

Health effects of non-ionizing electromagnetic radiation in the workplace

What is electromagnetic radiation?

Electromagnetic radiation (EMR) is present everywhere in our environment and results from both natural and human-made sources.

Some of this radiation, such as ultraviolet light, X-rays, and gamma rays, is “ionizing” and can cause diseases such as cancer. Other types of EMR are “non-ionizing” and do not have the power to break chemical bonds.

Non-ionizing radiation is unlikely to cause cancer. However, if the energy level is high enough, there may be other effects on human health.

We are surrounded by EMR from radio, television, and cellphone transmissions, as well as emissions from thunderstorms and the Earth’s magnetic field.

EMR is often expressed by frequency or the number of “cycles” per second (one cycle per second equals one hertz or Hz):

- Extremely low frequency (ELF) radiation ranges from 1 Hz to 3 kHz
- Radiofrequency (RF) radiation ranges from 3 kHz to 300 MHz
- Microwave (MW) radiation ranges from 300 MHz to 300 GHz

The following table shows some examples of common sources of non-ionizing EMR and their frequencies.

Source	Frequency*	Type
Transmission lines	50–60 Hz	ELF
Computer monitors	60–90 Hz	ELF
AM radio transmission	530–1,600 kHz	RF
RF heaters used for bonding plastics	13–70 MHz	RF
Thunderstorms	30–300 MHz	RF
FM radio transmission	88–108 MHz	RF
Television transmission	50–700 MHz	MW
Cellphones	850 MHz–2.4 GHz	MW
Wireless data	2.4–5 GHz	MW
Microwave ovens	2.5 GHz	MW
Radar	20–40 GHz	MW

* 1 kHz = 1,000 Hz; 1 MHz = 1 x 10⁶ Hz; 1 GHz = 1 x 10⁹ Hz

What are the health effects of non-ionizing EMR?

Widespread use and the advancement of wireless technology have introduced non-ionizing EMR into many workplaces, from telecommunications to bonding plastics. Although these types of radiation are important parts of many work processes, there are concerns that these emissions can affect worker health.

Transmission lines (ELF)

- Worker exposure to ELF magnetic fields can cause circulating currents within the body. The strength of the currents depends on the intensity

of the magnetic field and the distance from the source of transmission.

- Exposure several metres from an antenna is extremely low, and health effects are unlikely.



- The International Agency for Research on Cancer (IARC) has classified ELF magnetic fields as possibly carcinogenic to humans (Group 2B).

Radio and television transmission antennas

- When working next to radio (AM and FM) and television antennas, workers can be exposed to very strong RF and MW fields.
 - If sufficiently strong, these fields could cause stimulation of nerves and muscles or affect other biological processes.
 - Body tissues heat up as energy from the fields is absorbed, and workers will start to feel warm. In extreme cases, workers may develop heat stress, especially in hot weather.
- Exposure several metres from an antenna is extremely low, and health effects are unlikely.

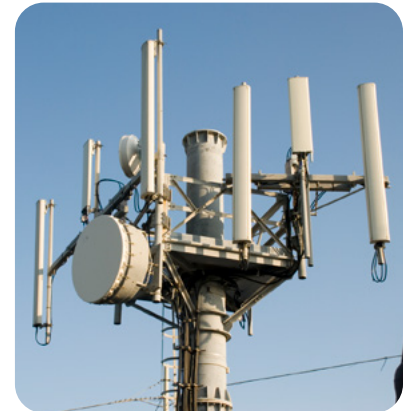
RF sealers

- RF sealers are used to bond layers of plastic, laminate, particleboard, plywood, and veneer together. They can also be used to dry and cure coatings. RF radiation causes the molecules in the material (for example, plastics and glues) to heat up. Pressure is applied, and the materials flow together and bond.
- Many RF sealers are unshielded or improperly shielded, so they leak RF energy into the workplace.

- RF fields next to RF sealers can be extremely strong.
 - If sufficiently strong, these fields could cause stimulation of nerves and muscles or affect other biological processes.
 - The main health effect is body heating. Workers may feel warmth in their bodies (particularly the ankles).
 - Ocular damage (for example, cataracts) may occur if a worker is exposed to strong RF fields for more than a couple of hours.
 - Numbness in the hands has been reported.

Cellular transmission antennas

- When working next to MW cellular antennas, workers can be exposed to strong MW fields. Exposures within 3 m (10 ft.) of the front of these antennas may exceed the Health Canada RF standards.
 - The body absorbs energy from the fields, so the main health effect is body heating.



Cellphones and wireless networks (wi-fi)

- Cellphone signals are very low energy and are unlikely to cause health effects.
- There is a potential for the heating of body tissue close to the location of the phone antenna.
- IARC has classified RF and MW electromagnetic fields as possibly carcinogenic to humans (Group 2B) based on an increased risk for two types of tumours (glioma and acoustic neuroma).
- Wireless networks have very low transmission power — far lower than from cellphones.

Other issues

- EMR may interact with pacemakers or metallic implants (for example, cochlear implants, surgical pins, and artificial joints). Workers with implants should speak with their doctors before working near sources of EMR. Pacemaker users may wish to contact the device manufacturers.
- Be aware that metal frames on eyeglasses can concentrate EMR in the vicinity of the frames.

How can exposure to RF and MW radiation be controlled?

Employers can do the following:

- Ensure that any device or equipment is used safely and according to the manufacturer's instructions.
- Develop safe work procedures for using or working around RF and MW equipment.
- Ensure workers understand the risks and know how to minimize their exposure to non-ionizing radiation.

Workers can do the following:

- Follow safe work procedures for using or working around RF and MW equipment.
- Maintain a safe distance from RF and MW sources. (The intensity of the radiation decreases substantially with distance from the equipment.) Worker protection is based on limiting the time of exposure and maintaining a distance from the source.
- Report any damaged or broken devices (for example, a broken radio antenna) to a supervisor or manager.

- When using a cellphone or radio, do the following:
 - Spend less time on the phone.
 - Use alternative ways to make calls (for example, speakerphone), or send text messages.
 - Hold the device away from the body during a call.

For more information

BC Centre for Disease Control:

Radiofrequency exposures

www.bccdc.ca/health-info/prevention-public-health/radiofrequency-exposure

Health Canada:

- Cell phones, cell phone towers and other antenna installations
www.canada.ca/en/health-canada/services/health-risks-safety/radiation/everyday-things-emit-radiation/cell-phones-towers.html

- Radiation — technical reports and publications
www.canada.ca/en/services/health/publications/health-risks-safety.html

International Commission on Non-Ionizing Radiation Protection (ICNIRP):

About ICNIRP

<http://www.icnirp.de>

WorkSafeBC:

Radiation (non-ionizing)

worksafebc.com/health-safety/hazards-exposures/radiation-non-ionizing