# Article Title: The iPhone 12 Isn't the Only Phone to Fail France's Radiation Test

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# Article Content:

Last week, Apple’s iPhone 12 was [banned](https://www.washingtonpost.com/wellness/2023/09/14/france-ban-iphone-12-radiation-levels/) by a French regulatory body. The charge? The phone emits too much radiation.

If you browse the German or UK versions of Amazon, you’ll find plenty of iPhone 12s. But on the French [branch](https://www.amazon.fr/) you’ll see a black hole surrounded by iPhone 11s and iPhone 13s, among other generations.

This case raises a host of further questions. Why is the iPhone 12 being tested now, just as Apple is discontinuing it? Are these devices not tested thoroughly elsewhere? Is the iPhone 12 dangerous? And what kind of radiation are these phones emitting, anyway?

Why Has iPhone 12 Been Banned in France?

The [iPhone 12](https://www.wired.com/review/apple-iphone-12/) has been pulled off shelves in France following testing by the [ANFR](https://www.anfr.fr/en/home/), the Agence Nationale des Fréquences.

The agency says its representatives can stop by phone retailers and commandeer samples for testing. If those units comply with ANFR standards after being tested, they will be returned to the store.

“[An ANFR card] authorizes us, when presented to store managers, to take samples of mobile phones from shops. It is done randomly because we have to represent the entire possible market,” an ANFR rep says in one of the agency’s instructional videos.

The iPhone 12 in question failed ANFR’s testing, which took place at a lab called [CTC Advanced](https://cetecomadvanced.com/) in Saarbruecken, Germany. Two days after notice of the results were published online, on September 12, the ANFR demanded the “temporary withdrawal of the iPhone 12” from the French market.

It was one of 141 tested phones, according to the agency. WIRED has repeatedly asked when the ANFR plans to test the [iPhone 14](https://www.wired.com/review/apple-iphone-14/) and new [iPhone 15](https://www.wired.com/review/apple-iphone-15/) families, but we have yet to receive a clear answer from the agency.

Exactly What Radiation Does a Phone Emit?

All phones, including iPhones, emit a category of electromagnetic radiation called RF, radio frequency.

It’s the same kind of radiation used to transmit FM and DAB radio, and it refers to electromagnetic waves with a frequency between 20 kHz and 300 GHz. RF radiation is everywhere, and it only becomes a potential problem when someone is exposed to an unusually high amount of it.

How Much Radiation Does the iPhone 12 Emit?

The ANFR tested the iPhone 12 in two scenarios. “Limb” testing emulates the phone being held in the hand, while “trunk” testing emulates a phone stored in a jacket pocket.

One crucial difference between the two is how far the iPhone is from a person’s tissue. It’s directly on the body for limb testing, 5 mm away for trunk testing. The iPhone 12 failed the 0-mm distance limb testing, but not the test at 5 mm.

In each case, the test estimates how much a person’s hand, head, or leg is heated up from the radiation emitted by the phone, measured in watts per kilogram (W/kg).

The limit for the 0-mm test is 4 W/kg, per the ANFR standards. The limit for the 5-mm distance testing is 2 W/kg. The ANFR’s 0-mm testing on the Apple device registered 5.74 W/kg, 43 percent above the permitted maximum. By this measure, the iPhone 12 has a big problem.

How Is a Phone’s RF Radiation Tested?

[Specific Absorption Rate](https://en.wikipedia.org/wiki/Specific_absorption_rate) (SAR) is the standard for RF compliance testing and refers to the amount of energy transferred to the tissue of, say, your head or hand. It’s measured by looking for changes in temperature.

A robot hand places the phone in positions that emulate “real-world use.” But in place of an actual person, SAR testing uses a fiberglass mannequin filled with goop that can heat up from exposure to the RF radiation at the same rate as human flesh.

ANFR’s documentation even tells you how to [make your own](https://www.anfr.fr/das/COM091220013/VIL-COM0912200013-01%20%201-4050_22-11-02.pdf). It’s a mix of water, mineral oil, emulsifiers, and salt.

Changes in this liquid are measured via a probe stuck into the liquid, while the phone being tested cycles through its available wireless communication frequencies at maximum transmission power.

This may not make sense if you’re picturing the virtual person as a department store mannequin. In reality, it looks more like a tiny swimming pool, with each end shaped like half of a person’s head. The probe is then stuck into this gooey swimming pool. You can see a video of the process [here](https://www.youtube.com/watch?v=v56fdiamXQw&t=5s).

Did the ANFR Test Other Phones?

The ANFR regularly tests phones. You can look through the results over at the regulator’s [website](https://www.anfr.fr/rapports-etudes). Its database currently holds results for iPhone models up to the iPhone 13, although the results for the offending iPhone 12 are, somewhat oddly, not currently accessible.

There is a write-up of iPhone 12 testing from December 2021, and those results are within normal limits. However, that report omits the 0-mm distance testing that got the iPhone 12 into trouble in this latest round.

Have Other Phones Failed France’s Testing?

Yes. Some 50 phones are listed on the ANFR database as having failed the regulator’s testing to date. Some fail the test at a 5-mm distance, others at 0 mm.

Some of the biggest names include the Motorola Edge, which failed the 5-mm test, and the [Xiaomi Poco X3](https://www.gsmarena.com/xiaomi_poco_x3_nfc-10415.php), which managed to fail both. Samsung has failed twice—with the [Galaxy Note 10 Plus](https://www.wired.com/review/samsung-galaxy-note10plus/) and the [Galaxy Z Flip 5G](https://www.samsung.com/uk/support/model/SM-F707BZNABTU/).

The ANFR published a [press release](https://www.anfr.fr/fileadmin/medias/CP/2022/20220711-CP-DAS-nonconformites.pdf) in July 2022 announcing the test failures of the Samsung Galaxy Note 10 Plus, Hisense Infinity H30, and Gigaset GX290. But this was as much a recognition of the manufacturers agreeing to make software updates to the phones as it was an acknowledgement of their respective RF level failures.

Apple’s initial response may not have been deferential enough, which is what could have led to the ANFR’s more dramatic reaction and order to pull the iPhone 12 from shops, but the agency did not respond to our queries on this.

WIRED also asked Apple France for further comment on the 12 failing French testing requirements and its update plans, but we got no reply. Apple did, however, release this [statement](https://www.bbc.co.uk/news/technology-66795175): “We will issue a software update for users in France to accommodate the protocol used by French regulators. We look forward to iPhone 12 continuing to be available in France. This is related to a specific testing protocol used by French regulators and not a safety concern.”

What Generates RF Radiation in Phones?

The radiation generated by phones is RF, radio frequency. It is emitted by the wireless communication antennae found in every phone. Bluetooth, Wi-Fi, the call signal, 5G mobile internet—they all rely on RF because it’s what carries the relevant information.

The Bluetooth-streamed music sent to your headphones, the YouTube video you stream over 5G, the thank-you call to your grandma over traditional mobile phone signal … all relayed over RF. When you break it down a level further, RF is a form of electromagnetic energy, just like light.

The amount of RF transmitted by a phone is not consistent, though. It will typically be at its worst in a poor signal area, where its radio antennae end up constantly searching for a stronger signal. If you’ve felt your phone get strangely hot or seen the battery drop faster than usual when driving in the middle of nowhere, that’s why.

Several key components in an iPhone 12 are part of this RF generation. These include the Qualcomm X55 5G modem, Apple’s custom Wi-Fi/Bluetooth chip, the wireless charging tech, and Apple’s U1 ultra-wideband location-tracking chip.

RF radiation isn’t just normal, it’s a currency of modern electronics. And the iPhone 12 uses components found in other phones. The Qualcomm X55 5G modem was part of the highly popular Snapdragon 865 system on chip (SoC), as used in the Samsung Galaxy S20 Ultra, the OnePlus 8 Pro, the Xiaomi Mi 10, and the LG V60 ThinQ, among others.

Why Do Some Phones Generate More Radiation Than Others?

Around the time of the iPhone 12 launch, 5G tech seemed even more consolidated than it is today. Qualcomm was only on its second-gen 5G modem and MediaTek had yet to announce its first-gen one, leaving Qualcomm and Samsung Exynos as the key 5G providers for phones.

However, according to ANFR’s own database of results, the [Samsung Galaxy S20 Ultra](https://www.wired.com/review/samsung-galaxy-s20-ultra/) with shared components produces significantly less RF radiation. It recorded 1.162 W/kg and 2.493 W/kg in the same categories.

Other factors are involved too. For example, as part of the 5G wireless layout in today’s phones, you’ll see RF “frontend” chips, as well as the core 5G modem. These include power amplifiers that control how much “juice” is put through the transmitter.

Then there’s the software, which governs how the phone behaves when signal strength is limited. Crucially, too-high levels of RF can be altered with a software update.

You might imagine that other phones in the iPhone 12 family would have similar results. But ANFR tested the iPhone 12 mini and iPhone 12 Pro and found that they were within acceptable limits.

Is France’s Testing Different From Everyone Else’s?

Each country, region, or group of countries, like the EU, has their own set of RF standards, but a couple of key standards are found across the world.

In the US, Canada, and South Korea, the standard is 1.6 W/kg, measured across 1 g of virtual tissue. In Australia, Europe, and most of the rest of the world, the standard is 2 W/kg, measured across 10 g.

The standard in the US and Canada is significantly stricter. It’s not just about the lower acceptable ceiling of RF; the smaller sample size of 1 g means peak figures can’t be spread out as much.

But France uses one of the most demanding tests—putting the phone at a 0-mm distance from the virtual body. The United State’s FCC website doesn’t actually specify required distance, but 5 mm is the standard—and those few millimeters matter in the world of RF testing, thanks to the way RF dissipates.

In all cases, the reading you see on one of these SAR reports is the maximum recorded from all of the phones’ wireless frequency bands.

There’s another thing to consider. You might assume that all phones are tested by official bodies in their respective countries. That’s the FCC in the US, Ofcom in the UK, the Bundesnetzagentur in Germany, and so on.

In reality, Apple and other manufacturers organize testing at independent laboratories to ensure that they meet the required standards and have the documentation to prove it.

The ANFR’s testing is more like a secret shopper operation, performing additional testing to check manufacturers’ homework. Three years after the fact, Apple was found wanting.

Is Mobile Phone Radiation Dangerous?

RF is one of the least dangerous forms of radiation. These are low-energy waves with longer wavelengths than visible light, ultraviolet, x-rays, and gamma rays.

They are in non-ionising electromagnetic territory, which means they don’t have sufficient energy to cause major damage by breaking chemical bonds or removing electrons from atoms. That interaction is what can make higher-energy types of electromagnetic waves, like gamma rays, cause cancer.

The situation is muddied by the damage light can cause, however. Most forms of ultraviolet light are non-ionising, and yet we all know that too much exposure to them can cause skin cancer. So what’s going on there?

Skin damage from higher-energy UV light waves can cause an increase in free radicals, which are unstable molecules created by the body in response to “environmental insults,” as [**Harvard**](https://www.health.harvard.edu/staying-healthy/understanding-antioxidants) puts it.

The simplistic view offered by certain lifestyle blogs is that free radicals are bad but can be countered with antioxidants. However, more [**recent research**](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC10045152/%23:~:text=Some%20studies%20have%20found%20that,cancer%20with%20antioxidant%20supplement%20use.) has actually found that some antioxidants can help speed up cancer growth. On this point, we’re out of our depth.

The specific research done into the effects of RF radiation from phones is also inconclusive. The [World Health Organization stated](https://www.who.int/news-room/fact-sheets/detail/electromagnetic-fields-and-public-health-mobile-phones) in 2014 that, after a large number of studies, “no adverse health effects have been established as being caused by mobile phone use.”

A meta-analysis [**published**](https://www.ncbi.nlm.nih.gov/pmc/articles/PMC7663653/) in 2020 found that the results of studies appeared to vary based on the group enacting them, but it suggested that there is “significant evidence linking cellular phone use to increased tumor risk, especially among cell phone users with cumulative cell phone use of 1,000 or more hours in their lifetime.”

Still, a [**reaction**](https://www.mdpi.com/1660-4601/18/10/5459) to that meta-analysis by members of the Australian Radiation Protection and Nuclear Safety Agency suggested that the authors of the original analysis had unfairly maligned studies that suggested the opposite. To further muddy the waters, many of the studies in the original research are ancient in tech terms. More than 60 percent were published in 2010 or earlier, none after 2015. The fundamentals of RF may not have changed since then, but the hardware we use and the ways we typically interact with it certainly have.

Is RF Radiation Radioactive?

Radio frequency radiation is not radioactive, and it cannot make other objects radioactive. Neither can much higher-energy, more dangerous waves, such as gamma rays.

Instead, radioactive elements can emit gamma rays, alongside alpha and beta particles. These particles have actual mass, unlike gamma rays, which are composed of weightless photons much like RF emissions. All of these, unlike RF, are pretty dangerous in most scenarios.