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Interference-Causing Equipment Standard

Vehicles, Boats and Other Devices Equipped with Internal Combustion Engines, Traction Batteries or Both

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Aussi disponible en français – NMB-002

Canada

Preface

Interference-Causing Equipment Standard ICES-002, Issue 7, *Vehicles, Boats and Other Devices Equipped with Internal Combustion Engines, Traction Batteries or Both*, replaces ICES-002 Issue 6, *Vehicles, Boats and Other Devices Propelled by an Internal Combustion Engine, Electrical Means or Both*, published in March 2013 and updated in November 2014 and in February 2017. This issue of the ICES-002 standard will come into force upon its publication on the Innovation, Science, and Economic Development Canada (ISED) website. However, a transition period is provided, according to section 3.1, within which compliance with either ICES-002 Issue 6 or ICES-002 Issue 7 is accepted.

Listed below are the changes:

1. title of the standard changed from "*Vehicles, Boats and Other Devices Propelled by an Internal Combustion Engine, Electrical Means or Both*" to "*Vehicles, Boats and Other Devices Equipped with Internal Combustion Engines, Traction Batteries or Both*";
2. clarified the types of equipment that are in the scope of this standard (section 1);
3. clarified that outboard boat engines, if marketed independently, are in scope (sections 1.1);
4. added requirements for vehicles, boats and devices with wireless power transfer functionality (section 1.2);
5. added specific requirements for vehicles/boats/devices that connect to the ac mains, directly or indirectly (sections 1.4, 4.3 and 4.4);
6. added clarifications for the situation of multistage manufacturing (section 2.2);
7. removed requirements that are specified in ICES-Gen and referred to ICES-Gen for all general requirements (section 3.3);
8. clarified that the statistical compliance methods specified in the CAN/CSA-CISPR 12-10 standard cannot be used for demonstrating compliance with ICES-002 (section 4.2).

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1) Online, using the General Inquiry form at www.ic.gc.ca/res_general. (In the form, the Regulatory Standards Branch radio button should be selected and "ICES-002" should be specified in the General Inquiry field.)

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Comments and suggestions for improving this standard may be submitted online using the Standard Change Request form at www.ic.gc.ca/res_change, or by mail or e-mail to the above addresses.

All Spectrum Management and Telecommunications publications are available on the following website: http://www.ic.gc.ca/spectrum.

Issued under the authority of
the Minister of Innovation, Science and Economic Development Canada

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1. Scope

1.1 General

This Interference Causing Equipment Standard (ICES) sets out limits and methods of measurement of radio frequency emissions, as well as administrative requirements for:

1) vehicles propelled by an internal combustion engine, electrical means or both;

2) boats of up to 15 m in length, which are propelled by an internal combustion engine, electrical means or both; including outboard boat engines that are marketed independently, i.e. not factory-installed on a boat; and

3) devices equipped with internal combustion engines or traction batteries[1];

For definitions of the terms used above, see section 3.2.

1.2 Vehicles, boats and devices with wireless power transfer functionality

Products subject to this standard that include functionality for wireless power transfer shall meet the provisions and requirements of both this standard and RSS-216, *Wireless Power Transfer Devices*. In particular, while the product is in its primary (main) operating mode, ICES-002 shall apply, and while in wireless power transfer mode (e.g. battery charging mode), RSS-216 shall apply.

1.3 Vehicles, boats and devices that incorporate wireless modules

Products subject to this standard that include functionality for radio communication shall meet the provisions and requirements of both this standard and relevant *Radio Standard Specifications* (RSSs), as applicable to the specific radiocommunication technology.

1.4 Power supplies and converters for vehicles, boats or devices subject to ICES-002

Switched mode power supplies and semiconductor power converters intended for charging or powering electric or hybrid vehicles, boats or devices from the ac mains power supply, where the vehicle, boat or device is subject to ICES-002, shall comply with the requirements in this standard. However, if such a power supply or power converter is already in compliance with ICES-001, *Industrial, Scientific and Medical Equipment*, then it is exempt from all requirements specified herein (in ICES-002).

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[1] Some devices with traction batteries might be subject to CISPR 14-1 and not to CISPR 12 (for example: lawn mower or snow blower). However, CISPR 14-1 has not been adopted by ISED as a regulatory requirement in Canada. As such, for marketing in Canada, all devices equipped with traction batteries remain within the scope of ICES-002, as specified herein.

1.5 Exemptions from the scope of ICES-002

1.5.1 One-off modifications

ICES-002 does not apply to one-off modifications, such as a person installing a truck box, a winch, or a hitch on their truck for private/personal purposes.

1.5.2 Modifications involving components compliant with other ICES standards

ICES-002 does not apply in case of an after market modification performed on a vehicle, boat or device, which consists in the addition of a new component that is subject to and in compliance with one of the following ICES standards:

- Industrial, scientific or medical equipment that is in compliance with ICES-001;
- Digital or information technology equipment that is in compliance with ICES-003;
- Lighting equipment that is in compliance with ICES-005.

Examples include the aftermarket installation of a new entertainment system, e.g. CD-player, (compliant with ICES-003) in a vehicle or boat, or the aftermarket installation of a flood light (compliant with ICES-005) on the cabin of a truck or a boat.

The exemption only applies to the new component and to its installation on the vehicle, boat or device. However, the base product, i.e. the one on which the additional component is installed, shall be compliant with ICES-002.

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2. Responsible party

2.1 General

As specified in ICES-Gen, *General requirements for compliance of interference-causing equipment*, any person or entity involved in one of the activities listed in article 4(3) of the *Radiocommunication Act* is responsible under the Act for the product's compliance with the applicable ISED standard. As such, for the purpose of ICES-002, the responsible party is the one involved in the manufacture, importation, distribution, lease, offering for sale, or sale of a specific model of a final product (as defined in section 3.2).

2.2 Multistage manufacturing

If a product that is subject to and is already in compliance with ICES-002 is modified, the persons or entities involved in any of the activities listed in article 4(3) of the *Radiocommunication Act* relative to the modified product are responsible under the Act for this product's compliance with ICES-002. This includes the person or entity who performed the modification, if located in Canada, the importer of the modified product (if the product is modified outside Canada), as well as any person or entity distributing, leasing, offering for sale or selling the modified product in Canada.[2]

3. General requirements

3.1 Transition period

A transition period, ending one year after the publication of this standard (i.e. on 30 April 2021), is provided, within which compliance with either ICES-002 Issue 6 or ICES-002 Issue 7 is accepted. A copy of ICES-002 Issue 6 may be requested by email.

After the expiry of this transition period all products subject to this standard that continue to be manufactured, imported, distributed, leased, offered for sale, or sold in Canada shall comply with ICES-002 Issue 7.

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3.2 Definitions

For the purpose of ICES-002, the definitions in CAN/CSA-CISPR 12-10 shall apply, except for the definitions for "device", "traction batteries" and "vehicle", which shall be modified as follows (the notes to these definitions in CAN/CSA-CISPR 12-10 remain unchanged and, therefore, are not repeated herein). Three new definitions, for "final product", "manufacturer" and "outboard engine (motor)" are also added.

Device: machine, other than vehicle, driven by an internal combustion engine or traction battery (batteries), which is not primarily intended to carry persons or goods

Final product: vehicle, boat, outboard boat engine or device that is complete, with all its components, in the same state as it is delivered to the end user

Manufacturer: person or entity to whom all of the following conditions apply:

- is located in Canada;

[2] An example scenario is a flatbed truck imported in Canada: the importer, as well as all distributors, leasing agencies and vendors or dealers are responsible under the Act for the truck's compliance with ICES-002. If then one company purchases such trucks and installs various accessories on them to transform them into dump trucks, cement trucks, lorries, etc., that company (as the manufacturer), as well as all distributors, leasing agencies and vendors or dealers of the modified trucks are each considered as responsible party for the purpose of this standard and thus are each responsible under the Act for the compliance of the modified products.

- acts as the main fabricant or system integrator for constructing the vehicle, boat, outboard boat engine or device in its final state (as subsequently delivered to the end user); and
- places that vehicle, boat, outboard boat engine or device on the Canadian market, either directly (lease or sale to the end users) or indirectly (e.g. through distributors, dealers, leasing agencies).

Outboard engine (motor): self-contained boat propulsion/steering system, including the engine, gearbox and propeller or jet drive, all in one unit, which is installed to the outside transom (the rear part or the side of the boat hull) serving for both propulsion and steering of the boat

Traction battery (batteries): battery (batteries) used for the propulsion of electric or hybrid vehicles or devices

Vehicle: machine operating on land (but not intended for airborne operation) that is intended to carry persons or goods and/or that is operated by an on-board person

3.3 ICES-Gen compliance

In addition to this standard, the requirements of ICES-Gen shall apply, except where a requirement in ICES-Gen contradicts a requirement in this standard, in which case this standard shall take precedence.

3.4 References

3.4.1 General

The CAN/CSA standards listed in this section can be purchased online at https://store.csagroup.org. Furthermore, the CISPR and IEC standards can also be purchased online at https://webstore.iec.ch.

3.4.2 Normative references

This ICES refers to the following publications and, where such references are made, they shall be to the editions listed below. Not all normative references necessarily apply to a specific product subject to ICES-002. Section 4 specifies the normative reference(s) that apply to the specific product under test.

- CAN/CSA-CISPR 12-10, *Vehicles, boats and internal combustion engines – Radio disturbance characteristics – Limits and methods of measurement for the protection of off-board receivers* (IEC CISPR 12:2007+A1:2009, MOD; reaffirmed in 2014)

- CAN/CSA-IEC CISPR 16-1-1:18, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-1: Radio disturbance and immunity measuring apparatus – Measuring apparatus* (IEC CISPR 16-1-1:2015, IDT), excluding its Annex K.

  Note: Annex K of CAN/CSA-IEC CISPR 16-1-1:18 is not acceptable and shall not be applied for the purpose of demonstrating compliance of equipment with the requirements specified in ICES-002, due to references therein to unspecified "manufacturer calibration" requirements and procedures. Any measurement instrument used for ICES-002 measurements shall fully comply with all applicable requirements stated in CAN/CSA-IEC CISPR 16-1-1:18, excluding Annex K.

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- CISPR 16-1-2:2017-11, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-2: Radio disturbance and immunity measuring apparatus – Coupling devices for conducted disturbance measurements*, Edition 2.1, November 2017

- CISPR 16-1-4:2019-01, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 1-4: Radio disturbance and immunity measuring apparatus – Antennas and test sites for radiated disturbance measurements*, Edition 4.0, January 2019

- CISPR 16-2-1:2017-06, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-1: Methods of measurement of disturbance and immunity – Conducted disturbance measurements*, Edition 3.1, June 2017

- CAN/CSA-IEC CISPR 16-2-3:18, *Specification for radio disturbance and immunity measuring apparatus and methods – Part 2-3: Methods of measurement of disturbances and immunity – Radiated disturbance measurements* (IEC CISPR 16-2-3:2016, IDT)

3.4.3 Informative references

The following IEC standard is referenced within this document for further information on how to arrange the equipment under test during measurements. Its content does not constitute normative requirements for the application of ICES-002.

- IEC 61851-21-1:2017-06, *Electric vehicle conductive charging system – Part 21-1: Electric vehicle on-board charger EMC requirements for conducting connection to an AC/DC supply*, Edition 1.0, June 2017

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4. Technical requirements

4.1 General

Equipment subject to this standard shall comply with all the applicable requirements set out in CAN/CSA-CISPR 12-10, except if otherwise stated in this standard, and with the additional requirements specified herein.

4.2 Statistical compliance

The provisions of clauses 6.3, 6.4, 6.5, 6.6 and of Annex A of CAN/CSA-CISPR 12-10 shall not be applied for the purpose of demonstrating compliance with ICES-002. As per the *Radiocommunication Act* and the *Radiocommunication Regulations*, each unit of an equipment model shall comply with all applicable requirements, including conducted (where applicable) and radiated emission limits.

4.3 Technical requirements for ac mains plug-in electrical or hybrid vehicles, boats or other devices

4.3.1 General

In addition to the requirements set out in CAN/CSA-CISPR 12-10 (while in the primary mode of operation: see 4.1), electrical or hybrid vehicles, boats and other devices subject to ICES-002 that can be plugged into the ac mains power network (e.g. for charging their batteries) shall also comply with this section (4.3).

This section (4.3) only applies to vehicles, boats and other devices that directly connect to ac mains, by means of a detachable or permanently attached ac mains power cable. For the situation where the vehicle, boat or device connects to ac mains through another external device (e.g. power supply, converter or charger), the technical requirements applicable to that external device are set forth in section 4.4.

4.3.2 Instrumentation, test methods and test facilities

4.3.2.1. General

Unless otherwise stated in this section (4.3.2), the instrumentation, test methods and test facilities used to demonstrate compliance with the emission limits defined in section 4.3.3 shall be in accordance with the requirements set out in:

- CAN/CSA-IEC CISPR 16-1-1:18, CISPR 16-1-2 and CISPR 16-2-1, for conducted emissions;
- CAN/CSA-CISPR 12-10 and in its normative references, as listed therein, for radiated emissions.

For all emission measurements, if the product under test does not allow adjustment of the charging current, the traction battery shall be kept charged at least 20%, but no more than 80%, for the duration of each test. Therefore, longer tests (such as radiated emission measurements) may require splitting in smaller frequency ranges and the product's traction battery discharged after measuring one frequency range and before starting measurements in the next frequency range. If the charging current can be adjusted, it shall be set to at least 80% of its maximum value for the entire duration of the test.

4.3.2.2. Conducted emissions measurements

For conducted emission measurements:

- the ac mains cable shall be connected to an artificial mains network (AMN) and communication wires, if any included in the ac mains power cable/harness, shall be connected to impedance stabilisation networks (ISNs);
- the AMN and ISNs shall comply with the applicable requirements as per CISPR 16-1-2 and CISPR 16-2-1;
- any coaxial ("receiver") ports on the AMN/ISN that are not used for measurement shall be equipped with 50 Ω terminations;

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- the AMN/ISN shall be placed on and electrically-bonded to the metallic ground plane, with a lateral separation of 80 cm (+20 cm / -0 cm) from the projection onto the ground plane of the closest point on the vehicle/boat/device under test;
- the power cable, from the connection point onto the vehicle/boat/device under test, shall drop towards the ground plane, but its vertical portion shall have a separation of 10 cm (+20 cm / -0 cm) from the vehicle/boat/device body;
- the portion of the power cable that lies onto the ground plane shall be separated from direct contact with the ground plane by means of insulating supports up to 15 cm in height and, if longer than necessary, it shall be z-folded in the middle with a width of maximum 50 cm.

Example arrangements are illustrated in Figure 13 and Figure 14 of IEC 61851-21-1.

4.3.2.3. Radiated emissions measurements

For radiated emission measurements, the same conditions apply as for conducted emission measurements, except that the AMN/ISNs are optional. The measurement antenna shall be placed at the measurement distance from the vehicle/boat/device under test, without considering the power cable; as such, the projections onto the ground plane of the reference point of the antenna and of the closest point on the body of the vehicle/boat/device under test shall be separated by the measurement distance, as specified in the limit definition.

4.3.3 Limits

4.3.3.1. Conducted emission limits

The limits for the mains terminal disturbance voltage are presented in Table 1 and in Table 2, for Class A and Class B equipment, respectively. The application of Class A or Class B limits to a particular product under test shall follow the conditions specified in ICES-Gen.

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Table 1: Conducted emission limits for Class A vehicle/boat/device (AC mains terminals)

Frequency range (MHz)	Rated power of ≤ 20 kVA (Notes 3 and 4)		Rated power of > 20 kVA and ≤ 75 kVA (Notes 3, 4 and 5)		Rated power of > 75 kVA (Notes 3 and 6)	
	Quasi-peak (dBµV)	Average (dBµV)	Quasi-peak (dBµV)	Average (dBµV)	Quasi-peak (dBµV)	Average (dBµV)
0.15 – 0.5	79	66	100	90	130	120
0.5 – 5	73	60	86	76	125	115
5 – 30	73	60	90 to 73 (Note 2)	80 to 60 (Note 2)	115	105

Note 1: The more stringent limit applies at transition frequencies.

Note 2: The limit level in dBµV decreases linearly with the logarithm of frequency.

Note 3: Rated ac mains power is as stated by the manufacturer.

Note 4: Class A equipment intended exclusively for connection to isolated neutral or high impedance earthed industrial power distribution networks may apply the limits for rated power > 75 kVA, regardless of its actual rated power.

Note 5: These limits may be used only for equipment intended to be connected to a dedicated power transformer or generator and not to low voltage overhead power lines. If the equipment can be connected to low voltage overhead power lines, the limits for rated power ≤ 20 kVA shall be applied. The manufacturer or supplier shall provide information on installation measures that can be used for reducing emissions. The manufacturer / supplier instructions shall specify that the equipment is intended to be connected to a dedicated power transformer or generator and not to low voltage overhead power lines.

Note 6: These limits apply only for equipment that is intended to be installed as follows:

- Equipment is connected to a dedicated power transformer or generator and not to low voltage overhead power lines.
- Installation is physically separated from residential environments by at least 30 m or by a structure that acts as a barrier to radiated emissions.
- The manufacturer or supplier shall provide information on installation measures that can be used for reducing emissions. The manufacturer / supplier instructions shall specify that the equipment is intended to be connected to a dedicated power transformer or generator and not to low voltage overhead power lines.

Table 2: Conducted emission limits for Class B vehicle/boat/device (AC mains terminals)

Frequency range (MHz)	Quasi-peak (dBµV)	Average (dBµV)
0.15 – 0.5	66 to 56 (Note 2)	56 to 46 (Note 2)
0.5 – 5	56	46
5 – 30	60	50

Note 1: The more stringent limit applies at transition frequencies.

Note 2: The limit level in dBµV decreases linearly with the logarithm of frequency.

4.3.3.2. Radiated emission limits

The radiated emission limits specified in CAN/CSA-CISPR 12-10 shall be applied.

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4.4 Technical requirements for power supplies and converters for vehicles, boats or other devices subject to ICES-002

4.4.1 Instrumentation, test methods and test facilities

Unless otherwise stated in this sub-section, the instrumentation, test methods and test facilities used to demonstrate compliance with the emission limits defined in section 4.4.2 shall be in accordance with the requirements set out in:

- CAN/CSA-IEC CISPR 16-1-1:18, CISPR 16-1-2 and CISPR 16-2-1, for conducted emissions;
- CAN/CSA-IEC CISPR 16-1-1:18, CISPR 16-1-4 and CAN/CSA-IEC CISPR 16-2-3:18, for radiated emissions.

For all emission measurements, the power supply/converter under test should be loaded with an artificial load (e.g. electronic load), such that the power supply/converter is placed in a stable operating mode where it supplies a battery charging current of constant amplitude, which shall be set to at least 80% of its maximum value for the entire duration of each test.

In case an actual vehicle/boat/device is used for loading the power supply/converter under test, if the product under test or the load vehicle/boat/device does not allow adjustment of the charging current, the traction battery shall be kept charged at least 20%, but no more than 80%, for the duration of each test. Therefore, longer tests (such as radiated emission measurements) may require splitting in smaller frequency ranges and the load's traction battery discharged after measuring one frequency range and before starting measurements in the next frequency range. If the charging current can be adjusted, it shall be set to at least 80% of its maximum value for the entire duration of each test.

4.4.2 Limits

4.4.2.1. Conducted emission limits

The conducted emission limits specified in section 4.3.3.1 shall be applied.

4.4.2.2. Radiated emission limits

The limits for the electric field strength measured at a distance of 3 m or 10 m from the boundary of the power supply/converter under test are presented in Table 3 and in Table 4, for Class A and Class B equipment, respectively. The application of Class A or Class B limits to a particular product under test shall follow the conditions specified in ICES-Gen.

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Table 3: Electric field strength radiated emission limits for Class A power supply/converter

Frequency range (MHz)	OATS or SAC 10 m measurement distance		OATS or SAC 3 m measurement distance		FAR (Note 4) 3 m measurement distance	
	≤ 20 kVA Quasi-peak (dBµV/m) (Note 2)	> 20 kVA Quasi-peak (dBµV/m) (Notes 2 and 3)	≤ 20 kVA Quasi-peak (dBµV/m) (Note 2)	> 20 kVA Quasi-peak (dBµV/m) (Notes 2 and 3)	≤ 20 kVA Quasi-peak (dBµV/m) (Note 2)	> 20 kVA Quasi-peak (dBµV/m) (Notes 2 and 3)
30 – 230	40	50	50	60	52 to 45 (Note 5)	62 to 55 (Note 5)
230 – 1000	47	50	57	60	52	55

Note 1: The more stringent limit applies at the transition frequency.
Note 2: Rated ac mains power is as stated by the manufacturer.
Note 3: These limits apply to equipment with a rated power greater than 20 kVA and intended to be used at locations where there is a distance greater than 30 m between the equipment and third party sensitive radio communication apparatus. The manufacturer shall indicate in the technical documentation that this equipment is intended to be used at locations where the separation distance to third party sensitive radio services is greater than 30 m. If these conditions are not met, the limits for ≤ 20 kVA shall apply.
Note 4: The equipment shall fit within the validated test volume of the FAR.
Note 5: The limit level in dBµV/m decreases linearly with the logarithm of frequency.
Note 6: OATS = open-area test site, SAC = semi-anechoic chamber, FAR = fully-anechoic room (see CISPR 16-1-4).

Table 4: Electric field strength radiated emission limits for Class B power supply/converter

Frequency range (MHz)	3 m measurement distance Quasi-peak (dBµV/m)	10 m measurement distance Quasi-peak (dBµV/m)
30 – 230	40	30
230 – 1000	47	37

Note: The more stringent limit applies at the transition frequency.

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5. Administrative requirements

5.1 Test report

The requirements specified in ICES-Gen shall apply.

5.2 Labelling and user manual requirements

The requirements specified in ICES-Gen shall apply, except where otherwise stated herein. An example ISED compliance label, to be placed on each unit of an equipment model (or in the user manual, if allowed), is given below:

CAN ICES-002 / NMB-002

However, for products subject to the limits in section 4.3 or in section 4.4, if the Class A limits were used for demonstrating compliance, the Class shall appear on the ISED compliance label, as per the requirements specified in ICES-Gen. An example ISED compliance label in this case is as follows:

CAN ICES-002(A) / NMB-002(A)

For products subject to the limits in section 4.3 or in section 4.4, if the Class B limits were used for demonstrating compliance, the inclusion or not of the Class in the ISED compliance label is at the manufacturer's discretion.

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