SAR EXPLAINED - L2

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What is SAR

SAR stands for Specific Absorption Rate, which is the unit of measurement for the amount of Radio Frequency (RF) energy absorbed by the body when for example using a mobile phone, walkie talkie, or working in very close to radio communication transmitting antennas. SAR is expressed in units of watts per kilogram (W/kg).

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What are the SAR limits?

The international EMF exposure guidelines are based on careful analysis of the entire scientific literature and are designed to offer protection for all persons, including children, against known health effects of EMF with a large built-in safety margin.

General Public SAR limits

<table>
<thead>
<tr>
<th>General Public Exposure</th>
<th>Whole-body average SAR (W/kg)</th>
<th>Localized SAR head and trunk (W/kg)</th>
<th>Localized SAR limbs (W/kg)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>0.08</td>
<td>2</td>
<td>4</td>
</tr>
</tbody>
</table>

- For mobile phones, the localised general public SAR limits of 2 W/kg for the head and body apply.
- SAR values are averaged over a 6 minute period and use a 10gm average mass
- Refer to International EMF Exposure Guidelines (table 4) for details including occupational SAR limits

Some countries, such as Bolivia, Canada, South Korea and the US, have adopted slightly different localized SAR limits for the head and trunk - 1.6 W/kg in a 1gm average mass in the shape of a cube.

Mobile phones are tested to ensure compliance with the SAR limit for the countries into which the phones are sold.

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Does the SAR for a mobile phone vary when in use?

Yes. Although the SAR is determined at the highest certified power level in laboratory conditions, the actual SAR level of the phone while operating can be well below this value. This is because mobile phones use adaptive power control to reduce the transmitted power to the minimum possible whilst maintaining good call quality.

Once a call is established the mobile phone will power down to the minimum level required. Therefore, the closer you are to a base station and the better the reception, the lower the actual SAR level.

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Does SAR vary between mobile phones?

Yes. The maximum SAR level for different mobile phone models can vary and this is primarily due to where the antenna in
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SAR levels can also vary considerably when in use depending on how good the reception is. Once a call is established the mobile phone will power down to the minimum level required to reach the network and maintain a quality call.

How is SAR measured for mobile phones?

Specialised laboratory test equipment is used for conducting SAR measurements. The equipment consists of a ‘phantom’ (human or box), precision robot, RF field sensors, and mobile phone holder. The phantom is filled with a liquid that represents the electrical properties of human tissue.

Click here to watch the SAR measurements video

Head Measurements - SAR test inside a head phantom:

1. The mobile phone is positioned against the phantom head and switched on to full power.
2. The precision robot moves the RF probe throughout the phantom head measuring the radio signal level in the head phantom.
3. The computer analysing the data converts the radio signal levels into SAR (W/kg).
4. The full test is conducted at all operating frequencies and using different phone positions.
5. The maximum level measured is recorded as the SAR value against the head.

Body Measurements - SAR test inside a body (box) phantom:

1. The mobile phone is positioned against the phantom body and switched on to full power.
2. The precision robot moves the RF probe throughout the phantom body measuring the radio signal level in the body near the phone.
3. The computer analysing the data converts the radio signal levels into SAR (W/kg).
4. The maximum level measured is recorded as the SAR value against the body.

Can a mobile phone itself exceed the EMF exposure guidelines?

No. All mobile phones are designed and tested to meet the EMF exposure guidelines.

Is there a separation distance from the body required for mobile phones?

Mobile phones generally get better reception when used away from the main part of the body. Some mobile phones are designed to have a small minimum separation from the body when in use, typically 15 – 25mm depending on the phone. The minimum separation often represents the spacing created by a phone holder or clothing. This is to ensure the phone operates more efficiently and also meets the SAR requirements.

If a minimum separation is specified, the SAR test against the body will be conducted at that distance.

A mobile phone can always be used against the head without separation. This is because the antenna in the phone is designed to be far enough away from the head to meet SAR requirements and operate most efficiently.

What if I use my mobile in my pocket forgetting the minimum separation listed in the user guide?

Clothing and mobile phone covers often provide a separation, however it is important to always check the user guide for the minimum requirements. In most cases mobile phones operate at reduced power levels meaning a lower SAR, and for added safety, the international exposure guidelines have a large built-in safety margin.
Am I at risk by not using a separation distance?

Separation distances are used for more efficient operation of the phone and for SAR compliance. If a separation distance is specified and not adopted then the phone is possibly being used in a non-compliant position. However this does not compromise safety as the international exposure guidelines have large built-in safety margins.

Always consult the user guide for the recommended or intended use of the phone.

Do the SAR limits apply to children?

Yes. The EMF exposure guidelines are designed to offer protection for all persons including children with a large built-in safety margin.

Where can I find the SAR and safety information for mobile phones?

There are many ways to find SAR information for mobile phones. We have listed some easy tips below.

- Check the phone handbook or user manual – look under safety or specifications
- Search the manufacturer’s web site for your phone model and SAR – it is usually listed under safety, or product specifications.

Additional tips

- Use a web search engine like Google to search for your phone model and SAR
- Contact the manufacturer and ask for the SAR information
- Contact the mobile dealer or your network provider
- Check the Mobile Manufacturers Forum web site www.mmfai.org
- Check the www.sartick.com information resource
- Check the web site of the government regulator in your country

How is SAR measured for other wireless devices?

Wireless devices intended to be used in close proximity to the body for example laptops and data cards are also required to be SAR tested. The SAR test is similar to the body test for a mobile phone.

The wireless device is placed against the phantom in the SAR laboratory, and the precision robot scans the area inside the phantom near the device and measures the absorbed radio signals. The computer analysing the data converts the radio signal levels into SAR (W/kg).

How is SAR measured for base station antennas?

EMF exposure guidelines for radio communications transmitting antennas (like base stations) specify the maximum level of radio frequency energy (SAR) that can be safely absorbed by the whole body. This is because exposure from a radio communications transmitting antenna is typically over the whole body, for example a technician working on a rooftop near base station antennas.

SAR due to exposure to small base station antennas can also be tested using a similar procedure to the SAR test for wireless devices. The base station antenna is placed up against a human phantom and the precision robot scans the entire body and measures the absorbed radio signals. The computer analysing the data converts the radio signal levels into SAR (W/kg).

The SAR test procedures are specified in international standards.

What about devices such as 2-way radios and walkie talkies?

These devices like mobile phones need to comply with the SAR limits and similarly the user manual will specify the recommended or intended use positions.

Additional resources...