IMSure QA™ Software

Machine and Physics Data Guide

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STANDARD IMAGING

Most data required for IMSure QA is similar to that normally acquired in the commissioning process of a linear accelerator. With all data readily available an entire dual energy machine can be set up in as little as a half hour. The items needed for machine data configuration are listed below.

Items like machine names, configuration, tray factors and calibration specifications can be entered directly in the Physics Module. Tabular data such as TMR, PDD, OCR, OF and Sc must be imported from CSV format files as specified at the end of this guide. Some consistency rules apply to the imported data as listed in Table B.

Other machine parameters such as jaw distances, rotation configurations, and average MLC leaf leakages are needed as defined in Table A. Jaw distances are common for all available machines and can be noted from our sample data or from Table C on page 4. Leaf leakages are also fairly uniform from machine to machine, and this parameter may also be used to make small corrections in final IMSure QA IMRT results.

As many photon and electron energies along with their respective wedges and cones can be entered (i.e., both upper and lower wedges, even old-fashioned split wedges and half beam blocks).

Table A: Machine Names, Configurations, Parameters and Data used in IMSure QA

Names and Configurations	
Import Machine Name	Must match exactly the name used in the imported RTP or DICOM-RT convention
Abbreviated Name	Short name for printouts
Manufacturer	(optional)
Machine Model	(optional)
Serial Number	(optional)
Location	(optional)
Nominal SAD	Typically 100 cm
Nominal Gap	Typically 5 cm – describes the distance from the bottom of the cone to patient surface at 100 SSD
Beam Energy	Nominal in MV (photon), MeV (electron)
Nominal d_{MAX}	In cm
Calibration Reference Depth	Depth at which the calibrated does rate is set, in cm.
Calibration Field Size (Photons Only)	In cm, typically 10 cm
Calibration Cone Size (Electrons Only)	Choose from drop down list of available cones
Calibration Phantom Distance	In cm, typically 100 cm
Diode Calibration Factor	Calibration factor for diodes used with this energy
MLC Type	Choose your MLC configuration from drop down list
Wedge Name (Photons Only)	Common Wedge name for hard wedges (e.g. 15 deg). A default wedge named 'Open Field' must be present for all Photon energies
Wedge Angle (Photons Only)	The numerical value for the wedge angle. Must match the value used in the imported RTP or DICOM-RT convention.
Cone Name	Common Cone name for electron cones (e.g. A10).
Cone Size	The numeric value of the cone that describes it's dimension in both the X and Y directions (in cm)
Machine Geometry – IMSure QA defaults to the IEC 1217 Convention	
Base Gantry Rotation	IEC 1217 Convention describes 0 degrees as the Gantry pointing down. If your system describes 0 degrees as the Gantry pointing up you would insert 180 to let IMSure QA know that your coordinate system is set 180 degrees from the IEC standard.
Gantry Rotation Direction	IEC 1217 Convention describes Gantry rotation increasing clockwise (CW) if facing the Gantry from the foot of the couch. 90 degrees will be with the head of the accelerator to the right if facing the gantry from the foot of the couch.
Base Collimator Rotation	IEC 1217 Convention describes 0 degrees as pointing towards the foot of the couch. If your system describes 0 degrees as pointing towards the Gantry you would insert 180 to let IMSure QA know that your coordinate system is set 180 degrees from the IEC standard.
Collimator Rotation Direction	IEC 1217 Convention describes Collimator rotation increasing clockwise (CW) if facing the collimator while lying on the table in standard HFS position. 90 degrees would then be facing your right hand in the HFS position
Base Table Rotation	IEC 1217 Convention describes 0 degrees as the head of the table. If your system describes 0 degrees as the foot of the table you would insert 180 to let IMSure QA know that your coordinate system is set 180 degrees from the IEC standard.
Table Rotation Direction	IEC 1217 Convention describes Table Rotation increasing clockwise (CW) as looking up at the bottom of the table. 90 degrees would have the head of the table to the left if facing the Gantry.
Jaw Naming Conventions	May differ between manufacturers. Two alphanumeric characters allowed
Jaw limits	Machine dependent, may include over-travel. Specified for both upper and lower jaws.
Allowed Field Size Limits	May differ for Open and wedged data. May be specified in rectangular form, as for most hard wedges.
Jaw Transmission Factors	(for future use)
Source to Jaw Distances	See table C
Allowed EDW wedge angles	Any of 10, 15, 20, 25, 30, 45 and 60 degrees may be chosen
Source to MLC distances	See table C
Allowed Wedge Directions	Refers to the thin end (toe) of wedge
Measurements and parameters	
Calibration Dose Rate	In cGy/MU, at Calibration Depth and at Calibration Phantom distance
Tray Factor (Photons Only)	Tray Field/Open Field – less than 1.000

Mean Dose Leaf Leakage (Photon Only)	Used in 3-source model. Typically between 1 and 3 %.
Mean Fluence Map Leaf Leakage (Photon Only)	Used in 3-source model. Typically between 1 and 3%. Used in map comparisons.
Dosimetric Leaf Offset (Photon Only)	The distance from the light field edge of an MLC leaf to the radiation field edge.
EDW data (Photon Only)	Derived from STT. User must choose STT energy.
Wedge Factor (Photon Only)	At calibration field size (usually 10x10). Defined as the ratio of the measured values of the wedged field at reference depth over the similar open field.
Output Factor (Electron Only)	The ratio of the dose at the reference depth for the indicated cone versus the dose at reference depth for the reference cone.
VSSD (Electron Only)	Virtual Source to Surface Distance can be measured and used reliably over short ranges for extended distance use.
Tabular Input Data	Tables below must be read in from CSV (comma delimited) files set up in proprietary IMSure QA format.
TMR (Photons)	See discussion below
PDD (Electrons)	"
OCR (Photons and Electrons)	"
OF (Photons)	"
CF (Electrons)	"
Head Scatter, Sc (Photons)	"

All tabular data can be read into IMSure QA from a comma delimited file (see format below or the Sample Data CD-ROM for samples). The CSV file format was chosen because it is easily manipulated in Excel spreadsheets.

What data is needed?

The physics data required for setting up IMSure is similar to the data that is acquired during commissioning a linear accelerator. Therefore most people will already have the necessary information. All data needs to be setup in a proprietary .csv (comma delimited) format that can easily be created with Microsoft Excel. Examples of these files can be found in the Sample Data folder that installs in the IMSure 3.1 directory (see pg. 9 of user manual)

Photon Open field data

- TMR – Tissue Maximum Ratios
  - From smallest to largest fields size with a 0 field size extrapolated from available data. See the IMSure technical note available from the Standard Imaging website titled, "Obtaining and extrapolating data for IMSure calculations".
  - TMR must be normalized to the d_{MAX} value and should encompass all clinically relevant depths
- OCR – Off-center Ratios (also known as Off-axis ratios)
  - Only the largest field size is needed, e.g. 40 cm
  - Ideally OCR is measured at 100 cm SSD and at multiple depths including d_{MAX}, e.g. $d_{MAX,}$ 5cm, 10cm, 15cm, 20cm, 30cm
  - OCR data must be normalized to the central axis
- OF – Output Factors
  - The algorithms in IMSure require that output factors be measured or re-calculated to an SAD setup geometry and d_{MAX} depth
    - For output factors measured at a different depth, IMSure will automatically re-calculate the output factors to the required setup geometry as long as the geometry is specified in the setup and TMR tables have been previously imported (see pg. 13 of user manual)
  - The output factors should be measured for the smallest to largest possible square fields and normalized to the 10x10 field size. A zero field size output factor needs to be extrapolated for the model. See the IMSure technical note available from the Standard Imaging website titled, "Obtaining and extrapolating data for IMSure calculations". A typical OF table will look like this:

FS	OF	OF ref	PSF
0.00	0.847	0.847	0.953
2.00	0.887	0.887	0.963
3.00	0.908	0.908	0.968
4.00	0.928	0.928	0.974
5.00	0.948	0.948	0.983
6.00	0.962	0.962	0.987
7.00	0.973	0.973	0.990
8.00	0.983	0.983	0.993
9.00	0.992	0.992	0.997
10.00	1.000	1.000	1.000
12.00	1.015	1.015	1.007
15.00	1.033	1.033	1.017
17.00	1.043	1.043	1.023
20.00	1.057	1.057	1.030
25.00	1.073	1.073	1.040
30.00	1.085	1.085	1.046
35.00	1.093	1.093	1.050
40.00	1.099	1.099	1.053

- Sc – Head Scatter Factors
  - Sc is measured for each field size at isocenter (SAD) with an appropriate buildup cap of at least d_{MAX} effective radius over the measurement chamber. Sc is normalized to the calibration field size (10x10). Clean data at every cm below 10x10 will provide the best results for the 3-source model although measurements below 3 cm tend to be suspect due to the difficulty of accurately measuring fields this small. A zero field size head scatter factor needs to be extrapolated for the model. See the IMSure technical note available from the Standard Imaging website titled, “Obtaining and extrapolating data for IMSure calculations”. A typical Sc table will look like this:

FS	Imported Factor	Computed Factor
0.00	0.888	0.909
2.00	0.922	0.930
3.00	0.938	0.943
4.00	0.953	0.955
5.00	0.965	0.968
6.00	0.975	0.976
7.00	0.983	0.984
8.00	0.990	0.990
9.00	0.995	0.995
10.00	1.000	1.000
12.00	1.008	1.007
15.00	1.016	1.017
17.00	1.020	1.021
20.00	1.026	1.027
25.00	1.032	1.033
30.00	1.037	1.037
35.00	1.041	1.039
40.00	1.044	1.041

Photon Wedge Data

- TMR – Tissue maximum Ratios
  - From smallest to largest fields size with a 0 field size extrapolated from available data. See the IMSure technical note available from the Standard Imaging website titled, “Obtaining and extrapolating data for IMSure calculations”.
  - TMR must be normalized to the d_{MAX} value and should encompass all clinically relevant depths
  - If the largest field size for the wedge is rectangular, e.g., 40 x 20 then the table should contain a field size of 26.67 (equivalent square of 40 x 20). An additional field of 40 cm should be added at the end of the table duplicating the 40 x 20 measurements as this is required for the model. A typical table would look like this:

DEPTHS \ FIELD SIZE	3.00	4.00	6.00	10.00	15.00	20.00	26.67	40.00
0.00	0.360	0.382	0.403	0.428	0.465	0.503	0.559	0.559
0.10	0.393	0.415	0.438	0.462	0.497	0.535	0.589	0.589
0.20	0.444	0.464	0.484	0.507	0.541	0.579	0.630	0.630
0.30	0.507	0.525	0.544	0.564	0.595	0.630	0.679	0.679
0.40	0.578	0.595	0.611	0.629	0.657	0.689	0.732	0.732
0.50	0.654	0.668	0.683	0.698	0.723	0.750	0.787	0.787
0.60	0.724	0.735	0.747	0.760	0.781	0.803	0.835	0.835
0.70	0.793	0.803	0.812	0.822	0.840	0.857	0.883	0.883
0.80	0.852	0.859	0.866	0.875	0.889	0.901	0.921	0.921
0.90	0.898	0.903	0.908	0.915	0.926	0.934	0.951	0.951
1.00	0.930	0.934	0.938	0.942	0.950	0.957	0.968	0.968
1.10	0.951	0.954	0.957	0.961	0.965	0.970	0.980	0.980
1.20	0.967	0.969	0.971	0.975	0.977	0.980	0.988	0.988
1.30	0.979	0.981	0.983	0.985	0.986	0.988	0.994	0.994
1.40	0.987	0.989	0.991	0.992	0.993	0.994	0.997	0.997
1.50	0.994	0.995	0.996	0.997	0.997	0.997	0.999	0.999
1.60	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
1.70	1.002	1.002	1.002	1.001	1.002	1.000	1.001	1.001

- OCR – Off-center Ratios (also known as Off-axis ratios)
  - Only the largest field size is needed, e.g. 40 cm.
  - Ideally OCR is measured at 100 cm SSD and at multiple depths including d_{MAX}, e.g. $d_{MAX,}$ 5cm, 10cm, 15cm, 20cm, 30cm.
  - OCR data must be normalized to the central axis
  - OCR data for wedges should be set up with the thick edge of the wedge oriented to the positive (right) axis of the off-axis distance, i.e., OCR’s greater than one should be to the negative (left) axis and OCR’s less than one should be to the positive (right) axis.
- OF – Output Factors
  - The algorithms in IMSure require that output factors be measured or re-calculated to a setup geometry of 100 cm SSD and d_{MAX} depth
- ▪ For output factors measured at a different setup, IMSure will automatically re-calculate the output factors to the required setup geometry as long as the geometry is specified in the setup and TMR tables have been previously imported (see pg. 13 of user manual)
  - The output factors should be measured for the smallest to largest possible square fields and normalized to the 10x10 field size. A zero field size output factor does not need to be extrapolated for the wedge.
  - An additional wedge factor for the 10x10 field size (relative to open field) is needed. Variation of the wedge factors with field size are accounted for in the output factor and collimator scatter tables of each wedge.

Enhanced Dynamic Wedge: The Enhanced Dynamic Wedge model is algorithmically based, and no additional data is needed.

Electron Data

- PDD – Percent Depth Dose tables
  - Should be measured down the central axis with the phantom surface at calibration phantom distance. PDD should be normalized to reference depth. IMSure QA has no requirements for the actual depths measured, but in typical use, measurements to the practical range for each energy are preferred (rule of thumb: ½ cm depth for each MeV of energy). IMSure QA will not extrapolate PDD, and will not compute dose or MU for points that lie outside of the PDD table.
- OCR – Off-center Ratios (also knows as Off-axis ratios)
  - Should be measured with the phantom surface at calibration phantom distance, and at several depths. OCR must be normalized to the central axis value for each depth.
  - In many clinical situations, electron dose will always be specified at the central axis. In this case, where the off axis distances would not be used, the user may choose to use the default single point OAR, which is specified as 1.000 at the reference depth and central axis. IMSure QA will only allow the user to enter off-axis distances that are contained in this table, and in this case, the user will only be able to enter x and y calculation points as 0,0.
- CF – Cutout Factor Table
  - Should be measured for each cone and energy, with the surface of the phantom at calibration phantom distance, and the chamber at calibration reference depth.
  - A series of cutout apertures should be made for each cone, in 10-20% increments, down to 40-60% for the smallest aperture. For example, a 6x6 cone might have 3x3, 4x4, and 5x5 cutouts (and 6x6, by default). A 20x20 cone might range have 10, 12.5 15, 17.5 and 20 cm cutouts. By definition; CF (unblocked field) = 1.000. Typical ranges of CF will be from 0.900 to 1.100, but can go as low as 0.700 for very small cutouts.

VSSD (Virtual Source to Surface Distance): Should be measured for each electron energy and each cone. Electron output is affected by jaw and collimator scattering, as well as in-air scattering, and does not follow the inverse square law over large ranges as well as photons do. However, an effective or virtual SSD can be measured and used reliably over short ranges for extended distance use, as are often needed in clinical practice. A typical range for clinical use would be from 100 SSD to 115 SSD.

VSSD can be computed from measured dose at various distances using the method of Khan, with a chamber at the reference depth (dref) in a water or water equivalent phantom, beginning at SSDref (e.g. 100 cm) and taking several measurements down to a clinically useful extended distance, 115 cm or 120 cm SSD.

With these measurements, VSSD can be computed by following the algorithm below:

1. Beginning with these measurements, for n points, first compute a set of points,

x(i) = Distance(i) –SSDref *.1.a
y(i) = sqrt[Dose(SSDref) / Dose (Distance(i))] *.1.b

2. Compute the average of each set, x’ and y’

x’ = (x1+x2+…xn)/n , *.2.a
y’ = (y1+y2+…yn)/n *.2.b

3. Compute the average area,

xy’ = (x1*y1 + x2*y2 + … xn*yn)/n *.3

4. Compute the average of the distance squared,

xx’ = (x1*x1 + x2*x2 + … + xn*xn)/n *.4

5. Compute the slope (m) of the best least squares fit for these points,

m = (xy’ – x’*y’] /(xx’ – x’*x’) *.5

6. Finally,

VSSD = 1/m – dref *.6

VSSD will vary for each energy and each cone, and must be measured separately. VSSD also vary depending on accelerator and cone construction, but will typically range between 75 and 98 cm.

Cyberknife Data

- TMR – Tissue Maximum Ratio
  - From smallest to largest collimator size with values from 0 to clinically relevant depths
  - TMR must be normalized to the d_{MAX} value
- OCR – Off center Ratios (also known as Off-axis ratios)
  - Separate tables need to be created for each collimator size with measured data at multiple depths including d_{MAX}, e.g., 15 mm, 50 mm, 100 mm, 150 mm, 200 mm, and 250 mm, normalized to the central axis
- OF – Output factors
  - Output factors at different collimator sizes for differing SADs typically from 500mm to 1100mm.

Setting up your data for IMSure

There are two choices for getting your data into IMSure. 1. Send your data to Standard Imaging for conversion and setup. 2. Convert your data yourself. There are advantages to each. Having Standard Imaging convert your data of course means less work up front and we include the conversion of up to 3 different machine's data with your purchase. On the other hand, doing the conversion yourself gives you the peace-of-mind that the data was converted correctly and might mean less commissioning of the data before use.

Sending your data to Standard Imaging for conversion

Make sure you have all of the required data. In most cases this data is available from the scanning system that you use. Most scanning system's software offers multiple export functions. The data needs to be output in ASCII format and ideally output as Excel spreadsheets.

IMPORTANT - For Eclipse users only – The Eclipse system saves all of the raw beam data that is imported for beam modeling. If you use the Eclipse system contact Standard Imaging and ask for the IMSure – Eclipse export instructions. This document includes step-by-step instructions for exporting this data from Eclipse. This data then is zipped and sent to Standard Imaging via e-mail. It is easily converted to IMSure format and setup into an IMSure physics file which is then sent to you for commissioning.

Your data will be returned to you formatted into a physics.imsure file (see pg.12 of user manual) This file contains all of your data pre-formatted for use with IMSure. Place the physics.imsure file into the directory of your choice and then in IMSure preferences/Folder preferences (see pg. 6 of user manual) set the Machine folder to the same directory. Clicking on the Physics tab after setting this parameter will display the physics data.

NOTE: You will need to change the Machine Name(s) in the physics file to match the name your TPS uses for your machine.

Setting up your data yourself –

Use the sample .csv files that can be found in the Machine Data directory in the Sample Data folder (see pg. 9 of user manual) as a guide in setting up your data. The structure of these .csv files is very specific and will not import into IMSure if they are not correct. The structure for each is as follows:

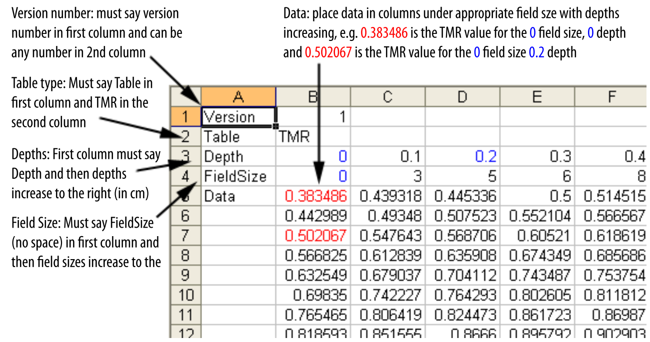
1. Photons
   a. From smallest to largest field size. A zero-field TMR must be added to the open field table by the user in order to use the 3-source model. See the IMSure QA Physics Technical Note regarding extrapolation of 0 field size data. However, the model is relatively insensitive to that extrapolated data. Wedged fields only need the smallest to largest field size.

      TMR should be normalized to the d_{MAX} of the energy. TMR data must include reference depth. IMSure QA does not extrapolate TMR depth, so values to clinically reasonable depths must be taken or extrapolated by the user.

      For non-square wedged fields there should be two entries for the largest field size, one at the equivalent square of the non-square field and one at the largest opening size for the individual jaws. For example in the case of a 40 x 20 field, there would be an entry for a field size of 26.7 (equivalent square) and one for 40 cm, both containing the same data.

      See the .csv files in the Machine Data folder in the Sample Data directory for an example on how to set up the file correctly. .

      .csv file formatted files can be created in various programs but Standard Imaging suggests utilizing Microsoft Excel for this task. **NOTE: Data must be set up exactly as shown or it will not import into the IMSure physics module. (See pg. 15 of user manual)**



	A	B	C	D	E	F
1	Version	1				
2	Table	TMR				
3	Depth	0	0.1	0.2	0.3	0.4
4	FieldSize	0	3	5	6	8
5	Data	0.383486	0.439318	0.445336	0.5	0.514515
6		0.442989	0.49348	0.507523	0.552104	0.566567
7		0.502067	0.547643	0.568706	0.60521	0.618619
8		0.566825	0.612839	0.635908	0.674349	0.685686
9		0.632549	0.679037	0.704112	0.743487	0.753754
10		0.69835	0.742227	0.764293	0.802605	0.811812
11		0.765465	0.806419	0.824473	0.861723	0.86987
12		0.818593	0.851555	0.8666	0.895792	0.902903

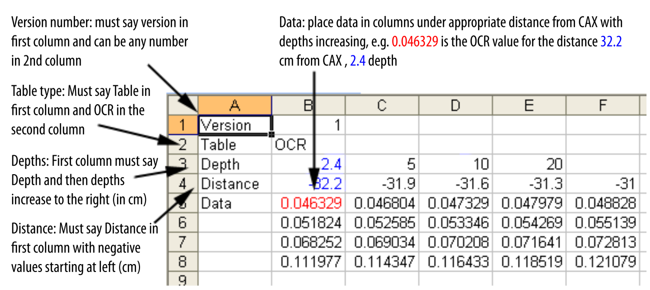
   b. OCR table – Only the largest field size for open and wedged. Ideally the OCR data is measured at 100 SSD, at multiple depths. Correction for depth dependent divergence is made by IMSure QA. No correction is made for the minor variances due to the true divergent depth at off-axis positions, but as the depth to the specification calculation point is defined as the depth down the central axis, no correction is required.

      For open fields, a diagonal scan, if available, may provide more reliable results. Half beam scans may be used, but must be mirror imaged before import. IMSure QA does not distinguish between radial and transverse scans, but averaged scans of transverse and radial setup are also acceptable

      For wedged data, only scans in wedged direction are needed, and only for the largest field size. OCR data should include reference depth and must be normalized to the central axis value at each depth, and independent of PDD. Wedge OCRs should be measured with the 'thick end' of the wedge oriented to the positive (right) axis of the off-axis distance, i.e., OCRs greater than one should be to the negative (left) axis and OCRs less than one should be to the positive (right) axis.

      See the .csv files in the Machine Data folder in the Sample Data directory for an example on how to set up the file correctly. .

      .csv file formatted files can be created in various programs but Standard Imaging suggests utilizing Microsoft Excel for this task. **NOTE: Data must be set up exactly as shown or it will not import into the IMSure physics module. (See pg. 15 of user manual)**



	A	B	C	D	E	F
1	Version	1				
2	Table	OCR				
3	Depth	2.4	5	10	20	
4	Distance	-32.2	-31.9	-31.6	-31.3	-31
5	Data	0.046329	0.046804	0.047329	0.047979	0.048828
6		0.051824	0.052585	0.053346	0.054269	0.055139
7		0.068252	0.069034	0.070208	0.071641	0.072813
8		0.111977	0.114347	0.116433	0.118519	0.121079
9						

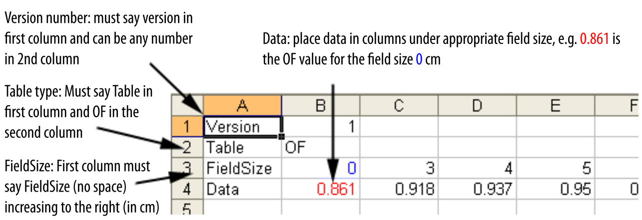
c. OF Table (Output Factors) – From smallest to largest possible square fields only, normalized to 10x10 FS. The models in IMSure require output factors measured at d_{MAX}. It is common practice to measure output factors at deeper depths, e.g. 5 cm to remove the electron contamination from the measurements. IMSure can automatically back adjust these measurements to d_{MAX} as long as there is TMR data already input into the physics module (see pg. 13 of user manual)

For Open-field data a zero FS extrapolation is needed. See the IMSure QA Physics Technical Note regarding extrapolation of 0 field size data. For wedged data, Sc,p should be normalized to 10x10 and should range from smallest to largest field sizes. An additional wedge factor for the 10x10 field size (relative to open field) is needed. Variation of the wedge factors with field size are accounted for in the output factor and collimator scatter tables of each wedge.

The output factors, in combination with the Collimator Scatter Factors, are used to compute the phantom scatter, as Sp = OF/Sc. OF is specified independently for wedged fields, so that FS dependent wedge factors may be accommodated.

See the .csv files in the Machine Data folder in the Sample Data directory for an example on how to set up the file correctly. .

.csv file formatted files can be created in various programs but Standard Imaging suggests utilizing Microsoft Excel for this task. **NOTE: Data must be set up exactly as shown or it will not import into the IMSure physics module. (See pg. 15 of user manual)**



d. Sc Table (Head Scatter) - Collimator Scatter, Sc, is very important to the 3-source model. Sc for the square field sizes is required to 1) compute the phantom scatter from the output factor and 2) verify that the three source model head scatter coefficients are modeled correctly.

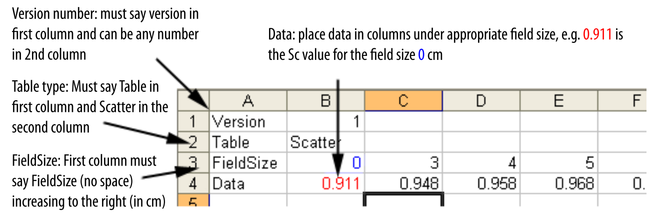
Sc is not necessary for wedged fields as this is automatically calculated from the formula Sc(wedged) = Sc,p (wedged)/ Sp(open).

Sc is measured for each field size at isocenter (SAD) with an appropriate buildup cap of at least d_{MAX} effective radius over the measurement chamber. Sc is normalized to the calibration field size (10x10).

A zero field size Sc is needed for the open-field (non-wedged) data to use the 3-source model, and may be extrapolated from the small field size data. See the IMSure QA Physics Technical Note regarding extrapolation of 0 field size data. Because of the nature of the model, clean Sc data ranging down to at least 3x3, measured for every FS between 3 and 12, will give the best results.

See the .csv files in the Machine Data folder in the Sample Data directory for an example on how to set up the file correctly.

.csv file formatted files can be created in various programs but Standard Imaging suggests utilizing Microsoft Excel for this task. **IMPORTANT: Data must be set up exactly as shown or it will not import into the IMSure physics module. (See pg. 15 of user manual)**



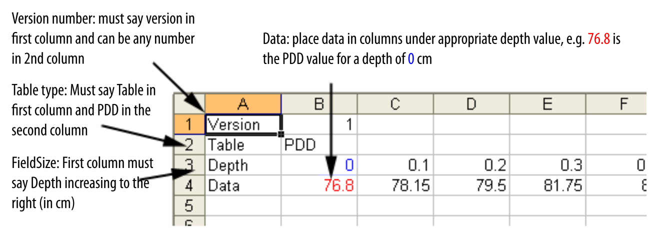
2. Electrons

a. PDD - Should be measured down the central axis with the phantom surface at calibration phantom distance. PDD should be normalized to reference depth.

IMSure QA has no requirements for the actual depths measured, but in typical use, measurements to the practical range for each energy are preferred (rule of thumb: ½ cm depth for each MeV of energy). IMSure QA will not extrapolate PDD, and will not compute dose or MU for points that lie outside of the PDD table.

See the .csv files in the Machine Data folder in the Sample Data directory for an example on how to set up the file correctly. .

.csv file formatted files can be created in various programs but Standard Imaging suggests utilizing Microsoft Excel for this task. **IMPORTANT: Data must be set up exactly as shown or it will not import into the IMSure physics module. (See pg. 15 of user manual)**



b. OCR - Should be measured with the phantom surface at calibration phantom distance, and at several depths. OCR must be normalized to the central axis value for each depth.

In many clinical situations, electron dose will always be specified at the central axis. In this case, where the off axis distances would not be used, the user may choose to use the default single point OAR, which is specified as 1.000 at the reference depth and central axis. IMSure QA will only allow the user to enter off-axis distances that are contained in this table, and in this case, the user will only be able to enter x and y calculation points as 0,0.

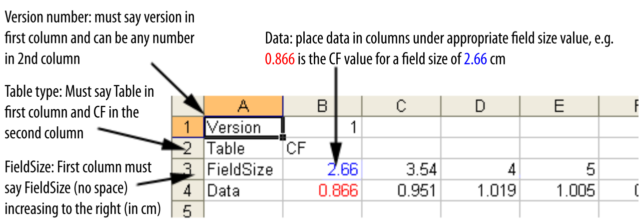
The file format for electron OCR is identical to photon (see pg.6 of this manual).

c. CF Table (cone factor) - Cone Factor tables for electrons should be measured for each cone and energy, with the surface of the phantom at calibration phantom distance, and the chamber at calibration reference depth. A series of cutout apertures should be made for each cone, in 10-20% increments, down to 40-60% for the smallest aperture. For example, a 6x6 cone might have

3x3, 4x4, and 5x5 cutouts (and 6x6, by default). A 20x20 cone might range have 10, 12.5 15, 17.5 and 20 cm cutouts. By definition; CF (unblocked field) = 1.000. Typical ranges of CF will be from 0.900 to 1.100, but can go as low as 0.700 for very small cutouts.

See the .csv files in the Machine Data folder in the Sample Data directory for an example on how to set up the file correctly. .

.csv file formatted files can be created in various programs but Standard Imaging suggests utilizing Microsoft Excel for this task. **IMPORTANT: Data must be set up exactly as shown or it will not import into the IMSure physics module. (See pg. 15 of user manual)**



	A	B	C	D	E	F
1	Version	1				
2	Table	CF				
3	FieldSize	2.66	3.54	4	5	
4	Data	0.866	0.951	1.019	1.005	
5						

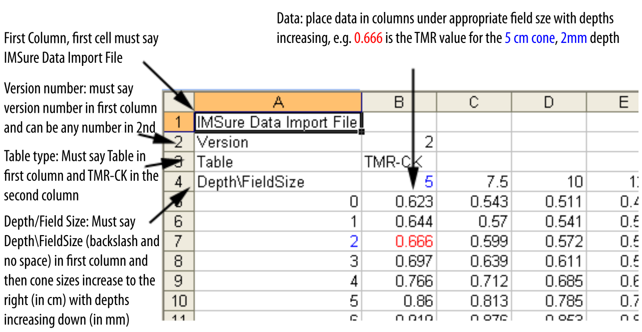
3. Cyberknife

a. TMR for Cyberknife – The Cyberknife planning system can export as text files the TMR tables that were originally input from machine data. The format for the IMSure .csv files for Cyberknife TMR was designed to be very similar to those in order to make it easy to create the correct file structure.

The TMR table should contain data for each collimator size and all clinical depths and must be normalized to the d_{MAX} value.

See the .csv files in the Machine Data folder in the Sample Data directory for an example on how to set up the file correctly. .

.csv file formatted files can be created in various programs but Standard Imaging suggests utilizing Microsoft Excel for this task. **IMPORTANT: Data must be set up exactly as shown or it will not import into the IMSure physics module. (See pg. 15 of user manual)**



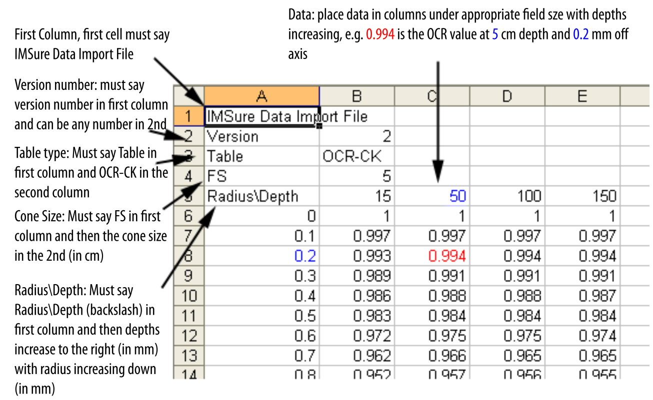
	A	B	C	D	E
1	IMSure Data Import File				
2	Version	2			
3	Table	TMR-CK			
4	Depth\FieldSize	5	7.5	10	[illegible]
5	0	0.623	0.543	0.511	[illegible]
6	1	0.644	0.57	0.541	[illegible]
7	2	0.666	0.599	0.572	[illegible]
8	3	0.697	0.639	0.611	[illegible]
9	4	0.766	0.712	0.685	[illegible]
10	5	0.86	0.813	0.785	[illegible]

b. OCR for Cyberknife - The Cyberknife planning system can export as text files the OCR tables that were originally input from machine data. The format for the IMSure .csv files for Cyberknife OCR was designed to be very similar to those in order to make it easy to create the correct file structure.

An OCR table should be created for each collimator size and should contain data out to the maximum radius used clinically at several clinically used depths normalized to the central axis.

See the .csv files in the Machine Data folder in the Sample Data directory for an example on how to set up the file correctly. .

.csv file formatted files can be created in various programs but Standard Imaging suggests utilizing Microsoft Excel for this task. **IMPORTANT: Data must be set up exactly as shown or it will not import into the IMSure physics module. (See pg. 15 of user manual)**



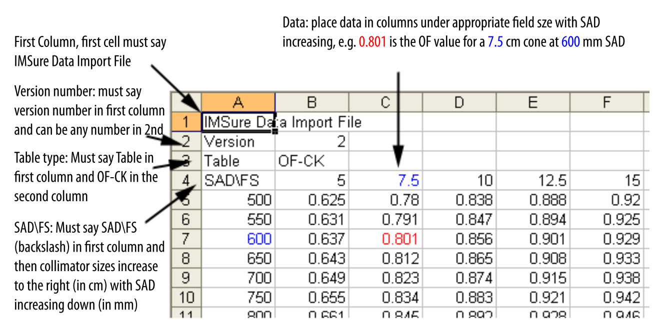
	A	B	C	D	E
1	IMSure Data Import File				
2	Version	2			
3	Table	OCR-CK			
4	FS	5			
5	Radius\Depth	15	50	100	150
6	0	1	1	1	1
7	0.1	0.997	0.997	0.997	0.997
8	0.2	0.993	0.994	0.994	0.994
9	0.3	0.989	0.991	0.991	0.991
10	0.4	0.986	0.988	0.988	0.987
11	0.5	0.983	0.984	0.984	0.984
12	0.6	0.972	0.975	0.975	0.974
13	0.7	0.962	0.966	0.965	0.965
14	0.8	0.952	0.957	0.956	0.955

c. OF for Cyberknife - The Cyberknife planning system can export as text files the OF tables that were originally input from machine data. The format for the IMSure .csv files for Cyberknife OF was designed to be very similar to those in order to make it easy to create the correct file structure.

An OF table should contain the measured output factors for each collimator size and a variety of SAD distances. All output factors are relative to the 60 mm collimator and are normalized to that value. The value of the 60 mm collimator OF is 1.00 by definition.

See the .csv files in the Machine Data folder in the Sample Data directory for an example on how to set up the file correctly. .

.csv file formatted files can be created in various programs but Standard Imaging suggests utilizing Microsoft Excel for this task. **IMPORTANT: Data must be set up exactly as shown or it will not import into the IMSure physics module. (See pg. 15 of user manual)**



	A	B	C	D	E	F
1	IMSure Data Import File					
2	Version	2				
3	Table	OF-CK				
4	SAD\FS	5	7.5	10	12.5	15
5	500	0.625	0.78	0.838	0.888	0.92
6	550	0.631	0.791	0.847	0.894	0.925
7	600	0.637	0.801	0.856	0.901	0.929
8	650	0.643	0.812	0.865	0.908	0.933
9	700	0.649	0.823	0.874	0.915	0.938
10	750	0.655	0.834	0.883	0.921	0.942

Table B: Rules for Machine Data Consistency

1.	The Maximum Field size for the TMR data must be greater than or equal to the Maximum Field size for that Wedge.
2.	For open fields, the Minimum Field size for the TMR data must be equal to 0.0 cm.
3.	For non-open fields, the Minimum Field size for the TMR data must be less than or equal to the Minimum Field size for that Wedge.
4.	A Field size must exist in the TMR data that matches the Minimum Field size for that Wedge.
5.	The values for the TMR depths must increase monotonically.
6.	The values for the TMR Field Sizes must increase monotonically.
7.	The values for the Output Factor Field Sizes must increase monotonically.
8.	The values for the Collimator Scatter Factor Field Sizes must increase monotonically.
9.	The values for the Off-axis Ratio Depths must increase monotonically.
10.	The values for the Off-axis Ratio Distances must increase monotonically.
11.	The minimum value for the Off-axis Ratio Distances must be equal to or less than (-Maximum Field Size/2).
12.	The maximum value for the Off-axis Ratio Distances must be equal to or greater than (+Maximum Field Size/2).
13.	The TMR depths must include the Reference Depth.
14.	The TMR Field Size set must include the Calibration Field Size.
15.	The Output Factor Field Sizes must include the Calibration Field Size.
16.	The Collimator Scatter Factor Field Sizes must include the Calibration Field Size.
17.	The output factors for all fields must be normalized to the value at the Calibration Field Size (i.e., the output factor at FS=CFS will equal 1.000).
18.	The Collimator Scatter factors must be normalized to the value at the Calibration Field Size (i.e., the output factor at FS=CFS will equal 1.000).
19.	The TMR value for the Calibration Field Size and at the Reference depth must equal 1.
20.	For open fields, the Min Jaw position for either upper or lower jaws may not be less than (-Maximum Field Size/2).
21.	For open fields, the Max Jaw position for either upper or lower jaws may not be greater than (+Maximum Field Size/2).
22.	PDD must contain the reference depth and the value at that point must equal 1.000
23.	PDD depths must increase monotonically
24.	OCR must have at least one point = 1.000 at d_{MAX} on CAX
25.	Cone Factor must contain at least one point = 1.000 for FS = sqrt (ConeX * ConeY)

Table C: Known Geometry Values for Various Linear Accelerator Heads

	Jaw Distances (in cm)			Distances for Primary collimator and Flattening Filter Geometry used in 3-source model (Fixed, non-editable)			
Linac MLC Type	Zx	Zy	Zmlc	Zsp	Zsf	R01	R02
Elekta 80 *	40.1	43.4	29.8	4.0	12.5	0.2	1.4
Siemens	28.3	19.7	28.3	4.0	10.5	0.2	1.1
Varian 52	36.7	27.9	48.3	4.0	12.5	0.2	1.4
Varian 80	36.7	27.9	48.3	4.0	12.5	0.2	1.4
Varian 120	36.7	27.9	48.3	4.0	12.5	0.2	1.4

***** The IMSure QA model assumes that MLC leaves are in the “X-direction”. The Elekta system can be accommodated by specifying the jaw distances as above with the “Lower Jaw” specified as closer to the source than the “Upper Jaw”. An additional offsetting correction must be made in the Jaw Naming convention, where the expected X jaw and Y jaw names are exchanged.