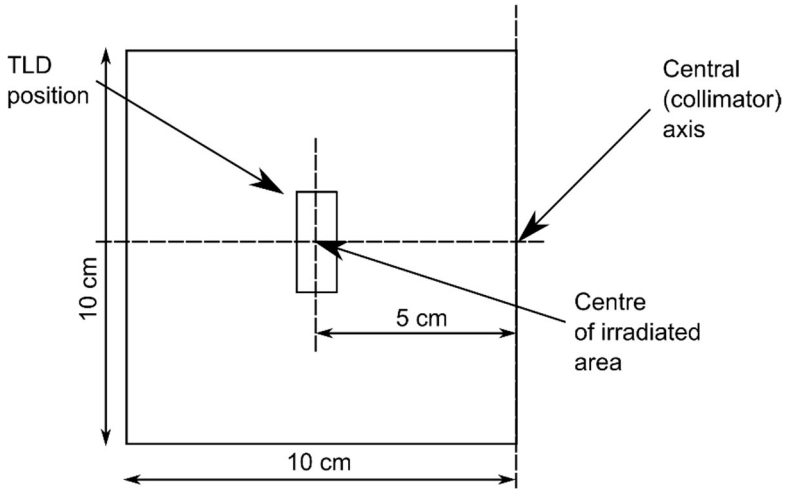


FIG. 12. Set-up for half blocked open field, where asymmetric collimators are available (beam view).

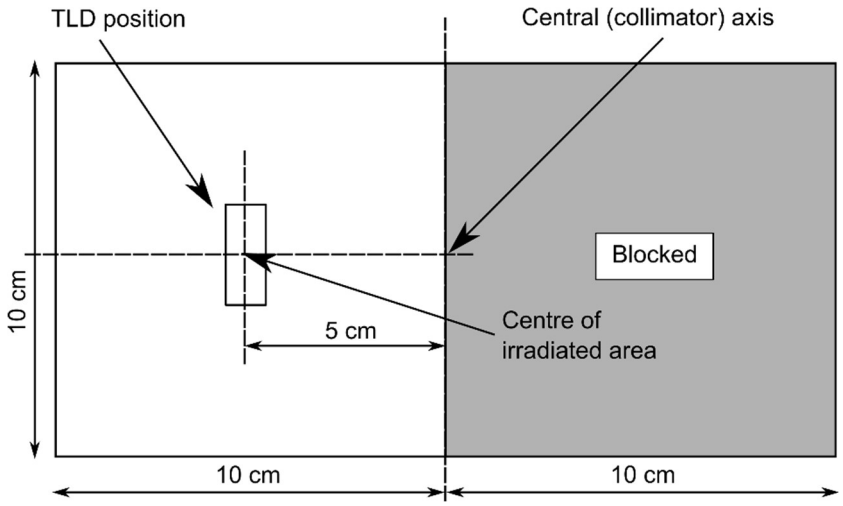


FIG. 13. Set-up for half blocked open field, where asymmetric collimators are NOT available and blocking is used (beam view).

4. Adjust the water level by filling the water tank **exactly** to the level of the top of the holder (see Fig.11).
5. Adjust the table height so that the water surface is at the standard distance to the source, according to the set-up selected (SSD or isocentric, see Fig. 11).

G. Irradiation of the TLD capsules for the half-beam blocked field measurements

G.1. Open half-beam blocked field measurements

1. Calculate the irradiation time or monitor units to deliver 2 Gy (200 cGy) to the TLD capsule positioned in the centre of the irradiated field (see Fig. 12 or 13).
2. Choose Box 'HBB'
3. nsert the green TLD capsule from this box into the off-axis hole of the holder, i.e. in the point along the arm in the field (Figs 11 and 12 or 13).
4. Position the holder with the TLD inserted in the water, making sure that the tube of the holder and the arm are completely filled with water (no air bubbles).
5. Align the vertical holder tube with the central (collimator) axis and align the arm along the major axis of the half-beam blocked field following Fig. 12 or 13.
6. Before irradiation, recheck that the alignment, field size, water level and distance are correct (Fig. 12 or 13).
7. Irradiate the TLD capsule with the time or the number of monitor units as calculated above to deliver 2 Gy to it.
8. Remove the capsule from the holder, wipe it dry and replace it back in Box 'HBB'.

G.2. Wedged half-beam blocked field measurements

Note: *This test is for linacs only.*

The wedged half-beam blocked field setting is the same as for the open half-beam blocked field used in Section G.1, with a wedge applied such that the thick end is towards the irradiated area and the thin end towards the shielded area, see Fig. 14 or 15. Keep the collimator rotation at the angle selected in Section G1.

1. Select the wedge which is most commonly used in your department for this treatment unit and ensure that the alignment with the asymmetric field is as required.
2. Calculate the monitor units to deliver 2 Gy (200 cGy) to the TLD capsule positioned at the centre of the irradiated field (10 cm depth), for the half-beam blocked field and the wedge selected.

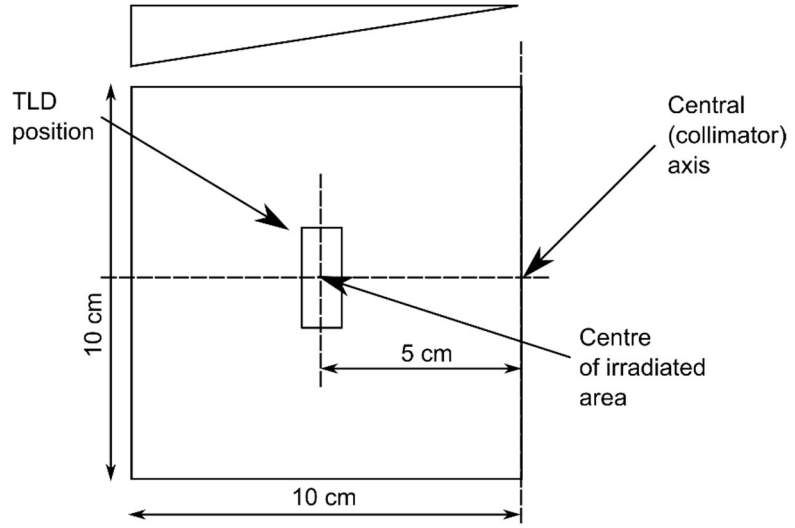


FIG. 14. Set-up for half blocked wedged field, where asymmetric collimators are available.

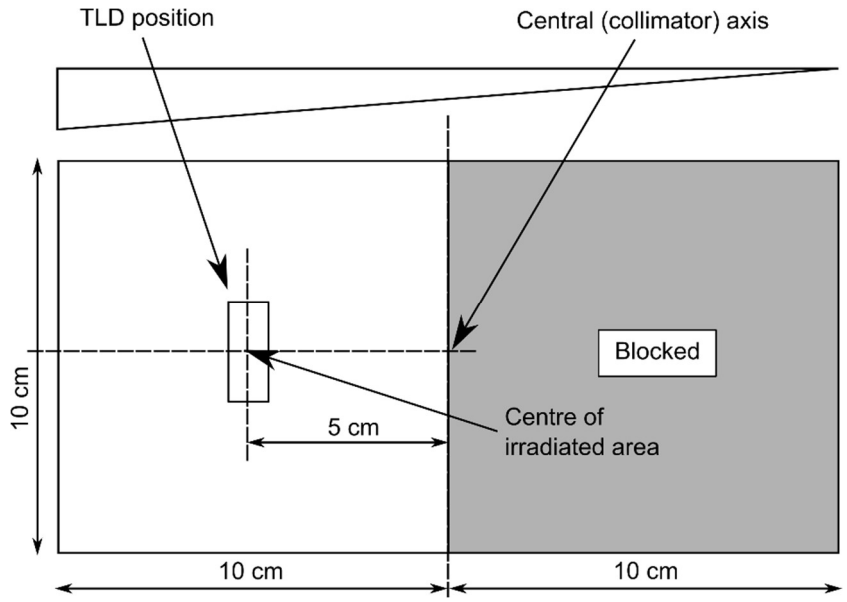


FIG. 15: Set-up for half blocked wedged field, where asymmetric collimators are NOT available, and blocking is used.

3. Select Box ‘HBB’.
4. Insert the blue TLD capsule from this box into the appropriate off-axis hole of the holder, i.e. in the point along the arm in the field (see Fig. 14).
5. Position the holder, with the TLD inserted, in the water, making sure that the tube of the holder and the arm are completely filled with water (no air bubbles).
6. Align the holder tube with the central (collimator) axis and align the arm along the major axis of the half-beam blocked field following Fig. 14.
7. Before irradiation, recheck that the alignment, field size, water level and distance are correct (see Fig. 14).
8. Irradiate the TLD capsule with the number of monitor units as calculated above to deliver 2 Gy to it.
9. Remove the capsule from the holder, wipe it dry and replace it in Box ‘HBB’.

H. Absorbed dose measurements with an ionization chamber (additional request for medical physicists)

Determine experimentally the absorbed dose to water in the reference conditions (symmetric field size 10 cm × 10 cm) for this beam according to your usual dosimetry protocol and complete the data sheet.

[DAN LETTERHEAD]

TLD POSTAL DOSE QUALITY AUDIT FOR Co-60 γ-BEAMS

DATA SHEET

Step 3: Reference and non-reference conditions off-axis

PART 2. ASYMMETRIC FIELDS

It is of 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

Has Step 3, Part 1, TLD audit for photon beams in reference and non-reference conditions on- and off-axis: symmetric fields, been successfully completed.

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 Co-60 treatment unit used for this audit is of the type

.....

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

installed in the year .....

and the date of the last source replacement is .....

B. Irradiation of the TLD capsules for the reference measurement

(see Sections B and C of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

day *month* *year*

The TLD capsules were irradiated at 10 cm depth in water using a 10 cm × 10 cm field at a distance

SSD = ……cm		SAD = ……...cm
fixed source skin distance	**OR**	fixed source axis distance
SSD set-up		*isocentric set-up*

For the different TLD capsules, the irradiation time (in minutes) and the dose delivered[3] (in grays) were:

TLD 1	t = ... min	D = ...Gy
TLD 2	t = ... min	D = ...Gy

C. Calculation of time setting for the reference measurement

Provide the data used for calculation of time setting for the TLD irradiation.

Please give detailed explanation of your procedure for the above time and dose calculation. Please provide all factors (beam output, any conversion or correction factors, etc.) you have used:

.....

.....

.....

.....

Beam output (*units*) as stated for your clinical data: ..... [.....] |__|__| |__|__| |__|__|__|__|

day *month* *year*

Please explain in detail the irradiation conditions for which this clinical beam output applies (e.g. in-air or depth in water, SAD or SSD, field size):

.....

.....

.....

.....

D. Irradiation of the TLD capsules for asymmetric field measurements

D.1. Open asymmetric field measurement

(see Sections D and E.1 of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

day *month* *year*

[3] Please adjust your irradiation time to get the absorbed dose as close as possible to 2 Gy (200 cGy).

The TLD capsules were irradiated at 10 cm depth in water using a 10 cm × 10 cm asymmetric field (as in Fig. 8 or 9 of the Instruction Sheet) at:

SSD = ……cm		SAD = ……...cm
fixed source surface distance	**OR**	fixed source axis distance
SSD set-up		*Isocentric set-up*

For these TLD capsules the irradiation time to deliver 2 Gy to the red capsule on the central (collimator) axis was:

Open asymmetric field	t = ... min
'Red' capsule on central (collimator) axis	D = ... Gy
'Blue' capsule off central axis	D = ... Gy

D.2. Wedged asymmetric field measurement

(see Sections D and E.2 of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

The TLD capsules were irradiated at 10 cm depth in water using a wedged 10 cm × 10 cm asymmetric field (as in Fig. 10 or 11 of the Instruction Sheet) at:

SSD = ……cm		SAD = ……...cm
fixed source surface distance	**OR**	fixed source axis distance
SSD set-up		*Isocentric set-up*

Nominal wedge angle: ..... degrees

For these TLD capsules the irradiation time to deliver 2 Gy to the red capsule on the central (collimator) axis was:

Wedged asymmetric field	t = ... min
'Red' capsule on central (collimator) axis	D = ... Gy
'Blue' capsule off axis (thick part of the wedge)	D = ... Gy

E. Calculation of doses for the open and wedged asymmetric field irradiations

Provide the data used for calculation of the irradiation times and doses on and off-axis for the TLD irradiations.

Please give a detailed explanation of your procedure for the above calculations. Please provide data from the TPS or factors (relative beam output, off-axis ratios, wedge factor, etc.), you have used in the manual calculation:

Open asymmetric field:

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

Wedged asymmetric field:

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

F. Irradiation of the TLD capsule for open half-beam blocked field measurement

(see Sections F and G.1 of the Instruction Sheet)

The TLD capsule was irradiated on the following date :

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

The TLD capsule was irradiated at 10 cm depth in water using a 10 cm × 10 cm half-beam blocked field (Fig. 14 or 15 of the Instruction Sheet) at a distance

SSD = ……cm		SAD = ……...cm
fixed source surface distance	**OR**	fixed source axis distance
SSD set-up		*Isocentric set-up*

For this TLD capsule the irradiation time to deliver 2 Gy to it, at the centre of the irradiated field was:

Open half-beam blocked field	t = ... min
‘Green’ capsule off the central axis	D = ... Gy

G. Calculation of dose for the open half-beam blocked field irradiation

Provide the data used for calculation of the irradiation time and dose off-axis at the position of the TLD.

Please give a detailed explanation of your procedure for the above calculations. Please provide data from the TPS or factors (relative beam output, off-axis ratios, etc.), you have used in the manual calculation:

Open half-beam blocked field:

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

ADDITIONAL REQUEST FOR MEDICAL PHYSICISTS

Determination of the absorbed dose to water by ionization chamber in reference conditions

Measurements were performed by

.....

name *position*

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

The absorbed dose rate to water in this beam was determined by using a dosimeter system composed of an ionization chamber .....
manufacturer *model*

and an electrometer.....
manufacturer *model*

The Co- 60 calibration factor of the dosimeter system (**ionization chamber <u>together</u> with electrometer**) was:

..... R/scale unit (exposure calibration factor N_X)
or ..... Gy/scale unit (air kerma calibration factor N_K)
or ..... Gy/scale unit (absorbed dose to water calibration factor $N_{D,w}$).

The above stated calibration factor was determined by the following laboratory/ manufacturer..... on the following date .....
and refers to a temperature of .....°C and a pressure [*units*] of..... [.....].
The absorbed dose to water in this beam was measured under the following conditions:

a) for measurements in phantom

☐ water ☐ plastic – *please specify material*.....
field size: ..... cm × ..... cm
distance:
SSD = ……
SSD set-up

b) for measurements in air:
build-up cap .....
material *thickness*

Please give your reading results:
Average reading ..... [*scale units*]
Measurement performed during ..... min
Temperature.....°c
Pressure [*units*] ..... [.....]
Electrometer scale .....
Polarizing voltage .....

The absorbed dose rate to water in this beam was determined using the following code of practice (dosimetry protocol):

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

Please give a detailed explanation of your procedure to determine the dose at the position of the centre of the TLD capsule based on the measurement described above. Please provide all factors you have used:

.....
.....

.....
.....
.....
.....
.....
.....
.....
and, if any, the shutter correction (timer error) applied was .....

[DAN LETTERHEAD]

TLD POSTAL DOSE QUALITY AUDIT FOR MEGAVOLTAGE X RAY BEAMS

DATA SHEET

Step 3: Reference and non-reference conditions on- and off-axis

PART 2: ASYMMETRIC FIELDS

It is of 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

Has Step 3, part 1, TLD audit for photon beams in reference and non-reference conditions on- and off-axis: symmetric fields, been successfully completed.

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: .....

B. Irradiation of the TLD capsules for the reference measurement

The TLD capsules were irradiated on the following date :

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

day *month* *year*

The TLD capsules were irradiated at 10 cm depth in water using a 10 cm × 10 cm field at:

SSD = ……cm		SAD = ……...cm
fixed source surface distance	**OR**	fixed source axis distance
SSD set-up		*Isocentric set-up*

For the different TLD capsules, the monitor setting (in MU) and the dose delivered[4] (in grays) were:

TLD 1: ..... MU D = ... Gy

TLD 2: ..... MU D = ... Gy

C. Calculation of monitor setting for reference irradiations

Provide the data used for calculation of monitor unit (MU) setting for the TLD irradiation.

Please give a detailed explanation of your procedure for the above MU and dose calculation. Please provide all factors (beam output, any conversion or correction factors, etc.) you have used:

.....

.....

.....

.....

.....

Beam output as stated for your clinical data: ..... [Gy/100 MU] |__|__| |__|__| |__|__|__|__|

day *month* *year*

Please explain in detail the irradiation conditions for which this clinical beam output applies (e.g. depth in water, SAD or SSD, field size):

.....

.....

.....

.....

.....

[4] Please adjust your monitor unit (MU) setting to get absorbed dose to the TLD capsule as close as possible to 2 Gy (200 cGy).

D. Irradiation of the TLD capsules for asymmetric field measurements

D.1. Open asymmetric field measurement

(see Sections D and E.1 of the Instruction Sheet)

The TLD capsules were irradiated on the following date: |__|__| |__|__| |__|__|__|__|
day *month* *year*

The TLD capsules were irradiated at 10 cm depth in water using a 10 cm × 10 cm asymmetric field (Fig. 8 or 9 of the Instruction Sheet) at:

SSD = ……cm		SAD = ……...cm
fixed source surface distance	**OR**	fixed source axis distance
SSD set-up		*Isocentric set-up*

For these TLD capsules the monitor setting (in MU) and the dose delivered (in grays) to the red capsule on the central (collimator) axis were:

Open asymmetric field 1 ..... MU
'Red' capsule on central (collimator) axis D = ... Gy
'Blue' capsule off central axis D = ... Gy

D.2. Wedged asymmetric field measurement

(see sections D and E.2 of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

The TLD capsules were irradiated at 10 cm depth in water using a wedged 10 cm × 10 cm asymmetric field (Fig. 10 or 11 of the Instruction Sheet) at:

SSD = ……cm		SAD = ……...cm
fixed source surface distance	**OR**	fixed source axis distance
SSD set-up		*Isocentric set-up*

Nominal wedge angle: ..... degrees

For these TLD capsules the monitor setting (in MU) and the dose delivered (in grays) to the red capsule on the central (collimator) axis were:

Wedge asymmetric field .....MU
'Red' capsule on the central (collimator) axis D =.....Gy
'Blue' capsule off the central axis (thick part of the wedge) D =.....Gy

E. Calculation of doses for the open and wedged asymmetric field irradiations

Provide the data used for calculation of monitor unit (MU) settings and doses on- and off-axis for the TLD irradiations.

Please give a detailed explanation of your procedure for the above calculations. Please provide data from the TPS or factors (relative beam output, off-axis ratios, wedge factor, etc.), you have used in the manual calculation:

Open asymmetric field:

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

Wedged asymmetric field

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

F. Irradiation of the TLD capsule for half-beam blocked field measurements

F.1. Open half-beam blocked field measurement

(see Sections F and G.1 of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

The TLD capsule was irradiated at 10 cm depth in water using a 10 cm × 10 cm half-beam blocked open field (Fig. 14 or 15 of the Instruction Sheet) at a distance

SSD = ……cm		SAD = ……...cm
fixed source surface distance	**OR**	fixed source axis distance
SSD set-up		*Isocentric set-up*

For this TLD capsule the monitor setting (in MU) and the dose delivered (in grays) to the green capsule at the centre of the irradiated field were:

Open half-beam blocked field ..... MU
'Green' capsule off the central axis D =..... Gy

F.2. Wedged half-beam blocked field measurement

(see Sections F and G.2 of the Instruction Sheet)

The TLD capsules were irradiated on the following date:

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

The TLD capsule was irradiated at 10 cm depth in water using a 10 cm × 10 cm wedged half-beam blocked field (Fig. 16 of the Instruction Sheet) at a distance

SSD = ……cm		SAD = ……...cm
fixed source surface distance	**OR**	fixed source axis distance
SSD set-up		*Isocentric set-up*

Nominal wedge angle: .....degrees

For this TLD capsule the monitor setting (in MU) and the dose delivered (in grays) to the blue capsule at the centre of the irradiated field were:

Wedged half-beam blocked field ..... MU
'Blue' capsule off the central axis (thick part of the wedge) D = ... Gy

G. Calculation of doses for the open and wedged half-beam blocked field irradiations

Provide the data used for calculation of the monitor unit (MU) settings and doses off-axis at the position of the TLD.

Please give a detailed explanation of your procedure for the above calculations. Please provide data from the TPS or factors (relative beam output, off-axis ratios, wedge factor, etc.), you have used in the manual calculation:

Open half-beam blocked field:

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

Wedged half-beam blocked field:

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

ADDITIONAL REQUEST FOR MEDICAL PHYSICISTS

Determination of the absorbed dose to water by ionization chamber in the reference conditions
Measurements were performed by

Measurements were performed by

.....

name *position*

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

The absorbed dose rate to water in this beam was determined by using a dosimeter system composed of an ionization chamber .....
manufacturer *model*
and an electrometer.....
manufacturer *model*

The Co-60 calibration factor of the dosimeter system (**ionization chamber TOGETHER with electrometer**) was:
..... R/scale unit (exposure calibration factor N_X)
or ..... Gy/scale unit (air kerma calibration factor N_K)
or ..... Gy/scale unit (absorbed dose to water calibration factor $N_{D,w}$).

If any other calibration factor was used please specify:
.....

The above stated calibration factor was determined by the following laboratory/ manufacturer..... on the following date ..... and refers to a temperature of .....°C and a pressure [*units*] of..... [.....].

The absorbed dose to water in this beam was measured under the following conditions:
☐ water phantom ☐ plastic – *please specify material* .....
field size: ..... cm × ..... cm
distance:
SSD = …… **OR** SAD = ……...
SSD set-up *Isocentric set-up*

The depth of ☐ the geometrical centre **or** ☐ the P_{eff} of the ionization chamber in phantom was ……. cm.
Please give your reading results:

Please give your reading results:
Average reading ..... [*scale units*]
Measurement performed during..... mu
Temperature.....°c
Pressure [*units*]..... [.....]
Electrometer scale.....
Electrometer voltage .....

The absorbed dose to water per MU in this beam was determined by the following code of practice (dosimetry protocol)
.....
.....
.....
.....
.....
.....

Please give a detailed explanation of your procedure to determine the dose at the position of the centre of the TLD capsule based on the measurement described above. Please provide all factors you have used:

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

STEP 3 AUDIT CERTIFICATE

RESTRICTED

[DAN letterhead]

[DAN] TLD POSTAL DOSE QUALITY AUDIT

Institution: *Institution name*
Address: *Institution address*

Country: *Country name*

TLD batch no: *xxx*
TLDs irradiated by: *Name*
Date of irradiation: *yyyy-mm-dd*
Evaluation: *yyyy-mm-dd*

STEP 3: RESULTS OF TLD MEASUREMENTS FOR Co-60 AND HIGH-ENERGY PHOTON BEAMS

Radiation unit	Beam	Field [cm × cm]	TLD Box/Code	User stated dose [Gy]	DAN (measured) dose [Gy]*	DAN mean dose [Gy]*	% deviation relative** to DAN mean dose	DAN mean dose / User stated dose

* 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. A relative deviation with negative (positive) sign indicates that the user estimates lower (higher) dose than what is measured; a patient would therefore receive higher (lower) dose than what is intended by the factor given in the last column.
Agreement within ±*x*% between the user stated dose and the [DAN] measured dose is considered satisfactory.

Signature
……...
[TLD Officer] – [DAN]

Date:
yyyy-mm-dd

Signature
……
Head – [DAN]

IMPORTANT NOTICE: This information is provided only as an independent verification of beam output and not as a machine calibration, nor as an alternative to frequent calibrations by a qualified physicist. **IT DOES NOT CONSTITUTE A STATEMENT WITH REGARD TO THE QUALITY OF RADIOTHERAPY TREATMENTS.**