TG 51 Q&A

1. **Due to a shift in the effective point of measurement using plane parallel chambers, %DD curve must be shifted upstream to match reality**

False. Effective point of measurement for plane parallel chambers is the same as the point of measurement (front/upstream face of the chamber). Therefore, no shift is required.

2. **When measuring photons with an ion chamber one directly measures the %DD curve**

True. After applying 0.6 r_{cav} upstream during measurement, we are measuring the depth ionization curve but for photon beams. However, the difference between the depth ionization curve and depth dose curve is negligible (<0.1% past d_{max}).

3. **TG 51 allows reference dosimetry to be performed in a solid water phantom**
   False. TG 51 requires measurements to be performed in water.

4. **Plane parallel chambers used for electron dosimetry should be cross-calibrated with a cylindrical chamber in the highest available energy electron beam as outlined by TG 39**
   True. Co60 calibration factors of at least some plane-parallel chambers appear to be very sensitive to small features of their construction, it is recommended that, when possible, plane-parallel chambers be calibrated against calibrated cylindrical chambers in a high energy electron beam.

5. **Please select which of the following equations is the appropriate form for calculating the P_{TP} correction factor for TG 51 reference dosimetry**

$$P_{TP} = \frac{273.2 + T}{273.2 + 22} \times \frac{101.33}{P\ (kPa)} = \frac{273.2 + T}{273.2 + 22} \times \frac{760}{P\ (mmHg)}$$

   Relative humidity is always in the range of 20-80%, introducing negligible errors in the range of $\pm$ 0.15%

6. **Inserting a 1mm lead filter in the beam for high energy %DD measurements functions to remove contaminant electrons from the beam which, in turn decreases the %DD curve compared to an open beam**

   False? The electrons from the accelerator head may significantly affect the dose at $dmax$ and hence reduce the value of %dd(10). Adding 1mm lead reduces that effect, which in turn increases %DD.

7. **When using an ion chamber for electron beam scans, the measured curves are %DD curves**
   False. Unlike photon beams, the depth ionization curve must be further corrected for the significant changes in the stopping-power ratio with depth.

8. **Which of the following are true when performing TG51 reference dosimetry on 18 MV photons**
   a. If you do not have a lead foil TG 51 allows you to make measurements without its use

True. Allowed for machines with 45 cm or more clearance between the jaws and the phantom surface with an equation obtained based on a global fit to data. This fit may result in up to 2% error in %dd(10)x , which would lead to error in k_Q, and error in absorbed dose of 0.4%
%dd(10)x = 1.267%dd(10)-20 for 75%<%dd(1)<= 89%

b. %DD measurements for obtaining k_Q should be taken without 1 mm of lead in the beam.
False.

c. Output measurements obtained at 10 cm depth should be corrected to dmax using the %DD with lead in the beam.
True?

d. %DD measurements for obtaining k_Q should be taken using 1mm of lead in the beam
True. 1mm lead foil is needed to determine %dd(10)x, the beam quality specifier.

e. Output measurements should be obtained with 1mm lead in the beam
False. Lead is only used to determine beam quality specifier, and must be removed for other measurements

9. **The function kecal is to take an electron beam of your specific energy and relate the chamber response to an electron beam of the reference energy of 4 MeV**

   False. Kecal is photon-electron conversion factor.

10. **TH 51 absolute output measurements can be obtained in either a 100 cm SSD or 100 cm SAD.**
    False? True only for photons but not electrons.
    Electrons require SSD setup from 90 to 110 cm. The stopping power ratios were done for SSD=100cm, but changes of up to 10 cm from this SSD do not affect the parameters used in the protocol

11. **TG 51 absolute output measurements can be obtained in either a 100 cm SSD setup or 100 cm SAD setup**
    True.
    Because the stopping ratio does not vary drastically with depth for photon beams?
12. **The effective point of measurement is shifted upstream of the center o fcylinrical chambers for both photons and electrons. So which way would you shift your chamber if you want to put the chamber's effective point of measurement where the point of measurement currently is?**
    Shallower.

13. **When performing a TG 51 measurement, if P_{pol} is outside of _____ then you should get another chamber**
    $1\pm0.3\%$. The value is generally below unity.

14. **P_{ion} should always be less than one**

False. P_{ion} is a factor that compensates for the lack of complete collection efficiency, it is therefore always more than 1. Another chamber should be used if P_{ion} is more than 1.05.

15. **TG 51 %DD curves can be obtained either with a 100 cm SAD setup or 100 cm SSD setup.**
    False. Measurements are always performed with SSD setup.

16. **What are the minimum allowable water tank dimensions for reference dosimetry according to TG51?**
    30x30x30 cm^3.
    If beam enters through the plastic wall of the water phantom and the wall is greater than 0.2 cm thick, all depths should be scaled to water equivalent depths by measuring from the outside face of the wall with the phantom full of water and accounting for the wall density. PMMA wall effective thickness = wall thickness x 1.12.
17. **The shift in the effective point of measurement for photon is?**
    0.6 r_{cav} upstream
18. **What is the function of Tg51's value k_Q for photon measurements? (select all that apply)**
    a. It correct for ionic recombination within the chamber.
       False. Corrected in M

    b. It functions to relate your chamber's response in a Co60 beam to the response of a beam of your specific energy
       True. K_Q converts the absorbed dose to water calibration factor for a Co60 beam into the calibration factor for an arbitrary beam of quality Q

    c. It corrects for the effective point of measurement of the chamber
       True? Correction for the effective point of measurement is accounted for in the calculation of K_Q

    d. It corrects for chamber polarity effects
       False. Polarity effects is corrected in M.
19. **According to AAPM TG 51 Addendum, which of the following is likely to be the single largest contributor to reference dosimetry uncertainty?**
    K_Q determination. Major improvements were made to include accurate look up tables for more types of ion chambers with more accurate geometrical setup within the Monte Carlo calculations.

20. **According to the AAPM TG 51 Addendum report, which of the following values corresponds to the reported error in measurement per every centimeter of missetting field size?**
    1% per 1 cm error in field size setting

21. **AAPM TG51 addendum delves deeper into P_{ion} than the original report and defines it as $P_{ion} = 1+C_{init}+C_{gen}D_{pp}$. It is suggested that by solving this equation for the general recombination C_{gen}, one can compare this value to that used by the ADCL in their Co60 beam as a further check of proper chamber functioning**
    True

22. **Which of the following correction factors are likely to be significantly larger in FFF beams than in beams utilizing flattening filter?**
    P_{ion}. The ion recombination is larger than standard linacs due the higher dose per pulse from FFF. P_{ion} < 1.05 is recommended
    P_{rp} Radial nonuniformity of the beam can also have an effect on volume average within the ion chamber volume. Chambers should have short collecting volumes or the effects should be corrected using P_{rp}

23. **For the following list of photon beams, select all those that the AAPM TG 51 addendum report requires a lead foil be used when measuring %dd(10)$_x$**
    10X FFF, 18 MV flat beam photons
    Lead should be used for all energy FFF beams. Lead should also be used for flattened beams with energy above 10 MV.

24. **AAPM TG51 Addendum suggests that given proper adherence to TG 51 and with proper experimental care, the total uncertainty associated with reference dosimetry is around ___%**
    1%

25. **The following options represent measurement volumes of cylindrical chambers. Select all of the volumes in this list that would qualify, according to the TG 51 addendum, as micro or pinpoint ion chambers (and should therefore not be used for clinical reference dosimetry**
    0.01 cm^3 and 0.045 cm^3
    Chambers <0.05cc are not recommended. Data indicate such chambers do not show expected polarity or recombination behavior and are more sensitive to leakage currents and irradiation history. These small chambers with high Z electrodes exhibit behavior in FFF beams that are not well specified by %dd(10)$_x$.

References

The physics of TG 51. https://vimeo.com/channels/ss2009/78875972

TG 51 Addendum – overview and implementation. https://vimeo.com/75783506