DECISION OF THE ENDURANCE COMMITTEE

To:	☒ Teams	☒ Manufacturers		
Category:	☒ LM P1	☐ LM P2	☐ LM GTE Pro	☐ LM GTE Am
Decision N°:	**17-D0030- Fluidic Switches and ERS Cooling**			
Date:	**06/06/2017**			
Re:	**Clarification on Fluidic Switches and ERS cooling**			

Mission concerned

Article: Article 3

☒ *2017 Technical Regulations for LMP1 Prototype Hybrid*

☒ *2017 Technical Regulations for Non Hybrid LMP1 Prototype*

Decision

Please find below two requests and the answers of the Endurance Committee.

- **Fluidic Switches**
- **ERS cooling**

ENDURANCE COMMITTEE REQUEST FORM

REQUEST NUMBER (to be completed by the Committee)	15-R0010-LMP1

This form must be sent by e-mail to: comite.endurance@fia.com

Applicant

☐ Team ☒ Manufacturer

Manufacturer or Competitor (licence name):	Audi AG
First name & name of the applicant:	Peter Ocker
Title of the applicant (position/function):	Audi Sport – Regulation
Email address of the applicant:	peter.ocker@audi.de
Date of the request:	26/02/2015

Car categories and/or groups

LM P1 ☒ LM P2 ☐ LM GTE Pro ☐ LM GTE Am ☐

Model of the car concerned by the application

Audi R18 e-tron quattro 2015 and successor(s)

Homologation number *(if applicable)*

Not applicable yet

Purpose of the request

Use of fluidic switches in 2015 and future cars

Regulations concerned

Year: 2015+

☐ *FIA World Endurance Championship Sporting Regulations*
☒ *Technical Regulations for Prototypes LMP1*
☐ *Technical Regulations for Prototypes LMP2*
☐ *Technical Regulations for Le Mans Grand Touring Cars - LM GTE Pro & LM GTE Am*
☐ *Other: ……………………………………………………….*

Article:

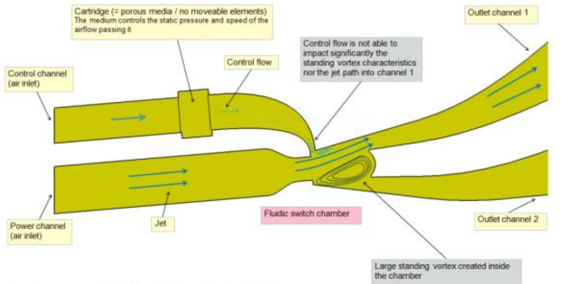
Art. 3 Bodywork and Dimensions
plus all other content of the Technical regulations that could be influenced by such a system

Description of the technical item that is the subject of the request *(skip if not applicable)*

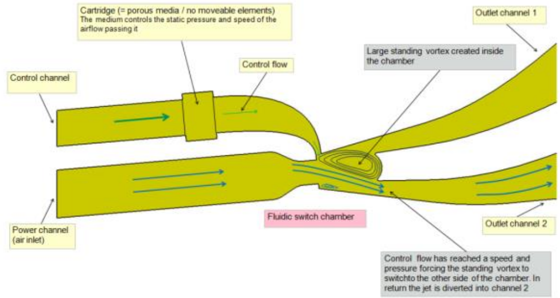
We are considering the development of aerodynamic systems utilizing the "fluidics" and/or "microfluidics" theory. The system would be passive at all times, i.e. is not controlled directly by the driver or connected actively to any car system. Only the static pressure variations induced by the variation of the car speed would activate the system.

Main target of the concept would be to try to improve the aerodynamic performances (reduce drag, increase downforce) of dedicated elements such as the rear wing, the front wing, the floor , the diffuser and/or any other bodywork element
The potential of such concept is proven and would offer substantial benefits.
The key is to have a so-called passive "fluidic switch" that can divert the flow in one or another channel depending on the surrounding boundary conditions , i.e. car speed, air pressure. No moveable part would be involved in the activation of the system.
The scheme below shows the logic of such a switch. No part of the system moves.Obviously this is an example to explain the principle. In reality the layout might differ from car to car.
The system has basically 2 states:

1) Under a given speed the flow entering the main inlet goes into the channel 1



2) Above a given speed the flow is diverted into channel 2
This happens thanks to the control channel that will be able to influence the separation (dead water zone) effectively "closing" one or the other outlet channels



In reality some further channels might be needed downstream to best control some dynamic effects (hysteresis) happening when the air going through channel 1 or channel 2 significantly modifies the aerodynamic behavior of an element (typically a biplane) sitting at the end of these outlet channels. But this complication of the final layout (see family 1 & 2 in the next pages) does not change anything to the principle shown here.

As examples, but not limited to, we would like to know if any of the schematic layouts presented below would be considered acceptable for the FIA-ACO.
The layouts shown are concentrating on impacting the rear wing assembly behavior However the idea could be applied as well for the front wing- and/or front diffuser- assemblies. It would simply means a different internal routing of the various ducts.

In other terms: if one of the concept listed below is declared not acceptable, we would consider it similarly not acceptable also if applied to the front wing and/or front diffuser- assemblies. Even if in the later case the geometric details could differ slightly from the schemes presented here.

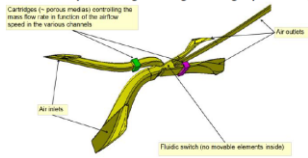
Illustration of the request *(skip if not applicable)*

On the following pages, you will find 2 different families with examples:

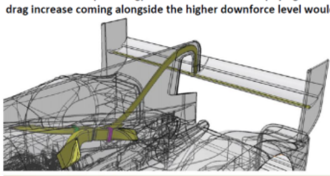
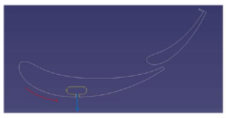
Family 1: central fluidic switch with 2 examples

Family 2: outboard fluidic switch with 6 examples

Family 1: central fluidic switch
Here the passive fluidic switch would be embedded below the top engine cover. One of the internal ducts would run through the rear wing vertical support and bring some airflow to the rear wing first profile when active.
The remaining installation is a typical passive fluidic switch layout. With various inlets, porous medias to control the static pressure in the various ducts and one or several fluidic switches.
This layout is schematic and would obviously from design to design look slightly differently.



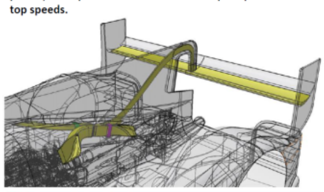
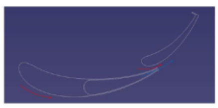
- **Design a)**
Aim: stall the RW above a given speed to substantially increase the top speed. This would be achieved by blowing some air on the suction side to harm the wing behavior. By doing so this would allow to run significant more downforce (and drag) where needed without paying the top speed penalty at higher speed where the drag increase coming alongside the higher downforce level would matter.

LHS picture: general schematic layout

RHS picture: y section showing typical arrangement of internal ducting in the rear wing mainplane. When active one blows almost perpendicular through a small slot (blue arrow) on the mainplane suction side to harm the normal behaviour

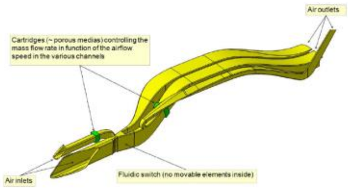
- **Design b)**
Aim: improve and/or reattach the flow on the RW below a given speed. Here one would on purpose design a rear wing that shows poor performance (or is even stalled) when the system is not active. This would simply mean that the system compared to Design a) needs to be active under a given speed to ensure that downforce (and drag) is available where needed. Above that speed the system would not blow any energy through the profile, the biplane in return would have poor performances coming alongside a low drag level favoring higher top speeds.

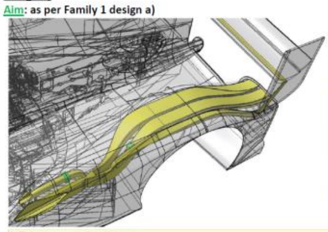
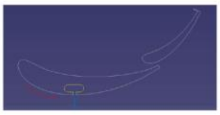
LHS picture: general schematic layout

RHS picture: y section showing typical arrangement of internal ducting in the rear wing mainplane. When active one blows almost tangentially to the mainplane suction side (blue arrow) through a slot on the trailing edge. This in order to reattach the flow and/or improve the overall performance of the mainplane.

Family 2: outboard fluidic switch
Here the passive fluidic switch would be embedded in the wheel arch. One of the internal ducts would run through the rear wing endplate and bring some airflow to the rear wing and/or exit below the rear wing elements (depending on the layout) when active.
The remaining installation is a typical passive fluidic switch layout. With various inlets, porous medias to control the static pressure in the various ducts and one or several fluidic switches.
This layout is schematic and would obviously from design to design look slightly differently.



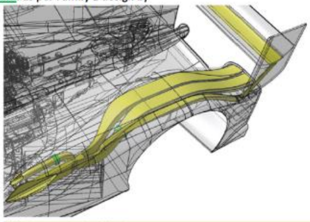
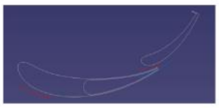
- **Design a)**
  Aim: as per Family 1 design a)

LHS picture: general schematic layout

RHS picture: y section showing typical arrangement of internal ducting in the rear wing mainplane. When active one blows almost perpendicular through a small slot (blue arrow) on the mainplane suction side to harm the normal behaviour

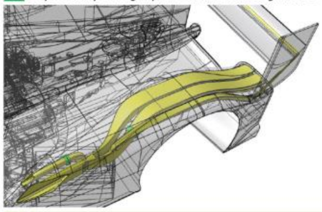
- **Design b)**
  Aim: as per Family 1 design b)

LHS picture: general schematic layout

RHS picture: y section showing typical arrangement of internal ducting in the rear wing mainplane. When active one blows almost tangentially to the mainplane suction side (blue arrow) through a slot on the trailing edge. This in order to reattach the flow and/or improve the overall performance of the mainplane.

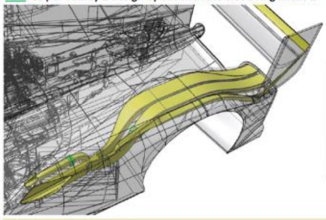
- **Design c)**
  Aim: as per Family 1 design a) but with the slot being in the 2[nd] profile, i.e. in the flap




LHS picture: general schematic layout

RHS picture: y section showing typical arrangement of internal ducting in the rear wing flap. When active one blows almost perpendicular through a small slot (blue arrow) on the flap suction side to harm the normal behaviour

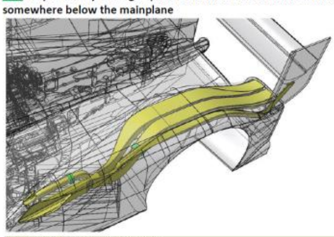
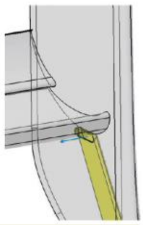
- **Design d)**
  Aim: as per Family 1 design b) but with the slot being in the 2[nd] profile, i.e. in the flap




LHS picture: general schematic layout

RHS picture: y section showing typical arrangement of internal ducting in the rear wing flap. When active one blows almost tangentially to the flap suction side (blue arrow) through a slot on the trailing edge. This in order to reattach the flow and/or improve the overall performance of the biplane.

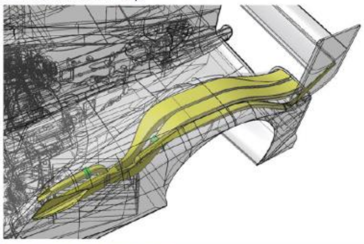
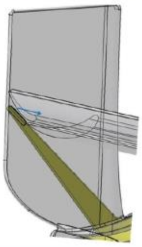
- **Design e)**
  Aim: as per Family 1 design a) but with the internal channel running through the endplate ending up somewhere below the mainplane

LHS picture: general schematic layout

RHS picture: y section showing typical arrangement of internal ducting in the endplate. When active one blows almost perpendicular to the general airflow through a small aperture (blue arrow) on the mainplane suction side to harm the normal behaviour

- **Design f)**
  Aim: as per Family 1 design a) but with the internal channel running through the endplate ending up somewhere below the flap

LHS picture: general schematic layout

RHS picture: y section showing typical arrangement of internal ducting in the endplate. When active one blows almost perpendicular to the general airflow through a small aperture (blue arrow) on the flap suction side to harm the normal behaviour

Reference / Mission concerned (to be completed by the Committee)

Article: 2.4.2

- ☐ *2015 FIA World Endurance Championship Sporting Regulations*
- ☒ *2015 Technical Regulations for Prototypes LMP1*
- ☐ *2015 Technical Regulations for Prototypes LMP2*
- ☐ *2015 Technical Regulations for Le Mans Grand Touring Cars - LM GTE Pro & LM GTE Am*
- ☐ *Internal Regulations of the FIA Endurance Commission*

Decision of the Endurance Committee (to be completed by the Committee)

Accepted	☐	../.../2015	
Suspended	☐	../.../2015	
Refused	☒	03/03/2015	Please see our comment below
Accepted with conditions	☐	../.../2015	
		Condition(s) fulfilled on:	

Comments:
We intend to send this request to the other LMP1 manufacturers as a matter of clarification as they are also potentially concerned by this decision.

Period of validity/application of the decision

This decision comes into effect:

- ☒ with immediate application
- ☐ from:
- ☐ from the following event :

And is applicable:

- ☒ until further notice
- ☐ for the above-mentioned event(s) only

The Endurance Committee

Denis CHEVRIER   Vincent BEAUMESNIL

Any decision taken by the Endurance Committee is not subject to appeal.

ENDURANCE COMMITTEE REQUEST FORM

REQUEST NUMBER (to be completed by the Committee)	17-R0006-LMP1

This form must be sent by e-mail to: comite.endurance@fia.com

Applicant

☐ Team ☒ Manufacturer

Manufacturer or Competitor (licence name):	Porsche Motorsport LMP Team
First name & name of the applicant:	Ivan Botti
Title of the applicant (position/function):	Manager Vehicle Engineering Support LMP1
Email address of the applicant:	Ivan.botti@porsche.de
Date of the request:	28/03/2017

Car categories and/or groups

LM P1 ☒ LM P2 ☐ LM GTE Pro ☐ LM GTE Am ☐

Model of the car concerned by the application

Porsche 919 Hybrid LMP1 MY2017

Homologation number *(if applicable)*

Purpose of the request

We are currently planning to optimize the use of the ERS cooling flow / ERS fan for the 2017 season compared to previous years. Before going into the 2017 we are seeking clarification if the following applications are allowed for ERS cooling from race 01 in Silverstone onwards.

Regulations concerned

Year :

- ☐ *FIA World Endurance Championship Sporting Regulations*
- ☒ *Technical Regulations for Prototypes LMP1 Hybrid*
- ☐ *Technical Regulations for Prototypes LMP1 Non Hybrid*
- ☐ *Technical Regulations for Prototypes LMP2 homologated in 2017*
- ☐ *Technical Regulations for Prototypes LMP2 homologated before 2017*
- ☐ *Technical Regulations for "Le Mans" Grand Touring Cars - LM GTE homologated since 2016*
- ☐ *Technical Regulations for "Le Mans" Grand Touring Cars - LM GTE homologated before 2016*
- ☐ *Other : ……………………………………………………………*

Article:
Article: Art 3.4. – Art.17.8.12

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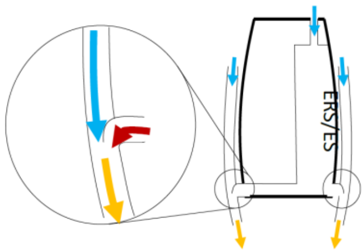
Description of the technical item that is the subject of the request *(skip if not applicable)*

- Current regulations permit a fan for ES/ERS cooling purposes.
- The fan power, inlet and outlet ducts positioning are not specified in the regulations.
- As a consequence we ask for clarification if the following is allowed in order to improve the overall effect of the ERS fan:

1. Positioning of the fan inlet behind the front wing on the "front wing flow expansion" volume.
2. Positioning of the fan outlet near the diffuser side wall.
3. Positioning of the fan outlet "below" the floor or blowing on it.
4. The use of layouts where the cooling airflow is bypassing the ES/ERS (see RHS picture below).
5. A powerful ERS fan with power consumption of more than 150 Watt.
6. Active control of the fan by the drivers and / or electronics to adjust the speed of the fan.

Illustration of the request *(skip if not applicable)*



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Reference / Mission concerned (to be completed by the Committee)

Article: …………………

- ☐ *2017 FIA World Endurance Championship Sporting Regulations*
- ☒ *2017 Technical Regulations for Prototypes LMP1 Hybrid*
- ☐ *2017 Technical Regulations for Prototypes LMP1 Non Hybrid*
- ☐ *2017 Technical Regulations for Prototypes LMP2 for cars homologated in 2017*
- ☐ *2017 Technical Regulations for Prototypes LMP2 for cars homologated before 2017*
- ☐ *2017 Technical Regulations for "Le Mans" Grand Touring Cars LM GTE for cars homologated since 2016*
- ☐ *2017 Technical Regulations for "Le Mans" Grand Touring Cars LM GTE for cars homologated before 2016*
- ☐ *Internal Regulations of the FIA Endurance Commission*

Decision of the Endurance Committee (to be completed by the Committee)

Accepted	☐	../…/2017	
	☐	../…/2017	must provide an EVO form
Suspended	☐	../…/2017	
Refused	☒	04/04/2017	
Accepted with conditions	☐	../…/2017	
		Condition(s) fulfilled on:	

Comments :
Date : 04/04/2017

As a general principle, the described functions are reflecting a possible abusive use of fan which would act as a movable aerodynamic element.

Period of validity/application of the decision

This decision comes into effect:

- ☒ with immediate application
- ☐ from:
- ☐ from the following event :

And is applicable:

- ☐ until further notice
- ☒ for the above-mentioned event(s) only

The Endurance Committee

Denis CHEVRIER Vincent BEAUMESNIL

Any decision taken by the Endurance Committee is not subject to appeal.

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Period of validity/application of the decision

This decision comes into effect:

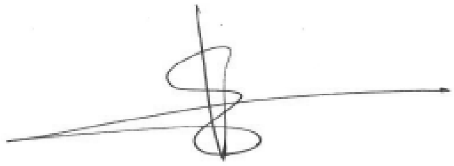
☒ with immediate application
☐ from:
☐ from the following event :

And is applicable:

☒ until further notice
☐ for the above-mentioned event(s) only

Committee Members

Denis CHEVRIER



Vincent BEAUMESNIL

Any decision taken by the Endurance Committee is not subject to appeal, in accordance with Article 4.11.2 b of the WEC Sporting Regulations.

This decision is available on the following websites:

- http://www.fia.com/fia-endurance-committee
- http://sport.lemans.org/login.php