

IROC Liver Phantom

Guidelines for *Planning and Irradiating* the IROC Liver Phantom.

Revised MARCH 2014

The study groups are requests that each institution keep the phantom for no more than 2 weeks. During this two-week period, the institution will image, plan, and irradiate the phantom and return it to the Imaging and Radiation Oncology Core Houston (IROC). Thank you for your cooperation with this constraint. This phantom has been designed and constructed by the IROC. The IROC phantom contains an imaging

and dosimetric insert. The insert contain two targets. There are two orthogonal sheets of radiochromic film passing through the center of the target and one TLD capsule within 0.5 cm of the center of each target. The phantom also contains normal structures: one to the left of the insert and the other to the right of the insert. Each structure holds a TLD capsule.

If you have any questions, please contact the appropriate person.

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DOSIMETRY INFORMATION TO BE SUBMITTED:

The following information is to be submitted to the IROC (include in the shipping box):

- Original hard-copy isodose distributions in the coronal and sagittal planes through the target center. Please ensure that each plane fills an entire page and that a scale is printed on the page.
- A completed **IROC IMRT Liver Phantom Institution Information** form.
- A copy of results of all film and ion chamber QA measurements.

The following information is to be submitted to the IROC:

Please follow the login URL: <https://mdandersonorg.sharefile.com> and the log in information below to submit the digital treatment planning data in the DICOM format which includes all CT slices that were used in contouring with **one** three dimensional dose file (dose grid) (RD), **one** structure (RS) and **one** plan files (RP) for each of your PTV's.

Username: trangnguyen@mdanderson.org

Password: Phantom8989

- Click on folder named **IROC Liver Folder**; select the **Add Folder** tab on the top right hand side of the screen. In the **folder name** box, enter your institution name, city and state, as shown in the example, then click **Create Folder**. Create one folder for **PTV1** and another for **PTV2**.
- Select the folder that you have created, then select **Upload Files** tab on the right hand side. In the Details box please type in **phantom type, irradiation date, and physicist name**. Follow the instruction and upload your file. **Select Send email notification box when done**. Lastly Click Upload Files.
- Please log out once you finish and inform IROC by email camador@mdanderson.org otherwise results will be delayed.

DOSE PRESCRIPTION:

Only photon beams with nominal energies equal to or higher than 6 MV are allowed. A minimum of 5 beams angles is strongly recommended. IGRT is mandatory.

Heterogeneity corrections approved by the ATC must be used. The prescribed dose to each target is 6 Gy. The prescription isodose line is planned to encompass 95% of PTV. A composite plan demonstrating the composite doses to the target volumes, liver and normal tissues must be submitted.

PTV:

- **CTV = GTV** (Note that this differs from the protocol). PTV = GTV + 0.4 cm minimum in all. The tumors will be labeled GTV1 and PTV1 for the tumor towards the superior portion and GTV2 and PTV2 for the tumor towards the inferior portion of the phantom.
- Prescribed dose of 6 Gy to PTV1 and PTV2.

- Maximum dose of 9 Gy allowed within the PTV. Maximum dose of 7.2 Gy allowed outside the PTV
- DVHs shall be calculated for the liver (liver minus the GTV), each normal structure and each target lesions (CTV and PTV).
- Critical Normal Structures
Constraints over the normal structures are specified in the following table

Normal structure	Volume	Dose
Normal structure	10%	≤ 1.2 Gy
Normal liver	70%	≤ 1.2 Gy

The phantom should be imaged, planned and irradiated as if it were an actual protocol patient, incorporating all of your customary quality assurance checks.

- Material included in box for the phantom:
Liver Phantom, with 3 TLD capsules taped to the shell (1 on left side, 1 on right side and 1 on anterior side)
Dosimetric insert
Rubber hose
Two acrylic rod containing TLD in one of the ends,
Envelope with background film and TLD (hidden from your view; please don't try to find it)
Traditional IROC TLD block and irradiation table.
(Please irradiate this at the time you irradiate the phantom.)
- Material included in box for the reciprocating platform (If needed by institution):
Motor driver
Motor to platform linkage
2D Reciprocating platform

If reciprocating platform is not used, avoid points 6, 7, 9, 11, 17, 19, 23

Procedures:

1. Fill the phantom with water:
 - 1.1. Thread the rubber hose into the filler hole placed on the base of the phantom.
 - 1.2. Fill slowly with water (the rubber hose stretches over most faucets). There is a breathing hole on the phantom, make sure it is open, to allow the pressure to release. You may need to jiggle the phantom to release air trapped inside the cavity.
 - 1.3. Remove hose and replace acrylic screw.
2. Allow the phantom to sit with water in it for 10 min. to check for leaks.
3. Look in the insert space and check for water leakage. If you find any water call the IROC. If not, proceed to the next step.
4. Position the insert. Make sure that the insert is in its correct position by making small rotations of the insert around its central axis. When it is in the correct position it will **lock** in place by an indentation at the base of the insert.
5. Position the acrylic rods in each one of the holes following the color code. Insert the side with the screw. You will see a TLD capsule in each one of the cavities closed with the screw.
6. Assemble the 2D reciprocating platform and motor drive system per the attached instructions. Assemble it on the CT couch so that the phantom and the platform can be imaged.
7. The motor driver for the platform will have been programmed to simulate the manner in which your institution instructs its patients to breathe during the 4D CT.
8. Position and CT the phantom as you would a patient. **You may wish to scan with 1.5 mm slices especially near the target to better identify the TLD capsules.** NOTE: There are TLD on the external shell of the phantom to give us an estimate of the CT dose to the target.
9. Turn on the motor drive and acquire your CT images for treatment planning. Turn off motor driver once CT process is completed. Disassemble the reciprocating platform.
10. Remove all inserts from the phantom during planning process. **REMOVE WATER FROM PHANTOM.** Store phantom and inserts in a dry place. Store insert and phantom where they will not be irradiate.
11. Segment the phantom images contouring the skin, liver, normal structures and PTVs. Note that the CTV = GTV. PTV = GTV + 0.4 cm(minimum). Also contour all the TLD volumes. Please use the following names for these contours:
 - PTV1_TLD for the TLD within the PTV1,
 - PTV2_TLD for the TLD within the PTV2,
 - NSLT_TLD for the TLD within the normal structure on the left side
 - NSRT_TLD for the TLD within the normal structure on the right side
 - The dimensions of the TLD volume are approximately 10 mm long by 2 mm diameter
 - The outside dimensions of the TLD capsules are 15 mm long by 4 mm diameter; the TLD axis is normal to the axial plane. (The capsules and the TLD should be visible on CT image)
12. Plan the treatment as specified in the DOSE PRESCRIPTION above.
13. Repeat steps 1 and 2.
14. Look in the insert space and check for water leakage. If you find any water call the IROC. If not, follow the instructions in step 5 to position the insert again and proceed to the next step.
15. Perform your customary QA of the plan prior to irradiating the phantom.
16. Irradiate the IROC TLD block according to the instructions provided.
17. Assemble the 2D reciprocating platform and motor drive system per the attached instructions. Assemble it on the treatment machine couch so that the phantom and the platform can be irradiated.
18. Position the phantom as you would a protocol patient. Try to avoid positioning the axial film at the abutment of adjacent MLC leaves or adjacent arcs. Abutting fields or leaves on the film may increase the uncertainty of the measurement.
19. Turn on the motor drive.
20. Perform all the verification needed to confirm the final position of the phantom.

21. **REMOVE THE TLD CAPSULES LOCATED ON THE EXTERNAL SHELL.** Put them into the designated container.
22. Irradiate the phantom with the developed plan.
23. Turn off the motor drive and put each part of the motion table into its shipping box.
24. Remove the insert and place it in the box.
25. Remove the acrylic rods from holes and place them in the box.
26. Please verify that there is no water in the insert space. If you find any water call the IROC.
27. Remove the screw on the base of the phantom and drain the water from the phantom.
28. Put all the material set in their boxes.
29. Make sure that the container with the external TLD's and the rubber hose are in the box.
30. Include the dosimetry data discussed above. Complete the attached forms. Be sure to include the scale used on the images coming from your TPS.
31. Return the complete package to IROC Houston. Return labels were included.

IROC Liver Phantom Institution Information

(Original to IROC)

Institution: _____

Address: _____

Person performing irradiation: _____

Person to receive report: _____

Oncologist to receive report: _____

Person to call in case of questions: _____

Phone Number: _____ Fax Number: _____

Email address: _____

Treatment Unit:

Manufacturer: _____ Model: _____

In-house specification: _____ Serial Number: _____

Photon Energy Nom _____(MV) __regular __SRS __FFF

Technique used: 3D-CRT: _____ IMRT: _____

If IMRT, Intensity Modulation Device:

___ MIMIC ___ Multileaf Collimator ___ Solid Attenuator Modulation ___ Other: _____

If IMRT, IMRT Technique:

☐ Segmental (step and shoot) MLC ☐ Dynamic MLC ☐ Intensity Modulated Arc Therapy (IMAT)

☐ CyberKnife ☐ TomoTherapy ☐ VMAT Other: _____

Please enclose original copies of your treatment plans. Include the coronal, axial and sagittal planes through the target center. Include scaling factors for each plane.

Treatment Planning System:

Manufacturer: _____ Model: _____

Software: _____ Version Number: _____

Algorithm used for dose calculation: _____

Total number of MU's: _____

Total number of segments: _____

Method to Account for Respiratory Induced Target Motion (If applicable):

Please describe your method:

___ Gating ___ Breath hold ___ ITV ___ Tracking

Number of isocenters for final plan (please check):

One: _____ Two: _____

Please enclose original copies of your treatment plans. Include the coronal, axial and sagittal planes through the target center. Include scaling factors for each plane.

Treatment of Phantom:

Date of Irradiation: _____

Dose specified is to: ☐ Muscle ☐ Water

Indicate the dose delivered to the TLD as determined by your treatment planning computer

TLD	Mean Dose (Gy)	Min. Dose (Gy)	Max. Dose (Gy)
PTV1_TLD			
PTV2_TLD			
NSLT_TLD			
NSRT_TLD			

Results of the QA: _____

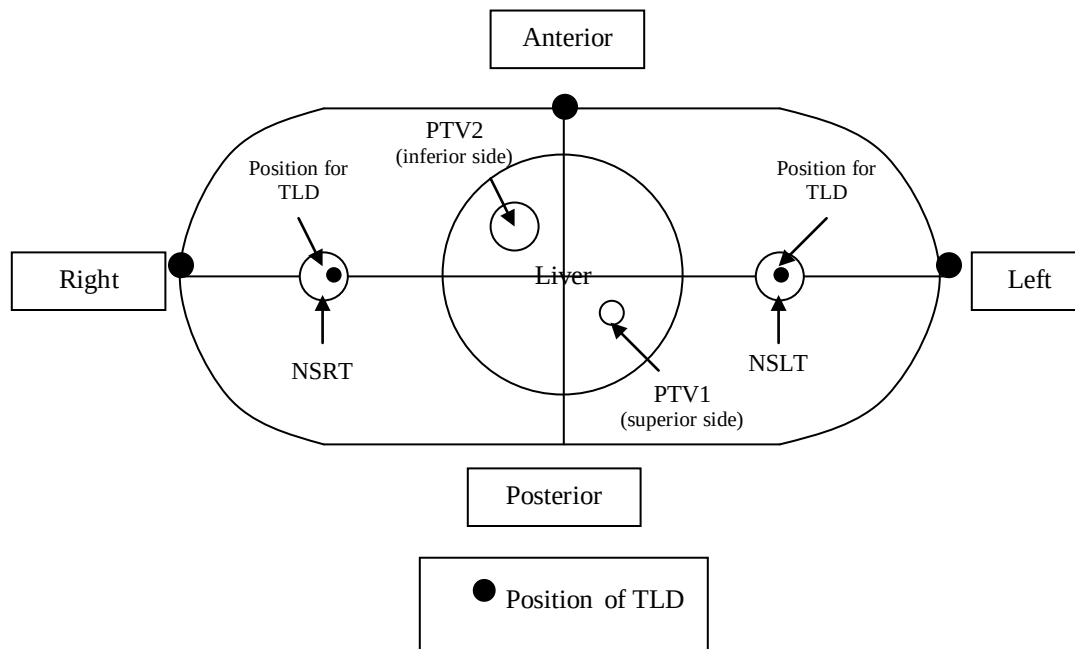
Did you adjust the MU based on these results?_____ If so, how much?_____

Attach copies of the treatment plan including slices in the sagittal, axial and coronal film planes.

Comments: _____

For Office Use Only 	TLD Batch B11	Film Batch A112912201	Phantom ID # PL-	Code	Date Sent	Date Rec'd
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This is a cross sectional view of the phantom.



Note: Please ignore all markings on the external shell of the phantom, use your own system to position the phantom and remove when done.

Note:

1. You need to deliver 6 Gy to each PTV (in 1 or more fractions).
2. If utilizing reciprocating platform, please take it into account during planning.

*Good Luck from the
Phantom team @ IROC HOUSTON*