Submitted by the experts from
Sweden and Japan

Informal document **GRRF-78-43**
78th GRRF, 16-19 September 2014
Agenda item 9(b)

Amendment proposals to UN R79 to introduce the requirements of Lane Keeping Assistance System

Presentation in conjunction with **GRRF-78-05**

The purpose of prescribing the requirements of LKAS in the UN regulation

- As LKAS is still a premature system and now on the developing stage, it is too early to regulate the specific value and the performance requirement in general.
- However, some requirement to be introduced were found;
- These requirements are necessary to maintain the road safety avoiding the confusion of traffic and the adverse impact to drivers and other road users even if LKAS is voluntarily equipped.
- They are not covered or not clearly prescribed by current R79 including Annex CEL.

The candidate items for the provisions of LKAS

1)The definition of LKAS, scope and the technical requirements (16 items) based on ISO, Japanese guideline and UN R130 (LDWS) etc. were proposed as candidate items on the LKAS Ad-hoc meeting in the last November .

2)Each item was reviewed whether it was covered by the current UN R79 or not and several items to be prescribed were found. And we concluded that the amendment of the current R79 was suitable because LKAS is one kind of Corrective Steering Function defined in R79.

3)The result of Ad-hoc meeting was reported in 76th GRRF. Sweden and Japan expressed that they would submit the informal document of the requirements of LKAS as the amendment of UN R79 in 78th GRRF through the discussion of Small Drafting Group(SDG).

4) SDG meeting was held on 26th and 27th of May in Paris participated by EC, Germany, Netherlands, Sweden, Japan, OICA and CLEPA.

Several items were selected and discussed from the candidate items in order to maintain the road safety with taking the care of avoiding the unnecessary design restriction. At the end, the amendment proposal of R79 was agreed by SDG.

(Reference)

The candidate Items studied as the technical requirements

- Operating speed
- Acceleration etc. caused by the operation of the system
- Road shape
- Lane marking
- LKAS performance (quantity of lane departure)
- Functional limitation of the system (notifying the driver if the system cannot operate)
- The end of the system operation (to avoid confusion of the driver caused by finishing the system control suddenly)
- Holding the steering wheel (Warning the driver when the system detects driver's hands off)

- Override (Steering operation by the driver is prior to the system operation)
- Condition of non-operational being allowed (in case of detecting driver's intention of a lane change)
- ON/OFF means (selectable by the driver)
- Malfunction warning to the driver
- Information to the driver (notification of functions and how to use the system)
- Failsafe (in case of a system malfunction, stopping the function safely and notifying the driver)
- Safety aspects of complex electronic control systems
- EMC (UN R10)

(Reference)

Examples of the items <u>not adopted</u> as proposal

Items	Reasons not to adopt as proposal				
	LKAS is still premature and to be introduced as if-fitted-requirement.	No safety risk without this requirement	Importance to inform the operation status of the system	Basic function is prescribed in the definition of LKAS.	Covered by the current R79
Operating speed	✔	✔			
Road shape	✔	✔			
Lane marking	✔		✔		
LKAS performance	✔			✔	
Malfunction warning					✔

Agreed items of LKAS SDG

(26th and 27th of May in 2014 at CCFA)

1)The definition of LKAS

"by influencing the lateral movement of the vehicle" is to distinguish LKAS from LDWS.

2)Suppressing an excessive intervention of steering control and smoothly fading out the intervention

The maximum limitation of the steering control effort necessary to counteract an intervention is prescribed (The value is quoted from the current R79 6.2.4.2. for a normally operating intact system)

3) Notifying the driver if the system cannot operate due to functional limitation

For example, inclement weather condition.

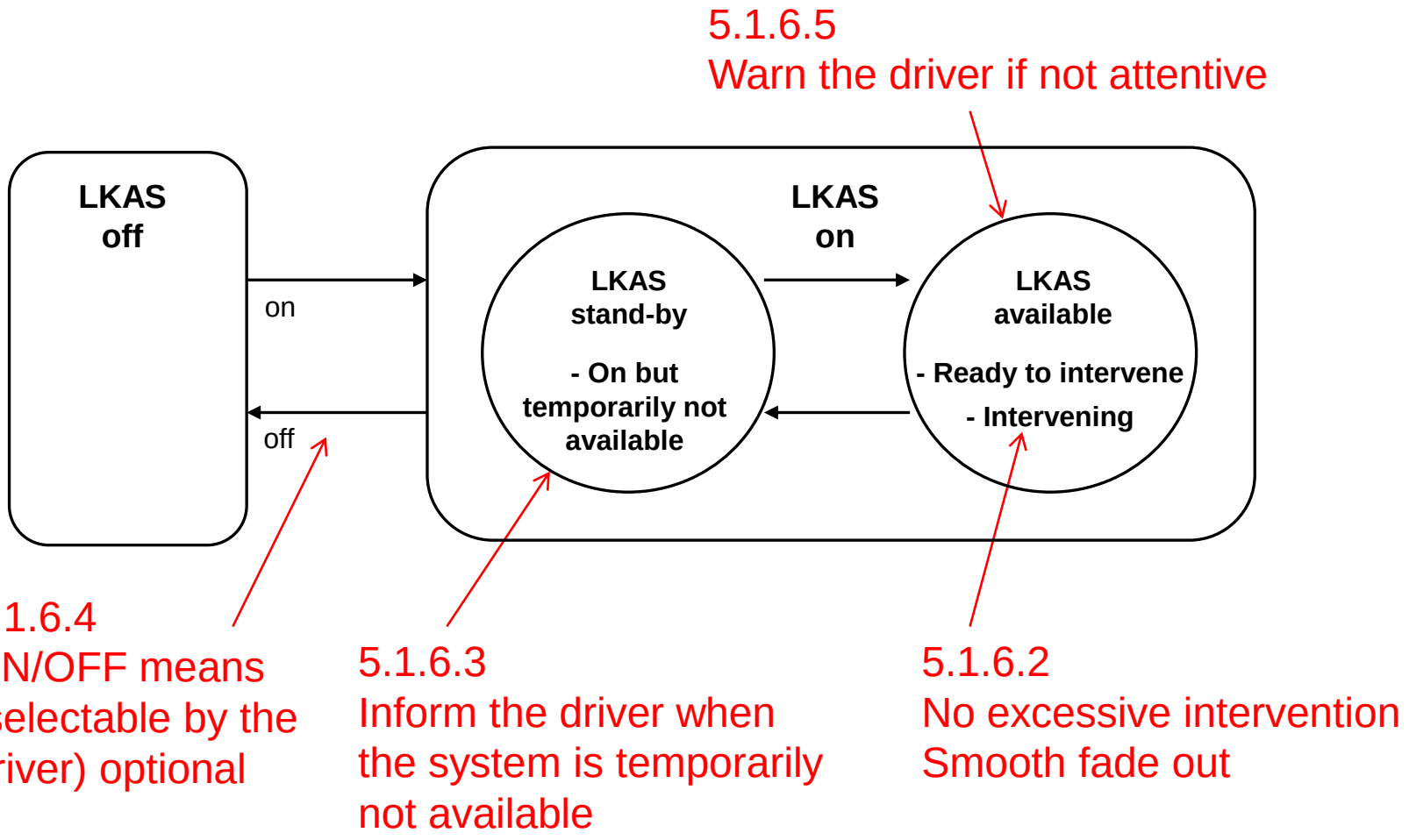
4)ON/OFF means (selectable by the driver)

ON/OFF means is optional, but the requirement is prescribed for clarification.

5)Warning the driver when the system detects inattention of the driver

If the system detects inattention of the driver e.g. by sensing driver's hands off from the steering wheel, the system shall give an effective warning to call driver's attention.

Provisions and LKAS functional modes



LKAS Requirements (Proposed by LKAS SDG).

Insert a new paragraph 2.3.4.2.1, to read:

2.3.4.2.1. "Lane Keeping Assistance System" means a system which assists the driver in keeping the vehicle within the chosen lane, by influencing the lateral movement of the vehicle.

Insert a new paragraphs 5.1.6.2. - 5.1.6.5., to read:

5.1.6.2. Lane Keeping Assistance System shall be designed so that excessive intervention of steering control (e.g. an excessive steering torque) is suppressed to assure the steering operability by the driver and to avoid unexpected vehicle behavior, during its operation. In addition, it shall be designed such that in its non-fault condition any intervention shall fade out smoothly. The steering control effort necessary to counteract an intervention shall not exceed the specified value in paragraph 6.2.4.2. for a normally operating intact system.

5.1.6.3. When the Lane Keeping Assistance System is temporarily not available, for example due to inclement weather conditions, the system shall clearly inform the driver about the system status, except if the system is in the OFF mode, e.g. switched off. This exception does not affect the required warning in the case of a system malfunction.

5.1.6.4. **The vehicle may be equipped with a means for the driver to activate or deactivate the Lane Keeping Assistance System.**

5.1.6.5. **[The system shall have at least 1 type of means to detect driver attention e.g. by sensing the driver's hands on the steering wheel. When the system detects inattention of the driver, it shall give an effective warning [, which shall be at least two means out of optical, acoustic and appropriate haptic,] to call the driver's attention.]**

（Appendix）

Outline of LKAS requirements

The following items were selected based on the ISO, the Japanese guide line and UN R130 (LDWS) etc..

Items	Purpose	References				
		Japanese technical guideline	ISO	LDWS regulation	ITS guideline High-priority Warning Signals	ITS guideline Design Principles for Control Systems of ADAS
1. Definition	Clarification of LKAS function	1.	Introduction			
2. Scope	Clarification of the vehicle categories	1.	1.	1.		
3. Operational requirements						
A. Requirements for activation						
Operating speed	In order to operate LKAS primarily on an highway where the environments such as lane marking are maintained.	3.(1)	5.1	5.2.3.		
Acceleration etc. caused by the operation of the system	In order to prevent a rollover or unstable vehicle behavior caused by rapid steering control. In case of the system preventing lane departure by operating braking, it is necessary to prescribe the requirement concerning speed reduction and deceleration to avoid negative effect to the following vehicles.	3.(3) 4.(2)	5.4			
Road shape	It is assumed that LKAS operates primarily on expressways.		Annex A	5.2.1.		
Lane marking	In order to guarantee proper operation of LKAS to lane marking in each country.		Annex B	Annex 3		
LKAS performance requirement	The minimum requirement for prevention of lane departure accidents		6.5.2.			

Items	Purpose	References				
		Japanese technical guideline	ISO	LDWS regulation	ITS guideline High-priority Warning Signals	ITS guideline Design Principles for Control Systems of ADAS
3. Operational requirements						
B. Requirements for deactivation						
Functional limitation of the system	In order to notify the driver that LKAS becomes not operational, and in order to let the driver operate steering appropriately.	6.(1)			3.8	4.3
Requirement for the end of the system operation	If the control of LKAS is finished suddenly, the driver might be cunfused. Therefore it is necessary that the control level of LKAS is lowered gradually at the end of the control.	3.(6)	5.4			
C. Requirements relevant to driver						
Holding a steering wheel by the driver	In order to make the driver understand that LKAS is not the autonomous steering. And in order to prevent overreliance to LKAS.	3.(2)	1.			4.4
Override	It is necessary for the driver to fulfill his/her responsibility of safety driving. Due to following Vienna Convention.	4.(1)	5.2.1			4.1
Condition of non-operational being allowed	In order to clarify that LKAS operation may be suppressed if it detects driver's intention of a lane change.		5.2.1	5.2.1.2.		

Items	Purpose	References				
		Japanese technical guideline	ISO	LDWS regulation	ITS guideline High-priority Warning Signals	ITS guideline Design Principles for Control Systems of ADAS
3. Operational requirements						
D. Information for driver						
ON/OFF switch	In order to clarify that the ON/OFF status of LKAS is decided by driver's intention.	3.(5)	5.2.1	5.3.		4.2
Malfunction warning /Status display	In order to indicate the system status to the driver correctly. However, it is allowed to indicate it to the driver by optical means only because it is not an emergency situation.	5	5.2.2	5.3.2. 5.4.2. 5.4.3. 5.4.4. 5.4.5.		4.3
Information to be known to users (P)	In order to make the driver understand the function and usage of LKAS correctly. It is one of the measures for prevention of over reliance.	8				
E. The other requirements						
Failsafe	In order to indicate malfunctions to the driver, and to stop the device safely same as the other electronic devices.	7	5.5			
Conformity with the safety aspects of complex electronic control systems (P)	In order to satisfy the requirement of the conformity with the safety aspects of complex electronic control systems related to LKAS.			5.1.3. Annex 4 (AEBS)		
EMC(P)	In order to prevent wrong operation caused by external electromagnetic wave etc.. And in order to prevent to affect adversely to the peripheral electronic devises.			5.1.2.		

Studied results on Candidate of LKAS requirements

Candidate of LKAS requirements

Each cell painted in this color is the first proposal at the present considered by Japan.

①Japanese Guideline
②ISO
③LDWS
④ITS Guideline
⑤Others（Japanese original idea）

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
1. Definition	1	①	LKAS is the device which are provided by motor vehicle manufacturers for the purpose of reducing the operating load of the driver when he attempts to keep his motor vehicle within the lane.	To align with the definition of Japanese Guideline.	Debate on whether LKAS definition is covered by R79. The Introduction namely cites LKAS, hence it is believed covering LKAS. Conclusion: keep the definitions unchanged.	(Result) Add the definition of LKAS ① Need to define LKAS in the section of definition for introducing the LKAS requirement in R79, although there is the similar explanation in Introduction section of R79.
	2	②	The main system function of a Lane Keeping Assistance System (LKAS) is to support the driver in keeping the vehicle within the current lane. LKAS acquires information on the position of the vehicle within the lane and, when required, sends commands to actuators to influence the lateral movement of the vehicle. LKAS provides status information to the driver.	To align with the definition of LKAS ISO.		
	3	⑤	LKAS is the system which detects lane marking and supports the driver to keep the vehicle within the lane. However, such systems which purpose only warning or which keep the vehicle within the lane by only braking control to the driver are out of the scope.	In order to clarify that such systems which purpose only warning or which keep the vehicle within the lane by only braking control to the driver are out of the scope.		

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
2. Scope	1	R79	M, N, O	To align with the scope of R79.	The group was content with the scope provided by R79.	(Result) No need to change
	2	③	Category 2 and 3（M2, M3, N2, N3）	To align with the scope of LDWS.		
	3	⑤	M, N	Mainly, LKAS is assumed to be installed in vehicles category M and N.		
3. Operational requirements						
A. Requirements for activation						
Operating speed	1	①	LKAS may start to operate above 50km/h. (LKAS shall not start to operate below 50km/h.)	Because LKAS is the system assumed to be operated on an expressway.	R79 does not provide speed limit for LKAS	(Result) No requirement ①To consider that LKAS will be introduced on voluntary basis and is under the developing stage. ②No safety risk without this requirement
	2	③	LKAS shall start to operate at least at vehicle speeds above 60km/h when all other operating conditions for are satisfied. (LKAS may start to operate less than 60km/h.)	To align with the requirement of LDWS.	The ad hoc group discussed whether there is need for requirement on speed limit. Conclusion: in-depth discussions to be held at a later stage	
	3	②	LKAS shall be operational between 72km/h and the maximum speed which is 108km/h or the maximum possible vehicle speed, whichever is less. (In this speed range, when all the operating conditions are satisfied, the system shall start to operate.)	To align with the requirement of LKAS ISO.		

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
3. Operational requirements						
A. Requirements for activation						
Acceleration etc. caused by the operation of the system	1	①	The lateral acceleration caused by the system operation while cornering shall not exceed 2 m/s^2. In case of the system keeping the center of the lane, the lateral acceleration caused by the system operation while straight running shall be 0.5m/s^2 or less. And also in case of the system operating near the lane marking, the lateral acceleration caused by the system operation while straight running shall be 1m/s^2 or less.	The value of lateral acceleration (2m/s^2) is the one which is occured while running on the curved road of the Japanese expressway with the speed limit (80km/h).	R79, para. 5.1.1. and 5.1.6. + CEL Annex partly cover this item, only the maximum lateral acceleration is not defined (subject to assessment from the Technical Services)	(Result) Prescribe as a general requirement ①Need to ensure the safety of the system ②To consider that LKAS is under the developing stage ③This requirement may be in common with ADASS
	2	⑤	The lateral acceleration caused by the system operation shall not exceed [xx] m/s^2.	Because if there is no limitation of the value of lateral acceleration occurred by the system operation, the driver might misunderstand that the system could go through any curved road. And also in order to prevent a rollover occurred by rapid steering operation by the system.	Conclusion: need for further discussions on this item	
	3	②	Lateral acceleration shall not exceed 3m/s^2, and lateral jerk shall not exceed 5m/s^3.	To align with the requirement of LKAS ISO.		
	4		The lane keeping action shall not cause a longitudinal deceleration larger than 3m/s^2. If the lane keeping action causes a longitudinal deceleration larger than 1.0m/s^2, this shall not cause a speed reduction more than 18km/h.	To align with the requirement of LKAS ISO.		

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
3. Operational requirements						
A. Requirements for activation						
Road shape	1	③	At least, the system shall be operational on a curved road which has the radius more than 250m. (LKAS may operate on a curved road which has the radius less than [250]m.)	To align with the requirement of LDWS.	item not covered by R79	(Result) No requirement ①To consider that LKAS will be introduced on voluntary basis and is under the developing stage. ②No safety risk without this requirement
	2	⑤	At least, the system shall be operational on a straight road which has the radius more than [1000]m. (LKAS may operate on a curved road which has the radius less than [1000]m.)	In order to be accepted such kind of LKAS which is operational on a straight road.	The ad hoc group discussed whether there is need for requirement on road shape. Conclusion: in-depth discussions on values to be held at a later stage	
	3	②	As the one of examples, The system shall be tested on a curved road which has the radius 800m.	To align with the requirement of LKAS ISO.		
Lane marking	1	③	The system shall be operational on the lane marking which is required in the LDWS regulation.	To align with the requirement of LDWS.	not covered by R79	(Result) No requirement ①To consider that LKAS will be introduced on voluntary basis and is under the developing stage ②Important to inform the driver the operation status of the system.
	2	⑤	The system shall be operational on the lane marking which is required in each countries.	The detection systems of LKAS for lane marking must be more accurate than one of LDWS.	need for further discussions.	

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
3. Operational requirements						
A. Requirements for activation						
LKAS performance requirement	1	⑤	When the LKAS is tested, the value of departure of the outside of the tire closest to the lane markings shall not exceed more than [XX]cm.	In order to prevent lane departure accidents certainly. And also in order to prevent lane departure triggered by the system operation. This requirement is prescribed in the test procedure of LKAS..	Not covered by R79	(Result) No requirement ①To consider that LKAS will be introduced on voluntary basis and is under the developing stage ②.Basic function is explained in the definition of LKAS
	2		When the LKAS is tested, the outside of the tire closest to the lane markings shall not depart from the lane marking.s.	In order to prevent lane departure accidents certainly. And also in order to prevent lane departure triggered by the system operation This requirement is prescribed in the test procedure of LKAS.		
	3	②	When the LKAS is tested, the outer edges of the tyres of the vehicle shall not exceed the lane boundary more than 0.4m for light vehicles, and 1.1m for heavy vehicles.	To align with the requirement of LKAS ISO		
	4	GRRF74-40	When the LKAS is tested, it shall start to activate at least when the outside of the tire closest to the lane markings crosses a line 0.3m beyond. (The value of departure is not specified.)	To align with the requirement of LDWS. This requirement is prescribed in the test procedure of LKAS..		

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
3. Operational requirements						
B. Requirements for deactivation						
Functional limitation of the system	1	①	An announcement shall be made through acoustic and optical means in the followiing cases. (a)The operation of the device is cancelled without the driver's intention while the device is operating. (b)There is the possibility that the device can no longer render the assist to the running of the vehicle within the lane while the device is operating.	Because an announcement might not be recognized by the driver immediately by only an optical means, plural means including an acoustic means are provided to the driver.	R79 is somehow dealing with warning, yet there is no test assessing the perf R130 covers this partially: mandates requirements if a warning is provided.	(Result) Prescribe the warning requirement ①Need to ensure safety to the driver
	2	④	An announcement shall be made through at least two means out of optical, acoustic and haptic in the above (a) and (b).	It is refered to LDWS regulation paragraph 5.4.1.. And also following "Guidelines on establishing requirements for high-priority warning signals" paragraph 3.8., and "Design Principles for Control Systems of ADAS" paragraph 4.3.		
Requirement for the end of the system operation		①, ②	When the system operation is ended, it shall not be ended suddenly but shall be faded out smoothly.	To align with the requirement of Japanese Guideline and LKAS ISO.	"Easy and safe handling in R79. Yet still subject to assessment by the technical service.	(Result) Prescribe as a general requirement ①To consider that LKAS is under the developing stage

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
3. Operational requirements						
C. Requirements relevant to driver						
Holding a steering wheel by the driver	1	①	The operation **shall be cancelled** when there is no steering operation of the driver for more than 5s.	In order to make the driver understand that LKAS is not the autonomous steering system.	R79 does not cover this item but the basic principle of discontinuous operation is covered by the definition of "corrective steering"	(Result) Prescribe the warning requirement. ①Warning requirement for "hands-off" is important.. ②This proposal permits to continue the intervention of LKAS if the warning signal is provided. ③It could be interpreted that hands off is not inhibited in WP.1/2014/1 which was adopted at 68th session of WP1 ④This requirement maybe in common with Automatically Commanded Steering for high way use.
	2	④	An announcement shall be made through at least two means out of optical, acoustic and haptic if there is no steering operation of the driver for a certain time, after that the system operation **shall be continued**.	Because to keep the safety by continuing the system operation if the driver's situation recognition is become uncertain. (Concern : Does that requirement increase driver distraction?)		
	3		An announcement shall be made through at least two means out of optical, acoustic and haptic if there is no steering operation of the driver for a certain time, after that the system operation **may be cancelled**. (equal to "may be continued")	In order to make the driver understand that LKAS is not the autonomous steering system. Because the driver might be confused if the system operation is cancelled without any announcement, .		
	4		An announcement shall be made through an optical means if there is no steering operation of the driver for a certain time, after that the system operation **shall be continued**.	In order to make the driver understand that LKAS is not the autonomous steering system. (Concern : Does that requirement increase driver distraction?)		
	5		An announcement shall be made through an optical means if there is no steering operation of the driver for a certain time, after that the system operation **shall be cancelled/may be cancelled**. (equal to "may be continued")	In order to make the driver understand that LKAS is not the automated driving system.		
	6	⑤	If there is no steering operation of the driver for a certain time, the system operation **shall be continued/may be continued**.	(Concern : Does that requirement increase driver distraction?)		

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
3. Operational requirements						
C. Requirements relevant to driver						
Override	1	①, ②, ④	Override steering operation by the driver **shall** be given priority to the system.	It is basic requirement for driving assistance. Due to following Vienna convention. Due to following "Design Principles for Control Systems of ADAS".	para. 5.1.6. covers this	(Result) Clarify the requirement of override during the system intervention as a general requirement. ①Important and necessary to introduce the more concrete requirement to ensure the safety of the driver. ②To consider that LKAS is on the developing stage and prescribe as a general requirement
	2	④	Override steering operation by the driver **may** be given priority to the system.	(Concerns : Inconsistency with Vienna convention, inconsistency with AEBS)		
	3		The system operation **shall** be given priority to steering oparation by the driver.	(Concerns : Inconsistency with Vienna convention, inconsistency with AEBS)		
Condition of non-operational being allowed	1	③	The system operation may be suppressed when there is a driver's action which indicates an intention of a lane change.	To align with the requirement of LDWS.	para 5.1.6. of R79 covers this item	(Result) No requirement ①Sufficiently covered by the paragraph 5.1.6
	2	②	Specific driver's actions, e.g. the turn signal, can be considered as a suppresion request.	To align with the requirement of LKAS ISO.		
	3	⑤	No requirement	It is considered to be icluded in the requirement of override.		

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
3. Operational requirements						
D. Information for driver						
ON/OFF switch	1	①, ④	The device may be equipped with a switch whereby at driver's intention the driver can select the status of operational/non-operational of the device.	In order to be decided the system status of operational/non-operational by driver's will. Due to following "Design Principles for Control Systems of ADAS" .	Covered by current D proposal at WP1 - REF - (Vienna Convention)	(Result) Important to require Off Switch ①WP.1/2014/1 requires to provide Off switch for keeping principle of road traffic regulations
	2	③	The device may be equipped with a means to deactivate the LKAS function, and the LKAS function shall be automatically reinstated at the status of operational of each new ignition "on" (run) cycle.	To align with the requirement of LDWS.		
	3	⑤	The device shall not be equipped with a means to deactivate the LKAS function, that means the LKAS function shall always be at the status of operational.	In order to make the safety system operate certainly.		
Malfunction warning /Status display	1	①, ③, ④	The status of the switch operational/non-operational, the status of the system operating/not operating, and the situation of system malfunctions shall be indicated to the driver through an optical means.	In order to indicate the status of the system to the driver correctly.	R79: CEL annex, para 3.4.3., 2nd part	(Result) No requirement ①Prescribed in the paragraph 3.4.3 in Annex 6(CEL)
	2	⑤	In the case of above ①, the teltail with the specific symbol for LKAS shall be used.	In order to indicate the status of the system to the driver more understadably.		
	3		In the case of above ①, the teltail with the specific color for LKAS shall be used.	In order to indicate the status of the system to the driver more understadably.		
	4	②	The teltale with the symbol referred to ISO2575 shall be used.	To align with the requirement of LKAS ISO.		
Information to be known to users		①	Necessary information shall be known appropriately to the users through the instruction manuals, caution labels and so forth.	In order to make the driver understand usage correctly. It is one of the measure for prevention of over reliance.	not covered by R79	(Result) No requirement ①Will be informed within Car Manufacturers discretion

Items	Option	Reference	Requirements	Reasons	R79 comparison	Further Consideration
3. Operational requirements						
E. The other requirements						
Failsafe	1	①	The device shall be capable of monitoring the operating conditions of the device concerned so that any malfunction may be detected. And in cases where the device should encounter any malfunction, the device shall have a function which makes it possible for the operation of the device concerned to be stopped safely.	In order to indicate malfunctions to the driver, and to stop the device safely same as the other electronic devices.	R79, CEL, para 3.4.3.	(Result) No requirement ①Prescribed in the paragraph 3.4. in Annex 6（CEL）
	2		The principal functions of the device shall be preferably of a dual system.	This item is not required in AEBS and LDWS.		
Conformity with the safety aspects of complex electronic control systems		R79 etc.	Concerning the conformity with the safety aspects of complex electronic control systems, the LKAS shall satisfy the requirement in Annex CEL (e.g. Annex 6 in R79).	In order to satisfy the requirement of the conformity with the safety aspects of complex electronic control systems.	Covered by R79	(Result) No requirement ①Prescribed in Annex 6 (CEL)
EMC		③	The LKAS shall not be adversely affected by magnetic or electrical fields. This shall be demonstrated by compliance with Regulation No. 10, 03/04 Series of Amendments	In order to satisfy the safety requirement of EMC.		(Result) No requirement ①Prescribed in the paragraph 5.1.5