



FEDERATION INTERNATIONALE DE L'AUTOMOBILE

NORME FIA 8872-2018
FIA STANDARD 8872-2018

ACCIDENT DATA RECORDER (ADR)

FOREWORD

The aim of this standard is to provide objective design and performance requirements for newly developed Accident Data Recorder (ADR) systems that are intended to be included in the FIA ADR programme.

An Accident Data Recorder (ADR) is an electronic device that is able to measure and record accident data, mainly, but not limited to, in-car accelerations along three axes (X, Y and Z) – also referred to as “G-forces”. The FIA ADR Programme supports the global deployment of ADR devices in motorsport.

Accident data is highly valuable for the FIA; and is used to obtain a greater understanding of the accident kinematics and injury mechanisms. R&D activities build on this data to improve the performance of safety systems, which can be delivered through new regulations and guidelines.

1. GENERAL

1.1 Homologation procedure

Any manufacturer applying for homologation agrees to have understood this standard, the FIA Homologation Regulations for Safety Equipment, and any other regulations relating to the safety equipment.

Manufacturers are requested to formally engage with the FIA (via adr@fia.com) to declare their intent to develop an ADR system that meets the requirements of this standard. Before submitting the homologation application dossier the manufacturers shall submit the technical specification document, including information in accordance with the template in APPENDIX B.

Models of ADR to be homologated shall be tested by a test house approved by the FIA and listed in the Technical List n^o[TBA].

The homologation application dossier shall be submitted to the ASN of the country of the manufacturer, which shall apply to the FIA for the homologation. The homologation application dossier shall consist of:

- the test report, in accordance with the template and guidelines in APPENDIX A;
- test results (documentation and data files) in accordance with APPENDIX E and APPENDIX F;
- detailed information regarding the quality control procedures to be put in place, including a full programme of the quality control testing expected at each stage of the device’s production process;
- a sample of the FIA label to be used;

Following an objective evaluation based on the design and performance requirements defined in this standard, the device will be submitted to the FIA Safety Department for a final subjective evaluation. The final homologation approval will depend on this subjective evaluation.

Following completed homologation, the FIA will assign a homologation number and will list all newly homologated ADR systems in the Technical List n^o[TBA], published on the FIA website (www.fia.com).

The FIA reserves the right to require the ASNs concerned to carry out post-homologation controls according to the post-homologation regulations on ADR systems selected at random. It also reserves

the right to cancel the homologation should the application prove to be incomplete or in the event of the ADR subjected to random quality tests being found to be non-compliant to the required standard.

1.2 Manufacturer's undertaking for the stability of his product

When applying for the homologation, the manufacturer undertakes not to modify the design, materials, software, hardware and fundamental method of production of the product.

2. SCOPE

This standard provides a pragmatic way, by engaging both testing and the opinion of experts, to ensure that any ADR homologated by the FIA will operate robustly and provide high quality data during significant crash events.

Although this standard is tuned around traditional technology, the FIA is supportive of manufacturers exploring alternative approaches to achieve an equal or greater level of performance. While the procedure set out in this standard is well defined, the precise requirements for each ADR cannot be exhaustively defined and may vary on a case-by-case basis; therefore it is strongly recommended that the ADR manufacturer approaches the FIA early in the development process to ensure that any potential issues are addressed as soon as possible.

3. DESIGN REQUIREMENTS

The FIA reserves the right to refuse the homologation if the design and function are deemed unacceptable.

The design requirements listed in Articles 3.1 to 3.16 are mandatory only when applicable for the relevant ADR technology. The FIA reserves the right to request further information if a new technology is presented for homologation.

If the proposed system solely consists of accelerometer(s), it shall be designed for use with an recognised FIA logger. In such a case, only Articles 3.1, 3.2, 3.6 (ii), 3.12, and 3.15 are applicable. The FIA may require the manufacturer to support the connection and integration of the device with the FIA logger.

3.1 General

The ADR system and software shall:

- (i) be fully developed;
- (ii) measure and record meaningful chassis acceleration data during an impact event;
 - a. measurement of impact accelerations $\pm 150G$ MIN when applying a CFC60 filter on the recorded data;
 - b. Sensing response of a mounting surface $\pm 1000G$ MIN between 0 and 3kHz MIN without aliasing and clipping. The manufacturer shall provide the relevant documentation to show that their system conforms with this requirement (e.g. theoretical flow chart or numerical simulation).
- (iii) Measure and record in 3 orthogonal axes with the following sign convention (note: FIA convention is different from SAE J1733 – affecting the Y axis only):

- a. X axis: positive forward acceleration;
- b. Y axis: positive left acceleration;
- c. Z axis: positive upward acceleration.

3.2 Accelerometer

The accelerometer shall have:

- (i) A prefilter headroom 1000G MIN or input filter to avoid clipping of signals as detailed in Article 3.1 (ii) b.
- (ii) A measurement range appropriate for achieving Article 3.1 (ii) b (examples: $\pm 150\text{G}$ for 100Hz output filter or $\pm 250\text{G}$ for 400Hz output filter).
- (iii) A gain sensitivity no greater than $\pm 5\%$ in the X, Y and Z axes over the full working temperature range of the ADR.
- (iv) A zero-g offset no greater than $\pm 15\text{G}$ in the X,Y and Z axes over the full working temperature range of the ADR.

Note: extreme care must be taken when using digital output MEMs sensors to ensure that as a complete system, the Nyquist requirements are fulfilled.

3.3 Anti-aliasing, sampling and logging

An anti-alias filtering strategy that fulfils the following minimum requirements shall be implemented and applied to the three acceleration channels:

- (i) before ADC sampling, hardware filters shall:
 - a. be low-pass only;
 - b. provide an overall attenuation of -30dB MIN at the Nyquist frequency (half of the sampling frequency);
- (ii) ADC sampling rate 1kHz MIN (note: recommended equal or more than 2kHz);
- (iii) ADC resolution must be less than 0.15G/bit;
- (iv) before logging, software filters shall:
 - a. be low-pass only;
 - b. provide an overall attenuation of -30dB MIN at the Nyquist frequency (half of the logging frequency);
- (v) logging frequency 1kHz;
- (vi) the combined attenuation over the range between DC and 100Hz shall be less than 0.2dB

The complete anti-aliasing, sampling and logging scheme shall be disclosed as per Appendix B.

3.4 Data storage and download

- (i) The system shall either:
 - a. Continuously record data using sufficient non-volatile log data storage memory to avoid wrapping and losing data;
OR
 - b. Utilise a permanent file-saving strategy using an accident detection algorithm (see Article 3.9), to record a minimum of 20 events of 30s each (15s before impact and 15s after).
In this instance, the system must be able to immediately revert back to a state in which it is ready to record another event. Additionally, in instances where the device's memory is full, the oldest file stored on the device must be overwritten if a new accident is detected.

Accident detection should resume 10 seconds before permanent storage of events will complete. If events are close together the data should be back-to-back with no missing or duplicated samples. For example if the next event is detected more than 10 seconds and less than 30 seconds after the initial event, two events would be stored that included all data from 60sec of elapsed time.

- (ii) The real data transfer rate from ADR to PC shall be such that the time to download a minute of data shall be no longer than 15 seconds.
- (iii) The system must supply downloaded data in a format such that the data can be viewed and analysed with existing PC data analysis software (e.g. .CSV, .ASCII).
Alternatively, the manufacturer must supply effective and adequate data analysis software to the FIA and ASNs at no extra cost.
The data files should be downloaded from the device in a format such that they are readable directly without the need for separate configuration files.
- (iv) The date and GMT time of the accident must be measured and recorded.
- (v) The data channels shall have the names, units and ordering as detailed in Appendix C.
- (vi) Each filename must automatically include as a minimum:
 - a. The unique ADR unit serial number: e.g. 'SNxxxx';
 - b. Date and time in the following format: yyyyymmdd-hhmmss;
Example: "SN7890-20160510-163324".

3.5 Power supply

The system may either be powered on-car with external power supply, or solely with an internal battery (without an external power supply).

- (i) If the system is to be powered on-car with external power supply (e.g. direct connection to the car battery):
 - a. operating voltage range: 8V to 16V DC;
 - b. whilst charging, the device must take no more than 2A from supply even when completely discharged, and typically less than 1A under normal conditions;
 - c. the device should withstand short-term exposure to 18V nominal supply with no permanent damage;
 - d. rate of charge: from a fully discharged state when connected to a 12V supply for 15 minutes, the device must accumulate enough backup charge for 45s MIN logging;
 - e. power loss management: when fully charged, the system must allow logging for a minimum of 1 event occurring 15s MIN after the loss of power, or 45 seconds if continuously recording, when no external power source is present. Furthermore, the system must be able to complete the write cycle for the current event or data file once this period of logging has concluded.
- (ii) If the system is to be powered solely with an internal battery (without an external power supply):
 - a. the battery must be rechargeable on-car without having to un-install the unit from the car or open the casing of the device.
 - b. the battery shall be of sufficient capacity such that the device remains operational for a minimum of 30 days of normal operation.

3.6 Connector

- (i) A Deutsch Autosport AS 2 10-35 PN, Souriau 8STA 10-35 PN, or any other compatible connector shall be used for connection to the car, with the pin prescriptions are per

Article 3.10.

If the proposed system solely consists of accelerometer(s), it shall be designed to be connected to a recognised FIA logger.

- (ii) A reasonable number of download cables must be provided on request of a championship promotor/delegate. The download cable must use a single USB connection to a pc for communication and power.

3.7 LED

- (i) The ADR device shall be equipped with at least one status LED
The minimum flashing scheme shall be:
 - a. normal running and communicating with ECU/CAN: LED solid green at 50% brightness;
 - b. accident stored: LED flashing red at full brightness at 4Hz with 5% duty cycle.
- (ii) If the system relies solely on an internal battery, an additional LED shall be used to indicate the status of the battery.
The flashing scheme for this LED should clearly indicate when the state of charge of the battery follows:
 - a. fully charged: LED solid
 - b. less than 24 hours of normal operation is remaining: LED flashing ON for 100ms every 2s

3.8 Zeroing (bias removal)

- (i) An offset removal protocol (automatic zeroing) should be applied each time the unit is powered on such that the device reading offset be less than +/- 1G for all axes.

3.9 Accident detection algorithm and Accident Severity Index

- (i) The three logged acceleration channels shall be software-filtered at least 1kHz rate with a 100Hz low-pass filter equivalent to CFC60 (e.g. 8ms-FIR filter). The precise algorithm used by the manufacturer shall be disclosed and detailed in the technical dossier.
- (ii) The accident detection shall operate on the above filtered channels (X, Y and Z simultaneously) and trigger according to configurable thresholds independent for each axis:
 - a. event store permanent file saving strategy;
default setting: 15G 5ms X or Y or 25G 5ms Z;
 - b. medical warning light algorithm;
default setting: 15G 5ms X or Y or 25G 5ms Z.
 - c. The ADR system shall log the Accident Severity Index (ASI) – the ASI is defined as the maximum absolute acceleration recorded in either channel during the 'medical warning light' detection phase.
The ADR must output a trigger (on/off) via CAN or via a dedicated pin to a medical warning light.

3.10 PIN-out

The PIN-out layout shall include the following outputs:

- PIN 1 RS232-Rx
- PIN 2 medical light (on/off trigger) (if used)
- PIN 3 CAN-Hi
- PIN 4 CAN-Lo
- PIN 5 status light
- PIN 6 manufacturer specific
- PIN 7 USB 5V
- PIN 8 USB D+
- PIN 9 USB D-
- PIN 10 manufacturer specific
- PIN 11 5V supply (if used)
- PIN 12 Battery Positive
- PIN 13 Ground and USB 0V

3.11 CAN

The ADR device shall be equipped with CAN and meet the following requirements:

- (i) hardware specification:
 - a. speed: 1Mbit/s;
 - b. standard: 2.0b;
- (ii) ability to get context 100Hz vehicle data channels, e.g. car speed, throttle pedal position, rpm, brake pressure, steer angle, lap number, track distance, GPS position and status;

The CAN protocol shall comply with that detailed in Appendix D.

3.12 Environment

The ADR system shall:

- (i) be able to function in accordance to the specification when exposed to operating temperatures between -15°C to 85°C;
- (ii) have an Ingress Protection Marking of at least IP 66.

3.13 PC software requirements

By connecting to the ADR, the PC software must be able to allow:

- (i) Data download (single or multiple events as per user selection)
- (ii) Manual date and time setting.
- (iii) Firmware update and verification
- (iv) Ability to trigger an accident manually (for the purposes of testing).

The following features must be available via a secure pre-set password or pin-code:

- (v) Calibration: ability of zeroing all acceleration channels. Configurable G thresholds and detection time duration for accident detection algorithm.
- (vi) Configurable mounting orientation (i.e. switch axes in cases where the unit has to be mounted in an alternative orientation).

- (vii) Memory formatting.

The password or pin-code must be provided solely to the FIA.

3.14 Embedded software requirements

- (i) Diagnostics including internal temperature, power supply, battery voltage, reset counter, sensor failure.

3.15 Strength of casing and components

The ADR system shall be sufficiently stiff and strong for its purpose, and shall include at least three bolt-holes for rigid fixation to the car.

3.16 Time

- (i) The ADR system shall possess a real time clock chip with a 1s/day MAX drift accuracy with dedicated battery to maintain accurate time for at least 5 years with no external power applied;
- (ii) The end-of-line time shall be set in the UTC time standard on delivery.
- (iii) The ADR shall have the ability to synchronise time through GPS or CAN;

4. MODEL CLASSIFICATION

Any significant changes to the devices internal componentry or functionality constitutes a change of model, and consequently an authorisation from the FIA is required. Additionally, further testing at an FIA-approved test house may be required.

4.1 Authorised modifications

Only those modifications expressly specified in points a) and b) below are authorised without consulting the FIA and the test house.

a) Change of colour of the casing:

It is permissible to change the colour of the casing on condition that the material is strictly identical (weight, thickness, structure, etc.) to that which was initially homologated.

b) In case of shortage on the market or obsolescence of passive components (resistors, capacitors, inductors) it is permissible to change the component supplier, maintaining the same electrical/mechanical characteristics and qualification standard.

Other changes such as memories, flash disks or minor PCB changes (such as improvements to eliminate any manual re-work) must be communicated to FIA, and it will be at the FIA's discretion to decide if further testing at an FIA-approved test house is required.

4.2 Extension to homologation

An extension applies to an existing homologation and refers to a modification of any of the original product's characteristics.

Manufacturers shall consult the FIA on the viability of the extension of the homologated ADR product before officially requesting the extension to the homologation.

The limit on the number of extensions number must comply with the FIA Homologation Regulations for Safety Equipment.

Any changes to the systems firmware, software or hardware that affect the devices performance or changes the declared specification when the system was originally homologated must be authorised by the FIA in agreement with the test house.

Further testing at an FIA-approved test house and further analysis by the FIA Safety Department may be required. Homologation extension tests shall be carried out in the same test house as the original homologation tests.

4.3 Miscellaneous

Along with the ADR device, the manufacturer shall provide a comprehensive and detailed user's manual.

The manufacturer shall make provisions to provide field programming, configuration and debugging tools to the FIA and their nominated representatives.

5. PERFORMANCE ASSESSMENT

The performance tests below are mandatory. The FIA reserves the right to request further tests if a new technology is presented for homologation.

If the proposed system solely consists of accelerometer(s), the tests shall be performed whilst the ADR is connected to a recognised FIA logger.

Three shaker tests and one sled test shall be conducted with three ADR units each, in accordance with the test procedure presented in APPENDIX E and APPENDIX F.

The ADRs shall also be tested on-track in a championship selected by the FIA.

5.1 Shaker tests (to be satisfied by each ADR unit)

- The consistency between the data obtained from the tests and the technical information stated by the manufacturer (as per APPENDIX B) will be analysed, and must meet the requirements set by the FIA Safety Department;
- The physical integrity and proper functionality of the ADR must be maintained.

5.2 Sled tests (to be satisfied by each ADR unit)

- The peak acceleration (CFC60) from the ADR data must be within $\pm 5\%$ of peak acceleration of laboratory measurement (CFC60);
- The final deltaV (integration of acceleration curve) from the ADR data must be within $\pm 3\%$ of final deltaV from sled measurement;
- The acceleration curve shall lie within a corridor defined as $\pm 10\%$ of peak acceleration of laboratory measurement, centred around the acceleration curve of the laboratory measurement. Certain deviations outside of this corridor may be accepted in the 'ramp-up' and 'ramp-down' phases of the pulse, provided they do not occur for more than 30% of the pulses' total duration;
- The physical integrity and proper functionality of the ADR must be maintained.

5.3 Track tests (to be satisfied by each ADR unit)

The manufacturer shall validate the system in a championship selected by the FIA in a minimum of

3 cars, each for a minimum of 3 races or test sessions. Any necessary track support shall be provided by the manufacturer and the data shall be reviewed by the FIA Safety Department.

6. LABELLING

The complete label and marking process shall be approved beforehand by the FIA.

Each ADR shall be marked with a FIA homologation label and a FIA hologram, both of which shall be glued onto the outer surface of the external casing. The dimensions of the label shall be 36 x 26mm and the empty square for gluing the hologram shall be 15 x 15 mm. The manufacturer's name can be replaced by its logo. The label shall have a white background and the print shall be in black. The text font style shall be Arial size 6pt, and the manufacturer shall follow the bold font style when applicable.

The label must be indelible and made in such a way that it cannot be removed intact. The label shall be in compliance with Figure 1 showing the name of this standard, the manufacturer's name, the homologation number, the date of manufacture and a unique serial number. Each ADR unit must have a unique identification number and a record shall be made available to the FIA on request.

The label shall be affixed in a secure location that is visible when the system is mounted in the vehicle. It shall be of a destruct-on-removal foil type and it is recommended that it include security features put in place by the manufacturer to avoid tampering and copying. The labels shall not be available outside the manufacturer's premises and may only be fitted by the manufacturer. The manufacturer shall follow the FIA labelling guidelines for ADR.

The label will be controlled by the FIA, which reserves the right for its officials or the officials of an ASN to remove or strike out the label. Such action will be taken when, in the opinion of the chief scrutineer of the event, the future performance of the ADR has been jeopardised.

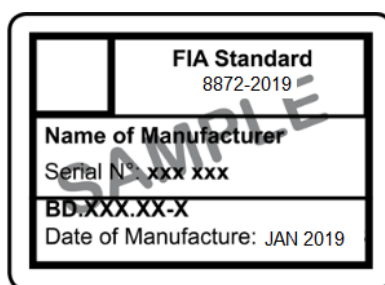


Figure 1. Modèle d'étiquette d'homologation à apposer sur le système de ADR

Figure 1. Sample of homologation label to be affixed to the ADR

7. VALIDITY

The validity of an ADR expires five years after the year of manufacture. For example, an ADR manufactured on 1.1.2018 will be valid until 31.12.2023; likewise, an ADR manufactured on 31.12.2018 will be valid until 31.12.2023.

8. DATA

The manufacturer agrees that the data ownership rights of any and all data recorded by the ADR should be assigned to the FIA in perpetuity, and will endeavour to ensure that this is stated in the relevant documentation between the manufacturer and the customer.

ANNEXE A APPENDIX A

RAPPORT D'ESSAI POUR ADR

(Voir ci-dessous)

TEST REPORT FOR ADR

(See below)

Modèle de rapport d'essai fourni sur demande.
Test Report Template to be provided upon request.

COMMENT REMPLIR LE RAPPORT D'ESSAI

Le rapport d'essai doit être rempli successivement par trois organismes pour être valable :

1. Le laboratoire d'essai complète le rapport et conclut sur la conformité du système de ADR à la norme FIA. Il est demandé de remplir chaque case soit par des coches, soit par des valeurs si elles sont requises, soit par tout commentaire que le laboratoire d'essai juge utile de mentionner. La personne certifiant les essais doit tamponner et signer dans les cases de la partie 2.2 du rapport.

2. Le représentant de l'ASN doit tamponner et signer dans les cases de la partie 2.1 du rapport.

3. ...

HOW TO FILL IN THE TEST REPORT

The test report shall be filled in by three different bodies consecutively in order to be valid:

1. The test house completes the report and concludes whether the ADR is in conformity with the FIA standard. Each box should be filled in, either with figures or ticks if these are required or with any comments that the test house may consider worth mentioning. The person certifying the tests must stamp and sign in the cells in Section 2.2 of the report.

2. The representative of the ASN must stamp and sign in the spaces provided in Section 2.1 of the report.

3. The FIA assigns the homologation once it has seen the report duly completed by all the parties concerned, and system has been approved by the FIA Safety Department.

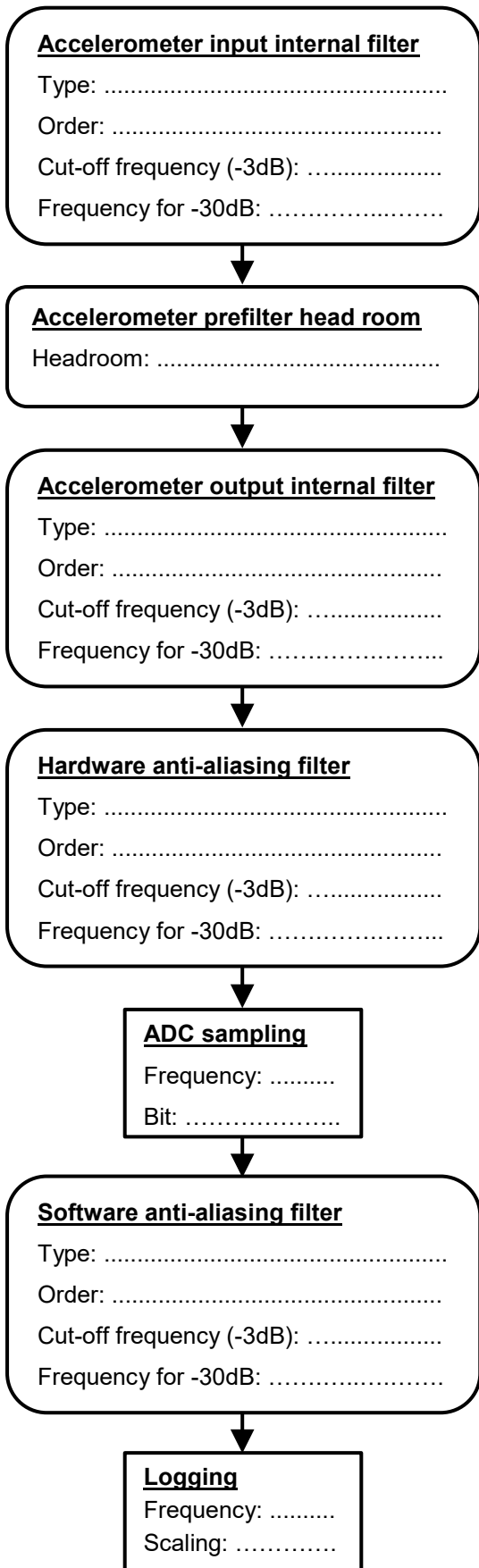
**ANNEXE B
APPENDIX B**

TECHNICAL SPECIFICATION INFORMATION

A full specification document shall be submitted. This should include the performance of the measurement system in accordance with the framework detailed below, and a complete set of technical drawings, bill of materials for the casing and internal componentry, and a component placement drawing:

	Characteristic	Unit	Value
Accelerometers	Data channel full scale	G	
	Reference sensitivity (provide frequency, temperature and acceleration references)	mV/G	
	Frequency response range (provide sensitivity deviation <u>graph</u>)	% or dB vs Hz	
	Transverse sensitivity	%	
	Amplitude linearity	...% per ...G	
	Mechanical frequency as mounted in ADR system	Hz	
Anti-aliasing, sampling	Please refer to the diagram below.		
Logging	Measurement range	G	
	Logging frequency	Hz	
	Numerical format	bit	
	Logging scaling	mg/bit	
Data	Download connector	(Ethernet, USB or other)	
	Download rate	Mbits/s	
	Format	ASCII, CSV, Excel, proprietary or other	
	Reader/visualisation tool	Wintax, Atlas, Excel, proprietary or other	
Environmental	Ingress Protection Marking	IP	
	Temperature operating range	°C	

Anti-aliasing, sampling and logging:



APPENDIX C

DATA HEADERS AND CHANNELS

The data shall be stored and exported in compliance with the format specified below. In instances where optional channels are not output, the values shall be empty but the overall order prescribed shall remain.

C.1. Headers and column titles

- Event date, time of day of first sample, and time zone
- Serial number
- Column titles
 - Channel name
 - Unit (on next row)

C.2. Mandatory channels

Order	Name	Unit/Format	Sign convention	Description
1	tTime	s	-	Sample time
2	gADRX	G	Positive = forward acceleration	Anti-aliased * ADR acceleration along its X-axis
3	gADRY	G	Positive = left acceleration	Anti-aliased* ADR acceleration along its Y-axis
4	gADRZ	G	Positive = upward acceleration	Anti-aliased* ADR acceleration along its Y-axis
5	gCFC60X	G	Positive = forward acceleration	CFC60** acceleration along its X-axis
6	gCFC60Y	G	Positive = left acceleration	CFC60** acceleration along its Y-axis
7	gCFC60Z	G	Positive = upward acceleration	CFC60** acceleration along its Z-axis
8	ASI	G	Absolute value	Accident Severity Index

* In this context, 'unfiltered' means post-logging, after all anti-aliasing filters have been applied, and before any analysis filter or accident detection algorithm is applied.

** Calculated with manufacturer specified filter to achieve CFC60 response from the system.

C.3. Context vehicle data channels (from CAN)

Order	Name	Unit/Format	Sign convention	Description
9	NLap	-	Positive	Lap number
10	sLap	m	Positive	Lap distance
11	vCarWheel	kph	Positive = forward speed	Car speed (calculated from Wheel Speed)
12	rThrottle	%	-	Throttle actuator position
13	aSteer	deg	Positive = left-hand-side turn	Steer angle
14	pBrakeF	bar	Positive	Front brake pressure
15	nEngine	rev/min	Positive	Engine rotational speed

C.4. GPS data channels (from GPS hardware or CAN)

Order	Name	Unit/Format	Sign convention	Description
16	gpsLat	DDD.DDDDDDD°	Positive values are north of the equator,	GPS latitude coordinate

			negative values to the south.	
17	gpsLong	DDD.DDDDDDD°	Positive values for east longitude, negative values for west longitude.	GPS longitude coordinate
18	gpsVCar	kph	Positive = forward speed	Car speed (calculated from GPS)
19	gpsStatus	chipset-related	-	GPS status

C.5. Gyro channels (if included within device)

Order	Name	Unit/Format	Sign convention	Description
20	nADRX	deg/s	Positive = from Y to Z	Rotational speed recorded by the ADR around its X-axis
21	nADRY	deg/s	Positive = from Z to X	Rotational speed recorded by the ADR around its Y-axis
22	nADRZ	deg/s	Positive = from X to Y	Rotational speed recorded by the ADR around its Z-axis

APPENDIX D

CAN PROTOCOL

D.1. Input packets (external to ADR)

Message 1

Message ID: **0x200**

Message rate: **f = 100Hz**

Format: Big Endian

Byte	Description	Scaling	Type
0-1	Engine rotational speed	rpm/bit	16-bit unsigned
2	Front brake pressure	bar/bit	16-bit signed
3	Rear brake pressure	bar/bit	16-bit signed
4-5	Lap distance	1m/bit	16-bit unsigned
6-7	Throttle actuator position	0.1 %/bit	16-bit signed

Message 2

Message ID: **0x204**

Message rate: **f = 100Hz**

Format: Big Endian

Byte	Description	Scaling	Type
0-1	Vehicle speed	0.1 km/h/bit	16-bit unsigned
2-3	Steer angle	°/bit	16-bit signed
4-5	Throttle pedal position	0.1 %/bit	16-bit signed
6-7	Pit Lane + Lap number	Pit Lane*0x8000 + Lap	16-bit unsigned

Message 3

Message ID: **0x680**

Message rate: **f = 10Hz**

Format: Big Endian

Byte	Description	Scaling	Type
0-3	GPS Latitude	1e7 degrees	32-bit fixed point (7dps) value
4-7	GPS Longitude	1e7 degrees	32-bit fixed point (7dps) value

Message 4

Message ID: **0x681**
Message rate: **f = 10Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0-3	GPS time	HHMMSS.sss	32-bit unsigned
4-5	GPS speed	0.1 km/h/bit	16-bit unsigned
6-7	GPS altitude	0.1m/bit	16-bit signed

Message 5

Message ID: **0x682**
Message rate: **f = 10Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0-2	GPS date	DDMMYY	24-bit unsigned
3	GPS valid*		8-bit signed
4-5	True course information	0.1 degree/bit	16-bit signed
6	Horizontal dilution of precision	0.1/bit	8-bit unsigned value
7	Number of satellites		8-bit unsigned value

*reporting the state of the position information. See NMEA0183 for definition for values.

Message 6

Message ID: **0x683**
Message rate: **f = 5Hz**
Format: Big Endian

Byte	Description	Scaling	Type
0-1	Magnetic variation	0.1 degree/bit	16-bit signed
2	DGPS station ID		8-bit unsigned value
3	DGPS update time	1s/bit	8-bit unsigned value
4	FAA mode*		8-bit signed
5	Fix quality*		8-bit signed
6-7	WGS84 height above geoid	0.1m/bit	16-bit signed

*See NMEA0183 for definition for values.

D.2. Output packets (ADR to external)

Message 6

Message ID: **0x7B**

Message rate: **f = 10Hz**

Format: Big Endian

Byte	Description	Scaling	Type
0	Accident Severity Index	0 = no accident 1-255 = severity of last accident detected since power on	8-bit unsigned
1	ADR software version	10 (e.g. 0x25 = 37d => 3.7)	unsigned
2-3	ADR Status	See table below	bitmapped
4-5	ADR serial number	-	16-bit unsigned

ADR status:

Bit	Description	Note
0	Logging in progress	1 if logger is in LOGGING state, else 0
1	Logging config OK	1 if a configuration table is good, else 0
2	CAN Team OK	1 if ADR is receiving CAN messages from ECU, else 0
3	Accident stored	1 if an accident is stored in memory, else 0
4	Accident active	1 if an accident is being detected
5	DLMode	1 when USB is connected for data download
6-15	0	Always zero

Message 7

Message ID: **0x81**

Message rate: **f = 100Hz**

Format: Big Endian

Byte	Description	Scaling	Type
0-1	Yaw rate (if gyro)	8.75 mdps/s/bit	16-bit signed
2-3	Acc Y (G-Lateral)	0.006125 G/bit	16-bit signed
4-5	Acc X (G-Longitudinal)	0.006125 G/bit	16-bit signed
6-7	Acc Z (G-Vertical)	0.006125 G/bit	16-bit signed

APPENDIX E

SHAKER TESTS

Three shaker tests with three ADR units each shall be performed as per the Matrix shown in D1.

For each test, the three ADR units shall be hard-mounted on the shaker such that:

- a. ADR unit n°1 X = shaker Z
- b. ADR unit n°2 Y = shaker Z
- c. ADR unit n°3 Z = shaker Z

E1. Shaker Test Matrix

<u>TEST</u>	<u>MAGNITUDE</u>	<u>FREQUENCY SWEEP</u>	<u>DURATION</u>
1	5G	10-2500Hz [linear]	No less than 2min
2	40G	40-2500Hz [linear]	No less than 2min
3	70G	100-2000Hz [linear]	No less than 2min

E2. Lab instrumentation

Instrumentation and data recording should conform to the relevant requirements of ISO standard 6487-2015 and SAE J211.

E3. Minimum documentation to be provided:

- (i) raw (unfiltered) numerical data from laboratory sensor and the ADR units in ASCII or Excel format;
- (ii) a graph of the recorded accelerations (gADRX, gADRY, gADRZ), against time overlaid with the laboratory's own sensor measurement against the three ADR units measurement.

APPENDIX F

SLED TESTS

One sled test with three ADR units shall be performed.

F1. Crash Pulse and Devices Installation

Minimum specification:

- (i) peak deceleration 40G MIN;
- (ii) impact speed 15m/s MIN;
- (iii) three ADR units hard-mounted on the sled such that:
 - a. ADR unit n°1 X = sled X;
 - b. ADR unit n°2 Y = sled X;
 - c. ADR unit n°3 Z = sled X.

F2. Lab instrumentation

The data channel shall have a frequency class equal to 60 (i.e. "CFC60" as per ISO standard 6487-2015 and SAE J211).

The sensor used by the laboratory must be hard-mounted to the same surface and as close as possible to the three ADR units that are being tested.

F3. Minimum documentation to be provided:

- (i) raw (unfiltered) numerical data from laboratory sensor and the ADR units in ASCII or Excel format;
- (ii) for each of the sled X, Y and Z axes, two graphs of acceleration (CFC60) and deltaV against time showing the overlay of the laboratory's sensor measurements against the three ADR units measurements;
- (iii) written evidence, from the test facility, that the test is successful.

LISTE DES MODIFICATIONS
LIST OF MODIFICATIONS

Nouveau texte : **ainsi**
Texte supprimé : ~~ainsi~~
Commentaires : *ainsi*

New text: **thus**
Deleted text: ~~thus~~
Comments: *thus*

Date	Modifications	Modifications
05.12.2018	<i>Première version – anglais uniquement</i>	<i>First version – English only</i>