Possibility of “Pass-by-Light” Noise-measurement of vehicles of Category L

„Pass-by-Light“-Test : PbL-Test
Background: Stationary Noise

Stationary Noise Measurement & Values were established > 50 years!

Intention was:
If Noise in Motion is too loud, Stationary Noise is also higher!

If Stationary Noise is measured as too loud, you know that Noise in Motion is also higher than Type Approval Value and/or Limit Value!

Worked well for PTI- and Road-side-checks of L-Cat.-vehicles for e.g.:

Wrong silencers

Mechanical Manipulations

Racing Silencer
Stationary Noise Measuring does not entirely reflect the driving noise of manipulated motorcycles, due to vehicle technology changes!

- Extremely modified gear ratio
- Mechanical variable flap systems
- Intelligent steered flap systems
- Remote control of flap systems
- Soundgenerator (may be in future?)
3.1 A test procedure for in-use compliance tests may be defined by a Contracting Party, taking due account of any differences from the test conditions used at type-approval.

3.2 Therefore UN-R41.04 approved motorbikes has to show on a sticker:

(a) **Gear (i)** (or gear selector position of vehicles tested “non-locked”),
(b) Pre-acceleration length $l_{PA}$ [m],
(c) Average vehicle speed at $V_{AA}$ [km/h] for tests in gear (i); and
(d) Sound pressure level $L_{wot,(i)}$ [dB(A)] in gear (i).

The Study German has done should find out:

- if it is possible to measure UN-R41.04 approved bikes with “road-side-check equipment”,
- taking into account all differences to Annex 3 measurements.
Therefore 12 motorbikes were tested:
- Original (not modified; Series/Standard)
- With NORESS
- With manipulated OEM- or NORESS

<table>
<thead>
<tr>
<th>No.</th>
<th>Manufacturer</th>
<th>Type</th>
<th>Commercial Name</th>
<th>Additional measured loud conditions</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Kawasaki</td>
<td>EN650A</td>
<td>Vulcan S</td>
<td>---</td>
</tr>
<tr>
<td>2</td>
<td>Kawasaki</td>
<td>LE650E</td>
<td>Versys 650 ABS</td>
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<td>3</td>
<td>Kawasaki</td>
<td>ER300A</td>
<td>Z300</td>
<td>NORESS Variant B</td>
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<tr>
<td>4</td>
<td>Triumph</td>
<td>V201</td>
<td>Explorer</td>
<td>NORESS Variant A</td>
</tr>
<tr>
<td>5</td>
<td>Triumph</td>
<td>DE01</td>
<td>Thruxton</td>
<td>NORESS Variant B</td>
</tr>
<tr>
<td>6</td>
<td>BMW</td>
<td>R12WR</td>
<td>R 1200 RS</td>
<td>NORESS Variant A and C</td>
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<tr>
<td>7</td>
<td>Yamaha</td>
<td>RN45</td>
<td>MT-10</td>
<td>OEM silencer (fixed flap)</td>
</tr>
<tr>
<td>8</td>
<td>Yamaha</td>
<td>RM14</td>
<td>MT07 Tracer</td>
<td>---</td>
</tr>
<tr>
<td>9</td>
<td>Ducati</td>
<td>AA</td>
<td>Multistrada 1200 S</td>
<td>---</td>
</tr>
<tr>
<td>10</td>
<td>Ducati</td>
<td>MA</td>
<td>Monster 1200 R</td>
<td>NORESS Variant A</td>
</tr>
<tr>
<td>11</td>
<td>Ducati</td>
<td>BA</td>
<td>Hypermotard 939</td>
<td>---</td>
</tr>
<tr>
<td>12</td>
<td>Ducati</td>
<td>GA</td>
<td>Xdiavel</td>
<td>---</td>
</tr>
</tbody>
</table>

Manipulation of OEM-Flap System:

- **NORESS A**
  - SLIP-On 1-1; Flap System fixed wide open!

- **NORESS B**
  - SLIP-On; 1-2; 2 dB-Eaters; One Removed!

- **NORESS C**
  - SLIP-On; 1-1; Approved to BMW R 1200 RS!
Tests carried out under:

- Annex 3 conditions
  (ISO-Test-track, Annex 3 equipment)

- “country road”
  with a full two lane cross-section

- "a paved farm road"
Equipment & Tolerances

High Level GPS Speed-Measurement (Price about 7000,-€)

Low Level GPS Speed-Measurement (Price about 100,-€)

Precision Sound Level Meter/Calibration (UN-R 41.04 Annex 3 Par. 1.1.1)

Weather Conditions (Temp., Air Humidity, Wind-Speed) measured by mobile instruments

Average of 5 Measurements per side; $L_{wot} - 1 \text{ dB(A)}$, Diff. $L_{wot} \leq 2 \text{ dB(A)}$; $V_{AA}: \pm 1 \text{ km/h to Sticker Value}$
### Measured Values

<table>
<thead>
<tr>
<th>Motorcycle</th>
<th>Ducati Monster 1200 R</th>
<th>Ducati Hypermottard 939</th>
<th>BMW R 1200 GS</th>
<th>Kawasaki Vulcan S</th>
<th>Triumph Thruxton R</th>
<th>Triumph Explorer XCA</th>
<th>Versys</th>
<th>Kawasaki MT10</th>
<th>Yamaha Z300</th>
<th>Kawasaki MT07</th>
<th>Ducati Multistrada 1200 SD Air</th>
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<tbody>
<tr>
<td><strong>1</strong></td>
<td>80.0</td>
<td>80.0</td>
<td>78.0</td>
<td>82.0</td>
<td>82.0</td>
<td>76.1</td>
<td>81.5</td>
<td>81.5</td>
<td>81.4</td>
<td>81.4</td>
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<td>79.2</td>
<td>82.2</td>
<td>87.5</td>
<td>76.1</td>
<td>80.8</td>
<td>84.0</td>
<td>81.9</td>
<td>84.1</td>
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<td>9.6</td>
<td>1.2</td>
<td>0.2</td>
<td>5.6</td>
<td>0.0</td>
<td>-0.7</td>
<td>2.5</td>
<td>0.8</td>
<td>-0.1</td>
<td>2.3</td>
</tr>
<tr>
<td><strong>4</strong></td>
<td>84.0</td>
<td>89.9</td>
<td>79.7</td>
<td>82.6</td>
<td>88.6</td>
<td>75.4</td>
<td>81.8</td>
<td>85.3</td>
<td>83.0</td>
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<td>0.5</td>
<td>0.4</td>
<td>1.0</td>
<td>-0.7</td>
<td>1.0</td>
<td>1.3</td>
<td>0.8</td>
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<td>1.7</td>
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<td>-0.7</td>
<td>0.3</td>
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<td>0.2</td>
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<td>-1.1</td>
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<td>8.7</td>
<td>0.3</td>
<td>-0.6</td>
<td>5.3</td>
<td>-1.0</td>
<td>-0.5</td>
<td>1.9</td>
<td>-0.2</td>
<td>1.6</td>
<td>-0.2</td>
</tr>
</tbody>
</table>

1. $L_{ref}$, TA (type approval)
2. max. value ISO-test track
3. difference ISO to TA-value
4. maximum value country road
5. diff. ISO to max. value country road
6. diff. TA to max. value country road
7. maximum value paved farm road
8. diff. ISO to max. value paved farm road
9. diff. TA to max. value paved farm road

*Table 3: Measured values*
Analysis and Results of PbL-Test measurements

Speed-Tolerance $V_{AA}$ of $\pm 1$ km/h is feasible for the driver and equipment

Speed-Tolerance $V_{PP}$ of $\pm 2$ km/h produces same level SPL-Values

Mass-Tolerances of Vehicle & Driver up to 6% of MRO has no influence

Measured SPL Country-Road doesn’t differ more than $+1.4 / -0.7$ dB(A) to ISO (higher values caused by minimally reflecting hill)

Measured SPL Paved-Farm-Road doesn’t differ more than $-0.1 / -1.3$ dB(A) to ISO (lower values caused by sound absorbing influence of trees soft soil beside driving lane)

“High- & Low-Level GPS-Speed-Measurement-Equipment” is OK for PbL-Tests
Conclusion

Significantly noisier L-Cat-Vehicles can easily be identified by PbL-Test

If driving lane shows

- similarity to ISO-track (e.g. surface layer, evenness, longitudinal gradient …)
- but deviation from cross-section (width, evenness, roadside vegetation)

the PbL-Test can be used for motorbikes.

Sound Level Increment

For the PbL-Test Final Result + 5 dB(A) should be added to the Sticker-SPL-Level to come to the classification OK or Not-OK.
The Increment of + 5 dB(A) consists by the Surcharges

- Influences caused by alternative test section + 1 dB(A)
- Influences caused by different Vehicle test speed + 1 dB(A)
- Influences caused by different Vehicle MRO incl. Driver + 1 dB(A)
- Serial production spread of the vehicle + 1 dB(A)
- Influences caused by aging of vehicle & its components + 1 dB(A)

Total + 5 dB(A)
Sticker value $L_{\text{wot}}(i)$ 82 dB(A) means that 87 dB(A) as a final result during PbL-Test would be the highest value which will be accepted as OK!

[82 dBA) + 5 dB(A) PbL-Increment]

87 dB(A) in general also means the highest accepted final result during PbL-Test of vehicles which have an 77 dB(A) Annex 3 $L_{\text{urban}}$ Limit Value!

[77 dB(A) + 5 dB(A) because of 6.2.3 + 5 dB(A) PbL-Increment]

Germany wants to establish a national PbL-Test-directive for UN-R 41.04 approved motorbikes and its NORESS for Road-Side-Checks and PTI in the future.
Thanks for your attention!