

Maximum Spatial Gradient

What is it?

As you approach the MRI scanner, the strength of the static magnetic field increases. At any point we can describe not only how strong the field is, but how quickly it changes with distance. This variation with distance is known as the spatial gradient of the static magnetic field, and is not related to the imaging gradients.

What are the units?

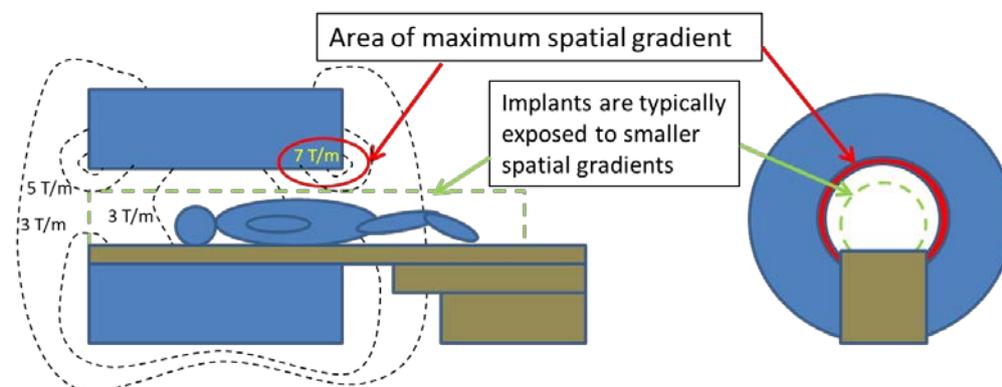
Spatial gradient is often quoted in units of tesla per metre (T/m). It is also common to see this quantity in units of gauss per centimetre (G/cm). You can convert between these units by using the relation: $100 \text{ G/cm} = 1 \text{ T/m}$.

Why is it important?

The attractive force experienced by a ferromagnetic object in the field of the scanner is dependent on the spatial gradient. The larger the spatial gradient, the larger the force on the object. The technical / safety documentation for the scanner will contain a diagram showing contour lines of the spatial gradient of that scanner. The spatial gradient is largest close to the opening of the magnet (as illustrated on the diagram below) and drops off significantly as you move away from this point.

Typically the patient will not encounter this maximum spatial gradient. The maximum spatial gradient encountered is smaller if the positioning of the implant is restricted to a region centred on the axis of the magnet. Details will be contained in the technical documentation of the scanner.

Some systems now provide options to visualise the regions within the MR scanner where the spatial field gradient exceeds a certain level.



Are there different limits for implants?

Often, implants that are MR conditional will specify a maximum spatial gradient as one of the conditions. It may be the case that the maximum spatial gradient for the scanner is larger than the specified MR Condition. However, it is often possible to meet the MR Condition by positioning the patient so that the implant is closer to the centre axis of the scanner and so experiences a lower spatial gradient.

Further Reading:

Scanner technical documentation

<https://www.sor.org/learning/document-library/safety-magnetic-resonance-imaging/5-static-magnetic-field>