



BERMUDA

MERCHANT SHIPPING AND FISHING VESSELS (HEALTH AND SAFETY AT  
WORK) (ELECTROMAGNETIC FIELDS) REGULATIONS 2019

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SCHEDULE

The Minister responsible for Maritime Administration, in exercise of the power conferred by section 93 of the Merchant Shipping Act 2002, makes the following Regulations:

Citation

- 1 These Regulations may be cited as the Merchant Shipping and Fishing Vessels (Health and Safety at Work) (Electromagnetic Fields) Regulations 2019.

PART 1  
PRELIMINARY

Interpretation

- 2 (1) In these Regulations—
  - “AL” means an action level set out in Parts 2 and 3 of the Schedule;
  - “Bermuda ship” means a ship which is—
    - (a) a Bermuda ship within the meaning of section 16(3) of the Act;
    - (b) a Government ship; or
    - (c) a hovercraft;
  - “direct biophysical effect” means an effect on human body tissue caused by its presence in an electromagnetic field;
  - “electromagnetic field” means a static electric, static magnetic and time-varying electric, magnetic and electromagnetic field with a frequency up to 300 GHz;
  - “ELV” means an exposure limit value set out in Part 2 of the Schedule;
  - “employer” means a person by whom a worker is employed on a ship under a contract of employment;
  - “General Duties Regulations” means the Merchant Shipping (Health and Safety at Work) Regulations 2004;
  - “Government ship” has the meaning given in section 4(3) of the Act;

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“health and safety” includes the occupational health and safety of persons while on board a ship and while boarding or leaving a ship;

“health effect” means a direct biophysical effect which is potentially harmful to human health;

“indirect effect” means an effect, caused by the presence of an object or a substance in an electromagnetic field, which may present a safety or health hazard;

“Merchant Shipping Notice” means a Notice described as such and issued by the Chief Marine Surveyor, or the equivalent UK Merchant Shipping Notice, as applicable;

“sensory effect” means a direct biophysical effect involving a transient disturbance in sensory perception or a minor and temporary change in brain function;

“ship” includes hovercraft;

“worker at particular risk” means—

- (a) a worker who has declared to his or her employer a condition which may lead to a higher susceptibility to the potential effects of exposure to electromagnetic fields; or
- (b) a worker who works in close proximity to electro-explosive devices, explosive materials or flammable atmospheres.

(2) In these Regulations, a reference to workers is, in relation to an employer, to be treated as a reference to the workers of that employer while they are at work.

(3) In the application of these Regulations to a hovercraft, a reference to the master of a ship includes a reference to the captain of that hovercraft.

### Meaning of “worker”

3 (1) In these Regulations, “worker” means a person employed under a contract of employment and includes a trainee or apprentice other than a person who is training in a vessel which is being used to provide instruction in—

- (a) the principles of responsibility, resourcefulness, loyalty and team endeavour and to advance education in the art of seamanship; or
- (b) navigation and seamanship for yachtsmen,

and which is operating under a relevant code.

(2) In paragraph (1), “relevant code” means—

- (a) the Large Commercial Yacht Code as set out in a Merchant Shipping Notice;
- (b) the Code of Practice for the Safety of Small Commercial Sailing Vessels;
- (c) the Code of Practice for the Safety of Small Commercial Motor Vessels; or

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- (d) the Code of Practice for the Safety of Small Vessels in Commercial Use for Sport or Pleasure Operating from a Nominated Departure Point.

(3) In paragraph (2), each reference to a Code includes a reference to any document containing an amendment or replacement of that Code, which is considered by the Minister to be relevant from time to time and is specified in a Merchant Shipping Notice which contains a statement to that effect.

Application of these Regulations

4 (1) Without prejudice to Regulation 5 (general duties) of the General Duties Regulations 2004 and subject to paragraph (2), these Regulations apply in relation to activities in which workers are subject to, or are potentially subject to exposure to, electromagnetic fields on Bermuda ships.

(2) Where—

- (a) a ship is being used in the course of public service activities or activities for the purposes of the civil protection services; and
- (b) characteristics peculiar to those activities inevitably conflict with a provision of these Regulations,

that provision does not apply in relation to activities on that ship, to the extent of that conflict.

(3) To the extent that a provision of these Regulations does not apply in relation to activities on a ship because of paragraph (2), there is in relation to that ship, a duty of the employer to ensure, so far as is reasonably practicable, the health and safety of the workers who are subject, or are potentially subject to exposure on the ship.

(4) This Regulation (other than paragraph (1)) and Regulations 14 and 16, apply in relation to activities on ships other than Bermuda ships, which are for the time being in Bermuda waters, during which workers are subject or potentially subject to exposure to electromagnetic fields.

(5) In this Regulation—

“civil protection service” includes the fire and rescue and ambulance services, and search and rescue services provided by any other person; and

“public service activities” includes the activities of the armed forces, HM Customs, immigration officers, police, prison officers and the security and intelligence services.

PART 2

EXPOSURE AND RISK

Limitation on exposure to electromagnetic fields

5 (1) Subject to paragraphs (2) and (3), an employer must ensure that workers are not exposed to electromagnetic field levels in excess of the ELVs.

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(2) Exposure may exceed the sensory effect ELVs during work activities in respect of which the employer has taken the applicable safety measures contained in the Schedule.

(3) Paragraph (1) does not apply in relation to the exposure of workers to electromagnetic fields during the development, testing, installation, use and maintenance of, or research related to, magnetic resonance imaging equipment for medical use, provided—

- (a) the exposure of workers to electromagnetic fields is as low as is reasonably practicable; and
- (b) workers are protected against any health effects and safety risks related to that exposure.

(4) In this Regulation—

“sensory effect ELV” means the sensory effect ELVs set out in Part 2 of the Schedule.

Exposure assessment

6 (1) Subject to paragraph (5), the employer must make a suitable and sufficient assessment of the levels of electromagnetic fields to which workers may be exposed.

(2) Where Regulation 5(1) applies—

- (a) the assessment must demonstrate whether that Regulation is complied with, if necessary, through the use of calculations and measurements; and
- (b) the employer may, in accordance with the Schedule, assess exposure against the ALs in order to determine that specific ELVs are not exceeded.

(3) An assessment may take into account—

- (a) emission information and other safety related data provided by the manufacturer or distributor of equipment;
- (b) industry standards and guidelines; and
- (c) guidance produced by the Minister.

(4) The employer must review an assessment when—

- (a) there is reason to suspect it is no longer valid; or
- (b) there has been a significant change in the matters to which it relates,

and make such changes to it as are necessary to ensure it remains suitable and sufficient.

(5) Where an employer has made an assessment before the date on which these Regulations come into force, which assessment would have complied with the requirements of this Regulation, that employer is to be treated, on and after that date, as having complied with paragraph (1).

Application of Regulations 8 to 10

7 (1) Regulation 8 does not apply—

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- (a) where the most recent exposure assessment under Regulation 6 demonstrates compliance with Regulation 5(1); or
  - (b) in relation to activities set out in Regulation 5(3).
- (2) Regulations 9 and 10 do not apply, where—
- (a) the most recent exposure assessment under Regulation 6 demonstrates that workers are not exposed to electromagnetic field levels in excess of the ELVs;
  - (b) the indirect effect ALs are not exceeded; and
  - (c) there are no workers at particular risk.
- (3) In this Regulation—
- “indirect effect ALs” means the Low ALs in Table AL1, and the ALs in Tables AL5 to AL7, in the Schedule.

Action plan

- 8 (1) The employer must make and implement a suitable and sufficient action plan to ensure compliance with Regulation 5(1).
- (2) The action plan must include consideration of, where relevant—
- (a) other working methods that entail lower exposure to electromagnetic fields;
  - (b) replacement equipment designed to reduce the level of exposure;
  - (c) technical measures to reduce the emission of electromagnetic fields, including, where necessary, the use of interlocks, screening or similar health protection mechanisms;
  - (d) demarcation and access control measures;
  - (e) maintenance programmes for work equipment, workplaces and workstation systems;
  - (f) the design and layout of workplaces and workstations;
  - (g) limitations on the duration and intensity of exposure; and
  - (h) the availability of suitable personal protection equipment.
- (3) Where, despite the measures taken in accordance with paragraph (1), the exposure of workers exceeds any ELV, the employer must, as soon as is reasonably practicable, identify and implement any changes to the action plan which are necessary to ensure compliance with Regulation 5(1).

Risk assessment

- 9 (1) Subject to paragraph (5), the employer must make a suitable and sufficient assessment of the risks to workers arising from their exposure to electromagnetic fields.
- (2) The risk assessment must include consideration of, where relevant—

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- (a) the ALs and ELVs;
  - (b) the frequency range, level, duration and type of exposure, including its distribution over the worker's body and the workplace;
  - (c) direct biophysical effects;
  - (d) replacement equipment designed to reduce the level of exposure;
  - (e) information obtained from any health surveillance or medical examinations provided under Regulation 20;
  - (f) information provided by the manufacturer or distributor of equipment;
  - (g) multiple sources of exposure;
  - (h) simultaneous exposure to multiple frequency fields;
  - (i) indirect effects;
  - (j) any effects on workers at particular risk; and
  - (k) other health and safety related information.
- (3) The risks referred to in paragraph (1) do not include the risk of effects—
- (a) caused by contact with live conductors;
  - (b) caused by multiple and separate instances of exposure; or
  - (c) which continue to develop when exposure has ceased.
- (4) The employer must review the assessment when—
- (a) there is reason to suspect it is no longer valid; or
  - (b) there has been a significant change in the matters to which it relates,

and make such changes to it as are necessary to ensure it remains suitable and sufficient.

(5) Where an employer has made an assessment before the date on which these Regulations come into force, which assessment would have complied with the requirements of this Regulation, that employer is to be treated, on and after that date, as having complied with paragraph (1).

Obligation to eliminate or reduce risks

10 (1) The employer must ensure that, so far as is reasonably practicable, the risks identified in the most recent risk assessment under Regulation 9 are eliminated or reduced to a minimum.

- (2) Measures taken under paragraph (1) must—
- (a) be based on the general principles of prevention set out in Regulation 5(1) of the General Duties Regulations; and

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- (b) take into account technical progress, the potential to restrict access to parts of the workplace, and the availability of measures to control the production of electromagnetic fields at source.

PART 3  
ENFORCEMENT

Offences and Penalties

11 (1) Any person who fails to comply with Regulations 5, 6, 8, 9, 10 or 20 commits an offence and is liable—

- (a) on summary conviction, to a fine not exceeding \$10,000; or
- (b) on conviction on indictment, to imprisonment for a term not exceeding two years or to an unlimited fine or both.

(2) Any person who fails to comply with Regulation 18 or 19 commits an offence and is liable on summary conviction, to a fine not exceeding \$5,000.

(3) Section 145 (1) of the Act (enforcement of fines) applies to any fine imposed for an offence under paragraphs (1) and (2), as if the reference to proceedings against the owner or master of a ship for an offence under Chapter III were a reference to proceedings against any person for an offence under those paragraphs.

(4) Where a body corporate commits an offence under these Regulations and that offence is proved to have been committed with the consent or connivance of, or to be attributable to any neglect on the part of, any director, manager, secretary or other similar officer of the body corporate or a person who was purporting to act in any such capacity, that person as well as the body corporate commits that offence and is liable to be proceeded against and punished accordingly.

(5) Where the affairs of the body corporate are managed by its members, paragraph (4) applies in relation to the acts and defaults of a member in connection with that member's functions of management as if that member were a director of the body corporate.

Burden of proving what is reasonably practicable

12 In any proceedings under these Regulations consisting of a failure to comply with a duty or a requirement to do something so far as is reasonably practicable, it is for the defendant to prove that it was not reasonably practicable to do more than was in fact done to satisfy that duty or requirement.

Detention of a Bermuda ship

13 (1) Where a surveyor of ships is satisfied that there is or has been a failure to comply in relation to any ship, with the requirements of these Regulations, that ship is liable to be detained until a surveyor of ships is satisfied that those requirements are complied with.



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(2) A surveyor of ships may permit a ship which is liable to be detained under paragraph (1), to proceed to sea for the purpose of proceeding to the nearest appropriate repair yard.

(3) A ship must not be delayed or detained unreasonably under this Regulation.

(4) Where a ship is detained because in relation to it, there has been a failure to comply with the requirements of these Regulations, and that failure has ceased, a person having the power to detain the ship must, at the request of the owner or master, immediately release the ship—

- (a) if no proceedings for an offence arising from the failure in question are instituted within the period of seven days beginning with the day on which the ship is detained;
- (b) if proceedings for an offence arising from the failure in question, having been instituted within that period, are concluded without the employer or other person having control of the matter in question being convicted;
- (c) if either—
  - (i) the sum of \$50,000 is paid to the Minister by way of security; or
  - (ii) security which, in the opinion of the Minister, is satisfactory and is for an amount not less than \$50,000 is given to the Minister, by or on behalf of the employer or other person having control of the matter in question;
- (d) where the employer or other person having control of the matter in question is convicted of an offence arising from the failure in question, if any costs or expenses, ordered to be paid by that person, and any fine imposed on that person, have been paid; or
- (e) the release is ordered by a court or tribunal referred to in article 292 of the United Nations Convention on the Law of the Sea 1982, and any bond or other financial security ordered by such court or tribunal is posted.

(5) The Minister must repay any sum paid in pursuance of paragraph (4)(c) or release any security so given—

- (a) if no proceedings for an offence arising from the failure in question are instituted within the period of seven days beginning with the day on which the sum is paid; or
- (b) if proceedings for an offence arising from the failure in question, having been instituted within that period, are concluded without the employer or other person having control of the matter in question being convicted.

(6) Where a sum has been paid, or security has been given, by any person in pursuance of paragraph (4)(c) and the employer or other person having control of the matter in question is convicted of an offence arising from the failure in question, the sum so paid or the amount made available under the security must be applied as follows—

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- (a) first, in payment of any costs or expenses ordered by the court to be paid by the employer or other person having control of the matter in question;
- (b) next, in payment of any fine imposed by the court; and
- (c) any balance must be repaid to the first mentioned person.

(7) Section 144 of the Act (interpretation of section 143) applies, for the purposes of paragraphs (4) to (6), as if—

- (a) references to the master or owner of the ship were references to the employer or other person having control of the matter in question; and
- (b) references to an offence under section 130 were references to an offence arising from the failure in question.

Inspection and other measures in respect of ships registered outside Bermuda

14 (1) When a ship which is not a Bermuda ship is in Bermuda waters, a relevant inspector may inspect that ship to ascertain whether the standards required in relation to Bermuda ships by these Regulations are met, in relation to that ship.

(2) Where a surveyor of ships is satisfied that the standards required in relation to Bermuda ships by these Regulations are not met in relation to a ship which is not a Bermuda ship, but is in Bermuda waters, that surveyor may—

- (a) send a report to the government of the State whose flag the ship is entitled to fly, and a copy of that report, to the Director General of the International Labour Office; and
- (b) where conditions on board are clearly hazardous to health and safety, take such measures as are necessary, to ensure those conditions are rectified.

(3) A ship to which paragraph (2)(b) applies, is liable to be detained until a surveyor of ships is satisfied that those conditions are rectified.

(4) A surveyor of ships may permit a ship which is liable to be detained under paragraph (3), to proceed to sea for the purpose of proceeding to the nearest appropriate repair yard.

(5) If any of the measures specified in paragraph (2)(b) or (3) are taken, the surveyor of ships must immediately notify the nearest maritime, consular or diplomatic representative of the State whose flag the ship is entitled to fly.

(6) A ship must not, in the exercise of the power under this Regulation, be delayed or detained unreasonably.

(7) In paragraph (1)—

“relevant inspector” means a person mentioned in section 219(1)(a), (b) or (c) of the Act (powers to inspect ships and their equipment, etc).

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### Application of powers of inspectors in relation to Government ships

15 Sections 219 to 227 of the Act apply to these Regulations as if they were for all purposes made under section 93 of the Act and accordingly, those sections apply in relation to Government ships.

### Enforcement of detention

16 (1) Section 242 of the Act (enforcing detention of ship applies where a ship is liable to be detained under these Regulations, as if—

- (a) references to detention of a ship under the Act were references to detention of the ship in question under these Regulations; and
- (b) subsection (7) were omitted.

(2) Where a ship is liable to be detained under these Regulations, the person detaining the ship must serve on the master of the ship a detention notice which—

- (a) states that a surveyor of ships is of the opinion that in relation to that ship, there is a failure to comply with the requirements of these Regulations;
- (b) specifies the matters which, in the opinion of the surveyor of ships, have the effect that in relation to that ship, those requirements are not met; and
- (c) requires the terms of the notice to be complied with, until the ship is released by any person mentioned in section 242(1) of the Act.

### Right of appeal and compensation

17 Regulations 14, 15 and 16 (right of appeal and compensation, arbitration and compensation for unjustified detention) of the Merchant Shipping (Port State Control) Regulations 2019 apply to a detention notice served under these Regulations as they apply to a detention order under those Regulations.

### Prohibition on charging of workers

18 No charging in respect of anything done or provided in accordance with any requirement of these Regulations may be levied or permitted to be levied on any worker.

## PART 4

### MISCELLANEOUS

### Information and training

19 The employer must provide relevant information and training to any workers who are likely to be subjected to the risks identified in the most recent risk assessment under Regulation 9, including in relation to—

- (a) the measures taken under Regulation 10;
- (b) the concepts and values of the ALs and ELVs and the possible risks associated with them;

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- (c) the possible indirect effects of exposure;
- (d) the results of the most recent exposure assessment under Regulation 6;
- (e) how to detect and report sensory and health effects;
- (f) the circumstances in which workers are entitled to health surveillance and medical examinations under Regulation 20;
- (g) safe working practices; and
- (h) any additional measures taken in respect of workers at particular risk.

Health surveillance and medical examinations

20 (1) The employer must ensure that health surveillance and medical examinations are provided as appropriate, to any worker who—

- (a) is exposed to electromagnetic field levels in excess of the health effect ELVs; and
- (b) reports experiencing a health effect to that employer.

(2) Any health surveillance or medical examination must be provided during any reasonable hours chosen by the worker.

(3) The employer must keep a record of any health surveillance and medical examination provided.

(4) In this Regulation—

“health effect ELVs” means the health effect ELVs set out in Part 2 of the Schedule.

Records

21 An employer who employs five or more workers must—

- (a) record the significant findings of the most recent exposure assessment under Regulation 6; and
- (b) where required to make them, record—
  - (i) the most recent action plan under Regulation 8; and
  - (ii) the significant findings of the most recent risk assessment under Regulation 9.

Duties of other persons

22 (1) Where a person on whom a duty is imposed by any of the preceding provisions of these Regulations does not have control of the matter to which that provision relates, because responsibility for the operation of the ship falls upon another person, that duty also extends to any other person who has control of that matter.

(2) It is the duty of every worker performing activities to which these Regulations apply, to—

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- (a) make full and proper use of all clothing and equipment provided by the employer to that worker, in pursuance of these Regulations; and
- (b) give effect to all information and training provided to that worker, under Regulation 19.

Exemptions

23 (1) The Minister may exempt an employer from the requirements of Regulations 5(1) and 8 in relation to one or more work activities.

(2) An exemption under paragraph (1) must be subject to the following conditions—

- (a) the exposure of workers to electromagnetic fields must be reduced to the lowest level, reasonably practicable; and
- (b) workers must be protected against the health effects and safety risks arising from that exposure.

(3) An exemption granted under this Regulation must be—

- (a) in writing;
- (b) valid for a maximum period of five years; and
- (c) withdrawn as soon as the Minister is satisfied that it is no longer justified.

(4) The Minister may amend or revoke an exemption at any time.

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SCHEDULE

(Regulations 5, 6, 7 and 20)

Part 1

Introduction to Parts 2 and 3

1 In this schedule—

“contact current (IC)” is the current created when a person comes into contact with an object in an electromagnetic field, expressed in ampères (A);

“external electric field strength (E)” is a vector quantity corresponding to the force exerted on a charged particle in the environment, irrespective of its motion in space, expressed in volts per metre ( $Vm^{-1}$ );

“internal electric field strength (E)” is a vector quantity corresponding to the force exerted on a charged particle inside the human body, irrespective of its motion in space, expressed in volts per metre ( $Vm^{-1}$ );

“limb current (IL)” is the current induced in the limbs of a person exposed to electromagnetic fields in the frequency range from 10 MHz to 110 MHz, expressed in ampères (A);

“magnetic flux density (B)” is a vector quantity resulting in a force that acts on moving charges, expressed in tesla (T);

“power density (S)” is the radiant power incident perpendicular to a surface, divided by the area of the surface, expressed in watts per square metre ( $Wm^{-2}$ );

“specific energy absorption (SA)” is the energy absorbed per unit mass of biological tissue, expressed in joules per kilogram ( $Jkg^{-1}$ ); and

“specific energy absorption rate (SAR)” is the rate at which energy is absorbed per unit mass of body tissue, expressed in watts per kilogram ( $Wkg^{-1}$ ).

2 The ALs and ELVs set out in tables are grouped according to their potential effects, being—

(a) thermal effects, related to the heating of tissue due to its absorption of electromagnetic fields; and

(b) non-thermal effects, related to the stimulation of muscles, nerves or sensory organs due to the presence of electromagnetic fields.

3 The low ALs in Table AL1 in Part 2, and the ALs in Part 3, specify the electromagnetic field levels above which specific indirect effects may occur.

4 (1) The remaining ALs in Part 2 are defined physical quantities related to the direct biophysical effects of exposure to electromagnetic fields.

(2) Employers may, as part of their exposure assessment, assess electromagnetic field levels against these ALs.

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(3) Each AL table states which ELV or ELVs will be complied with, if electromagnetic field levels at a particular frequency do not exceed the specified AL.

(4) Exposure to electromagnetic field levels that exceeds an AL may still be below the relevant ELV, but in order to determine this, the employer will need to undertake a further assessment under Regulation 6.

5 Except where otherwise indicated—

- (a) “f” is the frequency expressed in hertz;
- (b) the ALs and ELVs relate to exposure in any part of the body; and
- (c) notes to the tables apply only to the table under which they appear.

6 The applicable safety measures referred to in Regulation 5(2) are those required by the notes to the table or tables containing the sensory effect ELV which is to be exceeded, being the note to Table ELV1, and note 2 to Tables ELV3 and ELV5.

Part 2

Direct biophysical effects of exposure

Action Levels - non-thermal effects

Table AL1 – ALs for exposure to electromagnetic fields from 1 Hz to 10 MHz		
<i>Frequency range</i>	<i>External electric field</i>	<i>External electric field</i>
$1 \leq f < 25 \text{ Hz}$	$2.0 \times 10^4$	$2.0 \times 10^4$
$25 \leq f < 50 \text{ Hz}$	$5.0 \times 10^5 / f$	$2.0 \times 10^4$
$50 \text{ Hz} \leq f < 1.64 \text{ kHz}$	$5.0 \times 10^5 / f$	$1.0 \times 10^6 / f$
$1.64 \leq f < 3 \text{ kHz}$	$5.0 \times 10^5 / f$	$6.1 \times 10^2$
$3 \text{ kHz} \leq f \leq 10 \text{ MHz}$	$1.7 \times 10^2$	$6.1 \times 10^2$
Exposure levels not exceeding the ALs will be compliant with:	Tables ELV2 and ELV3	

NOTES

1 Between the Low and High ALs, exposure will be below the ELVs but spark discharges may occur. These can be prevented through the provision of information and training under Regulation 19 and the use of suitable technical and personal protection measures.

2 The ALs in Tables AL1 and AL2 are root mean square (RMS) values of the field strength. These RMS values are equal to the peak values divided by  $\sqrt{2}$  for sinusoidal fields. The corresponding ELVs in Tables ELV2 and ELV3 are peak values in time, which are equal to the RMS values multiplied by  $\sqrt{2}$  for sinusoidal fields. In the case of non-sinusoidal fields, the exposure assessment under Regulation 6 must be based on the weighted peak method (filtering in time domain) or on a scientifically proven and validated exposure evaluation procedure which produces comparable results to the weighted peak method.

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3 The ALs represent the maximum field values at any place where a worker may be working, before the entry of any person into the field. In the case of an electromagnetic field source in the immediate vicinity of the body, compliance with the ELVs must be determined dosimetrically on a case by case basis.

<i>Frequency Range</i>	<i>Magnetic flux density Low ALs (B) [<math>\mu T</math>]</i>	<i>Magnetic flux density High ALs (B) [<math>\mu T</math>]</i>	<i>Magnetic flux density ALs for exposure of limbs to a localised magnetic field (B) [<math>\mu T</math>]</i>
$1 \leq f < 8$ Hz	$2.0 \times 10^5/f^2$	$3.0 \times 10^5/f$	$9.0 \times 10^5/f$
$8 \leq f < 25$ Hz	$2.5 \times 10^4/f$	$3.0 \times 10^5/f$	$9.0 \times 10^5/f$
$25 \leq f < 300$ Hz	$1.0 \times 10^3$	$3.0 \times 10^5/f$	$9.0 \times 10^5/f$
$300 \text{ Hz} \leq f < 3$ kHz	$3.0 \times 10^5/f$	$3.0 \times 10^5/f$	$9.0 \times 10^5$
$3 \text{ kHz} \leq f \leq 10$ MHz	$1.0 \times 10^2$	$1.0 \times 10^2$	$3.0 \times 10^2$
Exposure levels not exceeding the ALs will be compliant with:	At and below 400 Hz: the sensory effect ELVs in Table ELV3	The health effect ELVs in Table ELV2	
	Above 400 Hz: the health effect ELVs in Table ELV2		

NOTES

1 Between the Low and High ALs for exposure up to 400 Hz, exposure in the head of the worker will be below the health effect ELVs but may exceed the sensory effect ELVs in Table ELV3.

2 Notes 2 and 3 to Table AL1 apply.

Action levels – thermal effects

<i>Frequency Range</i>	<i>External electric field strength ALs (E) [<math>Vm^{-1}</math>]</i>	<i>Magnetic flux density ALs (B) [<math>\mu T</math>]</i>	<i>Power density ALs (S) [<math>Wm^{-2}</math>]</i>
$100 \text{ kHz} \leq f < 1$ MHz	$6.1 \times 10^2$	$2.0 \times 10^6/f$	-
$1 \leq f < 10$ MHz	$6.1 \times 10^8/f$	$2.0 \times 10^6/f$	-
$10 \leq f < 400$ MHz	61	0.2	-
$400 \text{ MHz} \leq f < 2$ GHz	$3.0 \times 10^{-3} f^{1/2}$	$1.0 \times 10^{-5} f^{1/2}$	-
$2 \leq f < 6$ GHz	$1.4 \times 10^2$	$4.5 \times 10^{-1}$	-
$6 \leq f \leq 300$ GHz	$1.4 \times 10^2$	$4.5 \times 10^{-1}$	50



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Exposure levels not exceeding the ALs will be compliant with:	Up to 6 GHz: the health effect ELVs in Table ELV4	The health effect ELV in Table ELV6
	6 to 300 GHz: the health effect ELV in Table ELV6	

- 1 The electric field strength and magnetic flux density ALs are root mean square values.
- 2 For radiofrequency pulses, the peak power density averaged over the pulse width must not exceed 1000 times the respective AL (S) value. For multi-frequency fields, the analysis must be based on summation.
- 3 Note 3 to Table AL1 applies in relation to the ALs for electric field strength and magnetic flux density.
- 4 The power density is the maximum level averaged over any 20cm<sup>2</sup> of exposed area. Spatial maximum power densities averaged over 1cm<sup>2</sup> must not exceed 20 times the value of 50 Wm<sup>-2</sup>.
- 5 From 6 to 10 GHz, power density must be averaged over a six minute period. Above 10 GHz, it must be averaged over a  $68/f^{1.05}$ -minute period (where f is the frequency in GHz).

Table AL4 - AL for exposure to electromagnetic fields from 10 to 110 MHz	
<i>Frequency Range</i>	<i>Limb current AL (I<sub>l</sub>) [mA]</i>
10 ≤ f ≤ 110 MHz	100
Exposure levels not exceeding the ALs will be compliant with:	The health effect ELV in table ELV4 - localised SAR in the limbs

NOTES

The AL is a root mean square value.

Exposure Limit Values - non-thermal effects

Table ELV1 - ELVs for exposure to electromagnetic fields from 0 to 1 Hz	
<i>Area of exposure</i>	<i>Sensory effect ELVs -magnetic flux density (B<sub>0</sub>) [T]</i>
Head and Trunk	2
Limbs	8
	<i>Health effect ELV -magnetic flux density (B<sub>0</sub>) [T]</i>
Any part of the body	8

NOTES

The sensory effect ELVs may be exceeded during a worker's shift where the employer ensures that—

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- (a) they are only exceeded temporarily;
- (b) protection measures have been adopted which minimise, so far as is reasonably practicable, the sensory effects related to movement in static magnetic fields, including nausea and vertigo;
- (c) adequate information is provided to the worker on the possibility of those sensory effects; and
- (d) where any of those sensory effects are reported to the employer, the exposure assessment under regulation 6 and the protection measures are updated where necessary.

Table ELV2 - Health effect ELVs for exposure to electromagnetic fields from 1 Hz to 10 MHz	
<i>Frequency Range</i>	<i>Health effect ELVs - internal electric field strength (E) [Vm<sup>-1</sup>]</i>
1 Hz ≤ f < 3 kHz	1.1
3 kHz ≤ f ≤ 10 MHz	3.8 × 10 <sup>-4</sup> f

NOTES

- 1 The ELVs are limits for electric fields induced in the body from exposure to time-varying electric and magnetic fields.
- 2 The ELVs are spatial peak values in the entire body of the worker.
- 3 Note 2 to Table AL1 applies in relation to methods of determining exposure.

Table ELV3 - Sensory effect ELVs for exposure to electromagnetic fields from 1 to 400 Hz	
<i>Frequency Range</i>	<i>Sensory effect ELVs- internal electric field strength (E) [Vm<sup>-1</sup>]</i>
1 ≤ f < 10 Hz	0.7/f
10 ≤ f < 25 Hz	0.07
25 ≤ f ≤ 400 Hz	0.0028 f

NOTES

- 1 The ELVs are spatial peak values induced in the head of the exposed worker, and can arise from exposure to either external electric or external magnetic fields.
- 2 The ELVs may be exceeded during a worker's shift where the employer ensures that—
  - (a) they are only exceeded temporarily;
  - (b) hazardous spark discharges and contact currents in excess of those in Table AL5 are prevented through the provision of information and training under regulation 19 and the use of suitable technical and personal protection measures;

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- (c) adequate information is provided to the worker on the possibility of sensory effects related to time-varying magnetic fields, including retinal phosphenes; and
- (d) where any of those sensory effects are reported to the employer, the risk assessment is updated where necessary.

3 Note 2 to Table AL1 applies in relation to methods of determining exposure.

Exposure Limit Values – thermal effects

Table ELV4 - Health effect ELVs for exposure to electromagnetic fields from 100 kHz to 6 GHz	
Area of exposure	Health effect ELVs - specific energy absorption rate (SAR) [Wkg <sup>-1</sup> ]
Whole body	0.4 (averaged SAR in the body)
Head and trunk	10 (averaged SAR in the head and trunk)
Limbs	20 (averaged SAR in the limbs)

NOTES

- 1 The ELVs correspond to the SAR values averaged over a six minute period.
- 2 Localised SAR in the body and limbs can be assessed by either computational dosimetry or physical measurement of 10g of tissue. For computational dosimetry, 10 grams of contiguous tissue with approximately homogeneous electrical properties must be used for the SAR average. For direct physical measurements, a simple geometry, such as cubic or spherical tissue mass, may be used. The maximum value obtained must be assessed against the ELVs.

Table ELV5 - Sensory effect ELVs for exposure to electromagnetic fields from 300 MHz to 6 GHz	
Frequency range	Sensory effect ELV - specific energy absorption in the head (SA) [mJkg <sup>-1</sup> ]
300 MHz ≤ f ≤ 6 GHz Whole body	10

NOTES

- 1 When determining SA, energy absorption must be averaged over 10 grams of tissue.
- 2 The ELV may be exceeded during a worker's shift where the employer ensures that—
  - (a) it is only exceeded temporarily;
  - (b) adequate information is provided to the worker on the possibility of sensory effects related to pulsed microwave radiation, including auditory sensations; and
  - (c) where any of those sensory effects are reported to the employer, the risk assessment is updated where necessary.

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Table ELV6 – Health effect ELVs for exposure to electromagnetic fields from 6 to 300 GHz	
<i>Frequency range</i>	<i>Health effect ELVs - power density (S)[ Wm<sup>-2</sup>]</i>
6 GHz ≤ f ≤ 300 GHz	50

NOTES

- 1 The power density is the maximum level averaged over any 20cm<sup>2</sup> of exposed area. Spatial maximum power densities averaged over 1cm<sup>2</sup> must not exceed 20 times the value of 50 Wm<sup>-2</sup>.
- 2 From 6 to 10 GHz, power density must be averaged over a six-minute period.
- 3 From 6 to 10 GHz, power density must be averaged over a six-minute period. Above 10 GHz, it must be averaged over a 68/f<sup>1.05</sup> -minute period (where f is the frequency in GHz).

Part 3

Indirect effects of exposure

Action levels – non-thermal effects

Table AL5 - ALs for contact currents	
<i>Frequency of electromagnetic field in which an object is present</i>	<i>Contact current ALs (I<sub>c</sub>)[mA]</i>
up to 2.5 kHz	1.0
2.5 ≤ f < 100 kHz	0.4 f
100 ≤ f ≤ 10,000 kHz	40

NOTES

- 1 “f” is the frequency expressed in kHz.
- 2 The ALs are root mean square values.
- 3 The ALs represent the maximum steady state current created during a continuous contact with an object in an electromagnetic field.

Table AL6 – ALs for static magnetic fields	
<i>Potential indirect effect</i>	<i>Magnetic flux density ALs (B<sub>0</sub>)[mT]</i>
Interference with active implanted medical devices	0.5
Attraction and projectile risk in the fringe field of high field strength sources (> 100 mT)	3

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NOTES

The AL for interference with active implanted medical devices represents the maximum field value at any place where a worker may be working.

Action levels - thermal effects

Table AL7 - AL for contact currents	
<i>Frequency of electromagnetic field in which an object is present</i>	<i>Contact current ALs (<math>I_c</math>) [mA]</i>
100 kHz $\leq$ f < 110 MHz	40

NOTES

- 1 The AL is a root mean square value.
- 2 The AL represents the maximum steady state current created during a continuous contact with an object in an electromagnetic field.

Made this 16th day of October 2019

Minister of Tourism and Transport

[Operative Date: 17 October 2019]