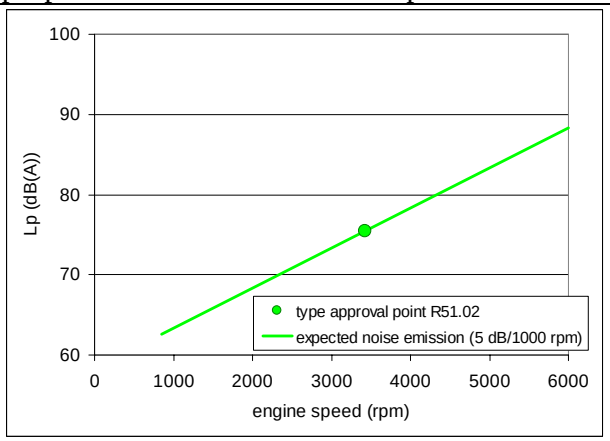
Draft report to GRB on ASEP

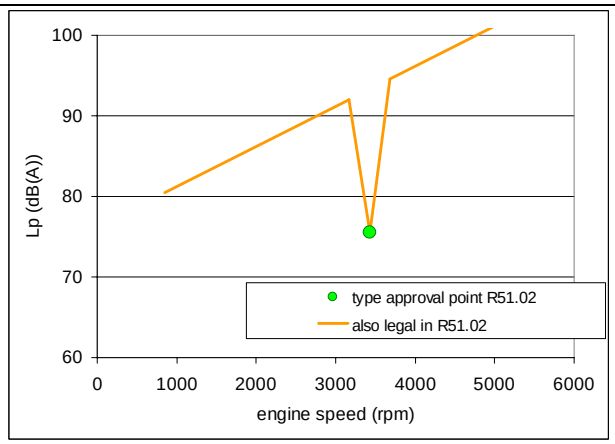
Prepared for the GRBIG ASEP meeting 8-10 December 2009
Issued by the chairman
version 2

Management Summary

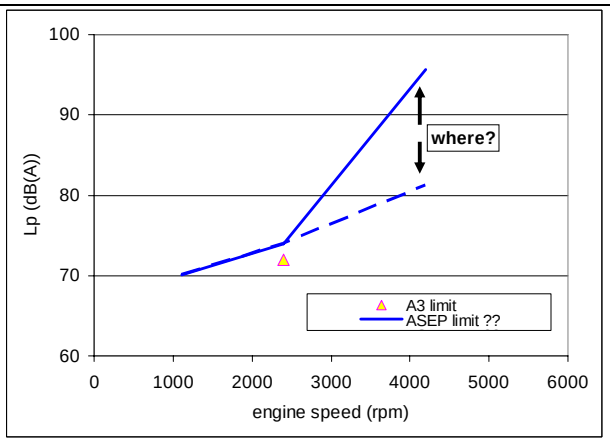
Two proposals for ASEP are evaluated by the GRBIG ASEP, the OICA proposal and the NL proposal. The two proposals are identical on 80%. The main difference between the two proposals is summarized in the pictures below:



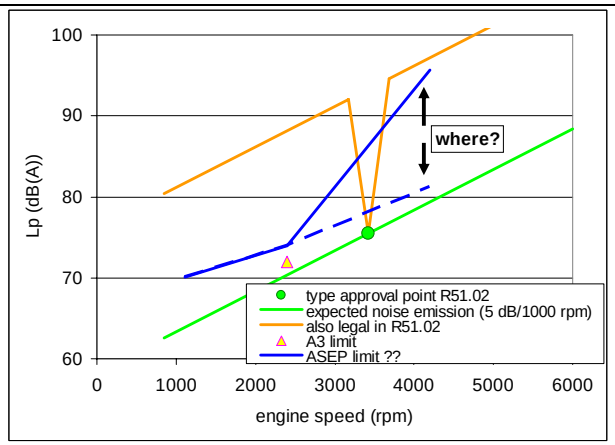
R51.02 is a point check. Based on this point the sound emission was expected to increase linear as function of engine speed with a slope around 5 dB/100 rpm.



Legally it is possible in R51.02 to design a sound curve which behaves non linear. The dBase shows various vehicles with this behavior; mainly high performance sport cars.



The main difference between the OICA and the NL proposal focuses on the question how stringent the ASEP limit line above the anchor point should be.



For many vehicles the OICA and NL proposal differ only marginally (1 or 2 dB(A)). Especially for high performance vehicles with a high rated engine speed, the NL proposal is significantly more stringent than the OICA proposal (sometimes up to 20 dB(A))

During the meeting an additional proposal by the German KBA had been put forward. When this proposal has been evaluated by the members of the ASEP group it may be added to this report.

Introduction

Note: This document is intended as a starting point for a report to GRB on behalf of the total group. The proposal is to complete it at the ASEP meeting with the input of the group. The text as given here is functioning as place holder only and may be changed to what the group desires.

In GRB September 2009 two ASEP proposals were introduced. Proposal A was discussed earlier in the GRB IG ASEP and originally designed by OICA. Proposal B was introduced by the Netherlands and not discussed earlier in the informal group. GRB has asked the informal group to discuss both proposals and report GRB on its findings. This reports summarizes the essentials of the discussion in the informal group.

Goal of ASEP:

- to set requirements to the sound emission of vehicles in addition to Annex 3
- in a wider operating range around Annex 3
- in order to prevent that the sound emission deviates too much from what can be nomally expected on the basis of the Annex 3 test results

How ASEP works:

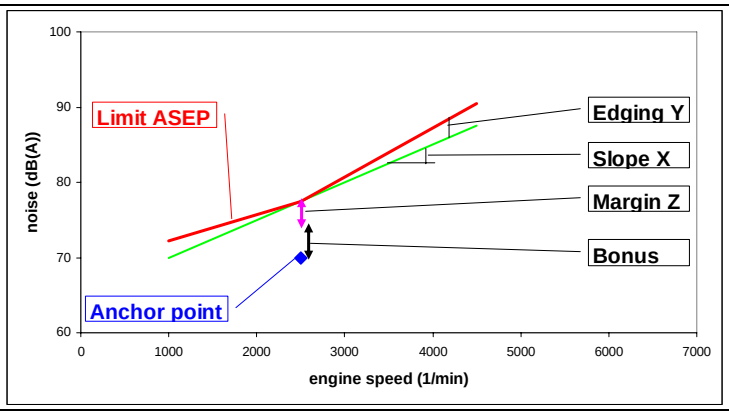
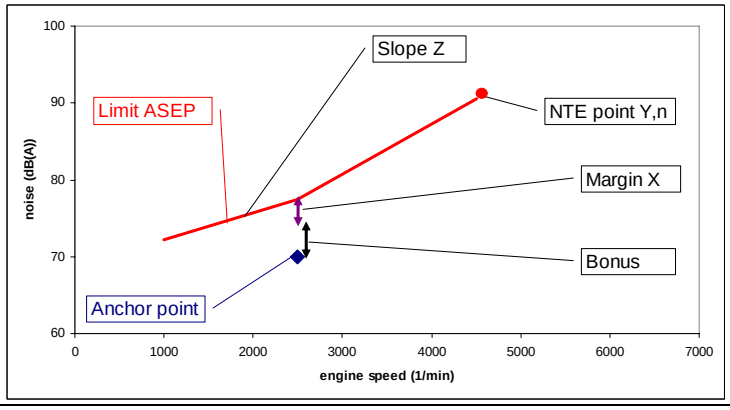
both proposals have in common:

- ASEP is a set of demands; The manufacturer has to sign a declaration that the vehicle fulfills these demands; Verification tests may be carried out, but are not necessary.
- ASEP tests can be carried out within a control range of valid vehicle operation conditions. Boundary conditions are set to vehicle speed, engine speed and vehicle acceleration.
- A limit line as function of engine speed
- An anchor point for the limit curve coming from Annex 3 test results.

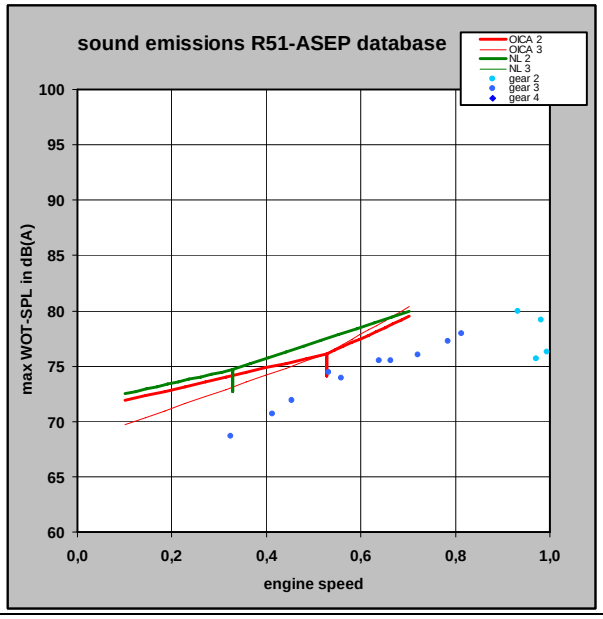
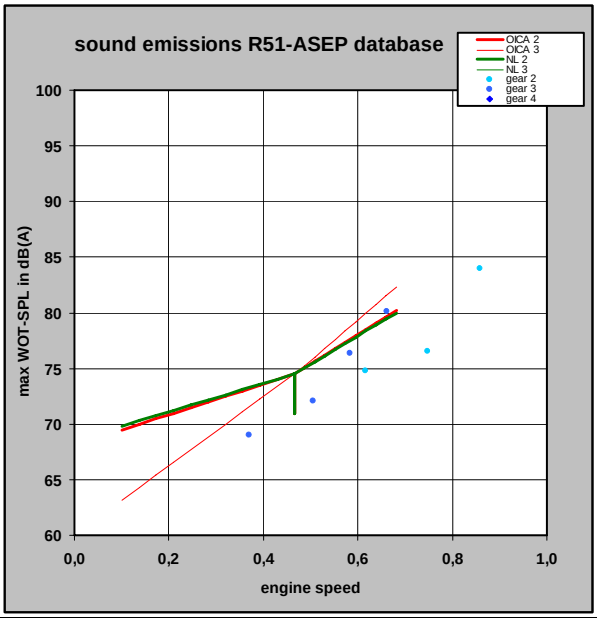
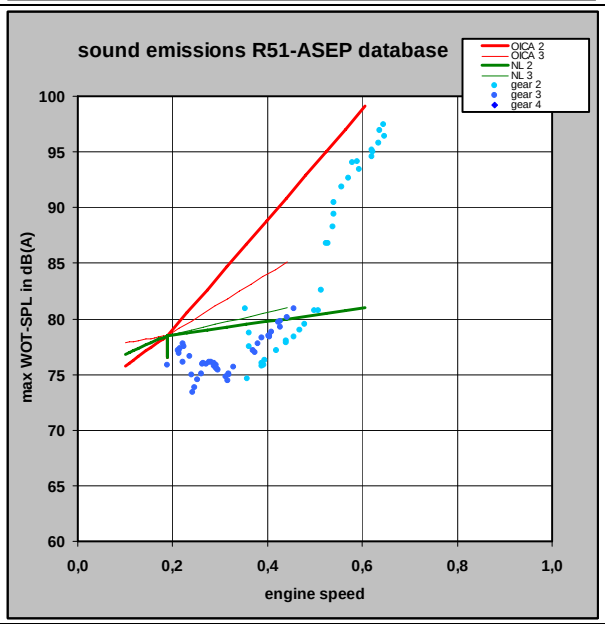
Besides a lot of similarities, the two proposals have some differences as well.

Main differences

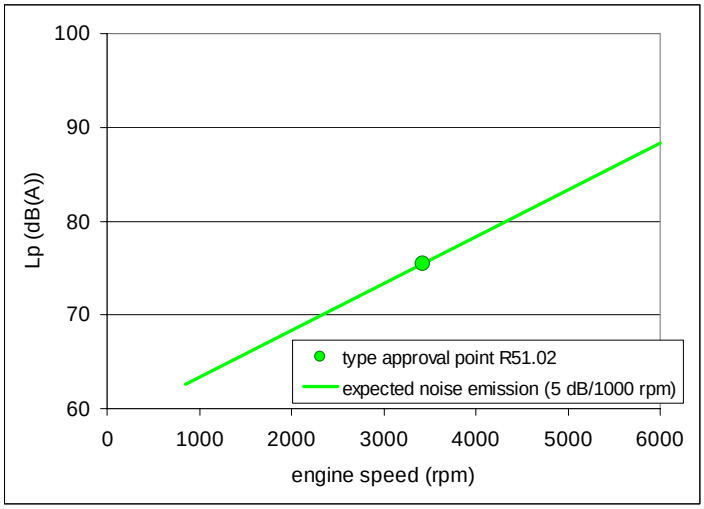
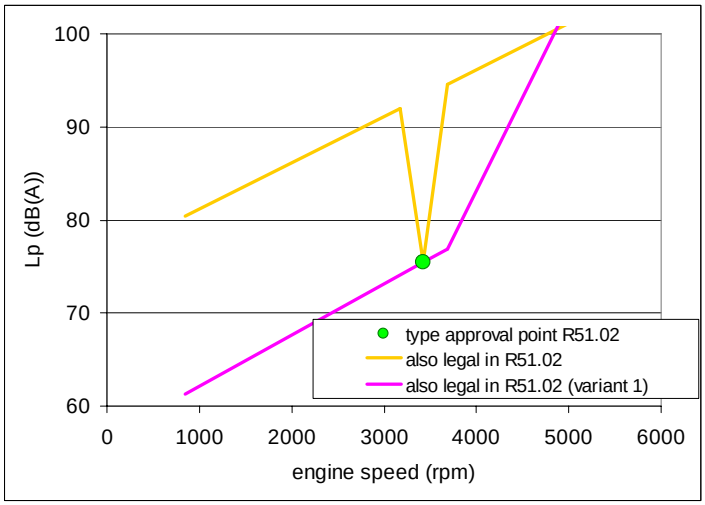
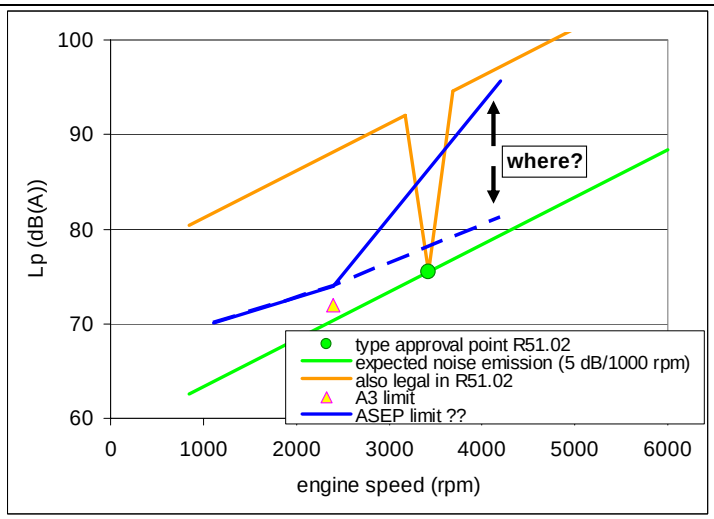
Issue 1	proposal A (OICA)	proposal B (NL)
Construction of ASEP limit line above the anchor point	The limit line is constructed with one point and a slope: The point is based on the anchor point, which comes from Annex 3. The slope comes from linear regression of ASEP measurements and is limited to X dB/1000 rpm. The Edging of Y is added to that as uncertainty margin on slope.	The limit line is constructed with two points. The first point is based on the anchor point, which comes from Annex 3. The second point is a Not To Exceed point. The noise level of the NTE point is based on the limit of Annex 3 increase by a fixed value of Y dB(A). The engine speed of the NTE point is determined by the maximum engine speed within the ASEP control range in that gear.
Clarification and Aspects	Requirement takes into consideration the physical behavior of current technology	Requirements are independent of the design
remarks	The values given are typical and depend on the ASEP coefficients XYZ and the individual vehicle.	

	OICA proposal
	NL proposal

Issue 2	proposal A (OICA)	proposal B (NL)
Maximum allowable noise within ASEP control range	Wide range over the vehicles in the dBase: Typically 78-103 dB(A).	Small range over the vehicles in the dBase: Typically 80-83 dB(A).
Clarification and Aspects	Depends on the effective engine speed range. And therefore on the rated engine speed. For vehicles with a low engine speed range (typically diesel engines) the maximum allowable noise is relatively low (around 80 dB(A)). For vehicle with a high engine speed range (typically high performance petrol engines) the maximum is significantly higher (some over 100 dB(A)). This requirement takes into consideration the physical behavior of current technology. Some vehicles are allowed to be significantly more noisy than in proposal B (up to 20 dB(A)) Tighter XYZ coefficients will not fail a stipulated group of vehicles.	The maximum allowable noise is a fixed Not To Exceed level. Dependent only on the limit value of Annex 3 and a fixed offset (Y=8) Requirements are independent of the design. Some designs may technically not be possible with this requirement (e.g. engine with very high rated engine speed). Tighter XYZ coefficients tend to fail especially high performance vehicles.
remarks	The values given are typical and depend on the ASEP coefficients XYZ and the individual vehicle.	

	vehicle 1-44 pmr = 76 kW/t diesel rated engine speed: 4000 rpm OICA limit slightly lower than NL limit Vehicle passes both OICA and NL ASEP
	vehicle 2-03 pmr = 94 kW/t petrol rated engine speed: 5000 rpm both limits comparable vehicle passes OICA ASEP marginally and fails NL ASEP marginally (0,3 dB(A))
	vehicle 200-09 pmr = 159 kW/t petrol rated engine speed: 7000 rpm OICA limit up to 18 dB(A) higher than NL limit Vehicle passes OICA ASEP and fails NL ASEP by 13 dB(A)

Issue 3	proposal A (OICA)	proposal B (NL)
Stringency compared to R51.03 Annex 3 and R51.02	With the default OICA XYZ coefficients about 2% of the vehicles in de dBase fail the limit line. Typically vehicles with a non linear sound curve fail this demand.	About 26% of the vehicles in the dBase fail this ASEP demand.
Clarification and Aspects	Especially vehicles with a non linear sound design (e.g. due to valves) will fail this demand. The ASEP sets demands over a wider area, where R51.02 is a point check. Some members of the group argue that any requirement outside of the R51.02 operating condition is more stringent than the point check of R51.02. Some members of the group argue that at the R51.02 operating condition for several vehicles significant room exists to increase the sound compared to R51.02. (some up to 10 dB(A)) Some non-linear sound curves may be adjusted (and approved) by increasing the sound of the more silent parts. (ref GRBIG-ASEP 13-008, 009 and 011)	Especially vehicles are detected with a non linear or steep sound curve. The amount of vehicles failing is comparable to the amount of vehicles that fail the R51.02 demand (22%). At the R51.02 operating condition the NL ASEP requirement is slightly less stringent compared to the R51.02 demand (typically 1 a 2 dB(A)).
remarks	The values depend on the ASEP coefficients XYZ and the individual vehicle. The numbers given are for the XYZ coefficients as proposed by OICA and Netherlands. Finetuning of the XYZ coefficients may change this picture.	

	The type approval point of R51.02 and the expected noise emission as function of engine speed: linear and with a moderate slope around 5 dB/1000 rpm
	Since R51.02 is a point check, the non linear curves as depicted are currently legal. Such sound design is currently used for various sports cars.
	Discussion focuses on the question how the ASEP limit above the anchor point should look like: For many normal vehicles there is not much difference between the OICA proposal and the Netherlands proposal. For high performance vehicles the Netherlands proposal is closer to the green curve and the OICA proposal is closer to the orange curve

Issue 4	proposal A (OICA)	proposal B (NL)
To be accomplished		
Clarification and Aspects		
remarks		

Secondary differences →

Issue a	proposal A (OICA)	proposal B (NL)
Engine speed of reference point	Only lowest gear (highest engine speed	Weighted average of two gears
Clarification and Aspects	Anchor point may swap depending ono test results	More stable
remarks		

Issue b	proposal A (OICA)	proposal B (NL)
Construction of ASEP limit line below the anchor point	Based on regression analysis	Fixed slope of 3 dB/1000 rpm
Clarification and Aspects		
remarks		

Issue c	proposal A (OICA)	proposal B (NL)
Slope of limit line based on ASEP measurements or independent from measurements	Slope is based on measurements and limited to a X dB/1000 rpm	Independent from measurements
Clarification and Aspects		
remarks		

Issue d	proposal A (OICA)	proposal B (NL)
To be accomplished		
Clarification and Aspects		
remarks		