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NRC-CMRC

***Technical Standard for Vehicular Breath
Alcohol Interlock Devices in Canada***

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Technical Report

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Rapport technique

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Canada

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ABSTRACT

At present there is no national standard for the performance, qualification testing and use of vehicular breath alcohol interlock devices in Canada. Transport Canada has contracted NRC-CSTT to develop a standard, outlining the technical specifications and testing requirements for such devices in Canada. This document does not address the issues of how an interlock program would be implemented or managed in Canada (See “Canadian Interlock Program Standard”; D.J. Beirness; May 2007).

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- Dr. Doug Beirness wrote the companion “program” document;
- Paul Boase managed the project for Transport Canada; and
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1 INTRODUCTION

1.1 Purpose

This document describes the proposed performance standards, technical specifications, physical markings and the qualification tests required for type acceptance of Breath Alcohol Interlock Devices by the Canadian federal government and the provinces and territories. It identifies the functional, durability, environmental, accuracy, electromagnetic compatibility and special alcohol interlock performance requirements and tests needed to qualify any particular unit, or family of units. It is principally directed at test laboratories and alcohol interlock manufacturers but may also be relevant to policy and regulatory personnel at all levels of government. The specific details of the qualification tests are presented in the test protocol document CSTT-HVC-TR-150 [1].

1.2 Background

Presently there is no Canadian standard that describes the technical specifications, features, functionality and qualification testing requirements for vehicular alcohol ignition interlocks. Transport Canada is interested in drafting a new standard to address these issues.

There are a variety of standards published worldwide, each describing alcohol interlock performance and test requirements for specific countries, and/or regions of the world. Although some of these documents were drafted for particular Canadian provinces, none of them refer to Canada as a whole. As such, it is of interest for Transport Canada to develop a relevant, and technologically current, standard that could be accepted nationwide and adopted by all the provinces and territories. This proposed standard is a compendium of the alcohol interlock documents researched to date with any irrelevant or out-dated information removed and any new information, based on new technology, added as necessary. Special attention was paid to information that was deemed to be particularly relevant to Canada, such as climatic conditions. Although many documents were reviewed as part of this program, the following documents formed the primary reference set for the development of this proposed standard:

1. Province of Alberta – Qualification testing specifications for BAIID 1992 [2]
2. US Federal Register – Model specifications for BAIIDs 1992 [3]
3. Australia – Breath alcohol testing devices for personal use 1993 [4]
4. Europe – Test Methods and performance requirements 2007 [5]

A breath alcohol interlock device is designed to prevent starting of the vehicle's engine when the driver's blood alcohol concentration (BAC) is higher than a preset limit. This limit value is typically lower than the BAC limit set by justice authorities for drinking and driving offences. Alcohol interlocks are available to individuals who have been convicted of drinking and driving offences and who are eligible to use such a device (the specifics of the legal requirements and eligibility are outside the scope of this document). These devices normally consist of a handset connected to an electronic control module (ECM). The ECM communicates with the vehicle's ignition system, typically via wires that are spliced into the vehicle's wiring harnesses, and controls the flow of current to the starter motor. The handset is designed to fit easily in a person's hand while providing a breath sample through the mouthpiece. The display provides visual and/or audible indicators to alert the driver of the test status. The alcohol interlock will not allow the vehicle's engine to be started until a successful breath test has been achieved.

The following text is quoted from the Canada Safety Council Web Site [6]

“In Canada, two levels of government deal with impaired driving. The federal Criminal Code is applied at blood alcohol content (BAC) of 0.08 and over. In addition, nine of Canada’s 13 provincial and territorial jurisdictions impose administrative licence suspensions on drivers whose BAC is over 0.05 but less than 0.08. Those drivers immediately lose their licence for four to 24 hours, longer with subsequent violations. Driving with a BAC of .05 is not permissible under the traffic acts in most provinces and territories. The real issue is whether drivers should be criminalized if their BAC is under 0.08”.

Although the legal limit for BAC while driving in Canada is set at 0.08 (80 mg/dL), it is important to define a reasonable lower threshold on the alcohol interlock to ensure that drivers who are permitted to regain driving privileges maintain a BAC significantly below 80 mg/dL. This will also ensure that drivers who are very close to, or slightly above, the limit of 80 mg/dL are not allowed to start their vehicles due to any slight error associated with sensing the alcohol levels in blood via a breath test.

1.3 Limitations

The information contained in this document has been drafted with all of the provinces’ interests in mind. However, at the time of publication, there is no evidence to suggest that all the various provinces will adopt this technical standard in whole, or in part.

The information contained in this document pertains exclusively to devices mounted inside a motor vehicle. This document does not refer to those devices used for evidential purposes by law enforcement authorities nor does it refer to devices found in commercial establishments such as bars and restaurants.

There are two types of interlock programs in Canada: voluntary and mandatory. The information found in this document pertains to government imposed mandatory programs and does not pertain to voluntary programs such as those used for commercial fleet vehicles.

The purpose of this document is to define the technical specifications for the interlock device itself and the interface between it and the vehicle in which it is mounted. It is in no way intended to define how a national interlock program would function nor to define the social, legal or economic implications of such a program. For such aspects of an interlock program, please refer to the companion document [7] written by D.J. Beirness.

This standard is intended for alcohol interlocks that use human breath as the medium for the determination of blood alcohol content. In the future, it may be possible to detect blood alcohol levels by other methods; however, those methods are not considered in this document.

For this standard it is assumed that the method by which an alcohol interlock prevents someone from driving his or her vehicle is by blocking the engine from being started. As vehicle technologies evolve from pure internal combustion to hybrid to pure electric propulsion systems, it may be possible to prevent someone from driving their vehicle by other means, even if the engine/motor is already running.

2 DEFINITIONS

For the purposes of this Canadian Standard, the following definitions shall apply:

2.1 Alcohol

Ethanol or Ethyl Alcohol with chemical composition C_2H_5OH .

2.2 Breath Alcohol Interlock Device

A device intended to prevent a vehicle's engine from starting until such time as a breath sample with an alcohol concentration below a setpoint value is presented.

2.3 Blood Alcohol Concentration (BAC)

Blood Alcohol Concentration refers to the weight of alcohol (expressed in milligrams) in a standard volume of blood (usually 100 millilitres). For example, it is an offence under the Criminal Code of Canada to operate a motor vehicle with a BAC that exceeds 80 milligrams of alcohol per 100 millilitres of blood (80 mg/dL). Because the amount of alcohol in the deep lung breath is directly proportional to the amount of alcohol in the blood, BAC is readily and most often inferred by means of a breath test - i.e., using a "breath analyzer" which is actually measuring Breath Alcohol Concentration. The definition is presented here for information purposes but all references to alcohol concentration in this document are Breath Alcohol Concentrations, defined in paragraph 2.4.

2.4 Breath Alcohol Concentration (BrAC)

Mass concentration of ethanol, given in mg/L (milligrams ethanol per litre of breath air), in a breath sample delivered into an alcohol interlock. Although the exact amount varies from person to person, it is generally accepted that the same amount of alcohol may be found in 1 mL of blood as in 2,100 mL of breath. The calculations required to illustrate the conversion are outside the scope of this document. However, it has been demonstrated, via testing, that an alcohol concentration of 80 mg/dL in blood is equivalent to an alcohol concentration of 0.38 mg/L in breath.

2.5 Breath Sample

Breath air sample delivered under forced expiration through the mouth.

2.6 Setpoint

The setpoint is the pre-defined value of BrAC below which the vehicle's engine may be started. A breath alcohol test result equal to, or above, this limit value will prevent the vehicle's engine from being started.

2.7 Accepted Breath Sample

A breath sample fulfilling the requirements for volume, flow, exhalation time and other considerations such as human recognition. The acceptance of the breath sample is independent of alcohol concentration.

2.8 Not Accepted Breath Sample

A breath sample not fulfilling the requirements for volume, flow, exhalation time and other considerations such as human recognition. The rejection of the breath sample is independent of alcohol concentration.

2.9 Accepted Test

An accepted test occurs when an accepted breath sample is delivered to an alcohol interlock and the alcohol interlock determines that the sample has a BrAC below the setpoint.

2.10 Not Accepted Test

A test is not accepted when an accepted breath sample is delivered to an alcohol interlock and the alcohol interlock determines that the sample has a BrAC equal to, or above that of the setpoint.

2.11 End Expiratory Breath Sample

Expired breath originating from the lower part of the respiratory tract (i.e. the lungs). For the purposes of this standard, all specifications will be based on end expiratory breath samples. It is important that breath samples be delivered from the deep lung region because breath alcohol levels are only in equilibrium with the blood alcohol levels when taken from the deepest part of the respiratory tract. It is not possible to infer a blood alcohol level from a breath sample when the breath sample originates from the upper respiratory tract.

2.12 Corridor breath sample

Expired breath originating from the upper part of the respiratory tract (i.e. mouth or throat).

2.13 Blocked State (Blocking)

State in which the alcohol interlock is inhibiting the vehicle's engine from being started.

2.14 Unblocked State (Unblocking)

State in which the alcohol interlock allows the vehicle's engine to be started.

2.15 Mouthpiece

The mouthpiece is the hygienic interface between the alcohol interlock and the person delivering the breath sample. The mouthpiece's function is to ensure that the breath sample is not mixed with ambient air.

2.16 Retest

A breath test that takes place after the vehicle's engine has been started. Retests may be random or scheduled.

2.17 Start Period

Period of time after an accepted breath sample has been delivered during which the vehicle's engine may be started. After the start period has expired, a new breath sample is required.

2.18 Restart Period

Period of time after the vehicle's ignition is switched off during which the vehicle's engine may be re-started without the requirement for a new breath sample. This is particularly important should the engine stall in heavy traffic or at high vehicle speed or in any other situation where it would be dangerous to stop the vehicle and provide a breath sample.

2.19 Override

Method of unblocking the start of the vehicle's engine without providing an accepted breath test by means of a code or key (electronic or physical) or any other secure method.

2.20 Bypass

Starting the vehicle's engine without providing an accepted test result below the setpoint or without engaging the override function.

2.21 Tampering

An unauthorized change to, or interference with, the alcohol interlock or its installation in the vehicle.

2.22 Circumvention

An attempt to bypass the alcohol interlock whether by providing samples other than the natural unfiltered breath of the driver or by starting the vehicle's engine without using the ignition switch or any other act intended to start the vehicle without first providing an accepted breath test.

2.23 Filtered air samples

Breath samples that are passed through some form of filter, or other device, to remove alcohol from the breath sample.

2.24 Calibration

The process of comparing the alcohol interlock's BrAC readout against a recognized standard and subsequently adjusting its internal settings until the performance criteria are met.

2.25 Calibration period

The calibration period is the maximum time interval for which the alcohol interlock has been tested and certified to remain within the limits of the accuracy for the BrAC test results.

2.26 Electromagnetic Interference and Compatibility

Electromagnetic Interference (EMI) occurs when the electromagnetic field of one device interferes with the normal operation of another device by coming into close proximity with the other device.

Electromagnetic Compatibility (EMC) is a state that is achieved when two or more electrical devices function in close proximity to one another and do not influence each other's performance.

2.27 Spirometer

Instrument used to measure lung breath volumes and flow rates.

2.28 Monitoring Period

Monitoring period is the time interval between service appointments in which the user presents himself, or herself, for a status review and the vehicle for physical inspection at which time the data logs may also be downloaded and analyzed.

2.29 Positive User Identification

Positive User Identification is a method, or methods, by which an alcohol interlock distinguishes that a breath sample is coming from a human source rather than a non-human source and that the breath sample is coming from a designated user.

3 GENERAL CHALLENGES

The broad requirements, as well as the challenges faced by alcohol interlock manufacturers are presented in Section 3. The more detailed technical requirements are presented in Section 4.

3.1 General

Alcohol interlocks are designed to block the starting of a vehicle's engine, and subsequently driving the vehicle, by persons with a BrAC above the limit value. There are many technical and sociological challenges that must be overcome in order to achieve this goal. The sociological challenges are covered in the companion "Program Document" produced by D.J. Beirness [7]. The primary technical challenges covered in this document include:

- The automotive environment is a hostile environment and may include severe vibration, environmental extremes such as temperature and humidity and other factors such as smoke, noise and electromagnetic interferences. As such, the alcohol interlocks must be rugged enough to be reliable in this environment;
- The breath sample delivered from the driver to the sensor must be the driver's end expiratory breath (i.e. not corridor air);
- The sensor must be specific to breath alcohol and not be activated by other common substances that can be found in human breath such as acetone, hydrocarbons or cigarette smoke (i.e. false positive);
- The sensor must be able to detect if a sample was given from a non-human source such as a balloon or air compressor (i.e. false negative);
- The device should be tamper proof and difficult to circumvent;
- The device should be reliable and easily maintainable;
- The device should be easy to use, particularly for those drivers with reduced lung capacity;
- The device should not be cost prohibitive; and
- The sensor should not cause the engine to stop functioning at inopportune or unsafe times.

In addition to the technical challenges listed above, there are some logistical challenges associated with these devices. These include:

- The details associated with the device's built in features and functions such as the random re-tests, interlock setpoints, emergency starting of the vehicle and data record memory, to name a few;
- The devices require regularly scheduled and properly executed device calibrations;
- The devices must maintain their accuracy between monitoring periods; and
- Continuing compliance and enforcement by all the various levels of government.

Alcohol interlock manufacturers have undertaken various approaches concerning sensor technology and the logistics associated with these devices. The specification details and test procedures contained in this document are meant to specify a performance standard for the alcohol interlock and in no way are meant to dictate the methods by which the manufacturers meet this standard. As such, the alcohol interlock technology itself is not specified or described.

4 SPECIFIC REQUIREMENTS

All alcohol interlocks destined for use in Canada shall comply with all the requirements of this Canadian Standard. The specifics of the mandatory requirements for these devices are outlined below and grouped under the following headings:

1. Performance Requirements (4.1);
2. Environmental Requirements (4.2);
3. Features (4.3); and
4. Displays and Documentation(4.4);

The performance and environmental requirements apply to the alcohol interlock's main modules as well as any peripheral or accessory devices.

4.1 Performance Requirements

4.1.1 *Type of sensor*

All alcohol interlocks must use alcohol specific sensors that distinguish between the presence of alcohol and other chemicals or substances. In some cases, spicy foods when mixed with Hydrochloric Acid (HCL) in the stomach create methane gas (i.e. hydrocarbons) The use of non-alcohol specific sensors may trigger false positives because the sensor reacts to the hydrocarbons. Anti-acids and water will usually relieve the situation and eliminate the false positives; however, this false positive phenomenon doesn't occur with the alcohol specific alcohol interlock because they do not react to methane, or other gases from environmental contaminants or endogenous sources.

4.1.2 *Flow rate and minimum deep lung air sample*

None of the tests described in this document may be successfully performed with a corridor breath sample since the breath alcohol concentration is not in equilibrium with the blood alcohol concentration in that area of the respiratory tract. Tests conducted on corridor breath samples are likely to result in false negatives, potentially allowing vehicles to be started by drivers whose actual BrAC is higher than the setpoint.

In order to ensure the alcohol interlocks receives an end expiratory breath sample for testing, rather than a corridor breath sample, the devices must be designed to accept breath flow rates and breath volumes that fall within pre-determined ranges. Setting the lower thresholds of the ranges too low would possibly allow corridor breath samples to result in an unblocked condition. Setting the lower thresholds of the ranges too high could exclude smaller drivers (who tend to have lower lung capacity, on average), asthmatics and drivers with respiratory ailments or other physical characteristics that cause reduced lung capacities. It will also be important to consider the combined effect of flow rate and volume to ensure a reasonable breath sample delivery time.

The minimum value for breath volume shall be between 0.7 litres and 1.2 litres. There is no mandatory value for maximum volume, however, in order to satisfy test time requirements and to respect the upper limits for vital breath volume capacities of the users, the upper threshold for

breath volume should be between 1.5 litres and 2.0 litres.

The breath sampling duration shall be 3 seconds as a minimum but less than 7 seconds. The sampling time includes the delivery of any human recognition event (e.g. hum tone while breathing). In order to achieve an acceptable sampling time, breath flow rates should be programmable based on the pre-selected volume setting. Table 1 illustrates some of the possible flow and volume combinations with corresponding sampling times. Any breath sample falling outside of the flow or volume requirements or test time (e.g. cells shaded in gray) shall trigger a visual or audible message, instructing the driver to alter some aspect of their breath delivery.

Table 1 – Various test delivery times

Volume (L)									Flow Rates (L/sec)
0.7	0.8	0.9	1.0	1.1	1.2	1.3	1.4	1.5	
7.0 s	8.0 s	9.0 s	10.0 s	11.0 s	12.0 s	13.0 s	14.0 s	15.0 s	0.10
4.7 s	5.3 s	6.0 s	6.7 s	7.3 s	8.0 s	8.7 s	9.3 s	10.0 s	0.15
3.5 s	4.0 s	4.5 s	5.0 s	5.5 s	6.0 s	6.5 s	7.0 s	7.5 s	0.20
3.0 s	3.5 s	3.9 s	4.3 s	4.8 s	5.2 s	5.7 s	6.1 s	6.5 s	0.23
2.8 s	3.2 s	3.6 s	4.0 s	4.4 s	4.8 s	5.2 s	5.6 s	6.0 s	0.25
2.3 s	2.7 s	3.0 s	3.3 s	3.7 s	4.0 s	4.3 s	4.7 s	5.0 s	0.30
2.0 s	2.3 s	2.6 s	2.9 s	3.1 s	3.4 s	3.7 s	4.0 s	4.3 s	0.35
1.8 s	2.0 s	2.3 s	2.5 s	2.8 s	3.0 s	3.3 s	3.5 s	3.8 s	0.40
1.6 s	1.8 s	2.0 s	2.2 s	2.4 s	2.7 s	2.9 s	3.1 s	3.3 s	0.45
1.4 s	1.6 s	1.8 s	2.0 s	2.2 s	2.4 s	2.6 s	2.8 s	3.0 s	0.50

4.1.3 Current Draw

The alcohol interlocks shall include a 'sleep mode' to be activated when the device will not be used for extended periods of time. This will minimize the drain on the vehicle's battery when not in use.

Regardless of how many features are installed on the alcohol interlocks, the average current draw allowable when the engine is off, and the alcohol interlock is in the quiescent state (sleep mode), shall not be greater than 20 mA. Peak levels greater than 20 mA are acceptable for specific events such as self-check, however, the time weighted average current draw for every 24 hour period must not be greater than 20 mA when the device is not in use.

4.1.4 Vehicle Circuitry

The electrical properties of the vehicle (e.g. alternator, accessories, on-board circuitry, grounding, contact safety etc) shall not be adversely affected by an alcohol interlock when installed according to the manufacturer's instructions.

4.1.5 Power Interruption

The alcohol interlock shall have its own backup power supply to ensure that data and the real time clock (RTC) will not be lost or corrupted due to low vehicle battery voltage or removal of the battery from the vehicle for maintenance purposes. All low or no voltage conditions at the vehicle battery will be logged as an event in the data log. The alcohol interlock shall be equipped with a 'low power' warning to alert the driver when the alcohol interlock's backup power has been depleted to 10% of its nominal fully charged value. If the backup power becomes completely depleted, the alcohol interlock will go into early recall mode (Section 4.3.8).

4.1.6 Supply Voltage

The alcohol interlock shall be able to operate properly in steady state with a supply voltage that may range between 9 VDC and 16VDC, as per ISO 16750-2 para 4.2 [8].

The alcohol interlock shall be capable of withstanding electrical polarity reversals for a period of one minute as per ISO 16750-2 para 4.7.2.3 [8].

The alcohol interlock shall be capable of withstanding a doubling of nominal battery voltage (i.e. 24V on a 12V system) for a period of one minute, as per ISO 16750-2 para 4.3.1.2 [8].

4.1.7 Combination with other systems

An alcohol interlock may be a stand alone device or it may be integrated with other vehicular systems such as engine management computers or alarms. All of the alcohol interlock's specific requirements, as outlined in Section 4, must be met when an alcohol interlock is integrated with other systems.

4.1.8 Integration of Handset into the Vehicle

When fitted inside the vehicle, the alcohol interlock's handset shall be wireless or supplied with a sufficient length of cable between it and the ECU to allow the driver to blow into the mouthpiece while comfortably seated in the driver's seat, regardless of the longitudinal location of the driver's seat, provided the seatback is set to a reasonable angle of recline (i.e. not at, or close to, the horizontal position). None of the alcohol interlock components should interfere with, or require relocation of, critical vehicular devices such as the pedals, the transmission shifter, the HVAC controls etc. The handset should be free of sharp edges. Although most current alcohol interlocks display messages on the handset, it is also acceptable for vehicle integrated alcohol interlocks to use the vehicle's instrument panel to display messages.

4.1.9 Electromagnetic Compatibility (EMC) and Interference (EMI)

Alcohol interlocks must comply with Canadian standard CAN/CSA-C108.4-M92 (R2003) [9] "*Limits and methods of measurement of radio interference characteristics of vehicles, motorboats, and spark-ignited engine-driven devices*".

In addition to the general tests, the alcohol interlocks must comply with ISO 7637-2 [11] (or equivalent) for the influence of electrical disturbances along power supply lines with the following test conditions:

- test pulses 2a, 2b, 3a, 3b (functional status: Class A) and test pulse 4 (functional status class C);
- test level: IV.

The alcohol interlocks shall also comply with ISO 7637-3 [12] (or equivalent) for the influence of electrical disturbances along lines other than supply lines with the following test conditions:

- functional status: Class A;
- test pulse a, b;
- test level: IV

4.1.10 Fuses

The alcohol interlocks shall require a fuse that is not greater than 10 amps.

4.1.11 Communication Integrity

If the handset of the alcohol interlock is detachable or if the handset and the control unit communicate wirelessly, the communication between the handset and the ECU shall be encoded in a secure method to prevent the alcohol interlock from going to an unblocked state until the delivery of a successful breath test.

4.1.12 Wireless communication

If the handset and the ECU of the alcohol interlock communicate wirelessly, the signal to the ECU shall be transmitted within 30 seconds after the analysis of the breath sample.

The maximum distance for the wireless communication between the handset and the ECU under free field conditions shall be 50 metres.

4.1.13 Calibration

Each alcohol interlock shall be capable of being calibrated/re-calibrated and shall provide a visual indication and sound an audible warning to alert the driver seven days before the re-calibration is due. The calibration stability period shall not be less than 90 days nor more than 180 days.

4.1.14 Ingress Protection

Ingress protection shall be measured against EN 60529:1992 [13], as follows:

All parts to be fitted inside the passenger or luggage compartment must conform to IP40: Protection from objects not greater than 1 mm in diameter (with the exception of ventilation grilles, tubes, ports or orifices used to accept a breath sample). A 1 mm diameter probe may pass through ventilation grilles, tubes, ports or orifices to accept a breath sample, however, the probe shall not be able to contact any electronic components. There is no requirement for waterproofing for these items.

All parts fitted inside the passenger compartment of roadsters and convertibles and vehicles with moveable roof panels must conform to IP42: Protection from objects not greater than 1 mm in diameter (with the exception of ventilation grilles, tubes, ports or orifices used to accept a breath sample). A 1 mm diameter probe may pass through ventilation grilles, tubes, ports or orifices to accept a breath sample, however, the probe shall not be able to contact any electronic components. These parts must also be protected from vertically dripping water (tilted up to 15 degrees).

All other components must conform to IP54: Complete protection against contact and dust deposits and protection from splashed water. IP54 shall also apply to all components fitted to motorcycles and open construction vehicles.

4.1.15 Wiring

All wiring and cabling between alcohol interlock modules and between the alcohol interlock and the vehicle must be non flammable. The wiring must conform to all applicable automotive standards for the vehicles in which they will be installed.

4.1.16 Hearing or Physical Impaired Drivers

Each alcohol interlock shall provide accessory means for hearing impaired drivers to be alerted to audible signals from the alcohol interlock in its normal operation, and shall be compliant with the needs of physically impaired drivers who may be subjected to the use of an alcohol interlock as a condition of licence reinstatement.

4.2 Environmental Requirements

4.2.1 Ambient temperature conditions

The working ambient temperature range of the alcohol interlock shall be $-40\text{ }^{\circ}\text{C}$ to $+85\text{ }^{\circ}\text{C}$. This includes the performance of the internal functions of the alcohol interlock as well as some visual or audible indication that the device is responding, operational and ready for use.

Regardless of how the device is configured, the temperature standard does not refer to the surface temperature of the handset nor to the internal temperature of the alcohol interlock. Rather, it refers to the steady state ambient air temperature inside the vehicle. This would allow for a much warmer handheld unit to be used for start up in extreme temperatures as a result of the allowable warm up period (Section 4.2.2).

4.2.2 Warm up Period

The vehicle's engine cannot be started until a successful breath test is presented. As such, the vehicle's climate control heater cannot be relied upon to warm up the alcohol interlock in cold weather conditions. Therefore, it is not reasonable to expect that the alcohol interlock will receive cabin heat before it must be used. Any heat needed to warm the device for starting must be self-generated. However, the heat should be generated only after the device has been activated by the driver. This will prevent the unit from drawing more than the allowable quiescent current and draining the vehicle battery when the vehicle is stationary. For these reasons, warm up and cool down periods are permissible. At a temperature of $-40\text{ }^{\circ}\text{C}$ the driver should not wait more than five minutes for the alcohol interlock to switch from 'sleep' to 'ready for test' mode after a self warm-up. It is not likely that a performance standard will be set for a cool down period at $+85\text{ }^{\circ}\text{C}$ since the driver will likely have to wait for the unit to cool down without the assistance of any form of on board cooling. Unlike built in heaters, built in coolers would pose a serious technological and logistical burden on the development and use of the alcohol interlock.

4.2.3 Humidity

The alcohol interlock must also be expected to perform its functions in high relative humidity (RH) conditions. The proposed upper limit for relative humidity is 95% at $+40\text{ }^{\circ}\text{C}$.

4.2.4 Shock and vibration

The handheld unit must be able to withstand shock that could be induced as a result of being accidentally dropped onto a concrete or asphalt surface.

In addition, a motor vehicle can be a harsh environment producing high frequency vibrations. As such, all alcohol interlock components inside the cabin and inside the engine bay of the vehicle shall be expected to withstand such vibrations without degrading performance or causing

maintainability/reliability issues. The units must therefore be compliant with a modified version of the instrument panel portion of SAE J1211, Recommended Environmental Practices for Electronic Equipment [10]. The vibration test curve may be found in the test plan document [1].

4.2.5 Altitude

The alcohol interlocks must be able to perform its functions at altitudes as high as 2.5 km above sea level.

4.3 Features

4.3.1 Setpoint

Although it would be possible to use a setpoint of 0.00%, this could potentially cause false positive tests for drivers who use mouthwash, smoke, or who produce small amounts of gas as a result of certain combinations of food and non-alcoholic beverages. Therefore, the alcohol interlocks must have an adjustable setpoint. The actual setpoint value will be defined in the "Program Document" [7].

4.3.2 Blocking and unblocking

Unblocking the ability to start the vehicle's engine shall be achieved after delivery of an accepted breath sample below the setpoint value. An override function is permissible (see Section 4.3.12).

Until an accepted breath test is achieved, an alcohol interlock shall block starting of the vehicle's engine. Once an accepted breath test has been achieved, the driver will have a minimum of one minute and a maximum of three minutes in which to start the vehicle's engine. At the end of this period, a new breath test will be required.

In the case of an unaccepted breath test, a suitable lockout time should be implemented, forcing the driver to wait before attempting a subsequent test. The details of the lockout time are presented in the Program Document [7].

After turning off the vehicle's ignition, the driver may restart the vehicle's engine without the requirement of an additional breath test within a time period of one to three minutes (See Section 4.3.11).

The alcohol interlock should not go into the unblocked state as a result of a breath sample that is above the setpoint that has been filtered via charcoal, water, condensation or any other device or product.

4.3.3 Readiness and response time

All alcohol interlocks shall provide a visual and/or audible indication when ready for a breath sample. A breath sample shall only be accepted after the ready indication has been illuminated or sounded.

The alcohol interlock must be able to provide an output message within the following times:

- No more than 10 seconds after analyzing a test gas with an alcohol concentration of 0 mg/l.
- No more than 15 seconds after analyzing a test gas with an alcohol concentration of 0.25 mg/l.
- No more than 20 seconds after analyzing a test gas with an alcohol concentration of 0.35 mg/l.

4.3.4 Influence on the vehicle engine

An alcohol interlock may only prevent starting of the vehicle's engine. It shall not influence a running engine, even in the case of a missed or unaccepted random or timed retest.

4.3.5 User Interface

All alcohol interlocks must feature a digital display that is easily visible from the driver's seat. The display may be presented on a handset or the instrument panel of the vehicle. The display shall be used for all pre-test and post-test instructions/prompts as well as any instructions that are required during the test. It will also be used to display messages regarding routine tests, random retests, calibration, recalls or any other program related messages. All messages shall be written with an easily readable font and backlighting to allow the messages to be viewed equally well in daylight and in darkness.

See Section 4.4.1 for more details on language requirements for the display.

4.3.6 Mouthpiece

Each alcohol interlock shall require a mouthpiece for the delivery of the breath sample. The mouthpiece shall be easily exchangeable for hygienic reasons.

4.3.7 Data memory, download and evaluation

A record of time and date demonstrates that the alcohol interlock is being used by the client. Data records that show many consecutive days of non-use following many days of use could indicate to program officers that a driver has begun using a non-alcohol interlock equipped vehicle. Similarly, a data record that shows multiple failed tests within a short period of time, each with high BrAC, followed quickly by a successful test and/or vehicle start would be a strong

indication of circumvention. For these reasons, the alcohol interlock shall have an intrinsic real time clock (RTC) and date feature. Neither the RTC nor the date feature shall be adjustable by the end user although the date and time may, or may not, be displayed on the unit's handset. All events logged into memory must be accompanied by a date/time stamp.

The alcohol interlock shall be capable of storing and retrieving an event log that records events with date and time in memory, even if the mobile handset is disconnected. Alternately, the data may be sent via wireless signal to the program office.

At a minimum, the following date/time stamped events shall be recorded:

- Test results above the setpoint;
- Vehicle engine start or running and stop and/or vehicle motion;
- Missing delivery of a breath sample during a retest;
- Detachment and reattachment of handset;
- Connections and disconnections from supply voltage;
- Manipulation or circumvention attempts, including:
 - Overriding and bypassing;
 - Push starting the vehicle; and
 - Hot-wiring the vehicle.

The data may be stored in flash memory or RAM or any other form of current technology memory, provided that power supply interruptions do not corrupt or delete the stored data. The details of the logged data such as file size, column allocation, file type etc are outside the scope of this document.

It shall be possible to download the data using a laptop computer and software and to evaluate the data including the generation of a report with all stored events as well as a condensed report with violations. The data logger shall be able to store at least 10,000 distinct events (line items).

When the data logger reaches 90% of its nominal capacity, a message must be displayed on the handset indicating that service is required to download the stored data and restore available memory.

4.3.8 Early Recall

If a pre-determined number of recall events occur during a prescribed monitoring period and the driver does not obtain service for a reset, the alcohol interlock shall provide an early service recall warning by visual and audible means. Upon expiration of the warning period of five to 12 days, the alcohol interlock shall place the vehicle in the blocked state until the unit has been serviced.

4.3.9 Service Reminder

The alcohol interlock shall have a warning that activates, after a prescribed period of time, to remind the driver of a scheduled monitoring check or calibration.

4.3.10 Random Retests

In order to minimize the likelihood that an unauthorized person will provide the breath sample or that the vehicle will be left to idle for extended periods of time while the driver consumes alcohol, an alcohol interlock shall be capable of requesting random retests. The method by which the retest is requested from the driver may be visual or audible. The details of the random running tests are as follows:

- The first random retest should occur within 15 minutes of the initial engine startup.
- Subsequent retests should be random, but never more than 60 minutes apart;
- The driver should not be requested to turn the engine off when performing a random retest;
- Once a retest is requested, the driver should be allowed between two and five minutes to perform the re-test;
- In the event of a successful retest, the driver will be allowed to continue to drive the vehicle without further action until the next random retest request;
- In the event of an unsuccessful re-test, the alcohol interlock must display a warning message and prompt the driver to pull over and turn off the vehicle's engine. A breath test may be attempted once the countdown timer expires. The vehicle's engine should be prevented from starting until a successful breath test is logged.
- In the event that the driver ignores the warning message(s), an alarm should be activated. This may include the vehicle's horn, the four way flashers, headlights flashing on and off, the vehicle's built-in alarm siren, CB radio signal sent on known police frequencies, GPS or a combination of any or all of the above. The alarm(s) should sound until the vehicle has been completely stopped and a successful retest has been logged;
- At no time should a missed or failed re-test cause the vehicle's engine to be shutdown;
- Once the vehicle is turned off, the random running retest cycles must be reset again; and
- In order to minimize confusion while driving, the anti circumvention methods must be consistent for all requested breath tests.

4.3.11 Restart

It is possible that an alcohol interlock equipped vehicle could stall while in heavy traffic or while the vehicle is traveling at high speed or while the vehicle is situated in a dangerous area. In such situations it would be potentially hazardous for the driver in the alcohol interlock equipped vehicle, or drivers in other vehicles, to impose an immediate re-test in the alcohol interlock equipped vehicle. For these reasons, alcohol interlocks shall have a restart capability which would allow the vehicle to be restarted without a retest within a prescribed time frame. The allowable time between the vehicle stall event and the vehicle restart event shall be programmable and will therefore be defined in the Program Document [7].

4.3.12 Emergency Override

All alcohol interlocks shall be equipped with an emergency override feature to allow a vehicle to be started when an alcohol interlock becomes inoperable or fails to allow a vehicle unblocked

condition even after what would otherwise be an accepted breath test. This will allow the driver to call the service provider to determine how to activate the emergency override function. Use

of this one-time-only feature allows the vehicle to be started without the need for a breath sample. The alcohol interlock is then immediately placed in the five day recall mode and the driver will have five days to have the alcohol interlock reset by a service technician. It shall be possible to enable or to disable the override function.

4.3.13 Immediate Recall Mode

All alcohol interlocks shall be capable of providing an immediate recall mode that puts the vehicle into the blocked mode when a circumvention attempt has been logged. The details of the recall mode are defined in the Program Document [7].

4.3.14 Tampering

All alcohol interlocks shall be designed and built such that, when installed in a vehicle according to the manufacturer's instructions, they cannot be put out of service or be rendered ineffective or destroyed without visible changes to the alcohol interlock or its installation. Where possible, tamper proof witness seals should be installed over, or around, ingress points to help indicate attempted, or successful, infiltration into the working components of the alcohol interlock.

4.3.15 Bypass detect

The alcohol interlock should be capable of providing a bypass detection mode if an accepted breath test is not delivered within a prescribed time after the vehicle is put into the run state. When bypass detection is triggered, an alarm will sound (e.g. horn blowing, 4 way flashers, headlight high beams, alarm) until the vehicle's engine is turned off or an accepted breath test is delivered. This feature is intended to deter bypassing of the normal ignition circuitry by means of 'hot-wiring' or push-starting the vehicle. All bypass detection events should be logged and date stamped. The specifics of the bypass detection are defined in the Program Document [7].

4.3.16 Differentiation between human and non-human breath samples

Since alcohol interlocks are mechanical devices that cannot differentiate between a human breath sample and, say, a sample of CO₂ or air from an aerosol device, it shall be mandatory for every alcohol interlock to make use of some form of human recognition feature that the driver must provide in addition to the breath sample. The number, frequency, timing and duration of the recognition events are not mandated, provided the event(s) properly distinguishes a human breath sample from a non-human sample. The method by which this is achieved may include, but is not limited to, any one of the following techniques:

- Breath code/signature;
- Blow/suck cycling;
- Breath humidity measuring sensor;
- Warm lip sensor;

- Hum tone recognition; or
- Voice recognition.

4.4 Displays and Documentation

4.4.1 Language

Alcohol interlocks complying with this standard must be capable of displaying all messages in English and in French. This may be accomplished by offering two distinct models, one for each language, or the manufacturer may use a user selectable feature to switch between English and French on the same unit.

All user and repair manuals must also be available in English and French.

4.4.2 Labeling and Marking

An alcohol interlock shall be marked legibly and indelibly with the following minimum information:

- Name of manufacturer and/or authorized distributor;
- Country of origin;
- Model name or number;
- Serial number;
- Type/Electrical approval (e.g. UL, CSA, CE); and
- Operating temperature range (visible to the user or printed in the user manual).

4.4.3 Installation Manuals

At a minimum, the following information must be provided so that a trained technician can install the alcohol interlock into the vehicle. The installation manuals should not be provided to the end user.

- A list of vehicles for which the alcohol interlock is intended. This may be a list of vehicles that are included, vehicles that are excluded or a generic instruction (e.g. all vehicles with gasoline engines, fuel injection and a 12V negative ground electrical system).
- Installation methods including easily understood text and clear drawings and figures such that when installed by a trained technologist, the safety and reliability of the vehicle has not been compromised.
- A list of any restrictions on the positioning of any part of the product with respect to dust, water and temperature.
- Special warnings and cautions relating to the positioning of components near sensitive vehicle systems such as air bags and any critical distances between the driver and the alcohol interlock.

- Identification of the electrical power requirements of the alcohol interlock.
- Post installation testing to ensure that the devices have been installed correctly and have not negatively affected the performance of the vehicle.
- Instructions for removal of the devices and returning the vehicle to its original condition
- Information regarding the disposal of the unit at the end of its service life.

4.4.4 Operator Manuals

At a minimum, the manufacturer must provide the following information to each user, in hard format, to allow users to fully understand and operate the equipment:

- Complete instructions, figures and diagrams for proper and safe operation of the alcohol interlock;
- Recommendations to regularly check and calibrate the alcohol interlock and information regarding the calibration frequency and why the calibration must be performed;
- Details of proper operation and operational limitations including the following precautions:
 - Temperature range and warm up time;
 - Battery voltage;
 - Influence of mouth alcohol;
 - Influences of substances containing alcohol; and
 - Influences of substances other than alcohol
- List of recommended spare parts and accessories;
- Recommendations for hygiene procedures;
- Explanation of the significance of all the various signals, alarms and messages;
- Basic troubleshooting procedures;
- Basic care and cleaning instructions;
- General warnings and/or cautions about performing alterations to the alcohol interlock; and
- Information about the proper disposal of the alcohol interlock at the end of its service life.

4.4.5 Maintenance Manuals

Maintenance manuals should not be provided to the end user. End users should be provided with documentation that is limited to general care and cleaning of the product. As a minimum, the manufacturer must provide the following information in either softcopy or hardcopy format to allow maintenance to be performed on the unit by trained personnel or program officers:

- Methods for downloading the data from the memory of the alcohol interlock;
- Service procedures, both corrective and preventative (if any);
- Calibration procedures;
- General inspections; and
- Troubleshooting methods (if any).

5 COMPLIANCE TESTING

The specifications found in this technical standard define the applicable requirements and the installation conditions for the alcohol interlock to be fitted in Canadian vehicles.

Each alcohol interlock type must therefore be tested by an ISO/IEC 17025:2005 accredited laboratory facility for compliance with this technical standard. The specifics of the test procedures and the requirements of the technical report may be found in the companion test protocol document (CSTT-HVC-TR-150).

Upon successful completion of the test sequence, a technical report and proof of the lab's ISO/IEC 17025:2005 accreditation shall be issued by the test facility to the alcohol interlock manufacturer and Transport Canada for review and approval of the test results. If the results are found to be satisfactory, Transport Canada shall then issue a qualification/type rating certificate for that particular alcohol interlock.

LIST OF ACRONYMS/ABBREVIATIONS

A	Amps
AC	Alternating Current
BAC	Blood Alcohol Content
BrAC	Breath Alcohol Content
C	Celsius
CB	Citizen's Band
CO	Carbon Monoxide
CO ₂	Carbon Dioxide
CSTT	Centre for Surface Transportation Technology
DC	Direct Current
Deg	Degree
ECM	Electronic Control Module
EMC	Electromagnetic Compatibility
EMI	Electromagnetic Interference
GPS	Global Positioning System
HC	Hydrocarbons
HCL	Hydrochloric acid
HVAC	Heating, Ventilation and Air Conditioning
L	litre
mg	milligram
NRC	National Research Council Canada
RE	Radiated Emissions
RF	Radio Frequency
RH	Relative Humidity
RTC	Real Time Clock
SAE	Society of Automotive Engineers
Torr	Torrilli (unit of pressure equal to 1/760 of an atmosphere)
V	Volts
VDC	Volts, Direct Current
W	Watts

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