

LISTE DES DEBITMETRES D'ESSENCE EMBARQUES HOMOLOGUES*
PAR LA FIA
LIST OF ON BOARD FUEL FLOW METERS HOMOLOGATED* BY THE
FIA

LISTE TECHNIQUE N° 45 / TECHNICAL LIST N° 45

Numéro d'Homologation <i>Homologation Number</i>	Fabricant <i>Manufacturer</i>	Modèle <i>Model</i>
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***CONDITIONS DE DELIVRANCE D'UNE HOMOLOGATION**

La délivrance d'une homologation par la FIA atteste que le débitmètre homologué est conforme aux Spécifications techniques de la FIA. La FIA n'exerce aucun contrôle sur le processus de fabrication du débitmètre. La responsabilité de la FIA se limite à la seule délivrance de l'homologation au titre des Spécifications techniques de la FIA et ne pourra jamais être engagée en relation avec le débitmètre et/ ou ses conditions de fabrication et/ ou le respect de toute exigence de sécurité applicable.

*** CONDITIONS OF ISSUE OF THE HOMOLOGATION**

The grant of a homologation by the FIA attests that the homologated flow meter meets the Technical Specifications of the FIA. The FIA does not have any control over the manufacturing process of the flow meter. The FIA's liability is limited solely to issuing the homologation as per the FIA Technical Specifications, and cannot be engaged in relation with the flow meter and/or its manufacturing conditions and /or compliance with any applicable safety requirement.

**SPECIFICATIONS REQUISES
POUR LE DEBITMETRE D'ESSENCE EMBARQUE
REQUIRED SPECIFICATIONS
FOR THE ON BOARD FUEL FLOW METER**

1 Introduction

1.1 Scope

This specification defines the requirements for the fuel flow meter.

The sensor will be used in the Formula 1 and LMP1 WEC race series (World Endurance Championship).

2 System Overview

2.1 Measurement Description

The device to measure fluid velocity, fluid direction, temperature.

The device to compute volumetric flow rate, cumulative volumetric flow, cumulative mass flow and mass flow rate. Mass flow can be determined from a calculated density-temperature equation/lookup table

2.2 Environment Description

The flow sensor to operate in the fuel line of a combustion based engine.

2.3 Atmospheric Environment

The sensor may be operating in one of two environments:

The sensor to operate submerged in the fuel cell of a Formula 1 vehicle (2 bar maximum fuel cell pressure)

The sensor to operate surrounded by ambient air in a vented to atmosphere chassis pocket on a LMP1 (WEC) car.

2.4 External End-user Instruments

The device will typically be one instrument of several on the CAN bus. The data output from the sensor will be recorded by the FIA data logger over the CAN bus.

At the discretion of the regulatory body the teams will also have access to CAN bus data.

The acquisition system will be the FIA data logger.

The device shall have the ability to exchange its measurement data via CAN.

2.5 Power Source

System power for the device to be low voltage DC, provided typically from the data logger or power distribution module. Alternatively a battery pack could be used.

3 General Design Requirements

3.1 Reliability and Service Life

3.1.1 Operation Time

The device shall run up to 30 hours continuous without need for cleaning/power cycling

3.1.2 Lifetime between reconditioning

The device shall achieve 100 hours of running and still be within performance specification



3.1.3 Lifetime

The device shall perform 400 hours of service before its end of life

3.2 Safety Requirements

The device shall be of non-ferrous construction

The device shall not contaminate the fuel line with particulate
The device shall not contain materials that contaminate the fuel
4 Physical Requirements
4.1 General
The device shall have a volume of less than or equal to 500 cm ³
The device shall weigh less than or equal to 400grams
The device shall be fitted with std -6AN male fluid couplings
4.2 Identification
The following identifications shall be visible as a minimum:
Sensor manufacturer Logo
Unit Serial Number
Sensor Reference
Sensor Part Number
The sensor must offer a suitable place for an FIA sticker (25x25mm with 1mm radius)
4.3 Tamper Proofing
The device shall be protected by anti-tamper seals suitable for in fuel operation.
4.4 External Connections
The device shall use a fuel proof electrical connector
5 Functional Requirements
5.1 Sensing
5.1.1 General Performance
The device shall measure between a range of +/- 0-8000ml/min
The repeatability from one measurement to another under steady state conditions shall be no greater than +/- 0.25% uncertainty.
The device shall have an accuracy of no less than -1/+0% for post filtered instantaneous flow measurement (<0 mean that the sensor reads lower than reality)
The device shall allow up to 2 kHz measurement rate
The device measurement shall be repeatable from one sensor to the next to +/- 0.25% independent of sensor life.
The device shall operate within it's performance specification independent of flow direction.
The device shall operate within it's performance specification regardless of mounting orientation.
The device shall measure cumulative total flow to an accuracy of -1.0/+0% (<0 mean that the sensor reads lower than reality)
The device shall be capable of applying a 4th order low pass Butterworth with configurable -3 dB cut-off frequencies to instantaneous flow measurement for CAN transfer
The device shall be capable of making mass flow conversions based upon a temperature density equation or look up table.
The device shall be within performance specification when undergoing measurement of any of the fuels stated within section 5.71 over the specified fuel temperature range.
The device shall be able to power up and begin full functionality regardless of startup temperature and flow condition in under 3 seconds.
The device shall be able to recover automatically and without action from an incorrect fluid composition (Air bubbles for example).
When unable to read flow the device must store the last correct data and count no flow until it is able to measure flow again.
On powerup the device shall restore Cumulative volume flow (Stored in the device at a rate of 1Hz)
On powerup the device shall restore Cumulative mass flow (Stored in the device at a rate of 1Hz)
On powerup the device shall restore Max and Min Fuel Temps (Maximums & minimums only written when exceeded and then at a max rate of 1 Hz)

On powerup the device shall restore Max and Min PCB Temps (Maximums & minimums only written when exceeded and then at a max rate of 1 Hz)
On powerup the device shall restore Max and Min Accelerometer values x,y,z axis (Maximums & minimums only written when exceeded and then at a max rate of 1 Hz)
On powerup the device shall restore Max and Min Speed of Sound values [m/s] (Maximums & minimums only written when exceeded and then at a max rate of 1 Hz)
On powerup the device shall restore Max and Min Input Voltage (Maximums & minimums only written when exceeded and then at a max rate of 1 Hz)
On powerup the device shall restore Total Life Run Time [Mins:Secs] (Stored in the device at a rate of 1Hz)
On powerup the device shall restore Max and Min Signal to Noise (Maximums & minimums only written when exceeded and then at a max rate of 1 Hz)
5.1.2 Temperature Measurement
The device shall produce two fuel temperature measurements from two separately immersed temperature sensors that are accurate to within 0.15°C between 0°C and +110°C without factory calibration. The fuel information used for the density calculation shall be the average of the two measurements and it shall switch to one of the two when one is declared faulty. The device shall display the fuel temperature measurement status.
The fuel temperature measurements shall have a response time of T95% of 4seconds
The device shall produce a PCB temperature data output that is accurate to within 0.5°C between 0°C and +85°C without factory calibration.
5.2 Calibration
The device shall be able to be calibrated on top of the factory calibration.
The following maps must be programmable via CAN:
Informations related to density calculation
Complete calibration map f(Temperature/flow)
5.2 CAN
The device should communicate by CAN in accordance with the following CAN specification:
<div style="display: flex; justify-content: space-around; align-items: center;"> <div style="text-align: center;">  <p>Fuel Flow Sensor CAN FIA</p> </div> <div style="text-align: center;">  <p>Fuel_Flow_Sensor_C AN_Message_FIA</p> </div> </div>
CAN communications shall meet ISO 11898-2 (High Speed Applications)
5.3 Encryption
The device shall not allow unauthorised access to firmware and memory locations over RS-485 or CAN.
5.4 Electrical Requirements
5.4.1 Power Supply
A Minimum Supply Voltage of 4.5VMin shall apply
A Maximum Supply Voltage of 22VMax shall apply
A Nominal Supply of 12VNom shall apply.
Overvoltage (Non-destructive) of 30VTransientClamp shall apply.
Maximum Continuous Reverse Supply (Non-destructive) of -30VRevMax shall apply.
The supply current shall be less than or equal to 100mA from 12-17VDC
The supply current shall be less than or equal to 180mA from 4.5-5.5VDC
The devices power supply circuitry shall be protected from reverse polarity
The devices power supply circuitry shall be protected from ground and battery short circuits
5.5 Electromagnetic Compatibility
5.5.1 Immunity Requirements
The device shall meet EMC Immunity SAE J1113/2 1996

5.6 Environmental Requirements
5.6.1 Fluid Compatibility
The sensor shall be compatible with the following fuels:
Gasoline/Petroleum including Unleaded Formula One Fuel (as defined in the F1 FIA Technical Regulations)
Ethanol E10,E20,E50,E85R,E100
Methanol & all gasoline/methanol blends
Butanol(n-Butanol)& all gasoline/butanol blends
Avgas,JP4,JP5
Diesel
Biodiesel
Avgas 100LL
LPG Propane/Butane
5.6.2 Temperature
5.6.2.1 Fluid Temperature
The device must operate with a maximum fuel temperature of 110°C
The device must operate with a minimum fuel temperature of 0°C
5.6.2.2 Unit Operating Temperature
The device must operate with a maximum PCB temperature of 85°C
The device must operate with a minimum PCB temperature of 0°C
5.6.2.3 Storage Temperature
The device must not be adversely affected by a storage temperature minimum of -40°C
The device must not be adversely affected by a storage temperature maximum of 85°C
5.6.3 Pressure
The pressure drop of the device shall be no greater than 1000 mbar @ 6000ml/min in a 3mm ² /s viscosity fluid at 40degC
The device must be burst resistant to 60bar
The device shall operate with a liquid pressure of up to 20 bar.
5.6.4 Vibration
Vibrations should not affect measurement precision of the sensor.
5.6.5 Sealing
The device must be fully sealed to IP68
6 Glossary/Nomenclature
6.1 Nomenclature
F1- Formula One World Championship
WEC- World Endurance Championship (Sport Cars)
DOORS- Dynamic Object Oriented Rationale System. It is an IBM requirement management tool.
FIA- (Fédération Internationale de l'Automobile)
FIA F1 Logger Spec- FIA SDR (Surveillance Data Recorder)
LMP1- Le Mans Prototype class 1