Dear Contributor,

Thank you for participating in the public consultation of the ICNIRP draft guidelines.

Please note that it is important that ICNIRP understands exactly the points that you are making. To facilitate our task and avoid misunderstandings, please:

* be concise
* be precise
* provide supporting evidence (reference to publication, etc.) if available and helpful.

**How to complete the comments table:**

Please use 1 row per comment. If required, please add extra rows to the table.

This response document asks you to provide your ‘comment’, your ‘proposed change’, and the ‘context’ to this comment and proposed change. What is meant by these is the following:

**Comment :** A brief statement describing the issue that you have identified (and that you would like ICNIRP to take into account in the final version of the guidelines).

**Proposed Change:** A brief statement describing how you would like the document changed to account for this issue.

**Context:** A brief statement identifying relevant documents in support of your comment and proposed change.

**Please, provide your details below as per the online form and the provision of the privacy policy**

|  |  |  |
| --- | --- | --- |
| Last name, first name: KUHNE, Jens & SCHMIDT, Janine | Email address: Your email address. | Affiliation (if relevant): BfS |
| If you are providing these comments officially **on behalf** of an organization/company, please name this here: German Federal Office for Radiation Protection | | |
| I hereby agree that, for the purpose of transparency, **my identity (last and first names, affiliation and organization where relevant) will be displayed** on the ICNIRP website after the consultation phase along with my comments.  I want my comments to be displayed anonymously. | | |

|  | **Document**  **(Guidelines, App A,**  **App B)** | **Line Number**  **#** | **Type of comment (General/ Technical/ Editorial)** | **Comment. Proposed change. Context.** |
| --- | --- | --- | --- | --- |
| **1** | Guidelines | 47 | General | The WHO definition of health is used. This definition includes mental/social wellbeing and in the context of EMF it can be interpreted that “worrying” about the presence of EMF might be a health effect.  Please delete the footnote stating that the WHO definition is used.  Explain the context of your comment. |
| **2** | Guidelines | 122-127 | Technical | The generation of heat due EMF interaction with either charged and/or polarized molecules is briefly explained in this section. However in the corresponding Annex AA the different contributions of charge (conductive) and polarization (dielectric) is not addressed.  Please add a formula for the dielectric and conductive properties of the conductance quantity in Annex AA (eg. Introduce effective conductivity )  Explain the context of your comment. |
| **3** | Guidelines | 156 | Technical | It is not clear why some of the quantities are given in bold (E, H, Seq, Htr, Str and Sinc). Further in Annex AA only E,H, and J are given in bold which leads to the assumption, that bold is used to indicate vectorial character of quantities. However, Htr, Str and Sinc are scalar values.  Please explain the usage of bold letters in the text. If it is due to vectors, only apply bold to E and H  Explain the context of your comment. |
| **4** | Guidelines | 156 | Technical | Incident energy density (Hinc) is missing in the table  Please add Hinc  Explain the context of your comment. |
| **5** | Guidelines | 156 | General | Using the letter “H“ for both magnetic field and energy density quantities (Hinc and Htr) might be confusing  Please use another letter for energy densities (eg. U)  Explain the context of your comment. |
| **6** | Document ? | 266-271 | General | ICNIRP aims at adopting the OAHT that corresponds to ACGIH 2017 (+1 °C of “normothermia”,cf l. 261) However according to the footnote 2 normothermia means that no active thermoregulatory processes are engaged by the body. This is in conflict with the statements made in l. 269-l.271  Please resolve this discrepancy  Explain the context of your comment. |
| Continue numbering | Document ? | Line number | Type of comment | Insert your comment.  Insert your proposed change.  Explain the context of your comment. |

Add further rows if needed. For this copy the above row.

And paste it here.

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| 7 | Guidelines | 290 | General | „infrared radiation” is a more accurate term than just “infrared”  Please add „radiation„ after „infrared“  Explain the context of your comment. |
| 8 | Guidelines | 292 | General | See comment 8  Insert your proposed change.  Explain the context of your comment. |
| 9 | Guidelines | 366-370 | General | Citation missing  Please cite relevant work  Explain the context of your comment. |
| 10 | Guidelines | 380-383 | Technical | This statement is not very precise. What does “most of the power” mean? According to table 3.1 the penetration depth (86% absorbed power) at 6GHz is 8.1 mm. This does not fit to skin thicknesses as used in numerical simulations (eg. 1mm)  Please give a more sound justification (eg. Best compromise of constant heating factors for SAR or TPD) or change the transition frequency  Kanezaki, A., Hirata, A., Watanabe, S., & Shirai, H. (2009). Effects of dielectric permittivities on skin heating due to millimeter wave exposure. Biomedical engineering online, 8(1), 20 |
| 11 | Guidelines | 390-391 | Technical | What does sufficient mean?  Please specify (and cite) the maximum error introduced by the step function for averaging  Explain the context of your comment. |
| 12 | Guidelines | 411 | Technical | Below 1s there is a fixed value for SA although the sqrt(t)-rule should be valid below 1s as well! To our knowledge, applying sqrt(t-1) is not based on scientific results.  Please apply sqrt(t) rule instead of sqrt(t-1) with constant values below 1s or give a reasonable explanation for choosing the 1s limit  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
| 13 | Guidelines | 415-418 | Technical | Citation needed  Please cite relevant literature  Explain the context of your comment. |
| 14 | Guidelines | 423-424 | Technical | Adiabatic absorption of 5kJ/m2 may lead to temperature elevation of more than 10 K in the worst case scenario. Therefore it is not conservative at all!  Please lower the values below 1s by applying the sqrt(t) rule (instead the sqrt(t-1) with constant values below 1s). Otherwise lower the values below 1 s to maximally 2kJ/m2 and give a reasonable explanation for choosing the 1s limit  For details See my comment 41 regarding Annex A |
| 15 | Guidelines | 442 | Editorial | The pregnant woman is treated as a member of the general population even though she is currently working. This should be made clear in the sentence  Please Add:… and occupational limits are not to be used for her  Explain the context of your comment. |
| 16 | Guidelines | 508 | Technical | Below 1s there is a fixed value for SA although the sqrt(t)-rule should be valid below 1s as well! To our knowledge, applying Sqrt(t-1) is not based on scientific results.  Please apply sqrt(t) rule instead a sqrt(t-1) with constant values below 1s or give a reasonable explanation for choosing the 1s limit  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
| 17 | Guidelines | 518 | Technical | Below 1s there is a fixed value for SA although the sqrt(t)-rule should be valid below 1s as well! To my knowledge, applying Sqrt(t-1) is not based on scientific results.  Please apply sqrt(t) rule instead a sqrt(t-1) with constant values below 1s or give a reasonable explanation for choosing the 1s limit  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
| 18 | Guidelines | 520 | Technical | Below 1s there is a fixed value for SA although the sqrt(t)-rule should be valid below 1s as well! To my knowledge, applying Sqrt(t-1) is not based on scientific results.  Please apply sqrt(t) rule instead a sqrt(t-1) with constant values below 1s or give a reasonable explanation for choosing the 1s limit  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
| 19 | Guidelines | 541 | Technical | Below 1s there is a fixed value for SA although the sqrt(t)-rule should be valid below 1s as well! To my knowledge, applying Sqrt(t-1) is not based on scientific results.  Please apply sqrt(t) rule instead a sqrt(t-1) with constant values below 1s or give a reasonable explanation for choosing the 1s limit  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
| 20 | Guidelines | 548 | Technical | Below 1s there is a fixed value for SA although the sqrt(t)-rule should be valid below 1s as well! To my knowledge, applying Sqrt(t-1) is not based on scientific results.  Please apply sqrt(t) rule instead a sqrt(t-1) with constant values below 1s or give a reasonable explanation for choosing the 1s limit  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
| 21 | Guidelines | 552 | Technical | Below 1s there is a fixed value for SA although the sqrt(t)-rule should be valid below 1s as well! To my knowledge, applying Sqrt(t-1) is not based on scientific results.  Please apply sqrt(t) rule instead a sqrt(t-1) with constant values below 1s or give a reasonable explanation for choosing the 1s limit  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
| 22 | Guidelines | 597 | Technical | Point 5 seems not to be relevant for table 1 as there is no incident plane wave power density listed in table 2  Please delete point 5  Explain the context of your comment. |
| 23 | Guidelines | 601 | Technical | Table 3: Below 1s there is a fixed value for SA although the sqrt(t)-rule should be valid below 1s as well! To my knowledge, applying Sqrt(t-1) is not based on scientific results. For the transmitted energy density, the underlying limit of 5kJ/m2 is not conservative (see comment 41).  For SA and Htr please apply sqrt(t) rule instead a sqrt(t-1) with constant values below 1s or give a reasonable explanation for choosing the 1s limit. Htr values should be drastically reduced (at least by a factor of 2.5)  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
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| 24 | Guidelines | 610 | General | Regarding the whole reference level section: Plotting the curves would make it way easier to get an overview over the levels  Please add figures displaying graphs of the reference levels  Explain the context of your comment. |
| 25 | Guidelines | 615-618 | General | Although the reason why being within reference levels does not necessarily protect from exceeding basic restrictions is well and understandable explained in lines 650-679 and Annex A it induces more general problems in the concept. The new approach reduces the importance of the general meaning of basic restrictions. As you state that only basic restriction or reference level has to be met you “allow” higher basic **restrictions** for special situations. This “means” that the basic restrictions varies with body size and posture.  Just a comment, no proposed change  Explain the context of your comment. |
| 26 | Guidelines | 697-711 | General | Table 5, the minus in the exponent is barely visible. It looks like f^0.177 instead of f^-0.177  Please revise the table with the reference levels  Explain the context of your comment. |
| 27 | Guidelines | 697-711 | General | Table 5, note : It is quite inconvenient to look up values in different tables  Please add the corresponding values in table 5  Explain the context of your comment. |
| **28** | Guidelines | 718-738 | General | Table 6, the minus in the exponent is barely visible. It looks like f^0.177 instead of f^-0.177  Please revise the formula  Explain the context of your comment. |
| **29** | Guidelines | 718-738 | General | Table 6, the minus in the exponent is barely visible. It looks like f^0.177 instead of f^-0.177  Please revise the formula  Explain the context of your comment. |
| 30 | Guidelines | 718-738 | Technical | To my knowledge, applying Sqrt(t-1) is not based on scientific results. For the transmitted energy density, the underlying limit of 5kJ/m2 is not conservative (see comment 41).  Please apply sqrt(t) rule (instead of the sqrt(t-1) with constant values below 1s) or give a reasonable explanation for choosing the 1s limit. Htr values should be drastically reduced (at least by a factor of 2.5)  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
| 31 | Appendix A | 47 | General | Introducing an effective conductivity consisting of conductive and dielectric part would be helpful here because it would fit to the introduction in the main text.  Please add a formula that explains the quantity conductivity  See my comment #2 |
| 32 | Appendix A | 75 | Technical | The penetration depths given are inconsistent with the values given in table 3.1  Please revise the values  Explain the context of your comment. |
| 33 | Appendix A | 106 | Technical | This is not necessarily true for array antennas  Just a comment, no proposed change  Explain the context of your comment. |
| 34 | Appendix A | 225-232 | Editorial | This statement is incomplete, since eg. the applied power and exposure time are not reported (stationary conditions?).  Please add the relevant parameters  Explain the context of your comment. |
| 35 | Appendix A | 328-331 | General | This statement requires a citation  Please cite relevant literature  Explain the context of your comment. |
| 36 | Appendix A | 359 | Technical | Transmitted power density does not depend on depth! The formula given is not consistent with equation 2.9 (l. 80). Most likely SAR is meant here.  Please change formula accordingly (eg. SAR(z)=…)  Explain the context of your comment. |
| 37 | Appendix A | 388-391 | Technical | The error introduced by the step function has to be addressed in order to justify the decision for using it.  Please change the part accordingly  Explain the context of your comment. |
| 38 | Appendix A | 443-448 | Technical | Formula based on unpublished work and “empirical equations” without any further explanation are not reasonable to the reader  Please add a more detailed explanation  Explain the context of your comment. |
| 39 | Appendix A | 449-450 | Technical | Below 1s there is a fixed value for SA although the sqrt(t)-rule should be valid below 1s as well! To my knowledge, applying Sqrt(t-1) is not based on scientific results.  Apply sqrt(t) rule instead a sqrt(t-1) with constant values below 1s or give a reasonable explanation for choosing the 1s limit  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53 |
| 40 | Appendix A | 462 | General | According to the text SA is not required below 400MHz. This is based on unpublished (and not peer reviewed) work only.  Please add a more detailed justification or specify the SA limits below 400 MHz as well  Explain the context of your comment. |
| 41 | Appendix A | 492-502 | Technical | According to the ICNIRP main Document l. 421-424 for exposure durations less than 1s a time independent transmitted energy density of Htr=5kJ/m2 is given and it is claimed, that temperature increase won’t exceed 5°C  „***H****tr is specified as 5+3.54(t-1)0.5 kJ m-2 for intervals between 1 and 360 seconds, where ‘t’ is interval in seconds (Foster et al., 2016); for intervals less than a second, the value is set at 5 kJ m‑2. …* ***H****tr values are conservative in that, under worst-case (adiabatic) conditions, they are not sufficient to raise temperature by 5 °C*. “  By simple model calculations assuming one layer homogenous skin it can be shown, that this is not necessarily true for frequencies >60 GHz:  Assume a homogenous piece of human skin with a density of 1109 kg/m3 and a heat capacity of 3391 kJ/kg that completely absorbs an intense pulse with a transmitted energy density of 5kJ/m2 on a timescale that is far lower than the thermal diffusion (adiabatic case). (values taken from IT IS Website)  The specific absorption SA absorbed in the tissue has exponential character:  is the specific absorption at the surface of the skin and d is the frequency dependent penetration depth as given in Annex A table 3.1.  Applying Annex A eqn 2.9 to the case of specific absorption it follows that the transmitted energy density Htr is calculated by integrating the specific absorption in skin from zero depth to infinity:  In the homogenous case is a constant and the expression simplifies to:  Solving the integral and rearranging the expression gives a value for the maximum SA at the surface (:  In case of a frequency of 300 GHz and a corresponding penetration depth of a high specific absorption will be present at the surface:  This results in a surface temperature elevation of  In the adiabatic case the temperature elevation decays exponentially with depth in the same manner as the specific absorption:  For the frequencies given in annex A table 3.1, the following temperature distribution can be obtained by plotting the formula for different frequencies (see figure 1).    **Figure 1:** Temperature elevation for different frequencies and penetration depths. The black line represents a temperature elevation of 5K.  For frequencies greater than approx. 50 GHz a temperature elevation exceeding 5°C is possible up to a penetration depth of approx. 100 µm. Therefore using a transmitted energy density of 5kJ/m2 cannot be regarded as conservative.  Recent modelling results that include the bioheat equation show, that temperature increase is strongly depending on pulse duration, especially for durations below 1s (Ilkka Laakso et al 2017 Phys. Med. Biol. **62** 6980)  Please apply the sqrt(t) rule instead of the sqrt(t-1) rule and apply this rule for times below 1s. Reduce the limit for Htr at least by a factor of 2.5  Foster, Kenneth R., Marvin C. Ziskin, and Quirino Balzano. "Thermal modeling for the next generation of radiofrequency exposure limits: Commentary." Health physics 113.1 (2017): 41-53  Ilkka Laakso et al 2017 Phys. Med. Biol. 62 6980 |
| 42 | Appendix A | 561-563 | General | Why is that?  Please explain more detailed or cite relevant work  Explain the context of your comment. |
| 43 | Guidelines | 761 | Technical | The Formula is too simple as it only applies to the homogenous case. The different possible pathways of the current through tissue with different conductivity results in different current densities. The text doesn’t explain if this is considered by using the “effective section area”  Please add an explanation for „effective section area“ and discuss how the different conductivities are incorporated in this evaluation  Explain the context of your comment. |
| 44 | Appendix A | 803-805 | Technical | It is stated, that the time function for Htr are more conservative than for the time function of SA. This actually seems not to be the case  Please apply the sqrt(t) rule instead of the sqrt(t-1) rule and apply this rule for times below 1s. Reduce the limit for Htr at least by a factor of 2.5  Explain the context of your comment. |
| **45** | Appendix A | 809-813 | General | Citation needed  Please cite relevant work  Explain the context of your comment. |
| 46 | Appendix B | 1-410 | General | Inadequate citations. There are whole paragraphs without any citation (eg p2.1 p.4 p.5 and p.7). It is not possible for the reader to check the statements made by ICNIRP.  Please cite relevant work properly  Explain the context of your comment. |
| 47 | Appendix B | 41-46 | General | ICNIRP states that “it is important to consider research across a range of study types in order to arrive at useful conclusions concerning the relation between radiofrequency EMF exposure and adverse health effects”. However, the discussion seems to be “biased” towards studies showing no effect. Annex B insufficiently explains why certain studies showing effects are not taken into account. The argument that studies showing effect are inconsistent with other findings also applies to the studies that show no effect. For the reader it is important to understand why specific studies showing no effect have not been considered for setting guidelines.  Please expand the discussion and explain why studies have been not taken into account.  Explain the context of your comment. |