CAPITALIZATION & REPORT OF THE PRESENTATIONS DONE DURING THE FIRST 11 SESSIONS OF THE UN TF-VS (Task Force Vehicles' Sound) From March 2021 to September 2022

THE WONDERFUL TEAM THAT CONTRIBUTED TO THIS REPORT ☺

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Finalization of the original report : June 20, 2023

CONTENT OF THE REPORT

5. ANNEX FOR ACRONYMS & ABREVIATIONS

1. GENERAL INTRODUCTION & CONTEXT

a. Reminder of the context

At GRBP 73 in January 2021, the experts from EC, ETRTO and OICA reported on their studies on sound level limits (GRBP-73-23, GRBP-73-11 and GRBP-73-25, respectively). To coordinate such initiatives, GRBP decided to establish a taskforce (TF). GRBP considered that TF should address the sound level limits of UN Regulation No. 51 and, at a later stage, No. 41.

- Chair: France – Secretary: OICA
- Guidelines of this TF were established by the group and approved as *GRBP-74-03 Rev.1*.

  The **decided name of this TF is TF-VS (Vehicle Sound)** to consider future sound emissions in accordance with UN-R51 and UN-R9, 28, 41, 59, 63, 92, 117, 138, 165.

  The **aim of the group** is:
  - to have a vehicles' sound forum for discussions
  - to make a review of the different studies/works with identification of pro/cons through a holistic approach,
  - to review the new information for example studies about new technologies and tyre noise related to UN-R51-03 including phase 3,
  - to provide a technical report to contribute to any work on future sound emissions.

  The **scope of the group** includes M, N and L categories of vehicles and any fields with impact on Real Sound emissions such as tyres, ASEP, road surfaces, interaction between L_{EQ} and L_{MAX}, electrification, vehicles' fleet impact (L_{DEN} - L_{NIGHT}), soundscape, road mapping, measurement uncertainties ...

  The TF-VS shall:
  - for M and N categories vehicles
    - Identify available and upcoming studies,
    - Identify the data available,
    - Review and analyse these studies/data including effect of Phase 3,
    - Work on background information to enable third parties to deal with impact assessment including single vehicle's individual sound emission and based on the most recent regulatory framework
    - Identify the interactions between vehicles sound emissions approvals and environmental noise,
    - Determine the importance of all this information,
    - Define action plans if needed,
    - Propose any useful improvements or any additional actions to any official bodies.
  - Organize the same work for L category vehicles.
- TF-VS homepage: Task Force on Sound Limits (TF SL) - Transport - Vehicle Regulations - UNECE Wiki

b. Calendar of the first 11 sessions of the TF-VS

- 01st TF SL: March 24, 2021 (TFSL-01-07)
- 02nd TF SL: May 26, 2021 (TFSL-02-12)
- 03rd TF SL: July 12-13, 2021 (TFSL-03-08)
- 04th TF **VS**: September 13-14, 2021 (TFVS-04-16)
- 05th TF VS: October 26-27, 2021 (TFVS-05-07)
- 06th TF VS: December 17, 2021 (TFVS-06-04)
- 07th TF VS: February 07, 2022 (TFVS-07-15)
- 08th TF VS: April 04, 2022 (TFVS-08-10)
- 09th TF VS: May 24, 2022 (TFVS-09-08)
- 10th TF VS: July 12, 2022 (TFVS-10-08*)*
- 11th TF-VS: September 09, 2022 (TFVS-11-08)

c. Participants to the first 11 sessions of the TF-VS

- **Contracting Parties:**
  China, European Commission (DG-GROW & DG-ENV), France, Germany, India, Italy, Japan, Spain, Switzerland, The Netherlands, United Kingdom.
- **NGO's:**
  CLEPA, ETRTO, EUWA, IMMA, ISO, OICA.
- **GUESTS:** (independent experts)
  Aristotle University, ATEEL, BRUITPARIF, FEDRO, FEV, HS Data analysis & Consultancy, IDIADA, JARI, TNO, Brussels Env., …

d. Outcome of the TF-VS group during the 11th Session

A lot of materials to improve noise emissions and their impact in real life have been presented to the different sessions of the TF-VS.

During the 11th session, the group supported that a report to give an overview and a common view on what is the situation would be helpful to decide how the TF-VS should continue to work and what could be its future work.

To make this report, a subgroup was decided with as volunteers:

- France: Romain BARBEAU, Serge FICHEUX,
- Japan: Takehiro ITO, Yoshihiro SHIRAHASHI, Yoshihisa TSUBURAI,
- The Netherlands: Jan Sybren BOERSMA,
- ETRTO: Michael STEFFAN,
- IMMA: Edwin BASTIAENSEN, Alex DESPLENTER,
- OICA: Klaus NEUHAUS, Françoise SILVANI (pilot of the subgroup), Per-Uno STURK.

e. How the work has been done – approach followed by the subgroup

The subgroup had 15 meetings from November 2022 to June 2023.

NB: See figure below for illustration of the approach chosen by the subgroup.

1. During the 11 sessions of the TF-VS, there were 54 presentations on different topics such as:
    - Road surfaces,
    - Studies on noise emissions of M/N/L vehicles,
    - Test methods,
    - Noise mapping
    - Noise camera/sonar experimentation,
    - Test campaigns,
    - General ideas, studies & considerations,
    - Cross matrix to improve traffic noise scenario and test procedures.

    From these 54 presentations, the subgroup decided to combine them as much as possible by subject/theme. This step led to 25 subjects/themes.

2. An 'individual sheet' (targeted in 2 pages) was built for each of these 25 subjects/themes to:
    - Identify the main messages shared during the different sessions of the TF-VS,
    - Make a summary of the presentation(s),
    - Add points discussed at the TF-VS,
    - Identify the references related to the concerned subject/theme.

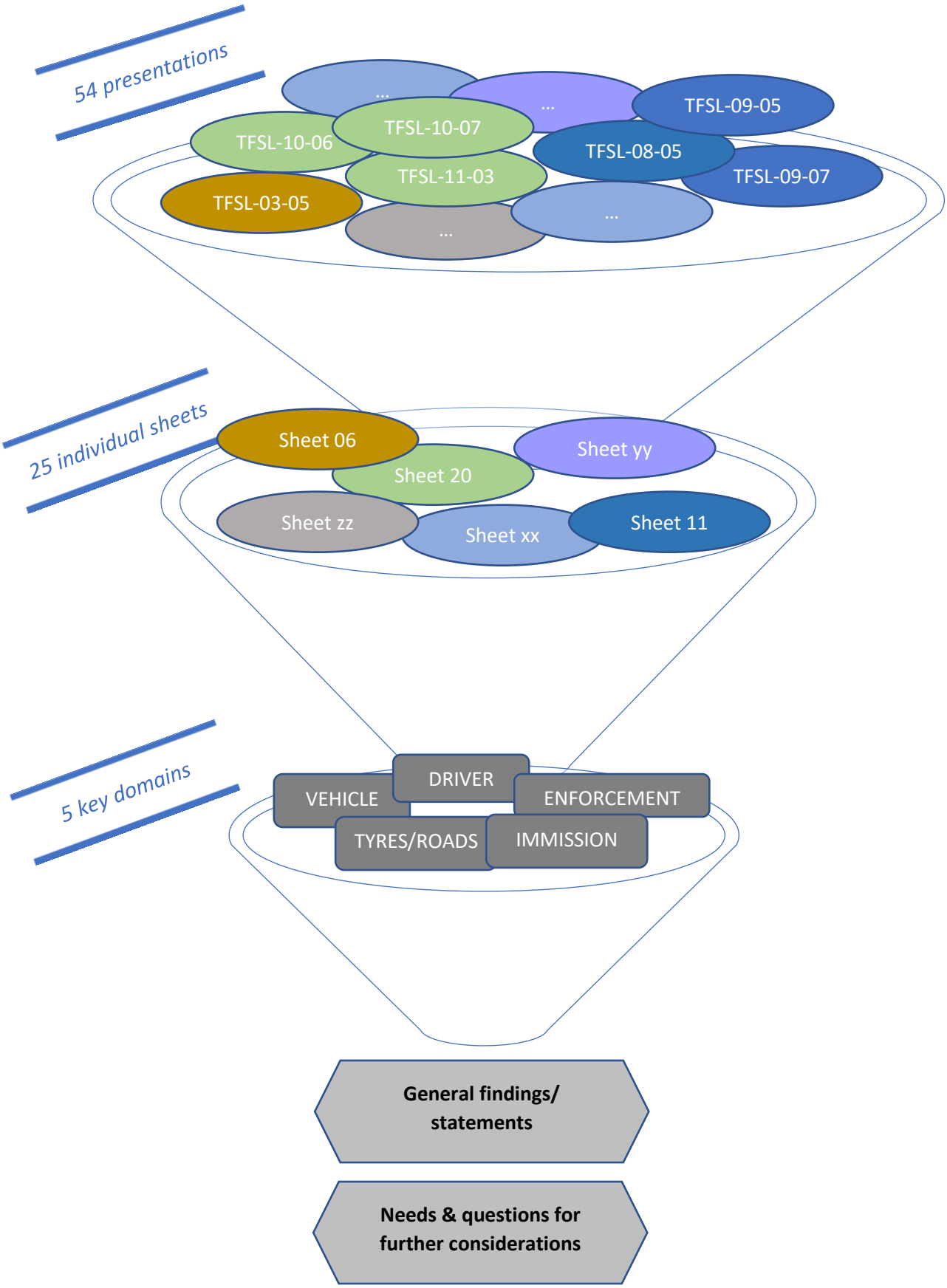
    The result is the Part 4. to this report.

    Through this exercise, the subgroup identified several key points. In the next step, these key points were combined and led to 5 key domains: vehicle, driver, enforcement, immission, tyres/roads.

3. For each of the 5 key domains, the subgroup created a sheet to:
    - Identify the general findings/statements explained during the presentations/ reports to the TF-VS, and
    - Identify the needs & questions for potential further considerations by the TF-VS.

    The result is in the Part 3 to this report.

    The needs & questions for further considerations should be discussed at next official session of the TF-VS for decision regarding the potential future work of the group.


54 presentations
...
...
TFSL-09-05
TFSL-10-07
TFSL-10-06
TFSL-08-05
TFSL-11-03
TFSL-09-07
TFSL-03-05
...
...
25 individual sheets
Sheet 06
Sheet yy
Sheet 20
Sheet zz
Sheet xx
Sheet 11
5 key domains
DRIVER
VEHICLE
ENFORCEMENT
TYRES/ROADS
IMMISSION
General findings/ statements
Needs & questions for further considerations

2. EXECUTIVE SUMMARY

a. Background

The approach as proposed by the subgroup and described above (in Part 1 of this report) has been presented at GRBP-77 in February 2023 (GRBP-77-25) and supported by the GRBP experts.

b. Key domains

- From the work to combine and summarize the presentations of the first 11 sessions of the TF-VS (*see PART 4. to this report*), 5 key domains (*see PART 3. to this report*) with a potential high impact on noise perception especially in urban area have been identified:
    - **"DRIVER"** means a person having the care and control of a motor vehicle on the road. He or she operates the vehicle's controls whether or not the motor vehicle is in motion. The driver is responsible for the safe, daily use of the vehicle including the after-market components in accordance with rules of the road.
    - **"ENFORCEMENT"** (in the context of sound) means the activities to ensure vehicles are and remain compliant to the regulations.
      The applicable regulations are related to bringing-vehicles-into-the-market (type approval, market-surveillance) and to use of vehicles in the jurisdiction (roadworthiness, Periodic Technical Inspection, roadside inspection, sound radar, manipulation).
    - **"IMMISSION"** means the sound recorded or predicted at receiver point, caused by the road vehicle fleet in continuous traffic flow or as single vehicle events, however potentially mitigated by abatement measures of various effect and efficiency (social impact and CBA).
    - **"TYRES_ROADS"** have a recognized influence on vehicle sound emissions. Different aspects have to be considered as the road surface itself, the tyre rolling sound, the interaction between the tyre and the road, but also the different tools available to classify them (e.g., the tyre labelling) taking into account the performances and impacts of tyres/roads on health, safety and environment.
    - **"VEHICLE"** (in the context of sound) means the sound produced by any means of transport resulting from its operation in traffic, including effects from alterations over its lifetime (NB: for tyre, see the other sheet related to tyre/road component).

  These 5 key-domains and their associated sheets have to be considered together, in parallel.

- For each of these key domains (*see PART 3. to this report*), have been identified:
    - the general findings/statements, and
    - the needs & questions for further consideration.

GENERAL FINDINGS:

Noise issues in the (urban) environment have to be considered in a holistic way (combination of complementary measures necessary) and are mainly linked to:

- the manipulation of vehicles and components
- the maintenance of the vehicles
- the driver behaviour and awareness
- the single events
- the 'organisation' of the vehicle fleet (traffic flow, vehicles distribution, speed, bumps, …)
- the tyres contribution to the vehicle's sound emissions and their interaction with
    - the road surfaces which are becoming still more important with electrified vehicles
    - the environmental & safety tyres performances and their inter-dependency
- the road surfaces including the road maintenance to maintain their performances regarding the noise
- the interaction between the environmental noise and the type-approval tests
- the sound assessment modelling tools to estimate sound from road traffic
- the various usages of the vehicles – private and commercial

NEEDS & QUESTIONS FOR FURTHER CONSIDERATION:

- ***Education of the drivers*** to make them aware of the impact of their driving behaviour
    - information's display (roadside information, noise information inside the vehicle, …),
    - prevention campaigns,
    - roadside checks,
    - sanction systems supported for instance by noise sonars/cameras including vehicle license plate detection, speed, acceleration, …
- Development of ***solutions against manipulation of vehicles***
    - better control of aftersales component,
    - periodical technical inspection,
    - market surveillance,
    - detection of illegally modified vehicles, for example by noise cameras
- ***Arrangement of traffic fleet*** to provide more 'relaxed' driving conditions and reduce noise by
    - optimizing traffic flow,
    - adding low speed areas,
    - avoiding speed bumps,
    - traffic flow distribution especially for the future with growing electrified vehicle part …
- Improvement of the ***knowledge of vehicles impacts on noise*** including

    - Future worldwide automotive electrification including AVAS and impact on environmental noise
    - Data from real life for all categories of vehicles and not only for M1 & N1 categories of vehicles to be considered through test campaigns
- Definition of a ***cross-matrix*** between the traffic noise situations, contributing factors and major complaints
- Update and improvement of the ***understanding of the environmental noise in real life*** concerning:
    - CBA (Cost-Benefit-Analysis) to assess the potential health benefits of noise reduction to be improved
    - Noise mapping tools including single events
    - Traffic scenarios
- Further improve ***knowledge of tyres*** for:
    - their performances and their inter-dependency regarding noise and other environmental aspects (as particles), and safety (as handling & braking of vehicles)
    - their interaction with the road surfaces
    - their test methods (indoor in addition to outdoor)
- Further research on ***low-noise road surfaces*** with a focus on their acoustic behaviour, their maintenance with the associated costs, and their safety performances
- Amend the ***UN Regulation no.51***
    - after assessment of previous steps and measures
    - to expand the various potential uses of the vehicles (RD-ASEP and its assessment in real life in the future)

For future studies, it would be recommended to differentiate simulated scenarios that are based on gathered data and those that are based on assumptions to avoid misinterpretations by readers trying to assess and to qualify the reported benefits for traffic noise.

c. Proposal for next steps of the TF-VS

According to the work done through this report, the following points have to be continued through the TF-VS:

- Follow-up of the different studies in progress already presented to the group, for instance:
  - Ongoing studies related to noise mapping & noise sonar/camera (UK, Japan, France, Brussels Env., …),
  - NEMO project, Belgium (roads or tyres label …), German presentation on NORESS,
  - …
- Potential actions/opportunities and prioritization:
  - Experience (forum) to be continued to share various information linked to noise topics for as much as possible promote worldwide harmonization,
  - ***Consider the needs and questions highlighted above through this report for potential future work of the TF-VS, especially about the following topics without prioritization:***
    - ***Education of the drivers***
    - ***Development of solutions against manipulation of vehicles***
    - ***Arrangement of traffic fleet***
    - ***Improvement of the knowledge of vehicles' impacts on noise***
    - ***Cross-matrix***
    - ***Improvement & update of the understanding of the environmental noise in real life***
    - ***Improvement of the knowledge of tyres***
    - ***Further research on low-noise road surfaces and their maintenance***
    - ***Future for UN-R51-03.***

3. “KEY-DOMAINS”

GENERAL FINDINGS & OPENED ISSUES

DRIVER

Consider in parallel all the PART 3. sheets
Driver, Enforcement, Vehicle, Immission, Tyres/roads

DESCRIPTION / DEFINITION:

- **DRIVER** means a person having the care and control of a motor vehicle on the road. He or she operates the vehicle's controls whether or not the motor vehicle is in motion. The driver is responsible for the safe, daily use of the vehicle including the after-market components in accordance with rules of the road.

- ***Keywords***: driving behaviour, driver awareness, manipulation, single events.

GENERAL FINDINGS/STATEMENTS FROM THE PRESENTATIONS/REPORTS

Manipulation:

- Need to address tampering issues with regards to motorcycle's noise as an urgency
- Reduce the limit value of noise regulations has no effect, even worse, low limits increase the tendency to manipulate vehicles
- Extend market surveillance activities, including replacement silencing systems in the noise emissions market surveillance planning

Driver behaviour & awareness:

- Develop the driver's awareness of his/her driving behaviour impact on sound environment.
- But, from some studies soft measures such as making the drivers aware of the noise they produce (for instance signage) have been shown as ineffective
- Extended requirements from UN-R51 (ASEP and RD-ASEP) to cover urban driving situations including aggressive driving, (will) provide significant improvements
- Reduce speed limitation and acceleration of vehicles will significantly decrease the noise emission

Single events:

- Fix a limit on all driving conditions in the UN-R51 for M/N categories, or on the acceleration test result will not provide a substantial benefit for the environment especially when looking to the wide field of "single events"

NEEDS & QUESTIONS FOR FURTHER CONSIDERATION FROM THE ORIGINAL PRESENTATIONS/REPORTS:

Further work needed to

- 'educate' the drivers and the owners' vehicles to make them aware of the impact of their driving behaviour (incivilities, peak events, excessive acceleration/deceleration, …) and of any manipulation of the vehicles
  - for instance, through awareness-raising actions (display of the sound level of the vehicle, as for speed limit, in certain areas with 'smiley' accordingly), prevention campaigns, road-side checks and sanction system
  - detection of illegally modified vehicles
- promote rearrangement of traffic to provide more 'relaxed' driving conditions for instance by adding low speed areas which would also reduce by itself noise, or avoiding speed bumps, or optimizing traffic flow
- better control of the components sold in after-sales (especially for muffler)

REFERENCES:

- ***01*** *– (GERMANY): General ideas about the work of the Task Force Sound Limits (Phase 3)*
  - TFVS-01-05 Rev.1 (GERMANY): General ideas about the work of the Task Force Sound Limits (Phase 3)
- ***02*** *– (JAPAN): General overview of vehicle noise in Japan*
  - TFSL-01-06 (JAPAN): General overview of vehicle noise in Japan
  - TFSL-02-09 (JAPAN): Further details of vehicle noise issue and reviewing process in Japan
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  - TFSL-03-05 (FRANCE/BRUITPARIF): Road noise in the environment – Measurements in real life
  - [1] BRUITPARIF, Le coût social du bruit en Île-de-France, 2021 (The social cost of noise in the Ile-de-France region – Bruitparif report 2021)
  - [2]: CREDOC (Centre de Recherche pour l'Etude et l'Observation des Conditions de vie - *Research Center for the Study and Observation of Living Conditions*) study for Bruitparif, 2021
- ***07*** *– (JAPAN): Development of automatic illegal replacement muffler detection system at NTSEL*
  - TFVS-04-08 (JAPAN): Development of automatic illegal replacement muffler detection system at NTSEL
- ***08*** *– (UK): DfT Acoustic Camera*
  - TFVS-04-06 (UK): DfT Acoustic Camera Research
    → Final report webpage: https://www.gov.uk/government/publications/roadside-vehicle-noise-measurement-study-enforcement-and-technology
  - TFVS-08-03 (UK): DfT Noise Camera Research (*3-part research project → result expected in 2023*)
- ***11*** *– (Brussels Env.): Testing the noise emission of individual motor vehicles in the Brussels-Capital Region*

- TFVS-08-05 (TFVS Sec.): Informal General overview(*) - EVALUATION OF VEHICLE NOISE EMISSIONS INDIVIDUALLY POWERED VEHICLES CIRCULATING IN BRUSSELS-CAPITAL REGION
- TFVS-09-05 (Brussels Env.): Testing the noise emission of individual motor vehicles in the Brussels-Capital Region
- TFVS-09-07 (Brussels Env.): Art_20220111_BruitRemoteSensing_EN
  Available only in French and NL languages:
  Bruxelles teste et met en œuvre de nouvelles technologies pour lutter contre le bruit du trafic routier… | Bruxelles Environnement
  Brussels is testing and implementing new technologies to combat road traffic noise... | Brussels Environment
  Projet « remote sensing » | Bruxelles Environnement
  « Remote sensing » project| Brussels Environment

- ***12** – (OICA): Considerations on Future Road Traffic Noise Regulations*
  - TFVS-02-10 Rev.2 (OICA): Considerations on Future Road Traffic Noise Regulations
- ***14** – (ETRTO): Tyres road traffic noise – Where is the potential?*
  - TFVS-04-11 (ETRTO): Tyres road traffic noise – Where is the potential?
- ***17** – (EC) EC Study for L-categories*
  - TFVS-04-15 (EC) TF_SL-4_13-14-09-2021_L_Cat_Euro_5_step_project_presentation
  - TFVS-09-04 (EC-Idiada) Present_L_cat_vehicles_IDIADA_RACC_TFVS 9 24052022_v3_Final2
  - TFVS-10-03 (EC) EC Study for L-categories
  - TFVS-11-08 (Secretary) Publication of EC impact assessment on euro-ET0522080ENN
- ***18** – (IMMA) Study IAI-TUG L-cat noise level limits*
  - TFVS-07-09Rev1 (IMMA) IAI-Acustica-TUG study_motorcycles
  - TFVS-07-10 (IMMA) TUGraz_-_Experimental_Noise_Source_Ranking
  - TFVS-07-12 (IMMA) IAI_and_Acustica_-_CBA_study_on_Euro_5_sound_limits_for_L-category_vehicles
  - TFVS-08-07 (IMMA) 220404 IAI-Acustica Presentation for TF-VS final
  - TFVS-08-09 (IMMA) Report FVT-044-21 ACEM NSR _April_4th_Meeting
- ***23** – (OICA_ACEA_ATEEL) Comp Emisia_Ateel studies limits M-N*
  - TFVS-10-04 Rev.1 (OICA/ACEA/ATEEL): Comparison of EMISIA (TFVS-07-11) & ATEEL (TFVS-07-03) study on sound limit values for vehicle category M & N – Interim results
  - TFVS-11-05 (OICA/ACEA/ATEEL): Comparison of EMISIA & ATEEL study on sound limit values for vehicle category M & N – Final
- ***25** – (GERMANY) KBA_Test_campaign_on_Noise_emissions 2021*
  - GRBP-76-27 (Germany) Campaign on noise emissions 2021.

ENFORCEMENT

Consider in parallel all the PART 3. sheets
Driver, Enforcement, Vehicle, Immission, Tyres/roads

DESCRIPTION / DEFINITION:

- **ENFORCEMENT** (in the context of sound emissions) means the activities to ensure vehicles are and remain compliant to the regulations.
  The applicable regulations are related to bringing-vehicles-into-the-market (type approval, market-surveillance) and the use of vehicles in the jurisdiction (roadworthiness, Periodic Technical Inspection, roadside inspection, sound cameras, manipulation).

- ***Keywords***: Sound limits, PTI, roadside check/sound cameras, roadside equipment, measurement uncertainties, ASEP (Additional Sound Emission Provisions), manipulation, market surveillance, policy documents.

GENERAL FINDINGS/STATEMENTS FROM THE PRESENTATIONS/REPORTS

- Different studies in Europe, UK and Japan address single events as a cause for disturbance and annoyance
- Main causes of single events are:
  - Driver behaviour related (acceleration, over speeding, high revs, horn)
  - Manipulation of exhaust system
  - Modification of mufflers
  - Illegal exhaust systems
  - Poorly maintained vehicles (e.g. broken exhaust)
- Roadside inspections are considered more effective than PTI to act on manipulation and illegal exhaust systems
- The research for sound monitoring (sound camera) is increasingly effective in distinguishing the contribution of single vehicle sound emissions from its environment
  - This includes the detection of vehicle license plate, speed, acceleration, engine speed and noise.
- Loopholes in the implementation of vehicle sound regulation in the EU allow the usage of older regulations for replacement silencers
- The performance of NORESS aftermarket silencers seems not in-line with original silencer systems

NEEDS & QUESTIONS FOR FURTHER CONSIDERATION FROM THE ORIGINAL PRESENTATIONS/REPORTS:

- Single event:
  - Traffic monitoring research gives necessary insight in specific causes of single events (especially in cities)
  - Sound cameras seem to be a solution for the enforcement of single events related to driving style and exhaust system (illegal, modified and manipulated exhaust systems).
    - Technology needs to be further developed
    - Research should be stimulated
  - The sound performance of aftermarket NORESS seems to be louder than original silencer systems. This needs more research to confirm conclusions.
    - An increase of effort on market surveillance of NORESS will improve the insight in their sound performance

- Average sound emissions (source)/ immission (receiver):
  - Speed reduction is a solution for noise reduction (in cities)
  - Increase market surveillance effort (and effectiveness) on aftermarket products (NORESS)
  - Future worldwide automotive electrification including the AVAS (Acoustic Vehicle Alerting System) has to be considered for the future works of the group because this should have an impact on the environmental sound level.
  - Works of the group not limited to M1/N1 only but to all M & N. Data needed for all vehicle categories.
  - To be able to identify where the noise issues lie, to build a kind of cross-matrix between traffic noise situations, contributing factors and major complaints as shown as an example in doc. TFSL-01-05 Rev.1 Page 9.

To sort out what is important as noise countermeasures beyond the Phase 3 of (EU)540/2014 or UN-R51-03, it is needed to continue to share issues and initiatives at TF-VS.

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- ***01*** *– (GERMANY) General ideas about the work of the TF*
  - TFVS-01-05 Rev.1 (GERMANY): General ideas about the work of the Task Force Sound Limits (Phase 3)
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  - TFSL-01-06 (JAPAN): General overview of vehicle noise in Japan
  - TFSL-02-09 (JAPAN): Further details of vehicle noise issue and reviewing process in Japan

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- ***04*** *- (STEER) CEDR (CONFERENCE OF EUROPEAN DIRECTORS OF ROADS) – BELGIUM - NOISE & NUISANCE – FINAL CONFERENCE LIEGE*
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  - TFVS-05-05 (ISO): 20211026 -- WG11 indoor method concept for GRBP TFVS
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  - TFVS-05-04 (France_SIA): Automotive in soundscape
- ***10*** *– (FRANCE) NATIONAL UPDATE: STUDY ON HEALTH AND SOCIAL COST OF NOISE IMPLEMENTATION OF SOUND CAMERAS*
  - TFVS-07-07 Rev.1: Study on health and social cost of noise – Implementation of sound cameras
- ***12*** *– (OICA) Considerations Future Road traffic Noise Reg*
  - TFVS-02-10 Rev.2 (OICA): Considerations on Future Road Traffic Noise Regulations
- ***13*** *– (OICA) Mngt. Noise R51-03 at low speeds vs. AVAS R138*
  - TFVS-04-12 (OICA): Management of Noise emissions according to UN-R51-03 at low speeds vs. AVAS compliant to UN-R138
- ***14*** *– (ETRTO) Tyres_road traffic noise-where potential*
  - TFVS-04-11 (ETRTO): Tyres road traffic noise – Where is the potential?
- ***15*** *– (DG-ENV TNO) PHENOMENA*
  - TFSL-03-04 (TNO): THE PHENOMENA PROJECT - Assessment of **P**otential **He**alth Benefits of **No**ise Abate**men**t Me**a**sures in the EU
  - TFSL-05-03 (EC DG/ENV.): Noise policy update & PHENOMENA
    - Official report: Assessment of potential health benefits of noise abatement measures in the EU - Publications Office of the EU (europa.eu)
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  - TFVS-10-03 (EC) EC Study for L-categories
  - TFVS-11-08 (Secretary) Publication of EC impact assessment on euro-ET0522080ENN
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- TFVS-08-09 (IMMA) Report FVT-044-21 ACEM NSR _April_4th_Meeting

- ***19*** *– (EC_EMISIA) Study sound limits M-N vehicles*
  - GRBP-73-23 (EC): Study on sound level limits of M- and N-category vehicles – intermediate report,
  - TFSL-02-08 (EC): M- and N- sound limit study – intermediate report,
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- ***21*** *– (JAPAN) Results simulations on reducing auto noise*
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- ***22*** *- (OICA/ACEA/ATEEL) STUDY ON FUTURE SOUND LIMIT VALUES FOR TYPE APPROVAL FOR VEHICLES OF CATEGORY M & N*
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IMMISSION

Consider in parallel all the PART 3. sheets
Driver, Enforcement, Vehicle, Immission, Tyres/roads

DESCRIPTION / DEFINITION:

- IMMISSION means the sound recorded or predicted at receiver point, caused by emitting sources, as the average sound of the road vehicle fleet in continuous traffic flow or as single vehicle events, mitigated by abatement measures of various effect and efficiency (social impact and CBA). Immission represents sound waves reaching the receiver/observer vs. "Emission" means sounds from the sources.

- ***Keywords***: single events, traffic flow/condition, vehicle fleet, (alternative) abatement measures, prediction model, cross-matrix, social impact, Cost-Benefit-Analysis (CBA).

GENERAL FINDINGS/STATEMENTS FROM THE PRESENTATIONS/REPORTS

Treating sound immission calls for holistic and local approaches, while immission is related not only to vehicle and tyre noise themselves but also to other factors (road surface, traffic flow, single event, sound wave damping etc.). An increased market share of xEVs will reduce the average equivalent levels in low-speed mixed-category traffic and the annoyance caused by single vehicles as their sound dynamics are much lower than those of combustion engine vehicles.

The UN type approval system for M & N categories covers the relevant sound sources for those vehicle categories.
For M & N categories: Vehicle sound emission – UN R51 (Annex 3) – and minimum sound of electric vehicles – UN R138 – in urban areas; Tyre rolling sound emission – UN R117; Signal horn – UN R28 – (single events – reference BRUITPARIF TFSL-04-05); Non-Original Replacement Silencer System – UN R59; ASEP – extended requirement in UN R51 (Annex 7) – covering other typical driving situations, inclusive aggressive driving.

Single events,

- WHO (World Health Organization) concludes that “relationship between single events and long-term negative health effects could not been proven”.
- For instance, public surveys in Paris area indicate that ~50% of people living around and ~70% inside Paris are annoyed by noise being at home – mostly single events, whereas neighbors and motorbikes stand out.

- The single events – the major annoyance – caused by loud vehicles and uncivil behavior eliminate (mask) the improvements of vehicle propulsion and tyre sound emissions (the result of reduction of limit values).
- In Paris, a very small portion (1,5%) of high-level events (recorded higher than 80 dBA) represents 37% of the cumulated sound energy.

Alternative abatement measures,

Improve maintenance of roads, install silent road surfaces, control vehicle traffic flow, apply sound wave damping etc.
"Noise cameras" can provide local authorities or the police with enforcement tools to identify noisy vehicles, however the use of technology needs guidelines and appropriate noise thresholds including tolerances, and how to handle complex traffic situations.

Cross-matrix, traffic flow/condition, vehicle fleet,

Traffic noise studies need commonly agreed definitions of scenarios in order to support relevant road traffic models (Road types; Reference Road surfaces; Vehicle categories; Vehicle sound source models; Share of traffic volume per vehicle category; Story for noise reduction in power train/tyre; etc.).

- Road traffic noise were calculated in three studies based on traffic flow scenarios including main roads of different geographic areas of concern.
  The two studies/examples concerning EU suggested the fractions of 93-96% of light vehicles at daytime and 90-98% in the night. The remaining fractions are estimated to be more or less equally shared between mid and heavy-duty vehicles.
  The Japanese studies estimated much higher rate of mid and heavy-duty vehicles both day (20-30%) and night (45-64%) compared to EU main roads.
- The sound levels of new vehicles themselves have decreased with improved limit values, but the effect on road traffic noise is delayed due to the year rate of market penetration of new vehicles.
- A study for distribution of electrified Vehicles will become important in the future. AVAS (Acoustic Vehicle Alerting System) is expected to have impact on the road traffic noise in the speed range lower than 40 km/h.

Prediction model,

- Reports (e.g. PHENOMENA) recognizes/anticipates gaps between the END/CNOSSOS methodology, the TA test and real traffic noise. Different countries and cities are in progress to collect technical information especially related to the vehicles and traffic flow (range of acceleration, manipulated vehicles, …). The correlation of pass-by noise measurements between vehicle homologation and source model description can be still improved. Nevertheless, there is a good correlation between computed environmental noise maps and measurements. Thus, tougher regulation has no real effect to reduce citizen complaints.

Sound Level Part Source Analysis

- M1 vehicles (Various PMR): Tyre rolling sound is the dominant sound.
- N2 and N3 vehicles: Power train noise reduction would make HDV quieter as single event in an urban environment, but these HDV are rare in urban traffic and thus contribute little to urban (average) noise. With higher speeds the tyre rolling sound becomes the dominating source.

  Heavy duty EVs have the capacity to reduce sound levels in low-speed traffic according to ATEEL (TFVS-07-04).

Social impact,

- The available reports and presentations in TFVS reveal national goals regarding improved road traffic noise of EU and Japan. The goals are referring to average sound immission levels (L_{eq}/L_{den}/L_{night}).
  Japan – Ministry of Environment – targets 100% EQS (Environmental Quality Standards) which means Leq below certain limit, and to reduce complaints from citizens related to road traffic noise.
  The European Commission proposed a policy target of reducing the share of people chronically disturbed by transport noise by 30% by 2030 in the Zero Pollution Action Plan (compared to 2017).
- The most annoying sources of noise among transport noises in Ile de France are the noise coming from 2 wheelers and horns [1].
  A second survey conducted by Bruitparif [2] shows that 49 % of the annoyance is related to road traffic in which passenger cars represent 25 % of the annoyance.

Cost-Benefit-Analysis (CBA)

Although Cost and Benefit Analysis are desired by stakeholders and required by policy makers it provides lots of room for questions and discussions and, an established balance between relevant aspects and a commonly accepted quota seems hard to derive. Therefore, assumptions and boundary conditions require further description for better understanding, assessment and then improvement. An effective reduction of noise health burden can only be reached by a set of combined and complementary traffic noise abatement measures, and have to be backed up by corresponding efficiency analysis (Cost Benefit Ratio).

NEEDS & QUESTIONS FOR FURTHER CONSIDERATION FROM THE ORIGINAL PRESENTATIONS/REPORTS:

- The hypothesis and assumptions of different studies (ref. 20, 22, 23) should be reviewed.
- The existing noise mapping models should be revised to better align with the real-life situation taking into account progress, recent studies and technical innovations.
- The effectiveness of vehicle noise reduction beyond phase 3 (and every phase) should go through a technical review before reaching global agreement. The studies on the subject presented to TF-VS conclude that benefits of further limit reductions are highly limited and time delayed.
- Evaluate the distribution and effect of xEV/electrified vehicles.
- CBA and the corresponding assessment of health benefits should be considered year by year and location by location. Combine alternative abatement measures where they are most efficient (traffic hot spots) and compare with measures on vehicle sources where they are most efficient.

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TYRES / ROAD SURFACES

Consider in parallel all the PART 3. sheets
Driver, Enforcement, Vehicle, Immission, Tyres/roads

DESCRIPTION / DEFINITION:

- **TYRES & ROAD SURFACES** have a recognized influence on vehicle sound emissions. Different aspects have to be considered as the road surface itself, the tyre rolling sound, the interaction between the tyre and the road, but also the different tools available to classify them (e.g. the tyre labelling) taking into account the performances and impacts of tyres/roads on health, safety and environment.

- ***Keywords***: tyre labelling, tyre particle emission, tyre road noise, road surface, safety.

GENERAL FINDINGS/STATEMENTS FROM THE PRESENTATIONS/REPORTS

- All the studies are in phase to say/affirm/conclude that the most important source of noise for road traffic is caused by the rolling sound.
- This phenomenon will be even more true for Electric vehicles due to the higher weight of these vehicles with wider or extra load tyres needed.
- The knowledge of the different performances of the tyres (rolling sound, abrasion, …), their interaction/interdependency and their effect on the safety and public health has to be improved. Then a further improvement in tire performance can only be possible within a reasonable time.
- The current outdoor test method related to the tyre rolling sound has important measurement uncertainties, up to 2,8 dB mainly due to parameters such as tracks, weather conditions, test vehicle etc. and a high cost.
- The tyre rolling sound is highly influenced by the excitation given by road roughness and road irregularities.
- Several studies show that the work on the road surface itself brings a win-win deal with the community with an immediate effect on sound emissions abatement and that for any vehicles (type, age, tyres, …). The road maintenance has also to be considered to maintain its beneficial effect on traffic noise over time.

NEEDS & QUESTIONS FOR FURTHER CONSIDERATION FROM THE ORIGINAL PRESENTATIONS/REPORTS:

- Future improvements of traffic noise require the assessment of methodologies necessary to evaluate the whole ecosystem, e.g., road surface, peak noise, traffic regulations, tyres, vehicles, etc. and stimulate its improvement regarding noise.
- All studies say/affirm/conclude that additional research is needed regarding low-noise road surfaces with a focus on their acoustic behaviour, maintenance costs and safety performance. A cost-efficient process for the renewal of low noise surfaces by exchanging the top layer has been presented.
- Regarding vehicle limit value adaptations beyond phase 3 of (EU)540/1024 or UN-R51-03, it was proposed to wait for phase 3 vehicles to enter the market and observe the impact on sound level in combination with additional tasks that could help to get a better understanding on real traffic noise issues. For instance, more campaigns are expected, similar to recent studies (Brussels Env., Bruitparif, G+P Switzerland and FEDRO) while gathering N3 vehicle data with realistic configuration especially on street types with higher driving speed.
- For electric vehicles with dedicated designed AVAS, extra-load tyres and/or wider tyres the noise source ranking analysis showed that the overall noise level is primarily influenced by the tyre/road noise.
- Existing noise mapping models should be revised to be better aligned with the real-life situation, considering recent studies and technical innovations as well as the application of reference scenarios to establish a comparability of simulations in different studies. A process to ensure a regular update of the sound emissions models (vehicles and tyres) should be implemented to avoid simulations based on traffic noise data that was gathered more than a decade ago and no longer represents the current vehicle fleet.
- The current outdoor test method related to the tyre rolling noise can be improved by developing an indoor drum test method, consisting in a unique & standardized drum surface replicating a reference test track to reduce measurement uncertainties with a better operational efficiency and improve correlation between sites.

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VEHICLE

Consider in parallel all the PART 3. sheets
Driver, Enforcement, Vehicle, Immission, Tyres/roads

DESCRIPTION / DEFINITION:

- **VEHICLE** (in the context of sound) means the sound produced by any means of transport resulting from its operation in traffic, including effects from alterations over its lifetime.

- ***Keywords***: Age, PTW, Mass, Power, category, market penetration, sound, NORESS, xEVs, minimum sound, abatement measures.

GENERAL FINDINGS/STATEMENTS FROM THE PRESENTATIONS/REPORTS

The sound that each individual vehicle produces in the overall traffic is very variable and has many dependencies.
The putting on the market of the vehicle marks the handover of the vehicle from the manufacturer responsibility to the user.

1. Before the vehicle is put on the market:
   This is the manufacturer's responsibility to meet the Type Approval requirements with the Authorities.
   The sound from a vehicle and the potential and cost of reducing the sound emissions depends on the vehicle (sub-)categories as well as the propulsion type. Different vehicles have different dominant sound sources, which vary depending on vehicle speed. Customer expectation and needs is also a factor that can influence the sound performance of a vehicle.

   The test procedure for Urban sound (L_{Urban}) in the UN Regulations provides a good match with driving conditions observed in Urban conditions. However, a mismatch with real world traffic sound is noticed as this test procedure only covers a part of all conditions the vehicle can operate in.
   To cover for real-world driving conditions outside of Urban conditions, the ASEP (Additional Sound Emission Provisions) part of the regulations have been strengthened: RD-ASEP (Real-world Driving ASEP) now covers a much wider testing area than the Urban sound test procedure, it includes testing all gears and a much wider speed and engine rotational speed (rpm) range, encompassing a comprehensive span of driving conditions as well as being more robust against possible abuse of regulatory gaps or 'grey zones'.

2. After the vehicle is put on the market:
   The results from tighter test procedures and limits are not always clearly noticeable on the roads because it takes time for the new vehicles to penetrate the market. But also, other effects like rough road surfaces, or the fitment of louder replacement tyres can fail to materialise the effects from Type Approval strengthening.
   Other means like lower speed limits or smoother road surfaces are considered as measures that can bring more immediate benefits to reduce annoyance from traffic sound.

   Technical advancements in vehicle technologies have already produced moderate improvements in real world traffic sound.
   Vehicle fleet Electrification will bring further progress, but less than expected due to
   - the need of specific tyres especially because of increasing weight of the vehicles including the batteries, and
   - new safety devices such as AVAS (Acoustic Vehicle Alert system)

   which must be carefully considered in order to ensure that they do not neutralize these improvements in Urban areas.

   Other traffic sound nuisances perceived by citizens are the 'single events'.
   The manufacturer has little control over these and also Type Approval regulations cannot solve the above phenomena.
   Only local enforcement can address these issues.

There is no single solution available to address sound caused by traffic. A holistic approach is needed: improving regulatory test procedures with balanced sound level limits, improving local circumstances (e.g speed limits or smoother road surface), as well as addressing single events by suitable enforcement measures. Advancements need to be reflected in traffic sound modelling so that effectiveness of a measure can be adequately judged

NEEDS & QUESTIONS FOR FURTHER CONSIDERATION FROM THE ORIGINAL PRESENTATIONS/REPORTS:

- A Holistic approach to traffic sound is needed, there is no single solution, a combination of complementary measures is necessary, and also other sound sources need to be considered in the overall sound picture.
- The Effects of previous measures (e.g., the introduction of Phase 3) need to be studied and understood before deciding next measures.

- Consider measures to address single events and/or manipulations (e.g., set up a database, set up a roadside check procedure, adjust the type-approval test method as 'RD-ASEP' …)
- Consider alternative measures that impact all vehicles with immediate effect. (e.g., speed limits, silent road surface asphalt, geofencing, …).
- Consider the effects of increasing electrification on the overall traffic.
- For new technologies like AVAS, consider the balance between safety and environmental, as well as customer acceptance.
- Investigate if (approved) aftermarket mufflers excessive sound is caused by incorrect Type Approval or because of differences between the approved muffler and production mufflers.

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- ***20** – (JAPAN-EC) EC-EMISIA study M&N veh-Q&A Comments*
  - TFVS-07-11 (EC): Study on sound level limits of M- and N-category vehicles
  - TFVS-09-06 (Cross matrix subgroup): Status 1st work package cross matrix
  - TFVS-10-06 (Japan): Questions to Study on sound level limits of M-and N-category vehicles on TFVS-09-06 and TFVS-07-11
  - TFVS-10-07 (Japan): Comment for the N2 category threshold
  - TFVS-11-03 (EC Consortium): Answer to TFVS-10-06
  - TFVS-04-10 (OICA/ACEA/ATEEL): Study on future sound limits values for type-approval for vehicles of category M & N
- ***21** – (JAPAN) Results simulations on reducing auto noise*
  - TFSL-03-06 (JAPAN): Technical review of R51-03 phase 3 in Japan
  - TFVS-08-04 Rev1 (JAPAN): Results of the simulation studies on reducing automobile noise from Japan
- ***22** - (OICA/ACEA/ATEEL) STUDY ON FUTURE SOUND LIMIT VALUES FOR TYPE APPROVAL FOR VEHICLES OF CATEGORY M & N*
  - TFVS-04-10 (OICA/ACEA/ATEEL): Intermediate presentation

- TFVS-07-03 (OICA/ACEA/ATEEL): Final report
- TFVS-07-04 (OICA/ACEA/ATEEL): Final presentation

- ***25*** *– (GERMANY) KBA Test campaign on Noise emissions 2021*
  - GRBP-76-27 (Germany) Campaign on noise emissions 2021.

4. SHORT SUMMARY OF PRESENTATIONS DONE DURING THE 11 SESSIONS OF THE UN TF-VS From March 2021 to September 2022

"INDIVIDUAL SHEETS"

Remark: The numbering of the 'individual sheets' does not reflect any order or priority

01 - (GERMANY) GENERAL IDEAS ABOUT THE WORK OF THE TASK FORCE SOUND LIMITS (PHASE 3)

SOUND LIMITS
MANIPULATION
GREYZONES
DRIVING BEHAVIOUR
ASEP
PTI, ROADSIDE CHECK

MAIN MESSAGES FROM THE PRESENTATION(S)

- In the current situation annoyance due to vehicle noise mainly has three different causes: manipulation, exploitation of grey zones within the existing regulations and driving behaviour.
- Limit value reductions are only effective for a very small group of vehicles.
- Limit value reductions have no effect on manipulated vehicles, even worse low limits increase the tendency to manipulate vehicles.
- Additional measures are recommended to have effects on manipulations and grey zones:
  - Introduction of RD-ASEP (Real Driving Additional Sound Emission Provisions)
  - support PTI (Periodical Technical Inspection) and roadside checks by an European Union-wide database on type-approval data (vehicles and components)
  - extending Market Surveillance (MkS) activities (required min. number of physical tests besides exhaust emission and MkS inside UNECE)
- The same approach (effect of different vehicle classes, engine types, perception areas and tyre types) should be worked out for the different vehicle classes to identify the best solutions for the specific problems.

SUMMARY

In the current situation with regards to introduction of phase 3 vehicles are often perceived as too loud due to:

1. manipulation(s) by the owner of the vehicle,
2. the exploitation of grey areas within existing regulations (“Flexibilities”),
3. and the driving behaviour of the driver.

On the other hand, non-manipulated standard vehicles without “flexibilities in the silencer area” are not perceived by the majority of the population as annoyingly loud.

Since the causes for annoyance are different in different vehicle classes/drivetrain concepts the relevance level/effect a measure (e.g. lower limit values) are also different in this categories.

GENERAL CONCLUSION:
(1) Limit value reductions alone only lead to marginal reductions in real driving noise emissions in the standard vehicle fleet due to the large proportion of vehicles with the possibility of complete flexibility in noise emissions (flap silencers, sound generators and hybrid drive boost).
(2) The reductions in limit values have no influence on manipulated vehicles or a negative influence, if the tendency to manipulate increases due to low limit values.

Useful alternatives or additions to Phase 3 limit reduction of M1 vehicles:

1. Introduction of RD-ASEP into UN-R 51 and Regulation (EU) No. 540/2014.
2. Adaptation of the interpretation of paragraph 6.2.3 (GRB-68-03) to RD-ASEP.

3. Creation of an EU-wide database on type-approval data (EU/UNECE) including sound emissions (vehicles & NORESS (Non Original Replacement Exhaust Sound System)) to support PTI and roadside checks.
4. Extending market surveillance activities with minimum measurement requirements of motor vehicles & NORESS with regard to their sound emissions.
5. Reduction of Sound emission limits in a moderate way, provided that the above four points should find support from the EU Member States and the UNECE Contracting Parties.

From the point of view of Germany, the work of the TF Vehicle Sound should be approached under the above five points

The Presentation only handles with M1 vehicles and the problems in Germany. Detail views are needed for all vehicles as defined in the UN Regulation No.51 with their engines, areas & tires etc. For each of these vehicles, engine, areas etc. the influence of limit value has to be clear. If there are better solutions to solve specific problems, these have to be worked out.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- It should be possible to introduce RD-ASEP in (EU)540/2014 through a co-decision process.
- 2 areas for the work field of the group = general traffic noise with L_{EQ} value + individual vehicle which can be really noisy due to 'flexibility'.
  Both areas have to be worked and the relation between these both areas has to be made clear. What to prioritize?
- Opportunity to be taken to transpose in (EU)540/2014 the progress done in UN regulations (close grey zones).
- In the future more and more Electric Vehicles. That will change the current view. Everything which was possible are now in vehicles as less aggressive flap systems.

REFERENCES

- TFVS-01-05 Rev.1 (GERMANY): General ideas about the work of the Task Force Sound Limits (Phase 3)
- GRBP-68-03 (IWG-ASEP): Interpretation of the last sentence in the paragraph 6.2.3. of the UN Regulation 51, 03 Series of amendments

Measurements & tests
Simulation
Survey
Lit. Study

02 - (JAPAN) GENERAL OVERVIEW OF VEHICLE NOISE IN JAPAN

NORESS&MANIPULATION
SINGLE EVENT
PREDICTION MODEL
SOUND LIMITS
ENFORCEMENT

MAIN MESSAGES FROM THE PRESENTATION(S)

- Both in-use vehicle with modified muffler and achievement of EQSs (Environmental Quality Standards) are allocated for noise issues.
- To improving noise issues, a holistic approach is necessary as well as reducing noise limits.
- The technical review to check the effect of the introduction of the Phase 3 from the UN Regulation No.51-03 in Japan should be useful to share such technical information at the TF-VS for next step (beyond phase3) discussion.
    - The effectiveness of Phase3 introduction in Japan will be done → See TFSL-03-06 & TFVS-08-04 Rev.1).

SUMMARY

- Current situation of vehicle noise in Japan
    - The achievement status of the EQSs (Environmental Quality Standards) of road traffic noise has gradually improved, but has not reached 100% yet.
    - The number of complaints of vehicle noise has increased or decreased depending on the year, but has not been decreasing in recent years.
    - In order to achieve the targets such as 100% in EQSs and reducing the number of complaints related to vehicle noise, holistic approach is necessary.

- Technical review of the UN Regulation No.51-03 phase 3
    - Japan have conducted the technical assessment before introduction of each phase of R51-03, and assessed its effectiveness by using a prediction model (JARI (Japanese Automobile Research Institute) model) detailed in the presentations.
    - Japan is planning for studies with effectiveness of the Phase 3 introduction including a survey regarding its impact in real life. Such study should be included in this TF-VS.

- Noise detection system
    - Modified muffler issue in Japan cannot be negligible.
    - NTSEL (National Traffic Safety and Environment Laboratory) is now doing research and development of noise detection device as described in the presentation in order to solve in-use noise issues.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- Future worldwide automotive electrification including the AVAS (Acoustic Vehicle Alerting System) has to be considered for the future works of the group because this should have an impact on the environmental noise.
- Works of the group not limited to M1/N1 only but to all M & N. Data needed for all vehicle categories.

To be able to identify where the noise issues lie, to build a kind of cross-matrix between traffic noise situations, contributing factors and major complaints as shown as an example in doc. TFSL-01-05 Rev.1 Page 9.

REFERENCES
- TFSL-01-06 (JAPAN): General overview of vehicle noise in Japan - TFSL-02-09 (JAPAN): Further details of vehicle noise issue and reviewing process in Japan - TFSL-01-05 Rev.1 (Germany): General ideas about the work of the TF

03 - (CH) LOW-NOISE ROAD SURFACES IN SWITZERLAND

ROAD SURFACE « ITSELF"

MAIN MESSAGES FROM THE PRESENTATION(S)

- Road traffic is the most important source of noise and is caused mainly by the rolling sound.
- Means used to control the propagation path of noise (e.g. barriers) only have an impact in a limited area, especially in urban areas.
- As reminder, +/-3 dB can just be perceived by human ear, while +/-10dB are perceived by humans as a doubling / halving of the noise level.
- -3 dB corresponds to halving of the traffic volume
- A low-noise road surface has an immediate impact on noise emissions up to 6dB and that for any vehicles (type, age, tyres, …)
  → road maintenance has also to be considered to keep benefits brought by a low-noise road surface. With low-noise road surfaces, an initial noise reduction of -3 dB can be achieved. Nevertheless, a shortened service life on average -10 years must be accepted.
- Work on road surfaces brings a win-win deal with the community and promote the acceptance by citizens. In the future, the aim is to increase the initial noise reduction linked to the new layer.

SUMMARY

From the study in Switzerland led by FEDRO (FEDeral Roads Office) related to the low-noise road surfaces, have been considered:

- Current noise situation in Switzerland
- Basic approaches to noise abatement: oppose the noise at the source (reduce the noise emissions, control the propagation path and the immission point)
- Traffic noise and noise perception
- Low-noise Road surfaces challenges

➔ Research & development on low-noise road surfaces in urban areas (2009-2017) through 3 subprojects (research, test tracks and monitoring test tracks)

  - 8 research projects including test methods, operation & maintenance of roads, variability of surface production, innovations
  - 15 test sections with innovative asphalt mixtures
  - Long-term monitoring

  Knowledge gained and initiated developments
    - Origin of rolling sound (vibrations, contact points, surface structure, cavities)
    - Semi-dense Road surface (SDA) for noise reduction on urban roads
    - Symposium in September 2017 → see document TFVS-04-04

- Low-noise surface 2021
    - Principles and service life of roads
    - International evaluation of StL86 surface in the Netherlands, Germany, France, USA, Japan, Sweden, Denmark
    - Practices & experiences through application of SDA surfaces with initial noise reduction -3dB(A) – up to -6dB(A) for SDA 4 and its evolution during service life
      → Challenge: optimization of acoustic and surface durability
- Additional research needed regarding the low-noise road surfaces
- Summary: with low-noise road surfaces an initial noise reduction of -3 dB can be achieved
  - a shortened service life on average -10 years must be accepted

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

This study shows a very holistic approach regarding what can be done through the roads vs. noise.

- Cost for new low-noise road surfaces and their maintenance (durability of the surface vs. noise) has to be considered.
- The cost can be reduced with a process to renew the road from the top layer and not fully from the ground.
- StI86/SMA 11 used according to Swiss calculation model (not a special surface) to compare roads worldwide with a gap up to 4dB(A) can be due to the potential different interpretations linked to the reference system definition of each country,
- Low-noise mastic asphalt developed by FEDRO (dense pavement) has a good potential and started last year. Results from the Research project expected within 5-7 years.
- For the time being, this project was looking for noise reduction in general, and not the type/source of noise.

REFERENCES

- TFVS-04-04 (Switzerland/FEDRO) : Lärmarme Strassenbeläge aus Asphalt / Revêtements bitumineux peu bruyants / *Low-noise bituminous surfacings*
- TFVS-04-09 (Switzerland/FEDRO) : Low-noise road surfaces in Switzerland
- Reports are available in German language (except EP1 in French) under the following link: RESEARCH+DATA-Shop - Mobilityplatform, or
  TFVS-04-17: Research package – Low noise pavements in urban areas – Report analysis
    - TFVS-04-18: EP1 No.1552 – Mix design of low noise asphalt
    - TFVS-04-19: EP2 No.1559 – Laboratory assessment of the durability of low noise pavements
    - TFVS-04-20: EP3 No.1423 – Operations and maintenance of low noise pavements
    - TFVS-04-21: EP4 No.1564 – Laboratory methods for acoustical characteristics of low noise pavements
    - TFVS-04-22: EP5 No.1566 – Optimisation of the accuracy of acoustic measurements
    - TFVS-04-23: EP7 No.1561 – Applicability of low noise asphalt in Switzerland
    - TFVS-04-24: EP8 No.1560- Acoustic effectiveness of cleaning measures on low noise pavements
    - TFVS-04-25: EP10 No.1616 – Sensitivity of acoustic properties of low noise pavements related to mixing plant production variability

04 - (STEER) CEDR (CONFERENCE OF EUROPEAN DIRECTORS OF ROADS) – BELGIUM - NOISE & NUISANCE – FINAL CONFERENCE LIEGE

MEASUREMENT UNCERTAINTY EUROPEAN TYRE LABELLING TYRES ROAD NOISE

MAIN MESSAGES FROM THE PRESENTATION(S)

- European tyre label is important information tool for consumers
- Noise is currently not a decisive purchase criterion for consumers
- Standard uncertainty evaluated between 1.4 and 2.0dB
  - labelling procedure in its current form is far from optimal.
- Measurement uncertainty can be halved if the improvements proposed by STEER (STrengthening the Effect of quieter tyres on European Roads) are implemented now (see recommendations below).

SUMMARY

European tyre label - recommendations by the STEER project:

- Improve temperature correction procedure
- Implement stricter requirements for test vehicles (ground clearance and wheelbase)
- Implement a procedure for testing entire tyre lines on laboratory drum
- Implement a reference tyre calibration procedure
- Add three legal noise classes to label (As before2021)

Recommendations regarding the impact of quieter tyres on European roads:

- Choose the optimal standard pavement of the road network
  - Consider choosing smooth to medium textured road surfaces
  - Avoid «rough-textured» road surfaces. -> High noise exposure

Recommendations: Increasing the market share of quieter tyres

- Further investigate, specify and test the different scenarios
- Industry agreement/ Consumer incentives
- Combine scenarios with additional incentives (benefits will likely offset the costs)

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

- TFVS stated that the proposals made by the STEER project should be reviewed and discussed in the framework of the informal working group on measurement uncertainty (IWGMU)
- Preliminary comments from IWGMU brought up a question about the comparability of measurement uncertainty values presented by STEER
- Furthermore, a question about the potential introduction of a systematic offset in R117 measurement results was raised in the IWGMU, that would be caused by one of the temperature correction models proposed by STEER
- As to this date the review and discussion of the STEER results is still ongoing in the IWG-MU

REFERENCES

- TFVS-11-04 / IWGMU-20-04: STEER-Project overview
- PEB: Research Programme 2018 Noise and nuisance (cedr.eu) → STEER (cedr.eu)

05 - (ISO) COAST-BY DRUM INDOOR METHOD ISO TC31 WG11, ISO 20908

TIRE ROAD NOISE MEASUREMENT UNCERTAINTIES

MAIN MESSAGES FROM THE PRESENTATION(S)

ISO 13325 standard [1] related to outdoor characterization of tyre sound emission is an expensive method with high dispersion. That justifies to develop an indoor sound emission measurement method with drum in indoor chamber (ISO 20908 standard [2])

The concept is based on:
- Microphone array in front of a coupled tyre/drum
- Corrections applied on noise result of 1 tyre to extend it to 4 tyres and to compensate microphone distance
- An alignment process with outdoor methods is proposed to establish corrections to apply to indoor results
- Development of a unique and standardized drum surface replicating the reference test track to reduce uncertainties with a better operational efficiency and improve correlation between sites (not yet available nor implemented in the standard, under development)

SUMMARY

Firstly, the test protocol described in the ISO 13325 [1] is reminded. This standard is related to the characterization of the tyre coast-by sound emission. This method consists in tyre noise measurements on an ISO test track at different vehicle speeds (from 70 to 90 kph). A linear regression is calculated to give the noise level of tyres at 80 kph. The "ISO TC31/WG 11" working group highlighted that a +/- 2 dB ([1]) measurement dispersion has been estimated due to some impacting parameters as tracks, vehicles, weather conditions, etc (see ISO 13325 amendment [4]). The author also argues that the current outdoor method is expensive.

The proposal of the ISO TC31/WG 11 working group is to develop an indoor sound emission measurement method using a drum in indoor chamber (ISO 20908 standard [2]). In this case, the environment could be controlled, there would be no influence of the vehicle and a better operational efficiency, allowing to reduce costs.
The method concept is the same as the outdoor standard with the use of a microphone array to simulate the trajectory of the vehicle as seen by the single microphone used in the outdoor method. In the presented experiment, the microphone array is at 1.8 m distance from a coupled tyre/drum. Corrections are applied to simulate the noise level of 4 tyres, and the microphone array distance from the tyre. The author precises that other sets-up could be implemented, as circular array or one moving microphone.

The next step is to quantify the correlation with the current outdoor methods on tracks (ISO 13325 standard [1] and UN R117 regulation). Different factors can affect indoor measurements as the drum diameter, the horn, the semi-anechoic chamber, and the rig. So, an alignment process has been proposed for C1 tyres. This process consists of a test campaign of 9 C1 ([2]) tyres according to the outdoor and indoor methods. These measurements allow to establish corrections applied to drum results. This process could be renewed each 2 years.

Then, the measurement uncertainties of the indoor methods have been estimated at +/- 2.2 dB ([3]) between sites. The main impacting factor identified is the drum surfaces deviation. To reduce this uncertainty, the author recommends working on a unique and standardized drum surface replicating the reference test track.

The author explained that works are ongoing to consolidate these initial results, and that he would like to implement this method in regulation, assuming acceptable performances.

The author concluded its presentation by giving some details on a current project by the WG11 working group. The concept is to produce thin surfaces reproducing on ISO 10844 tracks that could be used as drum surfaces. It would reduce uncertainties and improve correlation between sites. The concept consists of molding an ISO test track with a polyurethane mold. Then, to produce thin surfaces which will be fixed on drums. Thus, each drum will have a surface identical to that of the track and to that of the other drums.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

- Several road surfaces could be imagined and not only current ISO 10844 [3] to be able to characterize textures representative of real world and make possible for both road & tyre manufacturers to build products taking into account their mutual interactions.
  → an EC program could be developed to take into account road/ tyre/ vehicles.
- Get data at 50km/h should not be a problem, then an amendment to ISO could be proposed – however, much more difficult is how to simulate the torque.
- ISO will continue to work on a new test method to measure tyres for UN-R117 but data is needed to show good performances without changing the current limits, for discussions with Contracting Parties – for the time being no project for UN-R51.

REFERENCES

TFVS-05-05 (ISO): 20211026 -- WG11 indoor method concept for GRBP TFVS

[1]: ISO 13325:2019, Tyres — Coast-by methods for measurement of tyre-to-road sound emission
[2]: ISO 20908, Tyre sound emission test — Methods of drum
[3] ISO 10844:2014, Acoustics — Specification of test tracks for measuring noise emitted by road vehicles and their tyres

Please note that data have been updated after the presentation done during the 05th session of the UN TF-VS → *nb.: an updated presentation will be done in the future to the TF-VS.*

(1) Since this initial presentation, ISO TC31/WG11 has performed new estimations on ISO 13325 uncertainties, showing that track to track peak variation could be estimated at 5.4 dB, this value bringing a total uncertainty of +/- 3.1 dB for a coverage of 95%. See [4]: ISO 13325:2019/Amd.1:2023(E) (under publication process).

(2) Published ISO 20908:2022 requests 12 tyres to be measured to establish correlation and correct indoor measurement values.

(3) Published ISO 20908:2022 indicates an uncertainty of +/- 2 dB, without using unique surface concept under development. However, since ISO 13325 uncertainties have been re estimated to +/- 3.1 dB mainly due to track-to-track variation, the uncertainty of +/- 2 dB will not be reachable, unless using identical surfaces on drums.

06 - (FRANCE/BRUITPARIF) ROAD NOISE IN THE ENVIRONMENT – MEASUREMENTS IN REAL LIFE

SINGLE EVENTS
TYRE ROAD NOISE
ROAD SURFACE ‚ITSELF'
SOCIAL IMPACTS

MAIN MESSAGES FROM THE PRESENTATION(S)

Context:

- The environmental noise pollution is a major concern for Paris region with a social cost of noise due to road noise estimated to 16 billion €/year(*)

Main issues in road noise:

- People mostly complain about high noise peaks
- High noise peaks represent most of the noise generated by traffic in the city as well as on touristic roads
- As long as the vehicle fleet will be consisted of noisy vehicles and/or as long as uncivil behaviors will not be considered, improvements on passenger cars by manufacturers or the increase of Electric Vehicles (EV) will lead to light benefits on the overall noise situation
- Design efforts should be focused on reducing rolling noise
- Some development actions such as road requalification or/and implementation of anti-noise road surfaces have greater and more immediate positive impacts than the effects of renewing the car fleet or tightening regulations

Recommendations:

- Fighting against incivilities through awareness-raising actions, prevention campaigns and the reinforcement of the sanction system
- Act on rolling noise through better maintenance of roads, installation of noise-reducing road surfaces and reduction traffic speeds
- Generate more relaxed driving conditions by adding low speed areas, avoiding speed bumps, optimizing traffic signals
- Focus design efforts on the noisiest vehicles by encouraging the ecological transition of heavy vehicles, through a strengthening of regulations

SUMMARY

The environmental noise pollution is a major concern for Paris region with a social cost of noise due to road noise estimated to 16 billion €/year(*). 76 % of Paris region inhabitants are exposed to noise with 9 million people exposed to noise levels exceeding World Health Organization (WHO) recommendations and 1.5 million to French regulation limits. Also, 108 000 Disability-Adjusted Life Years (DALY) (*) are estimated every year due to noise health impacts.

Based on population surveys, the authors estimate that 54 %(*) of Ile de France residents are annoyed by noise when they are at home. This annoyance increases with the urban density (62 %(*) in Paris versus 42 %(*) in rural areas) and mostly about high noise peaks. 2 main sources are identified in the study: the noise coming from neighbors and from two-wheelers [1].

Focusing the study on transport noises, the authors argue that high noise peaks represent most of the noise generated by traffic in the city as well as on touristic roads. This conclusion is based on 3 specific test campaigns in Paris streets and on a touristic road. Using the acoustic-camera sensor named Medusa, the number of peak appearances and the noise sources per day have been identified. It has been observed that for the street located in the 3rd arrondissement of Paris, the contribution of noise peaks in ambient noise reaches 58 % and composed essentially of sirens (24 %), horn (15 %), trucks (8%) and two-wheelers (8 %). In the street located in the 15th arrondissement of Paris, the results of measurement show that the noise peaks

with a $L_{Amax} \geq 80$ dB(A) represent 1.5 % of the number of peaks measured per day but are responsible for 37 % in sound energy of road noise. Finally concerning the test campaign on a touristic road, the number of high noise peaks represents 13 % of events in average, responsible of 54 % of roadway noise on average.

After having identified the noise source types responsible of annoyance, the authors highlight that there are not significant improvements of the transport noise since 2013 with only a slight decrease of 0.2 dB(A) per year monitored on 3 locations in Paris region. It has been concluded that, as long as the vehicle fleet will be consisted of noisy vehicles and/or as long as uncivil behaviors will not be considered, improvements on passenger cars by manufacturers or the increase of Electric Vehicles (EV) will lead to light benefits on the overall noise situation. Indeed, the authors explained that the rolling noise of light vehicles is higher than the engine noise, even at slow speeds like 30 km/h, due to improvements on engine acoustic emissions. Therefore, the authors recommend that design efforts should be focused on reducing rolling noise and to keep in mind that the AVAS system of EV could be a risk to re-increase the engine noise in city centers.

The third part of the Bruitparif study is dedicated to the impact of infrastructure. According to the authors, some development actions such as road requalification or/and implementation of anti-noise road surfaces have greater and more immediate positive impacts than the effects of renewing the car fleet or tightening regulations. Indeed, the authors present some road improvements evaluated by Bruitparif. A reduction around 4 dB(A) have been measured thanks to a rearrangement of a national road. A resurfacing in Porte de Vincennes has been done in 2012 with an immediate reduction of 6.4 dB(A). The authors also show that the ageing of the road surface induces a 0.6 dB(A) increase per year. Other resurfacing roads on motorways are mentioned in the study showing a noise improvement of between 5.8 and 8.2 dB(A) one year after the replacement.

In conclusion, the authors make some recommendations to reduce road noise.

- First, they suggest fighting against incivilities through awareness-raising actions, prevention campaigns and the reinforcement of the sanction system.
- Secondly, they mention to act on rolling noise through better maintenance of roads, installation of noise-reducing road surfaces and reduction traffic speeds. The authors argue that rearrangement of traffic could be generate more relaxed driving conditions by adding low speed areas, avoiding speed bumps, optimizing traffic signals and so one.
- And finally, Bruitparif incites manufacturers to focus their design efforts on the noisiest vehicles by encouraging the ecological transition of heavy vehicles, through a strengthening of regulations.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

- The intention to reduce the speed limitation inside Paris at 30km/h is confirmed by the speakers.
- Noise peak events and driving behavior are predominant in noise complaints.
- The general approach is supported by several TF experts: where is the problem, what is the cause and then find the good solution.

REFERENCES

TFSL-03-05 (FRANCE/BRUITPARIF): Road noise in the environment – Measurements in real life

[1]: CREDOC (Centre de Recherche pour l'Etude et l'Observation des Conditions de vie - *Research Center for the Study and Observation of Living Conditions*) study for Bruitparif, 2016
(*) Please note that data have been updated in 2021 after the presentation done during the 03rd session of the UN TF-VS → *nb.: an updated presentation will be done in the future to the TF-VS.*

- BRUITPARIF, Le coût social du bruit en Île-de-France, 2021 (The social cost of noise in the Ile-de-France region – Bruitparif report 2021)
- CREDOC (Centre de Recherche pour l'Etude et l'Observation des Conditions de vie - *Research Center for the Study and Observation of Living Conditions*) study for Bruitparif, 2021

In 2021, the social cost of noise for Paris region was estimated to **42,6** billion €/year, of which **18,1** billion is due to road noise

158 000 Disability-Adjusted Life Years (DALY) are estimated every year due to noise health impacts.

Based on population surveys, the authors estimate that **56 %** of Ile de France residents are annoyed by noise when they are at home This annoyance increases with the urban density (**67 %** in Paris versus **48 %** in rural areas) and mostly about high noise peaks.

Category(ies) of vehicle: ALL → tests done only on L3 for the time being

Measurements & Tests
Simulation
Lit. Study

07 - (JAPAN) DEVELOPMENT OF AUTOMATIC ILLEGAL REPLACEMENT MUFFLER DETECTION SYSTEM AT NTSEL

NORESS & MANIPULATION
SINGLE EVENT
ENFORCEMENT

MAIN MESSAGES FROM THE PRESENTATION(S)

- NTSEL (National Traffic Safety and Environment Laboratory) is working on developing automatic sensing system from remote location, which detects vehicles equipped with illegal replacement muffler traveling on the road.
- By using microphone array, it was shown that it is possible to measure individual vehicle's pass-by noise in real-time.
- By using AI (Artificial Intelligence) created by deep learning, it was shown that it is possible to judge the vehicles whose proximity stationary noise level exceeds limit value from pass-by noise with high accuracy. However, the application is limited to motorcycles running alone.
- Now, NTSEL try to combine these two technologies to develop an automatic monitoring system that can measure individual vehicle's pass-by noise from the traffic flow and automatically judge whether it is illegal replacement muffler or not.

SUMMARY

Real-time noise source localization technique:

- When road traffic noise is measured with a single microphone, it is not possible to measure individual vehicle's noise in the traffic flow.
- Therefore, NTSEL developed a system that can measure each vehicle's pass-by noise in the traffic flow separately by using a microphone array.
- Microphone array is consisted of 31 microphones and a camera.
- Sound source localization is calculated by delay and sum beamforming algorithm.
- The calculation is executed by FPGA (Field Programmable Gate Array) and results are obtained at 25fps (frames per second).
- The system can measure sound pressure level emitted by a vehicle, but it cannot judge whether it is a vehicle equipped with illegal replacement exhaust muffler or not because it is judged by result of proximity stationary test in Japan.

Judgment method of illegal replacement exhaust muffler from pass-by noise:

- In Japan, street inspection is conducted by proximity stationary noise test. In case the results of the measurements exceed the limit value, a maintenance order will be issued.
- There is no correlation between proximity stationary noise and pass-by noise because the contribution rate of the noise source (engine, intake/exhaust, tires, etc.) at the measurement point is different each other. Therefore, it is difficult to judge illegal replacement muffler from pass-by noise.
- Deep learning is applied to determine illegal vehicle from pass-by noise.
- We will create AI model to classify illegal replacement muffler and legal mufflers.
- Accuracy is 90% or higher in creating AI-model.
- 6 L3-category vehicles were measured at public road. All of them were uncorrelated with the vehicles which were used to create the training data. AI model can judge 5 vehicles correctly.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

- Since the purpose of this system is to detect illegally modified vehicles, it does not take into account driving manners.
  For the time being, work done only on motorcycle because easier to be prepared for testing.

REFERENCES

- TFVS-04-08 : Development of automatic illegal replacement muffler detection system at NTSEL

Measurements & Tests
Lit. Study on radar

08 - (UK) DFT (DEPARTMENT FOR TRANSPORT) ACOUSTIC CAMERA RESEARCH

NORESS & MANIPULATION
SINGLE EVENTS
ENFORCEMENT
DRIVING BEHAVIOUR
DRIVER AWARENESS

MAIN MESSAGES FROM THE PRESENTATION(S)

- Roadside enforcement of excessive vehicle noise is complicated and time consuming.
- Softer measures such as driver awareness or signage have been shown to be ineffective.
- The objective of these projects is to provide local authorities or the police with enforcement tools capable of identifying noisy vehicles (especially for illegally modified vehicles, drivers revving engines unnecessarily and single events) from the roadside and capturing sufficient evidence for prosecution.
- Results of the work should be provided in 2023.

SUMMARY

1. Noise complaints received between 2018 & 2021 in the UK indicate that excessive vehicle noise is an issue and not only in rural areas.
   A two-phase research project was commissioned in 2018:
   - Phase one - Desktop review of existing technologies and practices related to the measurement and enforcement of vehicle noise
   - Phase two - Roadside trials of technology identified in phase one
     → Trial of noise camera device using microphone, ANPR (Automatic Number Plate Recognition) & video camera.
     → driving behaviour, such as decelerating, and acceleration was shown to have an impact.
     Some difficulties identifying vehicles were met when the traffic is complex.
     Software could be improved to reduce processing time and make interpretation of results easier.
2. Based on the findings of previous work:
   A 3-part research project was commissioned on ways to enable more effective enforcement of excessive vehicle noise.
   → Focus is on single events of excessive vehicle noise, and illegally modified vehicles.
   → Publication of results is expected in 2023.
   The 3 parts of the ongoing work:
   1. Defining excessive noise → identification of a series of simple guideline noise threshold including tolerances. The possibility for having a noise threshold dependent on the speed limit is also explored.
   2. Track testing of noise cameras including investigation of the impact of convoys creating complex traffic situations.
   3. Roadside trials linked to an amount of seasonal variations and modified vehicles to check the effectiveness of the noise cameras in different urban & rural environments to:
      - test out the technology in real conditions,
      - find out how the technology can interface with signs, road furniture and electrical connections.
      - allow police and local authorities to gain some experience and confidence in using these noise cameras which may encourage uptake in the future.

No data available for the time being but some data are expected in the coming months.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

- In the 2018 study, 75dB(A) was used as a threshold for investigation but not a limit – microphone was located at 6m height.
- When driving, the driver is able to see his speed from the dashboard, but he is not able to know how much noise he is producing.
- The driving style is in relation with noise and should be explored.
    - More and more 'road-devices' to be able to check the noise → it is important to learn: one side L_{EQ} and other side very loud vehicles; traffic noise vs. individual vehicle.
- The UN Regulation No.51 represents noise from vehicles with ASEP (Additional Sound Emission Provisions) for M1/N1 and soon RD-ASEP (Real Driving-ASEP).
- This presentation shows a lot of opened questions to be understood to be able to improve our understanding related to noise issues: what are the priorities?
- Complaints or long-term exposure with negative impact on health? Driving behavior? Illegal manipulation? Traffic? Weather conditions? Wet vs. dry road? Speed? Road surface? How to define the blanket noise? …
  A good knowledge is needed to be able to work on what UN-R can regulate.
- More issues due to single events rather than general traffic noise → Need to identify where the concerns are coming from.
- Roadside devices could allow authorities to tackle problem from single event not only for noise emissions but also for exhaust emissions.
- Introduction of panels displaying the sound measurement (as for speed limits) could be a good solution to reflect the noise measurement and stimulate people regarding the effect of their behaviour. Not necessarily with a fine, but at least information.
- The idea of having a general limit linked to the speed and perhaps the category of the vehicle with measurement by a noise radar to give information you are too loud. Similar approach in the US (75dB at 50m without questioning from which item is the noise coming), only to say you are too loud.
- Different levels/threshold of noise depending for instance on speed is an interesting approach.
- It was suggested to think if it would not be now the good time to separate discussion between type-approval of vehicles/limit values, manipulation/behaviours and roads.
- Maybe the good time for our TF to sort what needs to be done in our group that deals with the limits of new vehicles, and what needs to be done on the road, against manipulation and aggressive driver's behaviours.

REFERENCES

- TFVS-04-06 (UK): DfT Acoustic Camera Research
  → Final report webpage: https://www.gov.uk/government/publications/roadside-vehicle-noise-measurement-study-enforcement-and-technology
- TFVS-08-03 (UK): DfT Noise Camera Research (*3-part research project → result expected in 2023*)

09 - (FRANCE-SIA) « AUTOMOTIVE IN SOUNDSCAPE » FUTURE OF PASS BY NOISE REGULATION AND THEIR IMPACT ON CITY LIFE

TYRE ROAD NOISE
ROAD SURFACE « ITSELF'
GREY ZONES
SOCIAL IMPACTS

MAIN MESSAGES FROM THE PRESENTATION(S)

Context:
- The goal of the work is to analyze the noise emissions regulation with a broad vision: from noise sources to the urban soundscape
- The stakes are the improvement of environmental protection, public health/safety, and quality of life
- Technical inconsistencies exist between regulations and standards dedicated to vehicles, tyres and roads

Recommendations:
- Review the test protocol of the UN Regulation No.51 regulation by better considering the real car use
- Improve the consistency between the UN R51 and the regulation on tyre noise emission (UN R117)
- Update the current metrics used in regulations by implementing psychoacoustic metrics

Link to environmental data:
- In Ile de France, 49 % of the annoyance is related to road traffic
- Passenger cars represent 25 % of the annoyance
- Despite a weak correlation between vehicle homologation and source description, there is a good correlation between computed environmental maps and measurements
- Comply to tougher regulation to reduce citizen complaints has no real effect

Technical aspects of noise source impacting the pass-by noise:
- The tire/road interaction becomes a major source of noise
- The reduction of tyre sound emission is limited due to difficult compromise between noise and safety requirements
- A maximum noise deviation of 13 dB(A) has been measured between road surfaces

Conclusions:
- The rolling noise is so dominant that improving other sources has no effect when tire/road is at its best
- The reduction of tire and vehicle noises now reaches an asymptote
- It is recommended to work on road surfaces as the efficiency will be much better there

SUMMARY

The purpose of the work was to analyze the noise emissions regulation with a broad vision: from noise sources to the urban soundscape.

The SIA (Société des Ingénieurs de l'Automobile – *Society of automotive engineers*) working group explained the context of pass-by noise regulations, reminding the different stakes: the improvements of environmental protection, public health/safety, and quality of life. On the one hand, some technical inconsistencies between regulations and standards dedicated to vehicles, tyres and roads have been highlighted. In the other hand, the regulation (2002/49/CE) on noise in the environment has been introduced.

The author suggested a few recommendations. Firstly, it is proposed to review the test protocol of the UN R51 regulation by better considering the real car use. The second step would be to improve the consistency between the UN R51 and the regulation on tyres noise emission (UN R117). The last step mentioned would

be to update the current metrics used in regulations by implementing psychoacoustic metrics, to have a better quantification of the human perception.

The third part of the presentation was dedicated to noise perception in urban environment. The most annoying sources of noise among transport noises in Ile de France are the noise coming from 2 wheelers and horns [1]. A second survey conducted by Bruitparif [2] shows that 49 % of the annoyance is related to road traffic in which passenger cars represent 25 % of the annoyance.

Next, the author used studies from Bruitparif [1] to show that environmental noise data exist and only need to be analyzed (e.g. peak event measurements in Paris, noise radar implementation, …). The author finds that despite a weak correlation between vehicle homologation and source description, there is a good correlation between computed environmental maps and measurements. Due to this weak correlation, the author argues that comply to tougher regulation to reduce citizen complaints has no real effect.

The last part of the presentation was dedicated to technical aspects of noise sources impacting the pass-by noise of vehicles. The author pointed out that the tire/road interaction becomes a major source of noise (70 % for ICE (Internal Combustion Engine) and 90 % for EV (Electric Vehicles)). It was explained that due to the difficult tradeoff to find between tyre noise emission and tyre safety and CO_2/particle emissions requirements, the reduction of tyre sound emission is limited. Then, thinkings of the SIA working group on road surfaces are presented, consolidated by some examples of road improvements monitored by Bruitparif [1]. It has been shown that the aging of road surfaces induces a noise increase of 0.66 dB (A) per year. Furthermore, data provided by Cerema/Deufrabase on 22 roads tracks [3] showed that a maximum noise deviation of 13 dB(A) has been measured.
A last study on the impact of rolling noise has been performed by the author. Based on calculations, it is shown that the rolling noise dependency becomes so high that even considerable efforts on vehicles should have no impact on real roads, and that the reduction of noise limits to below 68 dB(A) should be useless.

The author concluded that the rolling noise is so dominant that improving other sources has no effect when tire/road is at its best. 4 dB improvement in vehicle pass-by noise would lead to 2 dB reduction on reference roads, which is well below the road variability (13 dB). The second conclusion is that the reduction of tire and vehicle noises now reaches an asymptote. The author therefore recommends working on road surfaces as the efficiency would be much better there (-6 dB).

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

- CNOSSOS (Common NOise aSSessment MethOdS in Europe – Environmental Noise Directive 2002/49/EC (END)) is a good tool because of harmonization, reproducibility everywhere in Europe and it allows to assess the effects of noise on the population. With the current limit values, it needs to be better understood and maybe updated.
- Progress have been made and now there is a need to evaluate the impact of these progress in real life and to understand what is reflecting by the noise maps. Limit values cannot have an immediate effect on real life.
- Measurements are in progress in different countries to catch technical information especially related to the vehicles measured (full acceleration or not, manipulated vehicles, …). Noise picture of different cities is needed.
- Different levels of contributions are possible for instance in making more difficult the manipulation of any vehicle. Nevertheless, everything is not possible through the regulations as for instance on driver behavior. With ASEP (Additional Sound Emission Provisions) and RD-ASEP (Real Driving-ASEP) in both UN Regulations No.41 & 51, some 'extreme' driving conditions are & will be considered.
- Regarding complaints, the peak events are one of the most annoying noise sources, and CNOSSOS is linked to that point. The peak events are not a part of our current regulations. A high flow of

vehicles in a dedicated street will have a different effect on health compared to the peak events/complaints.

REFERENCES

TFVS-05-04 (France_SIA): Automotive in soundscape

Working group members of SIA involved in this presentation: Acoucité, Bruitparif, Faurecia, Renault Group, Michelin, PSA group, Trèves, Valeo and Utac Ceram.

[1]: Bruitparif, 2016
[2]: Bruitparif, 2020
[3]: Cerema /Deufrabase

10 - (FRANCE) NATIONAL UPDATE: STUDY ON HEALTH AND SOCIAL COST OF NOISE IMPLEMENTATION OF SOUND CAMERAS

ENFORCEMENT
SOCIAL IMPACTS

MAIN MESSAGES FROM THE PRESENTATION(S)

Context:

- The environmental noise pollution is a major concern for France
- 2 studies have been conducted to highlight social costs of road noise by ADEME & BRUITPARIF
- 1 experiment supported by French government is on-going to participate in the fight against noise pollution

Main outputs:

- The cost of road noise is estimated at 81 billion euros per year in France according to ADEME
- The cost of road noise is estimated at 26 billion euros per year in Ile de France (Paris's region) according to BRUITPARIF
- The experimentation consists of 2 phases: the development of the sensor and next detection/recording of noisy vehicles for potential fines to drivers

SUMMARY

The presentation of France has the objective to give an up-to-date update of the transport noise status in France.

3 studies/experimentation have been mentioned:

- Social cost in France of all noise sources by ADEME [1];
- Social cost in Ile de France of road noise by Bruitparif [2];
- Noise cameras experiment launched by the French government in December 2021 [3].

The objective of the study led by ADEME, is to evaluate the social cost of all noise sources. This evaluation was carried out according to the ISO 1996-1:2016 standard and the 2002/49/EC regulation. The social cost has been estimated at 147.1 billion euros per year including direct costs (illness, accidents, hospitalization and medication) and indirect costs (health, well-being, productivity loss and property depreciation). According to the authors, the noise from transport (consisted of aeronautics, railways, and road transport) represents 66.5 % of the cost. The cost of road transport has been estimated to 54.8 %, i.e. 80.6 billion euros per year.

Bruitparif has carried out a second social cost study based on the data provided by ADEME on Paris and its suburbs area (Ile-de-France region). The authors inform that some calculation methodologies have been adjusted in comparison to calculations used in the ADEME study. The assessment conducted for the Île-de-France region (18 % of the French population) establishes that the costs caused by transport-related noise represent 26 billion euros per year, i.e. 27 % of the estimated cost of transport noise for the whole of France.

The last study presented is related to the inspection of vehicle noise emissions. Supported by the French government as part of the fight against noise pollution, the objective is to implement an experiment, that will allow the authorities to sanction vehicles that are too noisy. 3 French sonar companies have been involved in the project to propose a noise camera [4] able to automatic detect vehicle and its associated noise level. The implementation is leading in 2 phases: a first one dedicated to monitoring and calibration of noise cameras before their approval and a second phase dedicated to detection and recording of infractions.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS
- Social benefits should also be considered: what is the benefit compared to this huge amount of costs? - Fine at 135€ after a transitional period with threshold still to be defined

REFERENCES
TFVS-07-07 Rev.1: Study on health and social cost of noise – Implementation of sound cameras [1]: Coût social du bruit en France, ADEME, 2021 - https://librairie.ademe.fr/air-et-bruit/4815-cout-social-du-bruit-en-france.html [2]: Coût social du bruit en Ile de France, Bruitparif, 2021 - https://www.bruitparif.fr/cout-social-du-bruit-en-ile-de-france1/ [3]: Radars sonores : une expérimentation en conditions réelles pour lutter contre la pollution sonore, 2022 - Radar sonore | Ministères Écologie Énergie Territoires (ecologie.gouv.fr) [4]: Information on Medusa sensor is available at https://viginoiz.com/meduse.html

Category(ies) of vehicle : M, N & L (ICE & xEV)

11 - (BRUSSELS ENVIRONMENT) TESTING THE NOISE EMISSION OF INDIVIDUAL MOTOR VEHICLES IN THE BRUSSELS-CAPITAL REGION

DRIVING BEHAVIOUR
VEHICLE AGE, CAT., PWT, MASS, POWER

MAIN MESSAGES FROM THE PRESENTATION(S)

- The noise of each vehicle was identified in real situation at the 2 exits of one roundabout at a distance of 5 m from the passage of vehicles.
- One of the interests of this campaign lies in the access to data of each vehicle measured, speed and acceleration, but also model, type of vehicle, year of entry into service, etc. registered during the measurements in acceleration and with a moderate speed
- Conclusions
  - Reducing speed & acceleration will significantly decrease the noise emission → Decision done in Brussels since Jan.01, 2021 to reduce the speed to 30km/h leading to 10-20% of the population below the WHO guide values
  - Encourage public transportation
  - Prefer light vehicles (not too powerful)
  - No benefit with newer vehicle
- Next steps & goals:
  - Improve statistics for certain types of vehicles through 3 measurement campaigns per month in 2022
  - Test 'noise radar' technologies

SUMMARY

- In autumn 2020, The Real Urban Emissions (TRUE) assessed the air pollutant emissions of several thousand vehicles circulating in the Brussels-Capital Region. At the same time, Brussels Environment carried out noise level measurements at crossings on some of these vehicles, in a situation of acceleration and moderate speed.
- Factors analysed & their conclusions
  - Speed & acceleration → high impact of speed (rolling sound) and acceleration (engine noise) on noise emissions
  - Vehicle category → PC & LCV similar (+1dB) – Compared to PC & LCV, motorbikes & busses have a level +4dB, and for trucks +7.5dB
  - Vehicle age → almost no influence on the noise
  - Type of propulsion → a few differences between the different types of propulsion:
    - Petrol slightly less noisy than Diesel
    - Hybrid often in thermal mode
    - Additional measures are needed to highlight differences in the levels emitted for electric vehicles, which are under-represented during this measurement campaign. However, the first analyses highlight sports electric vehicles that are noisier than the average diesel or petrol vehicle.
  - Mass & power → general conclusion difficult because of the overrepresentation of private cars

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- Additional tests are needed and planned especially for motorbikes and trucks to be more representative.
- Accurate analysis was possible with collection of various data as age, type of propulsion, … from the registration plate (only Belgium plates) with the support of the federal public transport service.
- Mismatch between different study vs. real world is helpful to show that only sound pressure on vehicle is not enough. In parallel it has to be considered the use of the vehicle, manipulation, etc. with a potential penalty such as a fine.
- Suggestion done for future tests to also consider the tyres and especially their width which could explain what has been observed for electric vehicles and trucks.
- Other important points: Tests presented have been measured at 5m instead of 7,5m in the Regulations, and on wet surface. Corrections needed in order to be able to make accurate comparison regarding the values measured (about 2dB(A)). This has to be clear for instance through a footnote for 'public people'.
- Vehicle age seems to have almost no impact in real world → does it mean that in the future, lowering the L_{urban} value will change nothing in real world?

  Here we have the overall level of the vehicles and we do not see the composition. One explanation could come from the evolution over time of the noise distribution between the tyre rolling sound and the powertrain sound.
  Tyre noise has been improved. Nevertheless, the combination of the vehicle noise and the tyre noise is here not visible. Working on limits is not bringing tangible effects in real life in this case.
  Could also be linked to the more intensive use of wider bigger tyres and extra load tyres.

REFERENCES

- TFVS-08-05 (TFVS Sec.): Informal General overview - EVALUATION OF VEHICLE NOISE EMISSIONS INDIVIDUALLY POWERED VEHICLES CIRCULATING IN BRUSSELS-CAPITAL REGION
- TFVS-09-05 (Brussels Env.): Testing the noise emission of individual motor vehicles in the Brussels-Capital Region
- TFVS-09-07 (Brussels Env.): Art_20220111_BruitRemoteSensing_EN
- Available only in French and NL languages:
  - Bruxelles teste et met en œuvre de nouvelles technologies pour lutter contre le bruit du trafic routier… | Bruxelles Environnement
    Brussels is testing and implementing new technologies to combat road traffic noise... | Brussels Environment
  - Projet « remote sensing » | Bruxelles Environnement
    « Remote sensing » project| Brussels Environment

12 - (OICA) CONSIDERATIONS ON FUTURE ROAD TRAFFIC NOISE REGULATIONS

TYRE ROAD NOISE
SOUND LIMITS
ROAD SURFACE
xEVS
MINIMUM SOUND
ASEP
SINGLE EVENTS
VEHICLE FLEET
MEASUREMENT UNCERTAINTIES
PREDICTION MODEL
VEHICLE

MAIN MESSAGES FROM THE PRESENTATIONS

REPRESENTATIVENESS OF the UN Regulation 51, 03 Series ANNEX 3 VIA SOUND MODELLING

- Although UN R51.03 (Annex 3) has been designed already in the years 2000-2005 based on real in-use driving statistics of the 1990's and products representative for that time, the test procedure does still cover the urban relevant sound sources for all vehicle categories in a representative way.
- The sound behavior under different driving situations is still covered by the test procedures of Regulation UN-R51-03 for passenger cars.
  - UN-R51-03 ASEP (Additional Sound Emission Provisions) has already brought a significant progress for the sound emission in driving situations other than type approval condition. RD-ASEP (Real Driving-ASEP) will further optimize ASEP.
  - The major sound source on motorways is tyre rolling sound from truck tyres, which are not covered by UN-R51-03.
- UN R51.03 alone cannot cover environmental noise in a holistic way. Within the frame of the UN type approval system, more regulations address environmentally relevant sources
  - UN Regulation No.138 – AVAS (Acoustic Vehicle Alerting System) for electric vehicles in urban areas
  - UN Regulation No.117 for especially C2 and C3 tyres (retreaded tyres?)
  - UN Regulation No.28 on the horn (see data analysis by BRUITPARIF TFSL-04-05)
  - UN Regulation No.59 for NORESS (Non-Original Replacement Silencer Systems)

SINGLE EVENTS & RD-ASEP

- UN-R51-03 introduced extended requirements to cover not only urban driving situations, but as well other typical on road driving situations inclusive aggressive driving.
- ASEP has brought already significant improvements and RD-ASEP will provide further improvements.
- The UN Regulation R51 is a type-approval regulation on original equipment.
  - It cannot handle abuse of a vehicle and reckless driving behavior.
  - It does neither address nor cover aftermarket parts, such as replacement tyres or silencers.
- An increase of the market share of xEVs will help to reduce annoyance by single vehicles as their sound dynamic is much lower compared to combustion engine vehicles.
- OICA does not support a fixed limit on all driving conditions nor a limit on the acceleration test result similar to UN Regulation No.41.
  - Both ideas are not technically justified and will not provide a substantial benefit for the environment especially when looking to the wide field of "single events".

ELECTRIFIED VEHICLES (xEVs) & AVAS

- Pure electric vehicles will help to reduce potential annoyance from high powertrain noise due to high engine speed driving from ICE (Internal Combustion Engine), as their sound dynamic is much lower.

Electric vehicles will have the same sound emission and contribution to environmental noise as ICE vehicles whenever tyre rolling sound is dominant (road surface dependent > 50 km/h).

SUMMARY

REPRESENTATIVENESS OF UN-R51-03 ANNEX 3 VIA SOUND MODELLING

- The actual scope of UN-R51-03 is based on the Statistical background of ISO 362-1[1] on the Representativeness of the Test Method (Real Driving Cycles):
  The method provides excitation of all significant vehicle noise sources to provide the 90th percentile estimate of a vehicle's noise emission in an urban environment.
- RD- ASEP Based on a Sound Expectation Model (SEM) based on **physical principles** is assigned to each part source over its operation range. For every operation condition defined by vehicle speed, engine speed, load and performance an expected sound level $L_{EXP}(v, n, a, v{\cdot}a)$ can be calculated.
- Sound Level Part Source Analysis
  - M1 vehicles (Various PMR): Tyre rolling sound is the dominant sound.
  - N2 and N3 vehicles: Power train noise reduction would make HDV vehicle quieter as single event in an urban environment, but these vehicles are rarely seen in urban environments and thus do little contribute to urban noise. On motorways the tyre rolling sound becomes the dominating source for the overall sound emission.
- Sound Level Part Source and Vehicle Category Analysis
  - URBAN AREA
    - M1 and N1 vehicles: Tyre rolling is the predominant source.
    - N2 and N3 vehicles: Lower limits for trucks will have little impact in urban conditions.
    - M2 and M3 vehicles: Do not contribute to L_{EQ} traffic noise in a significant way. Are relevant to single event consideration
  - MOTORWAYS
    - Tyre rolling sound is the dominant for all vehicles categories on motorways.
    - Truck tyres are not covered by UN-R51-03
    - With a share of 10%-15% of heavy commercial vehicles on motorways during daytime, trucks create the major source for environmental noise.
    - Powertrain sound from trucks contributes little to the overall sound situation.
    - Lower powertrain limits for trucks will not result in a comparable improvement on highway situation.

SINGLE EVENTS & RD-ASEP

- WHO (World Health Organization) does not provide by now any recommendation, "as a relationship between single events and long-term negative health effects could not been proven".
- The vehicle sound emission regulation UN-R51-03 shall ensure that type approved vehicles have a sound performance consistent with physics and in line with the type-approved sound character.
- The provisions on ASEP introduced with UN-R51-03 provide already a good step forward, but RD-ASEP with its holistic approach will provide further progress especially on the maximum sound emission.
- Electric vehicles have a lower sound dynamic under high engine loads compared to ICE vehicles. More pure electric vehicles in traffic will help to reduce potential annoyance as single event from vehicles under extreme driving conditions.
- RD-ASEP is the right interim solution, to make sure that vehicles perform as technically foreseeable from the type approval and their sound emission will be dynamic limited.

ELECTRIFIED VEHICLES (xEVs) & AVAS

- A complete replacement of all ICE vehicles by electric vehicles (with AVAS) will in best case provide a benefit of 0,6 dB(A) for speed ranges below 55 km/h.
- Even this is questionable given that xEVs have typically more rolling sound, because their higher weight results in wider or extra load tyres.

- EVs will not change traffic noise in situations where tyre rolling sound is dominant.
- At low driving speeds (up to 30 km/h), EVs equipped with AVAS will not provide a substantial benefit to traffic noise, their “powertrain noise” is determined by regulations.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- It has been supported to take into account different types of tyres and highlighted that tyre/road contribution, and not only vehicle/tyre contribution should be taken into account.
- Driving behavior has still a big influence on vehicle’s noise result. A balance has to be found between future RD-ASEP in type-approval process and beyond the Phase 3.
- How to take into account in limit values the electrification of the vehicle’s market?
  For xEVs including current AVAS, extra-load tyres and/or wider tyres are used which can be a game-changer compared to the current ICE vehicles.
  AVAS prevents vehicle noise improvements in speed range < 40 km/h => compromise to find between single vehicle detection (safety for other road users) and environmental noise.
- The Phase 3 seems to be not very effective in reducing ambient noise.
- OICA requested a moratorium to be able to continue works:
  - in progress as MU (Measurement Uncertainties), RD-ASEP, different studies on vehicles and on tyres, …, and
  - to come as for R138 AVAS, R117 and retreaded tyres, R59 NORESS, tyres/road interaction, R28, …

REFERENCES

- TFVS-02-10 Rev.2 (OICA): Considerations on Future Road Traffic Noise Regulations
- TFSL-03-05 (FRANCE/BRUITPARIF): Road noise in the environment – Measurements in real life

[1] ISO 362-1 Measurement of noise emitted by accelerating road vehicles — Engineering method — Part 1: M and N categories.

13 - (OICA) MANAGEMENT OF NOISE EMISSIONS ACCORDING TO UN-R51-03 AT LOW SPEEDS VS. AVAS COMPLIANT TO UN-R138

SOUND LIMITS
MINIMUM SOUND
ASEP
TYRE ROAD NOISE
GREY ZONES

MAIN MESSAGES FROM THE PRESENTATION(S)

- AVAS (Acoustic Vehicle Alerting System) systems fail RD-ASEP (Real Driving-Additional Sound Emission Provisions) especially at lower speeds. -> needs Clarification
- With implementation of AVAS several grey zones in UN Regulation No.138 are detected.

Approach for Clarifications in UN-R138-01

- The AVAS operation range is expanded on the basis of the NHTSA model based on UN-R138-01 minimum sound levels to allow manufacturer a matching with existing regulations.
- In the presentation, a curve for the minimum/maximum level according to the speed and the tyres impact on vehicle's noise is proposed.
  - Minimum sound is defined up to 40 km/h. Maximum sound no longer constant, but ramped-up from > 0 km/h to 40 km/h and cannot become louder beyond 40 km/h.
  - Maximum sound is applicable to any driving condition up to 3 m/s² acceleration, not only to constant speed.
- Vehicles which are equipped with an AVAS fully compliant to these provisions are exempted from RD-ASEP.
- Sound enhancement systems which are operational beyond that speed range are subject to UN-R51 RD-ASEP.

Reflection of AVAS and Sound Enhancement Systems into RD-ASEP

- The AVAS max sound ramp-up principle can be established in RD-ASEP by creating a transient between UN-R138 to UN-R51-04 RDASEP
- The suggested parameter for Electric Vehicles set the power train and its dynamic in a way, that tyre rolling sound remains always the dominant source

SUMMARY

Conflicts between UN-R138 (AVAS Systems) and Draft of amendment to UN-R51 RD-ASEP

- According to draft of amendment to UN-R51, vehicles will have to comply to RD-ASEP when their sound systems operate outside the specification range of UN-R138.
- **AVAS systems fail RD-ASEP especially at lower speeds.**
- It is necessary to create a handshake between UN-R138 and UN-R51 RD-ASEP

Grey Zone in UN-R138-01

- 6.2. Acoustics characteristics :
  - "…Operation of an AVAS is permitted at vehicle speeds outside the specification range. …"
    This provision was primarily made to
    - Enable compatibility to USA FMVSS141
    - Allow fade-out of sound instead of a sudden shut-off to avoid driver and pedestrian irritations
- 6.2.7. Specifications on maximum sound level for AVAS
  - "… tested under the conditions of Annex 3 paragraph 3.3.2., …"
    Annex 3 paragraph 3.3.2. specifies constant speed test only. No specifications are given for sound emission accelerated condition.
  - "…shall not emit an overall sound level of more than 75 dB(A), if driving in forward direction.[3]"
    "[3] *The maximum overall sound pressure level of 75 dB(A) measured at a distance of 2 m is corresponding to the*

overall sound pressure level of 66 dB(A) measured at a distance of 7.5 m. The limit value of 66 dB(A) at a distance of 7.5 m is the lowest permitted maximum value in Regulations established under the 1958 Agreement."

Refers to UN-R63 for mopeds, which provides two limits for vehicles with maximum design speed below and above 25 km/h. (66 and 71 dB(A))

Approach for Clarifications in UN-R138-01

For clarity, the following modifications to UN-R138-01 could be considered

- **The AVAS operation range is expanded on the basis of the NHTSA model based on UN-R138-01 minimum sound levels to allow manufacturer a matching with existing regulations.**
- Minimum sound is defined up to 40 km/h.
- Maximum sound no longer constant, but ramped-up from > 0 km/h to 40 km/h and cannot become louder beyond 40 km/h.
- Maximum sound is applicable to any driving condition up to 3 m/s² acceleration, not only to constant speed.
- **Vehicles which are equipped with an AVAS fully compliant to these provisions are exempted from RD-ASEP.**
- **Sound enhancement systems which are operational beyond that speed range are subject to UN-R51-03 RD-ASEP.**

Reflection of AVAS and Sound Enhancement Systems into RD-ASEP

- **The AVAS max sound ramp-up principle can be established in RD-ASEP by creating a transient between UN-R138 to UN-R51 RD-ASEP**
- The ramp-up function is only applicable to vehicles equipped with AVAS devices which exceed the UN-R138-01 application range.
- In addition, the parameter table should be modified for electric vehicles (parameters in the presentation)
- EVs should be MANDATED to take measures to restrict the maximum acceleration during the test to 3 m/s².
- **The suggested parameter for EVs set the power train and its dynamic in a way, that tyre rolling sound remains always the dominant source**

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- As reminder:
  - Because of a new/young device/regulation, when UN-R138 has been created, the target was to allow flexibility and transient to US Standard FMVSS141. In EU/UN regulation, to regulate only the minimum values for other road user's protection, the speed range for type-approval has been limited to 20km/h vs. 30 in the US. And no compatibility with minimum levels in the US.
  - Discussions of the cut-off of the sound have to be continued because at that time the fade-out was not defined.
  - The maximum value was defined only to avoid eventual abuse.
- With the implementation of AVAS on more and more vehicles, several grey zones are detected.
- It is a good time to go more in detail and review this regulation with feedback/examples we have with vehicles equipped with AVAS, in keeping the EU/UN regulation compatible with the US Standard if possible.
- The group TF-VS supports the need to work on UN-R138 from the experience of last years

REFERENCES

- TFVS-04-12 (OICA): Management of Noise emissions according to UN-R51-03 at low speeds vs. AVAS compliant to UN-R138

Measurements & Tests
Lit. Study
Position

14 - (ETRTO) TYRES & ROAD TRAFFIC NOISE: WHERE IS THE POTENTIAL?

TYRE ROAD NOISE
SOUND LIMITS
VEHICLE SOUND
MEASUREMENT UNCERTAINTY
ROAD SURFACES
SINGLE EVENTS
TYRE LABELING
VEHICLE FLEET (TYRES)

MAIN MESSAGES FROM THE PRESENTATION(S)

- Tyre rolling noise is highly influenced by the excitation given by road roughness and road irregularities
- Target conflicts and the need to optimize not only tyre rolling noise, requires a holistic approach in tyre development and regulation
- Reducing measurement uncertainties, mainly caused by variations in the ISO 10844[1] test Road surface, is a major factor for improving the UN Regulation No. 117

1. Measurement Uncertainty regarding tyre noise:
   There is a potential to address a very significant part of the market that may result in not-compliant tyres if tested with a more accurate method and thus requiring re-design for noise reduction and improvements.
   - Significant improvement in measurement uncertainty is connected to introductions of ISO 20908[2] and especially a completely revised concept with a worldwide uniform test track surface within ISO 10844.
2. Tradeoffs regarding tyre performances
   Nonregulated performances are in clear trade off with noise performance and some of these performances are going to be regulated (Hydroplaning → Wet grip @ worn; Wear <- Abrasion)
   - There is a clearly scheduled industry commitment on the improvement of other performances addressing climate and safety while continuing working on the improvement of traffic sound emission by drastically reducing the measurement uncertainty.
3. Holistic Approach:
   Assessment of methodologies necessary to evaluate the whole ecosystem, e.g. road surface, peak noise, traffic regulations, etc. and stimulate its improvement regarding noise
   - Launch project calls on road/tyre interaction optimization for noise
   - Develop road labelling approach

SUMMARY

Generation mechanism of tyre-road noise (C1 tyres)

- Noise is the result of vehicle, tyre and road interaction.

History & Status

- The tyre industry has made important progress and reduced noise by up to 5 dB, more than halving sound emissions.
- Only by label comparison there are no apparent trade-offs, but in reality:
  - target conflicts do exist, especially amongst performances not visible on the label
  - the data sets are highly affected by noise measurement uncertainties

Margin for Improvements

- There are market groups with significant noise conflicts, but these conflicts differ per tire size, segment, niche market position & individual tire design strategy.
- Overall 80 % of analyzed groups show strong target conflicts of noise vs. other performances Potential
- The European Tyre Label is a good indicator of basic tyre performance. However, both tyre safety and comfort also depend on other performances in all conditions and for their entire lifespan.

- Many parameters are not covered by the label: wet-weather handling, dry braking performance, high-speed stability, aquaplaning , wear resistance, comfort and interior noise…
- Tradeoffs are not visible in assessments when based only on label performances! Tradeoffs are fully visible when analyzing non-regulated tyre performances, that by the way, are part of the forthcoming regulatory approach supported by tyre industry
- Measurement Uncertainty: about 70% of the C1 market is compliant within the test limit tolerance (2dB); If measured at the threshold, with the with current measurements uncertainty statistically there is a probability that 1 out of 3 tyres is approved as compliant with the limit although its noise emissions are actually above the limits.
- There is a huge improvement potential from addressing the measurement accuracy; Proposed roadmap in UN R117
    - -0,4 dB until 2024,
    - In addition -0,9 dB until 2027

<u>Potential for Noise Reduction</u>

- Influence of the road :
    - For the same tyre there are noise differences evaluated in different studies between 5 and 12 dB on public roads
    - Research into noise-optimized road surfaces, not impacting roads safety and durability, shall be one of the key objectives with regard to a further reduction in traffic noise.
- Local noise peaks disturbance caused by single events:
    - Local peaks represent a major part of local (not only traffic) sound emission.
    - However, L_{den} calculation does not consider them: regulatory limits on tyres and vehicles do not address the major disturbance as it is measured and felt by citizen.
    - Tyres are not a part of these peaks. Addressing tyre noise limits will not address the major disturbances that would remain out of scope. Taking into account the masking effect of the peak, the progress made on threshold will not be perceived by citizens.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

- Noise depends on the segment of the tyres.
    - E.g., xEV: wider and extra load tyres especially due to the additional weight of vehicles because of the batteries
- Only a small part of the tyre performances are currently regulated through Rolling Resistance, Rolling Sound & Wet grip (UN-R117). A lot of other parameters are considered as important by the customers.
- Uncertainties have also to be considered for tyres issues.
- Need of harmonization between UN-R51 & UN-R117.
- Roadmap on improvement of UN-R117 could be in two-steps:
    1. Uncertainties with Entry into force in 2025, and
    2. based on the work of ISO 10844 regarding the test track & outdoor/indoor with Entry into force in 2028

An approach as a working method could be to work on the different topics identified by different “teams”, and then to match all of them

REFERENCES

- TFVS-04-11 (ETRTO): Tyres road traffic noise – Where is the potential?

[1] ISO 10844: Acoustics — Specification of test tracks for measuring sound emitted by road vehicles and their tyres
[2] ISO 20908: Tyre sound emission test — Methods of drum

Category(ies) of vehicle : L, M, N

15 – (EC-PHENOMENA) THE PHENOMENA PROJECT - ASSESSMENT OF POTENTIAL HEALTH BENEFITS OF NOISE ABATEMENT MEASURES IN THE EU

POLICY DOCUMENTS:
Legislations, Noise Action Plans
LIMIT VALUES
ABATEMENT MEASURES
BENEFIT-TO-COST-RATIO

MAIN MESSAGES FROM THE PRESENTATION(S) AND REPORT

Long-term exposure to environmental noise from road traffic, railways and aircraft can lead to serious health effects, such as sleep disturbance, cardiovascular diseases, annoyance, cognitive impairment and mental health problems.

The European Environment Agency (EEA) estimates (2017-19 data) that 109 million people in the EU-28 are exposed to average road traffic noise levels (day-evening-night weigthed – L_{den}) of 55 dB(A) and higher.
The objective of the Phenomena study was to support the European Commission in defining the potential of measures capable of delivering significant reductions (20%-50%) of health burden due to environmental noise from roads, railways and aircraft by 2030, and to assess how relevant noise related legislation could enhance the implementation of measures, while considering the constraints and specificities of each transport mode.

The Noise policy should be integrated into a wider range of EU and national policy areas, while it interacts with climate targets, energy saving, vehicle and traffic safety, mobility, etc. to secure a holistic dimension and outcome likely to be more effective/efficient across the EU.

SUMMARY

NB: Please note that paragraph references below are coming from the report of Phenomena.
The report addresses traffic noise from road, rail and aircraft. The TF-VS is in particular interested in the road traffic noise. This is reflected in the summary.

A literature study summarized the history of the regulatory tools as well as their development. It assessed the progress and efficiency of EU as well as national regulations and Noise Action Plans, which revealed the need for alignment of the various assessment methods and also improvement of the EU method – END/CNOSSOS – since the interpretation varies over member states. (§.2.2.2.2).
The literature study also looked at various abatement measures, whereas in particular the EU Commission (2011) "Report on the implementation of the Environmental Noise Directive in accordance with Article 11 of Directive 2002/49/EC" suggests that "EU 'noise-at-source' legislation provides the most effective combination of measures for reducing noise impact", however the EEA report from 2020 suggests that combining solutions that affect source as well as the transfer through air will be the most cost efficient approach (§.2.2.3).

PHENOMENA recognizes/anticipates a gap between the END/CNOSSOS methodology and the TA test and real traffic noise. Since tyres that combine good safety and low noise exist, tighter limits and introduction of incentives targeting both OE as well as aftermarket tyres are expected to result in quieter tyres on the vehicle fleet. PHENOMENA recommends introducing a road surface indicator for noise and a corresponding label as well as guidelines on surface degradation and maintenance.

Regarding ***road noise solutions*** (§.2.3.1.), the consortium presented improvements on EU legislation for road. vehicle noise limits, tyre noise limits, and road infrastructure. The main points for **road vehicle noise limit legislation** is that there is room for targeted **tightening of limits** for **louder vehicles** in order to affect Lden levels and L_{max} levels as well as **for powered two-wheelers** (PWT). Furthermore, it was suggested that the whole speed and rpm range must be covered to achieve reductions in real world noise exposure. Therefore, **the gap** between **real-world** noise, type tests and **noise mapping** must be addressed. Additionally, in synergy with the Green Deal, propulsion noise should be reduced since electrification does not occur as fast as foreseen (or does not have a fast enough effect) .
Regarding **tyre noise limits**, the consortium highlighted that there seems to be room for further noise reduction based on tyre label statistics. If this reduction is feasible, it would have an EU-wide benefit within several years. Moreover, the consortium also recommended providing more (financial) incentives in addition to tightening noise limits. Finally, better information on the tyre fleet and its full reduction potential should be provided to improve tyre-related policies.

Noise abatement scenarios have been defined (see table below). The baseline assumes no change or improvement of the vehicle fleet sound emission linked to the introduction of step 1 and 2 of the Vehicle Sound Emission Regulation, but a stable deterioration as a result of increased people and goods transport.

Scenario	Highly annoyed persons (%)	Highly sleep-disturbed persons (%)	DALYs (%)	Monetized health burden (method 1 / 2) (%)
A quiet roads	0.6	0.4	0.5	1.0 / 0.5
B quiet tyres	14.0	11.8	12.8	17.6 / 12.8
C vehicle limits	2.0	1.9	2.0	2.7 / 1.9
D electrification	1.5	1.5	1.5	2.1 / 1.5
E barriers	1.1	0.8	0.9	1.6 / 0.9
F speed restriction	10.5	8.9	9.6	13.3 / 9.6
G car-free zones	1.5	1.5	1.5	1.5 / 1.5
H quiet facades	3.1	2.8	3.0	3.8 / 2.9
I dwelling insulation	2.3	2.1	2.2	2.6 / 2.2
J reception limits	11.1	3.2	6.9	19.3 / 7.7
ABC combined	17.2	14.8	15.9	21.5 / 15.8
ABCD combined	19.2	16.7	17.9	24.0 / 17.8
FGHI combined	16.6	14.9	15.7	20.0 / 15.7

The Benefit-to-Cost Ration (BCR) – the efficiency – of various measures and combinations of measures have been estimated with two methodologies, revealing that the more measures the better health improvement, however not consistently supported by the BCR. For example, only the EC 2019 Handbook for BCR, but not the HEIMSTA estimate positive BCR of the combined measures ABCD (source improvements) and none of the methodologies support FGHI (Traffic flow/access restrictions and building improvements).

PHENOMENA recommends the combination of assumingly individually independent measures ABCDFGHI, but not E (erection of noise barriers) since the efficiency can be low or the solution is impossible in city environments. However, the latter measure is popular in the national and local Noise Action Plans. On the other hand, the favourable BCR of scenario B is diluted by in the linear combination of scenarios by the much poorer BCR:s of the other scenarios.

An overview of recommendations as presented to the TF-VS embracing the scope of GRBP.

VEHICLE SOUND RECOMMENDATIONS (§.8.3.3. & §.2.3.1. & Annex 2 – Poll results):

- Reduced vehicle sound limits should focus on:
  - Available space for new limits derived from type test databases;
  - Available technical potential for further reduction;
  - Potential of electric and hybrid vehicles; and
  - Potential of the reduced tyre contribution, especially in combination with road surfaces.
- 1-2 dB beyond Phase 3 limits expected to be feasible, but also L_{WOT} besides L_{urban}
- The full speed/acceleration/rpm range must be covered to achieve reductions in real world noise exposure (gap between real noise, type test and mapping)
- In synergy with the Green Deal, propulsion noise should be reduced even if electrification is not as fast as foreseen
- More detailed analysis in parallel study on M and N category vehicle sound limits

TYRE ROLLING SOUND LIMITS RECOMMENDATIONS (§.8.3.2. & Annex 2 – Poll results):

- Further reduction from stage 2 limits in UN Regulation 117 and referred to by EU Regulation 2019/2144 regular review for potential reduction
- Better information on tyre fleet required, and full reduction potential
- Tyre limits also include aftermarket (replacement) tyres
- There seems to be room for further reduction based on the label statistics and research
- Besides tighter limits also incentives required (financial)
- Noise vs safety: take existing quiet tyres as a starting point
- Better models and test procedures for tyre noise required, include various road surfaces

ADDITIONAL POINTS FROM DISCUSSIONS IN THE TF-VS

Concerns were raised about the traffic noise model used for the CBA relied on an average estimation of the traffic flow – vehicle speeds, number of passages, etc.
The year-by-year introduction of new vehicles is considered in the study based on new vehicles sold. This could be more accurate when the annual mileage of the vehicles would be available.

REFERENCES

- TFSL-03-04 (TNO): THE PHENOMENA PROJECT - Assessment of **P**otential **He**alth Benefits of **No**ise Abate**men**t Me**a**sures in the EU
- TFSL-05-03 (EC DG/ENV.): Noise policy update & PHENOMENA
- - Official report:) Assessment of potential health benefits of noise abatement measures in the EU - Publications Office of the EU (europa.eu)
- END/CNOSSOS Directive 2002/49/EC
- WHO (2018) Environmental Noise Guidelines for the European Region. Regional Office for Europe. Available at: http://www.euro.who.int/__data/assets/pdf_file/0008/383921/noise-guidelines-eng.pdf
- WHO (2011) Burden of disease from environmental noise http://www.euro.who.int/__data/assets/pdf_file/0008/136466/e94888.pdf

16 - (EC/IDIADA) LEON-T - LOW PARTICLE EMISSION AND LOW NOISE EMISSION TYRES

TYRES PARTICLE EMISSION
TYRES ROAD SOUND

MAIN MESSAGES FROM THE PRESENTATION(S)

LEON-T (Low particle Emissions and lOw Noise Tyres) is a project mandated by the European Commission under the Societal challenges – Smart, Green and Integrated Transport.
The motivation of this project is to significantly increase the knowledge and evidence about particle and noise emissions from tyres and their associated effect on public health, in order propose mitigating measures through regulation, labelling and tyre design.

SUMMARY

Leon-T project objectives:

- Increase the knowledge about the measurement of **particle and noise emissions** from tyres and their associated **effects on public health**
- Propose effective and efficient **mitigating measures** through regulation, labeling and tyre design
- Correlate particle abrasion and particle emissions in lab and road tests
- Proposal and validation of an in-vehicle test set-up for the determination of **tyre abrasion** rate, suitable for consumer-oriented labelling
- Investigation of the cardiovascular health effects of exposure to tyre generated noise during sleep
- Design and construction of a low noise, low rolling resistance tyre
- Recommendation of policy measures to limit the contribution of tyre-road interaction to micro plastics in the environment, to airborne particles exposure and to traffic noise.

The work has been split in 8 Work Packages between the different partners implied in this project.
The work has started in June 2021 and expected to be finished in May 2024.

ADDITIONAL POINTS FROM DISCUSSIONS

The presentation explained the objectives of the program that had just started.

- Single events during night-time included in this study
- Based on studies from INSA and VTI, they have recreated real traffic scenarios in line with real life (motorways & high-speed roads nearby communities with realistic sounds which could be heard at different distances of motorways) – transition due to different density of traffics are included due to acceleration of vehicles but always in the context of high-speed tracks.
- Different concepts of airless tyres are considered. Only one tyre manufacturer for C3 in China
- Conservation of road is really important because of interaction road/tyres → The tests will be done on real roads (different types of roads) and their characteristics will be recorded. One representative pattern is defined. Overall particles generation and the size of particles will be evaluated for any tyres. But impact of road on tyres is not included in this study.
- This study could be used to make the link between tyres abrasion & noise.

REFERENCES

Partners of the Leon-T project:

- Car and tyre manufacturers: FORD, AUDI, LLG (Shandong Linglong Tire)
- Applied research organizations – Tyre/road interaction: IDIADA (Spanish Institute of Applied Automotive Research), TNO (Netherlands Organisation for Applied Scientific Research), VTI (Swedish National Road and Transport Research Institute), JRC (Belgium EC Joint Research Centre)

- Scientific research organizations – Health aspects (Noise & particles): RIVM (Dutch National Institute of Public Health and the Environment), INSA-Lyon (French university - Institut National des Sciences Appliquées), UGOT (Swedish University of Gothenburg)
- SME: ETU (Swedish Euroturbine AB), BAX (Spanish innovation consultancy)

- TFVS-08-08 Rev.1 (EC/IDIADA): ppt LEON-T project
  - EC Program : Low particle Emissions and lOw Noise Tyres | LEON-T Project | Fact Sheet | H2020 | CORDIS | European Commission (europa.eu)
  - Website LEON-T: https://www.leont-project.eu/

17 - (EU/IDIADA) STUDY BY IDIADA & RACC ON L-CATEGORY NOISE LEVEL LIMITS

SOUND LIMITS
NORESS & MANIPULATION
ENFORCEMENT

MAIN MESSAGES FROM THE PRESENTATION(S)

The objective of this study is to assist EC DG/GROW with the evaluation of possible new sound level limits for L-category vehicles. In order to do so, the following sub-objectives were defined:

a) Evaluation of the sound level of the state-of-the-art vehicles
b) Ranking of the different sources of noise of the vehicle
c) Proposal of new sound-level limits

To reduce real world noise issues from L-category vehicles, avoiding tampering by enforcement (market surveillance, PTI, …) is the better solution over lower Type Approval noise level limits.

SUMMARY

EU Commission study, performed by IDIADA & RACC -ACASA (Real Automòbil Club de Catalunya), as technical support for the impact assessment for the Euro 5 step of L-category sound emissions level limits.

- The study contained following tasks:
  - Estimation of L-category fleet representativeness in the sound emissions, by means of a stakeholder summary.
    Main conclusions:
    - Fitting NORESS (Non-Original Replacement Exhaust Sound System) is seen as having a significant impact on motorcycle noise perception,
    - L3's seen as the vehicle category more prone to tampering,
    - L3e-A3 seen as sub-category more difficult to comply to current sound level limits,
    - Opinions regarding a possible sound emission level limit reduction are divided
    - In-use controls are understood as an efficient way to lower the real-world noise emissions caused by motorcycles in an efficient way.
  - Verification of sound level limits of current motorcycles (19 vehicles tested)
    Main conclusions:
    - All 18 vehicles below current limits
    - The margins between the test results and the current limits vary depending on vehicle sub-category
    - Most vehicles tested according to the new R41-05 RD-ASEP give positive results.
  - Noise Source ranking tests, mapping out which sub-components are the main contributors to motorcycle noise. The tested vehicles were selected based on diverse configurations (not based on sales volume).
    Main conclusions:
    - Various technologies are used for L-category noise control and influenced by the type of vehicle.
    - Available space is a key point for the definition of the most cost-effective strategies for noise control
    - Technology refinements applied to silencers, shields, packaging, engine block vibrations, gearing or valve design can provide noise reductions.
    - Expected noise reduction of reasonable (evolutionary) design modifications of L-cat vehicles is low
  - Cost Benefit Analysis of different scenarios:
    Main conclusions:
    - Reduce tampering /Increased enforcement (scenario A); Positive cost-benefit ratios

- Reduce tampering and -2 dB (scenario B): Technically feasible (except for very low powered motorcycles PMR < 50); Positive cost-benefit ratios.
- Reduce tampering and -4 dB (scenario C): Technically unfeasible; Negative cost-benefit ratios;
  - "unfeasible" (1) Technical: not possible more than 3dB, and (2). Cost too high.
- Reduce tampering and -2 dB + -2 dB (scenario D): Technically unfeasible; Positive cost-benefit ratios
- The study confirms the need to address tampering issues with regards to motorcycle's noise as an urgency

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- The EC acknowledges that tampering should be addressed first (e.g., Market Surveillance, PTI, …)
  - Usually tampering issues are coming mainly from after-market, vehicles manufacturers can do more or less nothing
  - Do we need 'more regulation' if current ones are not enforced? Limits we have now are stringent, but there is need for enforcement.
- IMMA points out that that each motorcycle type has its own challenges (= no one technical solution to reduce Motorcycle noise).
- Germany MoT (Ministry of Transport) remarks that drastic noise limit reductions will have a negative effect on manipulations.

REFERENCES

- TFVS-04-15 (EC) TF_SL-4_13-14-09-2021_L_Cat_Euro_5_step_project_presentation
- TFVS-09-04 (EC-Idiada) Present_L_cat_vehicles_IDIADA_RACC_TFVS 9 24052022_v3_Final2
- TFVS-10-03 (EC) EC Study for L-categories
- TFVS-11-08 (Secretary) Publication of EC impact assessment on euro-ET0522080ENN
  Link to the official report: Technical support for the impact assessment on Euro 5 step of L-category sound emissions level limits published on June 03, 2022

18 - (IMMA) STUDY BY IMPACT ASSESSMENT INSTITUTE (IAI) – ACUSTICA AND T.U. GRAZ ON L-CATEGORY NOISE LEVEL LIMITS

SOUND LIMITS
NORESS & MANIPULATION
ASEP

MAIN MESSAGES FROM THE PRESENTATION(S)

1) Scrutiny study on EU commission's 2017 Cost benefit analysis on Euro 5 sound level limits for L-category (see references below):
   - High uncertainty inherent to cost benefit calculations
   - Reviewed and updated cost benefit calculation show lower benefit/cost ratios from reduced sound level limits
   - Single events difficult to fit in a cost benefit calculation
2) Noise Source Ranking study:
   - -2dB sound level limit reductions technically challenging, while -5dB reductions are unfeasible.

SUMMARY

Expert review of EU Commissions 2017 cost benefit analysis study on Euro 5 sound level limits for L-category by IAI (Impact Assessment institute) and Acustica,
Supported by a Noise Source Ranking study performed by T.U.Graz

1) Noise Source ranking:
   - Performed on 8 motorcycles, on intake noise, engine noise (mechanical), exhaust noise, overall noise.
   - Challenging technical interventions necessary to meet -2dB reductions,
     - Robust and accurate cost estimations are difficult to achieve due to:
       - Multiple vehicle systems need to be re-designed at the same time to achieve notable reductions,
       - Different vehicle types require intervention on different combinations of vehicle systems.
   - -5dB reductions unfeasible for smaller motorcycles and very challenging or potentially unfeasible for larger motorcycles
     - Not possible without extensive intervention into vehicle and engine concept
   - Due to different characteristics, the main noise sources vary model by model (e.g. smaller scooters' main contributor is usually the driveline, while for bigger motorcycles the exhaust has a much higher contribution to the overall sound emissions)

2) EU Commissions 2017 cost-benefit study scrutiny
   - 2017 results have a high level of uncertainty due to inconsistencies in input parameters and unsubstantiated assumptions (absence of sources).
   - After reviewing and updating the 2017 cost benefit's assumptions, data and calculations, the benefit/cost ratio (2dB reduction, 25% illegal exhausts scenario) reduced from 2,18 (2017 study) to 0,82 (2021 updated study), though still subject to high uncertainty
   - No validation of the 2017 study claims that impact of larger limit reductions is stronger for single events. The 2017 Single event analysis is incoherent.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- When considering future limit values also:
  - UN Regulation No.41-04 ASEP (Additional Sound Emission Provisions) and No.41-05 RD-ASEP (Real Driving-ASEP),
  - the type and category of vehicle, and
  - anti-manipulation and driving behaviour measures

  need to be considered.
- RD-ASEP step 2 is being considered

REFERENCES

- TFVS-07-09Rev1 (IMMA) IAI-Acustica-TUG study_motorcycles
- TFVS-07-10 (IMMA) TUGraz_-_Experimental_Noise_Source_Ranking
- TFVS-07-12 (IMMA) IAI_and_Acustica_-_CBA_study_on_Euro_5_sound_limits_for_L-category_vehicles
- TFVS-08-07 (IMMA) 220404 IAI-Acustica Presentation for TF-VS final
- TFVS-08-09 (IMMA) Report FVT-044-21 ACEM NSR _April_4th_Meeting
- Link to the official report: Technical support for the impact assessment on Euro 5 step of L-category sound emissions level limits published on June 03, 2022

19 - (EC/EMISIA) STUDY ON SOUND LEVEL LIMITS OF M- AND N-CATEGORY VEHICLES

SOUND LIMITS
TYRE ROLLING SOUND
VEHICLE SOUND
ROAD SURFACE/TYRE SOUND

MAIN MESSAGES FROM THE PRESENTATION(S)

Study linked to the project entitled "Study on sound level limits of M- and N-category vehicles" mandated by the European Commission, which aims at reviewing and possibly updating the sound level limits for all M- and N category vehicles, taking into account the evolution of sound levels of approved vehicle types, the citizens' needs, and the technical and economic feasibility.
Based on literature review, data, Cost Benefit Analysis with different scenarios, proposal for tightening limits on sound for certain types of vehicles and tyres, and ASEP (Addition Sound Emission Provisions) impact evaluation.

SUMMARY

The study makes an inventory of the needs of society on sound. This is based on a questionnaire for the social partners. Also, earlier research of WHO (World Health Organization)[1] and the PHENOMENA[2] report is referred to. Industry stakeholders are interviewed in order to identify areas for improvement.
The further steps of the study include

- Testing of vehicles and noise source ranking analysis,
- Cost benefit analysis,
- Proposals for phase 4 limit values only for some subcategories, and
- Proposals for amendments of the measurement method and ASEP requirements

The noise source ranking analysis showed that L_{urban} is dominated by tyre/road noise for M1 vehicles.
The cost benefit analysis included the following 6 scenarios:

A. Available limit space,
B. Targeted limit tightening,
C. 75 dB(A) cap,
D. L_{wot} restrictions,
E. Improved pass-by tests (incl ASEP),
F. Quieter tyres (-3 dB(A))

And 6 combinations of these

The most important result is that a further reduction of tyre limits (scenario F) is much more beneficial than further reductions of vehicle noise limits. The percentage health burden reduction in 2045 is calculated about 5 times higher for scenario F compared to the average of scenarios A to D. But scenario F is out of the scope of this study and thus was not considered for the proposal for phase 4 sound level limits.
Scenario E (improvements of the ASEP requirements) is a bit more effective than scenarios A to D, but its implementation would also require an extension of the scope of the study and more effort than limit value reductions according to scenarios A to D. Therefore, this scenario was also not considered.
Due to the low differences between the simulated scenarios A to D the potential for limit changes was based on the KBA and RDW database analyses (type approval and vehicle stock data from databases available at that time of this study), which are in line with the CBA scenarios A and B.
The proposals for phase 4 sound level limits were made vehicle subcategory specific as follows:

- No further phase 4 reduction (most important M1 subcategories, all M2 subcats, N1 with TPMLM > 2500 kg, N2 with P_{rated} > 135 kW and N3 with P_{rated} between 150 and 250 kW,

- 1 dB(A) reduction for very high powered M1, all M3 subcats, N1 with TPMLM <= 2500 kg, N2 with P_{rated} <= 135 kW and N3 with P_{rated} <= 150 kW,
- 2 dB(A) reduction for N3 with P_{rated} > 250 kW.

According to the measurement method for M1, M2 with TPMLM <= 3500 kg and N1, it is recommended to scrutinize the validity of the calculation method for L_{urban} since the database (in-use driving behaviour data) was collected between 1995 and 2005 and since the PMR (Power to Mass Ratio) of the vehicles under discussion have been increased significantly and this trend is not yet broken. The average values for M1 vehicles increased from 62 W/kg to 70 W/kg between 2005 and 2020.

An analysis regarding the contribution of different noise sources to the overall vehicle noise showed that, in particular with the advancing electrification of the vehicle fleet, the tyre/road noise will become the dominant noise source (certainly for M1 vehicles above 30km/h and likely for other vehicles, albeit at higher speeds).

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

In the GRBP TF-VS focusses on the scenarios of the CBA, there was controversy on the proposed timeframe and expected impact for the introduction of the measures related to tyres and road surfaces.
The assumptions used in the report indicate that quieter tyres are already on the market and this technology can be introduced more widely.
This is technically not feasible in the proposed timeframe according to the tyre industry. More detail in the ATEEL reports (TFVS-07-04 & TFVS-11-05).

REFERENCES

The research was conducted by a consortium consisting of
- Laboratory of Applied Thermodynamics (LAT) (overall framework contract coordinator)
- EMISIA (technical coordinator and project manager)
- Forschungsgesellschaft für Energietechnik und Verbrennungsmotoren (FEV)
- Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek (TNO)
- Heinz Steven Data Analysis and Consultancy (HSDAC).

on the request of EC DG GROW (Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs of the European Commission).

- GRBP-73-23 (EC): Study on sound level limits of M- and N-category vehicles – intermediate report,
- TFSL-02-08 (EC): M- and N- sound limit study – intermediate report,
- EC Study for M/N-cat. or TFVS-07-11 (EC/EMISIA): Study on sound level limits of M- and N-category vehicles – full report, https://op.europa.eu/en/publication-detail/-/publication/d23a63bc-8310-11ec-8c40-01aa75ed71a1/language-en
- TFVS-09-03 Rev.1 (EC-HSDAC): presentation of the EC study for M_N vehicles

[1] Environmental noise guidelines for the European Region: WHO Regional Office for Europe. ISBN: 9789289053563
[2] TFSL-03-04 (TNO) & TFSL-05-03 (EC DG/ENV.): Phenomena project → Official report: Assessment of potential health benefits of noise abatement measures in the EU - Publications Office of the EU (europa.eu)
[3] TFVS-07-03 & TFVS-07-04 (OICA/ATEEL): report & presentation of the OICA/ATEEL study, and TFVS-10-04 Rev.1 & TFVS-11-05 (OICA/ATEEL): Comparison between EC/EMISIA & OICA/ATEEL studies

Category(ies) of vehicle: M & N

20 - (JAPAN) QUESTIONS & ANSWERS/COMMENTS ON THE EC/EMISIA STUDY ON SOUND LEVEL LIMITS OF M- AND N-CATEGORY VEHICLES

VEHICLE CATEGORY
ROAD SURFACE
PREDICTION MODEL
TRAFFIC FLOW / CONDITION
CROSS-MATRIX
VEHICLE FLEET

MAIN MESSAGES FROM THE PRESENTATION(S)

- It is important to understand assumptions of traffic conditions on each study for defining a traffic scenario impacting the noise in real life.
- Asking questions and comments to the EMISIA study[1] in order to clarify the assumption or background for traffic noise simulation.
- Findings
  - There are several differences for the conditions of traffic noise calculation among studies.
  - Need consideration below to define a scenario.
    - Reference surface
    - Vehicle categories
    - Vehicle sound model
    - Road type
    - Share of traffic volume for each vehicle category
    - Story for noise reduction in power train/tyre
    - etc.
  - Keep N2 separated by 135kW as a sub-category for sound limit.
- Next steps & goals:
  - Crossmatrix group will make traffic scenario with consideration above.

SUMMARY

- We understood detail conditions for simulation.
  - Road surface data are used by the Netherland database. Reference surface is dense asphalt concrete.
  - Modified CNOSSOS (Common NOise aSSessment MethOdS in Europe – Environmental Noise Directive 2002/49/EC (END)) model was used. Vehicle sound model and correction factor on acceleration phase were used by the Netherland standard.
    wetten.nl - Regeling - Reken- en meetvoorschrift geluid 2012 - BWBR0031722 (overheid.nl)
  - 8 road types are considered. (residential street, main road, arterial road, motorway etc.)
  - 3 category vehicles (light, medium-heavy, and heavy vehicle)

- The EMISIA study[1] proposed the subcategory of N2 separated by 150kW. But GRBP had long discussion in the past when developing the UN Regulation No.51 03, and at that time the conclusion was to have a categorization for the N2 vehicles at 135kW → Taskforce TF-VS agreed to keep 135kW.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- Road traffic noise were calculated on three studies. Their study used difference traffic scenario in main road in each country.

Day % (Night%)

Vehicle	EMISIA	Japan	ATEEL
Light (C1)	93.1% (89.6%)	78.6~89.7% (35.6%~53.2%)	M1,N1 96.1% (97.9%)
Mid-heavy (C2)	3.4% (4.2%)	19.5~29.6% (44.8~63.6%)	M2,N2 2.9% (0.8%)
Heavy (C3)	3.5% (6.2%)		M3,N3 1.2% (1.3%)

REFERENCES

- TFVS-10-06 (Japan): Questions to Study on sound level limits of M-and N-category vehicles on TFVS-09-06 (Crossmatrix subgroup) - Status 1st work package crossmatrix and TFVS-07-11 (EC/EMISIA): Study on sound level limits of M- and N-category vehicles
  ➔ [1] full report, https://op.europa.eu/en/publication-detail/-/publication/d23a63bc-8310-11ec-8c40-01aa75ed71a1/language-en
- TFVS-10-07 (Japan): Comment for the N2 category threshold
- TFVS-11-03 (EC Consortium): Answer to TFVS-10-06
- TFVS-07-03 & TFVS-07-04 (OICA/ATEEL): report & presentation of the OICA/ATEEL study

Measurements & Tests
Simulation
Lit. Study
Position

21 - (JAPAN) RESULTS OF THE SIMULATION STUDIES ON REDUCING AUTOMOBILE NOISE FROM JAPAN

VEHICLE CATEGORY
TYRE ROAD NOISE
PREDICTION MODEL
TRAFFIC FLOW/ CONDITION
CROSSMATRIX
VEHICLE FLEET
SOUND LIMITS

MAIN MESSAGES FROM THE PRESENTATION(S)

- Position of Japan
  - Japan believe that it must be important to take the technical review in each country and assess the effectiveness of new regulation such as beyond phase 3 for vehicle noise reduction, before making global agreement on it.
  - Japan would like to propose to highlight importance of such process by using models and parameters we have discussed at TF-VS, in its technical report which is going to submit to GRBP.
- Current status in Japan
  - As a result of deliberations by the Expert Committee on Motor Vehicle Noise on the introduction of Phase 3, which has taken into consideration the results of the study presented here, it was agreed to introduce Phase 3 because of the noise reduction effect expected from the introduction of Phase 3 limit values.
- Next steps & goals:
  - [Next steps] Public comments will be made on the draft version of the fourth report of the Future Policy for Motor Vehicle Noise Reduction, and based on the results, the report will be formally reported to the Atmospheric Noise and Vibration Subcommittee for deliberation by the Central Environmental Council.
  - [Goals] To achieve 100% in the EQSs (Environmental Quality Standards) for Road Traffic Noise
  - [Goals] To reduce the number of complaints related to vehicle noise

SUMMARY

- In terms of the UN Regulation No. 51-03, before introducing phase 3, its effect should be verified
- Conducted the study to assess the effectiveness of the phase 3 introduction at the points exceeding EQSs, by using JARI (Japanese Automobile Research Institute) prediction model
- Targets
  - To achieve 100% in the EQSs for Road Traffic Noise
  - To reduce the number of complaints related to vehicle noise
- Method and condition for predictive calculations
  - The original road traffic noise prediction model developed by JARI was applied for the prediction.
  - Changes in road traffic noise were calculated in case that phase 3 was applied to all vehicles to those conformed to phase 2.
  - Assumed dense asphalt pavement (maximum chipping size of 13 mm) of average condition
  - Based on distributions of measured L_{urban} of vehicles conformed to phase 1 and phase 2 provided by JAMA (Japan Automobile Manufacturers Association).

- For the field surveys, 3 types of sites according to the traffic conditions have been defined. For each site (near intersection & in cruising section), hourly traffic volume, speed and L_{Aeq} have been measured per time zones.

- Results
  - In case of the reduction rate for each noise source for LDV was set to 75% (power train unit noise):25% (tyre noise), the L_{Aeq} reduction of applying phase 3 was 0.4 to 0.6 dB near intersections and 0.3 to 0.5 dB in the cruising sections.
  - In case of the reduction rate for each noise source for LDV was set to 50% (power train unit noise):50% (tyre noise), the L_{Aeq} reduction of applying phase 3 was 0.4 to 0.8 dB near intersections and 0.3 to 0.7 dB in the cruising sections.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- The JARI (Japanese Automobile Research Institute) model can also consider the evolution of the road surfaces due to its wear (road service) even if not included for the time being.
- The distribution between ICE & xEV/electrified Vehicles has not been considered in this study but Japan plans also to analyze this aspect which will become important in the future.

REFERENCES

- TFSL-03-06 (JAPAN): Technical review of R51-03 phase 3 in Japan
- TFVS-08-04 Rev1 (JAPAN): Results of the simulation studies on reducing automobile noise from Japan

Database assessment
Simulation
Lit. Study

22 - (OICA/ACEA/ATEEL) STUDY ON FUTURE SOUND LIMIT VALUES FOR TYPE APPROVAL FOR VEHICLES OF CATEGORY M & N

SOUND LIMITS
VEHICLE SOUND
TYRE ROAD NOISE
MARKET PENETRATION
ALTERNATIVE
ABATEMENT MEASURES

MAIN MESSAGES FROM THE PRESENTATION(S)

- The sound levels of new vehicles have decreased, but the effect on road traffic noise is delayed due to the market penetration of new vehicles.
- Reducing vehicle sound level limit values without significant improvements of tire/road noise would not provide the desired improvement in real driving conditions and thus introduction of limit values beyond phase 3 is regarded as technically unachievable given the current state of technology. The tyre is a key component for safety, energy consumption, noise and traction as well as handling performances.

SUMMARY

The study was conducted by ATEEL on request of OICA/ACEA.

- The study assesses the vehicle sound emission levels and evaluates the potential and feasibility of limit value reduction.
- It also translates the limit value reductions under type approval conditions to real road traffic conditions and estimates the efficiency of the defined reductions – scenarios – and compares the effect to alternative measures (**chapter 3**).

The minimum L_{urban} values of some vehicle categories – e.g. M1 and N1 – have not improved despite the introduction of alternative propulsion technologies, suggesting the feasibility limit has been reached. The introduction of alternative propulsion technologies to categories that are tested under the “truck principle”, whereas $L_{urban} = L_{wot}$, show a considerable benefit (**chapter 2**).

The dominant partial sound source varies over the complete vehicle speed range in all real-world traffic situations; the crossing point speed(s) varies over vehicle categories and propulsion types while tires dominate at higher speeds and propulsion at lower speeds (**chapter 4**). The sound emission levels of heavy commercial vehicles in low-speed traffic (and over short distances) benefit from the transition into electric propulsion.

The impact and efficiency of reduced type approval values as well as alternative measures were investigated by an in-house simulation tool. A potential increase of traffic volume over time, which may hamper the improvement of the road traffic noise, was not considered. It would only shift the absolute level of the calculated sound and would not change the message, because the delta (improvement) remains identical. Electric propulsion shows potential in lowering the sound emission of certain vehicle categories at low speeds, e.g. city buses. This could be beneficial for certain vehicle categories. However, AVAS (Acoustic Vehicle Alerting System) may deteriorate this benefit for some categories, e.g. M1. At high speeds, Electric Vehicles provide no benefit over ICE (Internal Combustion Engine) vehicles due to the dominance of tyre/road interaction. (**Chapter 5**) Other measures that influence the traffic flow have immediate effect on road traffic noise, e.g. lowering the speed limit.

The tire/road contribution will be the dominant sound source while entering phase 3 (**chapter 7**). The realistically available technologies for individual vehicle classes must be considered including the entire range of applications so that sensible concepts are not excluded from the market.

The effect of phases 2 and 3 as well as new and future alternative propulsion technologies should be awaited and analyzed (chapter 7.3.3).

- "Recommendations:
    - Further reductions of limit values in Regulation No.51 only achievable assuming improvements on the quietest available tyres, without sacrificing safety performance attributes.
    - Before determining new limit values, the improvements achieved by limit phases 2 and 3 should be evaluated in real traffic after the compliance of a sufficiently large proportion of the fleet is reached
    - Numerous available alternative measures are proposed to significantly reduce the overall sound level (e.g. speed limits, silent road surface asphalt, geofencing, …) impacting all vehicles with immediate effect.
    - A widespread use of quieter tyres would be recommended as improvements in real traffic would be immediately effective under all boundary conditions and for all vehicles.
    - The application of AVAS should be monitored in order to restrict configurations being louder than necessary.
    - Niche and special purpose/emergency vehicles shall not be neglected in new draft legislations in order to ensure their continued existence."

- Further investigations possible such as
    - Impact of RD-ASEP on real traffic sound level
    - Influence of measurement uncertainty on vehicle development
    - Benefits of geofencing
    - Classification of road noise in the overall context

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

There is a potential difference between OEM tyres – used in Type approval testing – and after-market (replacement) tyres. This could lead to reduced benefits of new vehicles in real world driving than what to expect from the type approval testing. This should be considered.
The impact of the future RD-ASEP (Real Driving-Additional Sound Emission Provisions) has not been assessed whereas relevant data was not available.

REFERENCES

- TFVS-04-10 (OICA/ACEA/ATEEL): Intermediate presentation
- TFVS-07-03 (OICA/ACEA/ATEEL): Final report
- TFVS-07-04 (OICA/ACEA/ATEEL): Final presentation

23 - (OICA/ACEA/ATEEL) COMPARISON OF EMISIA & ATEEL STUDY ON SOUND LIMIT VALUES FOR M & N VEHICLES

PREDICTION MODEL
TRAFFIC FLOW
CBA
SOUND LIMITS
SINGLE EVENTS
ROAD SURFACE
TYRE ROAD NOISE

MAIN MESSAGES FROM THE PRESENTATION(S)

This comparison study shows the need to review the different studies available and especially the EMISIA[1] & ATEEL[2] studies to better understand the hypothesis and the scenarios used. Then it will be possible in a timeline to be defined:

- to improve the current noise mapping model to make it still more representative of what it happens in real life and the impact of noise on citizen comfort & health.
- to consider really effective actions whether on vehicles, tyres, roads, speeds, noise sonar, …

SUMMARY

Points that have been considered in this comparison study:

- Comparison of the approaches and the findings in the ATEEL & EMISIA studies.
- Impact calculations for limit value scenarios and alternative measures using ATEEL simulation tool
- Reflection on Brussels Environment study
- Representativeness of type approval values for real traffic situations differing from type approval conditions

Conclusions after peer review and recommendations

- Regarding benefits and measures
  - Both studies conclude that benefits by further limit reductions are highly limited and time delayed
  - Both studies conclude that a reduction of tyre rolling sound provides the highest benefit
  - Benefits of the CBA (Cost Benefit Analysis) appear significantly too high according to recalculation with ATEEL tool. The values used for the CBA need to be updated & consolidated to make sure they are fully representative and realistic.
    Both studies are not in line on the implementation deployment and the effect of the achievable tyre noise improvement.
  - Powertrain measures can only contribute to sound improvements in conjunction with quite road surfaces and / or tyres
  - Improvements by alternative measure such as quiet asphalt or vehicle speed limits evaluated by ATEEL as most efficient since even older vehicles would immediately benefit
- Regarding results and final limit value proposals
  - EMISIA study final proposal provides only minor space for limit reductions → only a minor improvement can be expected
  - The final proposal for category N3 is not considered realistic (see presentations GRB-51-13, GRB-51-20, GRB-53-17)
  - Considering higher accelerations is a step back towards UN Regulation No.51-02 – inefficient and not representative for real traffic
  - Most single events, caused by bad driving style or manipulated vehicles, could be handled efficient by traffic monitoring
- Recommendations for next Steps
  - Legislation side – limit value adaptations beyond phase 3
    - Wait for new exhaust emission legislation impact on vehicle design
    - Wait for phase 3 vehicles to enter the market and observe the impact on sound level
    - Examine more closely costs and risks/drawbacks of other disciplines such as safety and pollutants

        - Take also into account the desired/efficient movement of goods and people. e.g. payload or packaging issues
    - Additional tasks that could help to get a better understanding on real traffic issues
        - More campaigns similar to recent studies (Brussels Env., Bruitparif, G+P Switzerland and FEDRO) help to understand real traffic noise
        - Gathering of N3 vehicle data with realistic configuration especially on street types with higher driving speed

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- Regarding the real sound level of the vehicles on the street, we may have a potential discrepancy between the vehicles running on OE (Original Equipment) tyres, used during the type-approval process, and the vehicles using replacement / aftermarket tyres fitted to the vehicle (according to the different priorities for the vehicle's owner).
- The status of tyres in real life is unknown.
- The interaction between the tire and the road including the road dispersion has to be considered, and not the tyre alone.
- CBA provides a lot of room for questions and discussions since the data (from 2010's – need to be updated), assumptions and boundary conditions require further description for better understanding, assessment and then improvement.
- In both studies (ATEEL[2] & EMISIA[1]), aging of vehicles was not considered. The renewal of the fleet was considered with a certain exchange rate of the vehicles.
- The existing noise mapping models should be revised to be better aligned with the real-life situation taking, into account the recent studies and technical innovations. Especially current vehicles (state of the art) , the road surfaces, the street types, the weather scenarios, the tire choice, the age of vehicles, the vehicle speeds, the number of lanes in the street, the distance between the facades and the street should be considered. The link between the knowledge on the testing and the knowledge on modelling the noise mapping needs to be aligned.
    - ➔ From different results on the current CNOSSOS (Common NOise aSSessment MethOdS in Europe – Environmental Noise Directive 2002/49/EC (END)) model vs. its representativity of the reality shows the need to re-work the noise mapping model.
    - ➔ For reminder, the Current CNOSSOS model is based on sound emission source data collected in 2007-2009 and the resulting sound emission model was adopted in 2012. The continuous progress of the vehicles and most of the other measures for the noise abatement like speed reduction, better roads should be better reflected in the calculation model Cnossos. This progress will be visible not only in the real sound environment but also in the resulting strategic noise maps.
    - ➔ A review of each study (Emisia, Phenomena, …) is needed to make a kind of a plausibility check on the hypothesis and the scenarios used in the studies to clearly law down what as is assumed in the establishment of such scenarios. These checks should be shared in reports so that readers can validate the scenarios and make them more comparable.

REFERENCES

- TFVS-10-04 Rev.1 (OICA/ACEA/ATEEL): Comparison of EMISIA (TFVS-07-11) & ATEEL (TFVS-07-03) study on sound limit values for vehicle category M & N – Interim results
- TFVS-11-05 (OICA/ACEA/ATEEL): Comparison of EMISIA & ATEEL study on sound limit values for vehicle category M & N – Final

[1] EC Study for M/N-cat. or TFVS-07-11 (EC/EMISIA): Study on sound level limits of M- and N-category vehicles – full report, https://op.europa.eu/en/publication-detail/-/publication/d23a63bc-8310-11ec-8c40-01aa75ed71a1/language-en

[2] TFVS-04-10 (OICA/ACEA/ATEEL): Intermediate presentation, TFVS-07-03 (OICA/ACEA/ATEEL): Final report, and TFVS-07-04 (OICA/ACEA/ATEEL): Final presentation

24 - (ETRTO) ON THE COST-BENEFIT-ANALYSIS BY EMISIA

TYRES ROAD NOISE

MAIN MESSAGES FROM THE PRESENTATION(S) and SUMMARY

An essential part of the EMISIA study[1] is the cost-benefit analysis for different scenarios that were set up by the EMISIA partners. This document shows that:

- A study from Switzerland used by EMISIA to justify the assumption of a possible 3 dB limit reduction was falsely interpreted
- The scenario for quieter tyres simulated in the CBA contains an unrealistic timeline for the implementation and was called “purely fictional” by a member of the EMISIA project

The EMISIA study presents the results of this fictional scenario without any marking alongside the simulation results of fact-based scenarios for traffic noise improvements.

This might be misleading for readers trying to assess and to qualify the reported benefits for traffic noise.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

- It has been reminded that tyres were out of the scope of the Emisia study. So in the CBA (Cost Benefit Analysis), this is purely fictional. It is mentioned in the Introduction of the Chapter 5 of the Emisia study “Proposal for Phase 4 limit values” that the tyres were out of the scope without mention to the level of realism of the scenario.

REFERENCES

- TFVS-11-06 (ETRTO): On the Cost-Benefit-Analysis by EMISIA

[1]

- GRBP-73-23 (EC): Study on sound level limits of M- and N-category vehicles – intermediate report,
- TFSL-02-08 (EC): M- and N- sound limit study – intermediate report,
- EC Study for M/N-cat. or TFVS-07-11 (EC/EMISIA): Study on sound level limits of M- and N-category vehicles – full report, https://op.europa.eu/en/publication-detail/-/publication/d23a63bc-8310-11ec-8c40-01aa75ed71a1/language-en
- TFVS-09-03 Rev.1 (EC-HSDAC): presentation of the EC study for M_N vehicles

25 - (GERMANY) KRAFTFAHRT-BUNDESAMT CAMPAIGN ON NOISE EMISSIONS 2021

SOUND LIMITS
NORESS & MANIPULATION
ASEP

MAIN MESSAGES FROM THE PRESENTATION DONE AT GRBP-76

A market surveillance campaign in Germany showed that (the tested) vehicles in original condition comply to the regulations, but the majority of (approved) aftermarket mufflers did not comply with the permissible limits.

SUMMARY

A 2021 KBA/Germany Market Surveillance study on passenger cars (M1) and motorcycles (L3e) with regards to noise emissions, in both original condition as well as with replacement silencing systems available on the market.

Main findings:

- Passenger cars (M1):
  - All vehicles in original condition comply with the regulations (including ASEP)
  - The majority of the tested (approved) aftermarket silencing systems did not comply with the permissible sound levels
- Motorcycles (L3e):
  - All motorcycles in original condition comply with the regulations (except for one older bike which was ≈ 0.5 dB(A) > limit; not 100% maintained after 16 000 km).
  - The majority of the tested (approved) aftermarket silencing systems did not comply, with results of 4 to 9dB(A) above the permissible L_{Urban} sound levels.
- KBA/Germany calls for the EU Commission to include silencing systems in their noise emissions market surveillance planning (a minimum number of physical tests has to be required).
- KBA/Germany notices still high permissible limits for the UN Regulation No.41, 05 Series ASEP (Additional Sound Emission Provisions) and calls to address this in RD-ASEP (Real Driving-ASEP) step 2.

Next steps:

- Testing will be extended in 2022/2023 with different vehicles.
- Future work is to investigate if the (approved) aftermarket mufflers failed due to wrong testing at Technical Service/Type Approval Authority or due to differences between the approved muffler and production mufflers.

ADDITIONAL POINTS FROM DISCUSSIONS IN THE UN TF-VS

Not yet presented at the TF-VS – should be done at the 12th session in 2023 – to be followed.

REFERENCES

- GRBP-76-27 (Germany): Campaign on noise emissions 2021.

ANNEX
SOME REMINDERS

ACRONYMES/ ABREVIATIONS & EXPLANATION OF INTITUTIONS/ASSOCIATIONS

ANNEX – SOME REMINDERS

ACRONYMES/ABREVIATIONS & EXPLANATION OF INSTITUTIONS/ASSOCIATIONS

ACEA	(Association des Constructeurs Européens Automobiles - *European Automobile Manufacturers' Association*) established in 1991 is the main lobbying and standards group of the automobile industry in the European Union.
ACUSTICA	ACUSTICA is an UK based independent consultant offering expert advice on acoustics, environmental and building noise control and IT solutions to government and commercial organisations.
ADEME	is the French Agency for Ecological Transition.
ANOTEC	'Aircraft NOise TEChnology' since 2001 is providing solutions for Aircraft and Airport noise.
AUT	Aristotle University of Thessaloniki created in 1925
ATEEL	(**A**llied **T**echnology **E**xperts - **E**nterprise of **L**uxembourg) is a Luxembourg international technical service with expertise in technical certification of motor vehicles and their components.
BRUITPARIF	is a French independent non-profit organization created in 2004 by the French Regional Council. Their activities consist in assessing noise, supporting public policies, and informing the public.
Brussels Environment	is a Belgium Environment and Energy Administration of the Brussels-Capital Region, responsible for designing and implementing regional policies in all matters related to the environment.
CEREMA	(Centre d'Etudes et d'expertise sur les Risques, l'Environnement, la Mobilité et l'Aménagement - *Center for studies and expertise on risks, the environment, mobility and planning*) is a French public establishment of an administrative nature placed under the joint supervision of the Minister for Ecological and Inclusive Transition, and the Minister for Territorial Cohesion created in 2014.
CREDOC	(Centre de Recherche pour l'Etude et l'Observation des Conditions de vie - Research Center for the Study and Observation of Living Conditions) is a study and research organization dedicated to the economic and social life.
DEUFRABASE	is a Franco-German database for the acoustics of road surfaces to evaluate the Noise Impact of Pavements in Typical Road Geometries
DfT	UK - Department for Transport
EC DG GROW	Directorate-General for Internal Market, Industry, Entrepreneurship and SMEs of the European Commission.
EMISIA	is a spin-off company of the Aristotle University of Thessaloniki / Laboratory of Applied Thermodynamics and was established in February 2008.

EMISIA Study	is a study mandated by the European Commission on "Study on sound level limits of M- and N-category vehicles", which aims at reviewing and possibly updating the sound level limits for all M- and N category vehicles, taking into account the evolution of sound levels of approved vehicle types, the citizens' needs, and the technical and economic feasibility. https://op.europa.eu/en/publication-detail/-/publication/d23a63bc-8310-11ec-8c40-01aa75ed71a1/language-en
ETRTO	(European Tyre and Rim Technical Organisation) established in 1964 is a tire standardization organization whose members are tire, rim and valve manufacturers who have a production facility in one of the European countries.
FEDRO	(FEDeral Roads Office) established in 1998 is a Switzerland's federal authority responsible for road infrastructure and private road transport.
FEV	'Forschungsgesellschaft für Energietechnik und Verbrennungsmotoren' is an independent development service providers in the development of combustion engines and vehicle technology with headquarters in Aachen starting in 1985.
HSDAC	'Heinz Steven Data Analysis and Consultancy' independent expert among others for noise and emission topics created in 2008.
IAI	IMPACT ASSESSMENT INSTITUTE is a Belgian based independent body with the mission to scrutinize the evidence based for existing and proposed legislation. IAI is open to cooperation with European Union institutions, civil society, Member State governments, business and individuals
IDIADA	IDIADA is a worldwide partner for the automotive industry providing design, engineering, testing and homologation services.
ISO	International Organization for Standardization
ISO	**ISO TC31/WG 11** is a working group dedicated to tyre test method development, as part of the Technical Committee 31 related to tyres, rims and valves.
JAMA	(Japan Automobile Manufacturers Association) is a trade association established in 1967 and serves as a platform for the automakers of Japan to share technological developments and management practices.
JARI	(Japanese Automobile Research Institute) established in 1969 is a comprehensive research institute that carries out basic surveys, research, and technology development, as well as testing and evaluation of technology related to automobiles.
KBA	Kraftfahrt-Bundesamt - *Federal Motor Transport Authority* in Germany
LAT	Laboratory of Applied Thermodynamics belongs to the Energy Division of the Mechanical Engineering Department, in the Aristotle University of Thessaloniki, Greece founded in 1974.
LEON-T Project	(Low particle emissions and low noise tyres) will study both particulate and noise emissions from tyres. The findings will be used to define and propose practical standardised methods of tyre abrasion rates and airborne particulate emissions. The potential effects of tyre noise on cardiovascular health will also be studied. The project's insights will be

	useful for the design of airless tyres that are expected to reduce noise and emissions. The project will also make policy recommendations to address potential health hazards. https://cordis.europa.eu/project/id/955387
NTSEL	(National Traffic Safety and Environment Laboratory) was established in 1950 under MOT and is contributing to a safe and environmentally-friendly traffic society through activities in research and automobile type approval tests.
OICA	(Organisation Internationale des Constructeurs Automobiles - *International Organization of Motor Vehicle Manufacturers*) established in 1919 is an international trade association whose members are 39 national automotive industry trade associations.
PHENOMENA Project	is the project "Assessment of **P**otential **He**alth Benefits of **No**ise Abate**men**t Me**a**sures in the EU" to define the potential of measures capable of delivering significant reductions (20%-50%) of health burden arising from the environmental noise of roads, railways and aircraft, and to assess how relevant noise related legislation could increase the implementation of the most effective measures, while considering the constraints and specificities of each transport mode.
RACC-ACASA	ACASA (Automòbil Club Assistència S.A. Unipersonal) is company of the RACC group (Real Automòbil Club de Catalunya), a non-profit organisation providing advice, information, protection and advocacy of interest to its members (drivers, pedestrians) in the fields of road safety, sustainable mobility and environmental protection.
SIA	(Société des Ingénieurs de l'Automobile – *Society of automotive engineers*) in France brings together all the specialists of the automotive industry and its technologies: OEMs and Tiers 1, Engineering consultancies, R&D clusters, Universities and Research Centres. The SIA's goal is to encourage the development and knowledge sharing by engineers, managers and technicians of French or French-based companies and major groups in the automotive sector and mobility of the future.
TECHNALIA	is a Technological Research and Development Center in Europe/Spain, whose mission is to transform technology into GDP (General Data Protection).
TNO	Nederlandse Organisatie voor Toegepast Natuurwetenschappelijk Onderzoek established in 1932 is an independent research organisation in the Netherlands that focuses on applied science.
T.U.GRAZ	Technical University in Graz/ Austria

TRUE	(The Real Urban Emissions) Initiative is a partnership of expert groups with a shared interest in cleaning up vehicles and improving urban air quality to inform policy makers, manufacturers, and consumers of the real impact of vehicle emissions on air quality through good data, transparency, and technical expertise.
UAB	Universitat Autònoma de Barcelona
UN TF-VS	United Nations - Task Force Vehicles'Sound is an Informal Working Group working on under the mandate of the GRBP (Groupe de Rapporteurs Bruit et Pneumatiques - *Working Party on Noise and Tyres*) as a vehicles' sound forum for discussions based on various available studies.
VVA	established in 1992, is a European consulting company based in Milan and Brussels with an international team of professionals including economists, sociologists, political scientists, public policy experts, digital talents, specialists in marketing and market research.
WHO	(World Health Organization) is the United Nations agency founded in 1948 that connects nations, partners and people to promote health, keep the world safe and serve the vulnerable – so everyone, everywhere can attain the highest level of health.

OTHERS ABREVIATIONS

AI	Artificial Intelligence
ANPR	Automatic Number Plate Recognition
ASEP	Additional Sound Emission Provisions
AVAS	Acoustic Vehicle Alerting System
CBA	Cost Benefit Analysis
CNOSSOS	Common NOise aSSessment MethOdS in Europe – Environmental Noise Directive 2002/49/EC (END)
DALY	Disability-Adjusted Life Years
END	Environmental Noise Directive in European Union
EQS	Environmental Quality Standards
EU MS	European Union Member State(s)
EV	Electric Vehicle
FMVSS	US Standard - Federal Motor Vehicle Safety Standard
ICE	Internal Combustion Engine
NORESS	Non-Original Replacement Exhaust Silencing System
PTI	Periodic Technical Inspection
RD-ASEP	Real driving - Additional Sound Emission Provisions
SEM	Sound Expectation Model
Technical symbols	Lexp, v, n, … are defined in UN Regulation No.51
TPMLM	Technically Permissible Maximum Laden Mass
xEV	Electrified Vehicle

VEHICLE CATEGORIES

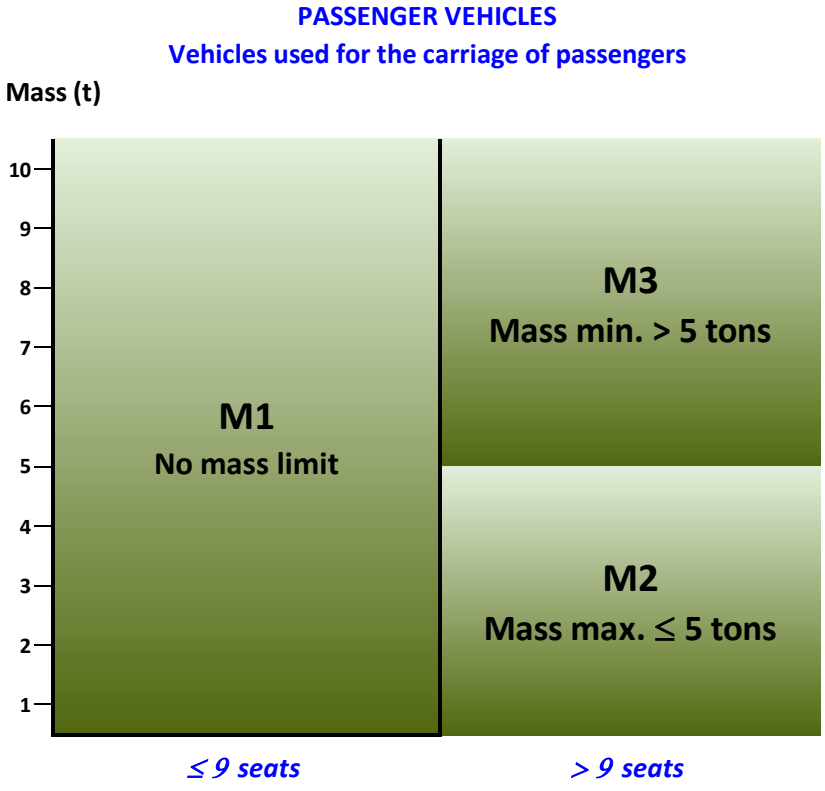
From definitions in EUROPEAN UNION - Directive 2007/46/CE – Annex II

PASSENGER VEHICLES

- **M1** Motor vehicles designed and constructed primarily for the carriage of persons and their luggage, comprising not more than eight seating positions in addition to the driver's seating position.
  Vehicles belonging to category M1 shall have no space for standing passengers.
  The number of seating positions may be restricted to one (i.e. the driver's seating position).

- **M2** Motor vehicles designed and constructed primarily for the carriage of persons and their luggage, comprising more than eight seating positions in addition to the driver's seating position and having a maximum mass not exceeding 5 tons.
  Vehicles belonging to category M2 may have space for standing passengers in addition to the seating positions.

- **M3** Motor vehicles designed and constructed primarily for the carriage of persons and their luggage, comprising more than eight seating positions in addition to the driver's seating position and having a maximum mass exceeding 5 tons.
  Vehicles belonging to category M3 may have space for standing passengers.

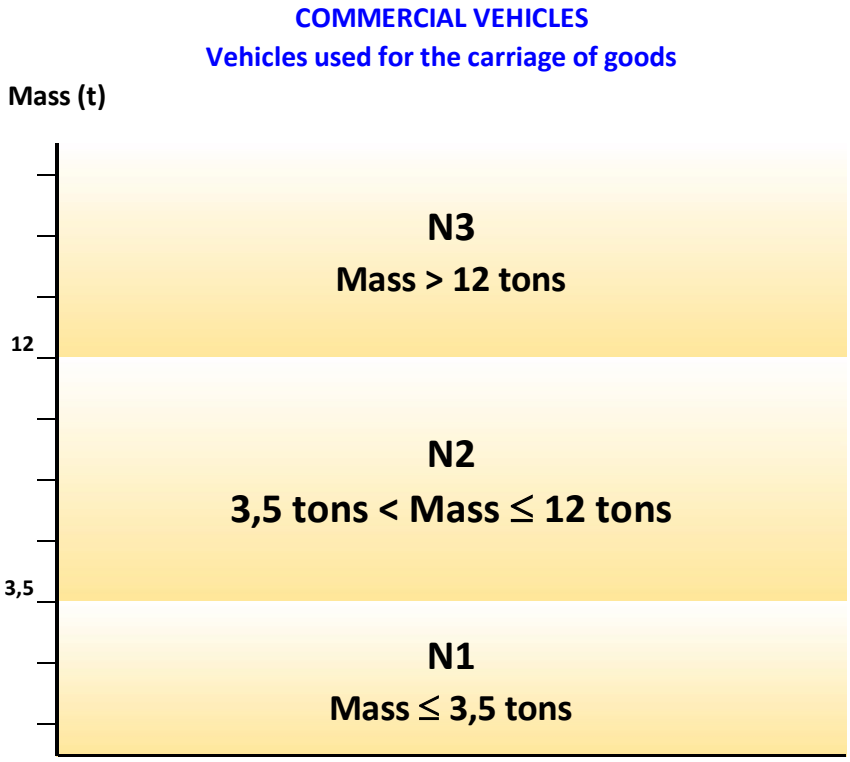


COMMERCIAL VEHICLES

- **N1** Motor vehicles designed and constructed primarily for the carriage of goods, having a maximum mass not exceeding 3.5 tons.

- **N2** Motor vehicles designed and constructed primarily for the carriage of goods, having a maximum mass exceeding 3.5 tons but not exceeding 12 tons.

- **N3** Motor vehicles designed and constructed primarily for the carriage of goods, having a maximum mass exceeding 12 tons



From definitions in EUROPEAN UNION - Directive 2002/24/CE – Article 1

MOPEDS, MOTORCYCLES, MOTOR TRICYCLES, QUADRICYCLES

- **L1 & L2** Mopeds, i.e. two-wheel vehicles (**category L1e**) or three-wheel vehicles (**category L2e**) with a maximum design speed of not more than 45 km/h and characterised by:
    - (i) in the case of the two-wheel type, an engine whose:
        - cylinder capacity does not exceed 50 cm3 in the case of the internal combustion type, or
        - maximum continuous rated power is no more than 4 kW in the case of an electric motor;
    - (ii) in the case of the three-wheel type, an engine whose:
        - cylinder capacity does not exceed 50 cm3 if of the spark (positive) ignition type, or
        - maximum net power output does not exceed 4 kW in the case of other internal combustion engines, or
        - maximum continuous rated power does not exceed 4 kW in the case of an electric motor;

MOTORCYCLES

- **L3 & L4** Motorcycles, i.e. two-wheel vehicles without a sidecar (**category L3e**) or with a sidecar (**category L4e**), fitted with an engine having a cylinder capacity of more than 50 cm3 if of the internal combustion type and/or having a maximum design speed of more than 45 km/h

MOTOR TRICYCLES

- **L5** Motor tricycles, i.e. vehicles with three symmetrically arranged wheels (**category L5e**) fitted with an engine having a cylinder capacity of more than 50 cm3 if of the internal combustion type and/or a maximum design speed of more than 45 km/h.

QUADRICYCLES

- **L6** Quadricycles, i.e. motor vehicles with four wheels having the following characteristics:
    - (a) light quadricycles whose unladen mass is not more than 350 kg (**category L6e**), not including the mass of the batteries in case of electric vehicles, whose maximum design speed is not more than 45 km/h, and
        - (i) whose engine cylinder capacity does not exceed 50 cm3 for spark (positive) ignition engines, or
        - (ii) whose maximum net power output does not exceed 4 kW in the case of other internal combustion engines, or

    - (iii) whose maximum continuous rated power does not exceed 4 kW in the case of an electric motor.

  These vehicles shall fulfil the technical requirements applicable to three-wheel mopeds of category L2e unless specified differently in any of the separate directives;

- **L7** (b) quadricycles, whose unladen mass is not more than 400 kg (**category L7e**) (550 kg for vehicles intended for carrying goods), not including the mass of batteries in the case of electric vehicles, and whose maximum net engine power does not exceed 15 kW. These vehicles shall be considered to be motor tricycles and shall fulfil the technical requirements applicable to motor tricycles of category L5e unless specified differently in any of the separate Directives.

UN REGULATIONS MENTIONED IN THIS REPORT

- **Symbols used in the report:**
  - **UN-Rxxx-01** means UN Regulation No.xxx, 01 Series of amendment.
  - **UN-Rxxx-yy.Sz** means Supplement z to the UN Regulation No.xxx, yy Series of amendment.

- **UN Regulation No.28 (UN-R28)**: Uniform provisions concerning the approval of audible warning devices and of motor vehicles with regard to their audible signals.
- **UN Regulation No.41 (UN-R41)**: Uniform provisions concerning the approval of motorcycles (L3-category) with regard to noise.
- **UN Regulation No.51 (UN-R51)**: Uniform provisions concerning the approval of motor vehicles having at least four wheels (M- & N-categories) with regard to their sound emissions.
- **UN Regulation No.59 (UN-R59)**: Uniform provisions concerning the approval of replacement silencing systems for vehicles of categories M1 and N1.
- **UN Regulation No.63 (UN-R63)**: Uniform provisions concerning the approval of two-wheeled mopeds (L1-category) with regard to noise
- **UN Regulation No.117 (UN-R117)**: Uniform provisions concerning the approval of tyres (C1-, C2- & C3-classes) with regard to rolling sound emissions and/or to adhesion on wet surfaces and/or to rolling resistance
- **UN Regulation No.138 (UN-R138)**: Uniform provisions concerning the approval of Quiet Road Transport Vehicles with regard to their reduced audibility to be applied to electrified vehicles of categories M & N.
- **UN Regulation No.165 (UN-R165)**: Uniform provisions concerning the approval of the reverse warning