Pass-by Noise Testing - Application Notes

R41 Pass-by Noise Testing Application

This application note describes the test equipment and performance monitor software used in SPEEDBOX R41 Pass-by noise system. The system produces results to comply with the R41 test procedure. Whilst the equipment is suitable for testing with all motorcycles; this application note will describe how the requirements are met for a motorcycle of the third category, using manual transmission capable of performing the WOT test in a single gear.

Motorcycles must comply with this test procedure in order for the manufacturer to get the ECE approval, allowing the legal import, sale and use of the motorcycle.

Limits:

Category	Power-to-mass ratio index	Limit value for L urban in dB(A)
First category	PMR ≤ 25	73
Second category	25 < PMR ≤ 50	74
Third category	PMR > 50	77

L urban is a sound level calculated using various correction factors and the results from constant (L CRS) and WOT (Wide Open Throttle) drive by noise tests. Further to these limits vehicles of the third category must comply with the Additional Sound Emission Provisions (ASEP).

PMR "power-to-mass ratio index" means the ratio of the rated maximum net power of the vehicle to its mass. It is defined as: PMR = (Pn/(Mkerb + 75))*1000

Three tests must be done, one at Wide Open Throttle (L WOT), one at constant speed (L CRS) and if the bike has manual or lockable gears: Additional Sound Emissions Provisions (ASEP).

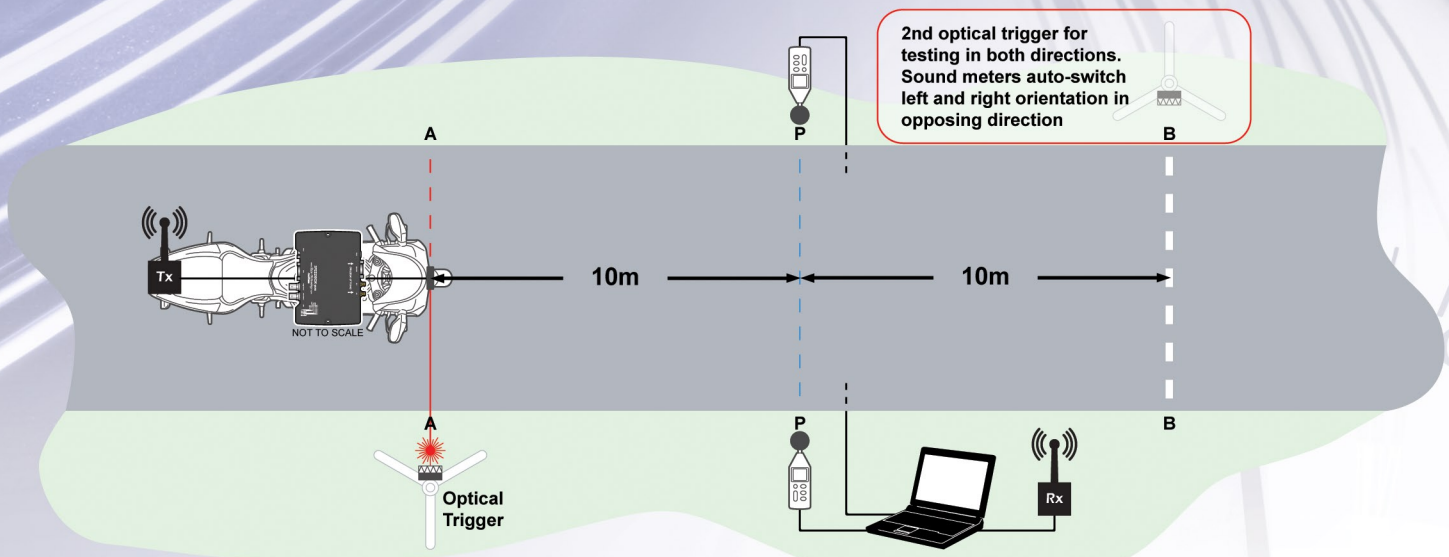
Full Throttle Acceleration Test (L WOT)

For full throttle acceleration tests the vehicle shall approach the line AA at constant speed. When the front of the vehicle passes the line AA the throttle control shall be shifted to the maximum throttle position as rapidly as possible and kept in this position until the rear of the vehicle passes the BB. At this moment the throttle control shall be shifted to the idle position as rapidly as possible.

The gear selection is the responsibility of the manufacturer to determine the correct manner of testing to achieve the required test speed and acceleration.

- The speed at PP (test speed) must be 50 +/- 1 Km/h
- The speed at BB (exit speed) must not exceed 75 percent of maximum speed
- Acceleration level must exceed 3.33*log(PMR)-4.16

The rider can then attempt to achieve these parameters using pre-calculated estimates and trial and error from the feedback on the DASH4PRO display.



The DASH4PRO display, shown above mounted to the motorcycle's handlebars, is setup with the following data to assist the test rider:

Data Outputs

Data from the bike is transmitted to the computer and is also displayed on the DASH4PRO for immediate feedback of test results; ensuring the rider can see if the test was run correctly.

Constant speed test (L CRS)

For the constant speed tests the gear and the test speed shall be identical to those used in the full throttle acceleration test previously performed. The test must be performed 3 times and the max result from left and right sound level meters from each test need to be averaged.

Calculation of final result

The final result is weighted combination of a constant speed test and a full throttle acceleration test. The results of the full throttle acceleration tests (L WOT) are used together with the results of constant speed tests (L CRS) to approximate partial load acceleration typical for urban driving. The corresponding target acceleration A urban is defined as:

A urban = 1.28 * log(PMR) - 1.19

The formula for calculating the final result is:

L urban = L WOT – (kp * (L WOT - L CRS))
Kp = 1- (A urban/A WOT)

A WOT = the average acceleration achieved in the Wide Open Throttle test.

Additional Sound Emission Provision (ASEP) Test

Test procedure: When the front of the vehicle reaches AA', the throttle shall be fully engaged and held fully engaged until the rear of the vehicle reaches BB'. The throttle shall then be returned as quickly as possible to the idle position.

Test parameters

1) Speed at PP should be 50KPH
2) Speed at AA should be at least 20KPH
3) Speed at BB should not exceed 80KPH
4) Engine speed at AA should not be less than 0.1 x (max rated RPM – idle RPM) + Idle RPM

The selected gear shall be 2nd. If the 3rd gear satisfies requirements, 3rd shall also be used. If the 4th gear satisfies requirements, 4th shall also be used.

Calculation for ASEP Limits:

L WOT,(i) + (0 * (nPP' – nWOT,(i)) / 1,000) + 3 (for tests that have RPM from ASEP at PP(nPP) < RPM from L WOT at PP(nwot))
L WOT,(i) + (5 * (nPP' – nWOT,(i)) / 1,000) + 3 (for tests that have RPM from ASEP at PP(nPP) > RPM from L WOT at PP(nwot))

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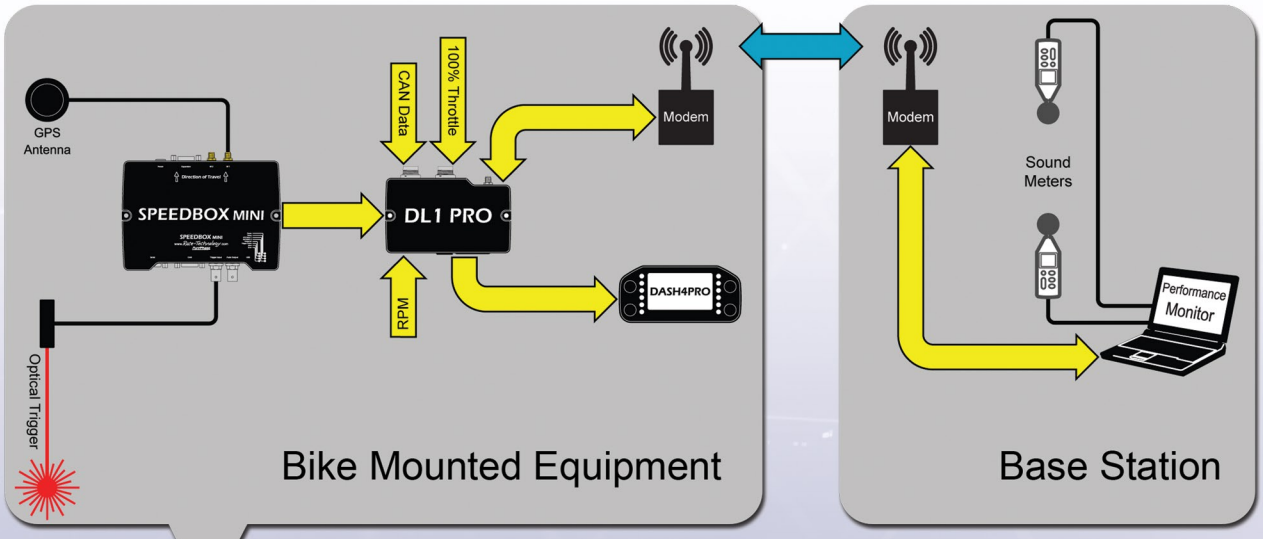

Equipment used

- **Custom built Peli case containing:**
  - SPEEDBOX MINI
  - DL1 Data Logger (optional CAN data licence)
  - Modem
  - Laser trigger
  - Lemo connector inputs for:
    1) GPS antenna connection
    2) Throttle position input
    3) Spare analogue input (gear)
    4) RPM input
    5) Power supply input
    6) CAN bus input
    7) RS232 modem antenna connection
    8) DASH4 display connection
- **100% Throttle switch**
  (For motorcycles without throttle position available on CAN bus)
  - Universal bracketry for mounting on hand throttle
  - 100% detection only
- **DASH4 display**
  - Universal bracketry
- **RPM VRS conditioning cable**
- **Base station**
  - Laptop computer
    - Long battery life
    - Preloaded full software
    - 3 USB ports
    - High visibility screen
  - **Modem**
  - **2x Larson Davis sound track LXT sound meter**
    (Supplied with tripods)
  - **Reflective barrier**
    (Supplied with tripods)
- **Large Peli case for transporting full kit**
  - custom foam insert

Equipment installation and setup

The SPEEDBOX R41 pass-by noise test kit was designed to be universal system that is possible to be installed on all types of motorcycle and to have a very short installation time.

If the motorcycle is equipped with a CAN bus then the installation is very simple only requiring 4 connections.

a. 12v
b. Ground
c. CAN high
d. CAN low

If the motorcycle is not equipped with a CAN bus then the direct inputs must be used to acquire RPM and 100% throttle position.

A 100% throttle switch to clamp on to the hand throttle is supplied with bracketry. This is designed to be adjusted so when 100% throttle is applied the switch is pressed as it contacts the brake lever or similar.

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Equipment installation RPM

For sensing the RPM the box is supplied with a low level input, high level input and a VRS conditioning cable with built in pulse divider.

Low level input spec

Triggering voltage requires a low input of <1v and a high input of >4v and 15v maximum. Suitable for connection directly to most ECU tacho outputs. Maximum input frequency >300Hz.

High level input spec

Designed to connect directly to negative terminal of ignition coil. Can also fire from fuel injectors and from CD ignition systems.

VRS conditioning cable

A VRS Signal Conditioner takes the unconditioned output from a Variable Reluctance Sensor (VRS), eg: an ABS wheel speed pickup, which is a noisy sine wave and outputs this as a clean square wave signal. It can also divide the pulse frequency by a number between 2 and 255. Typically ABS sensors read a wheel with many slots, which gives a high frequency signal. By dividing the number of pulses the signal is better suited for use with a DL1.

The computer is supplied with the kit and only requiring the modem and sound meters plugging into the USB ports. Tripods with reflective tape for the laser trigger on the bike needs positioning on each side of the test track.

How the equipment is used to perform the test

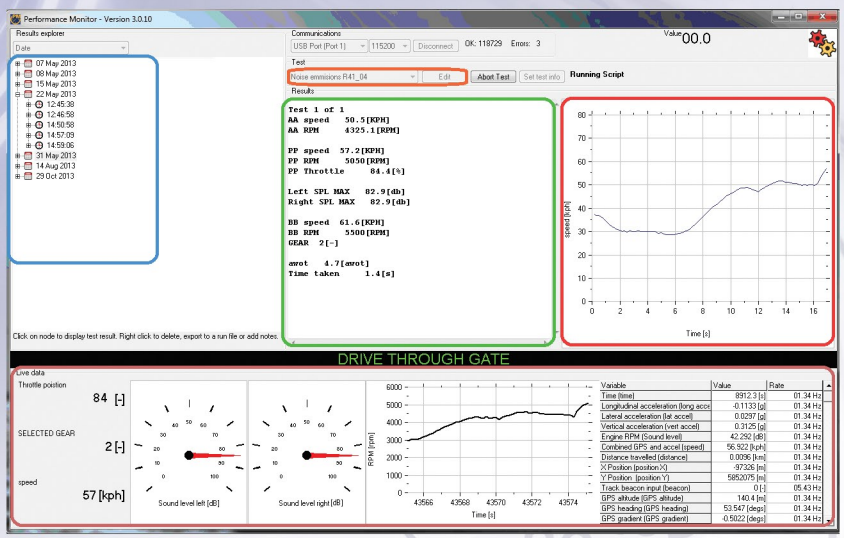
Results and Performance software:

The data is logged automatically in the performance monitor software which can be exported to excel or loaded into the Race Technology Analysis software. The following results in the green box below are produced from a fully editable script.

The test must be performed 3 times and the max result from left and right sound level meters from each test need to be averaged. By right clicking in the green box and selecting copy you can simply and quickly copy the results from each test into a spreadsheet to calculate the specific results to each of the tests and motorcycles.

Software Key:

Blue - Recorded Results History
Orange - Script Selector
Green - Test Results
Brown - Live Received Data
Red - Scrolling Graph Based on Script



AA

- Once test is started the Performance Software automatically resets the sound meter's SPL MAX.
- Laser trigger resets distance travelled to 0 at AA using the reflective barrier.
- Performance Monitor software detects 0 distance and outputs speed and RPM.

PP

- Performance Monitor Software detects distance travelled is 10m and outputs speed, RPM, throttle position, left side SPL MAX and right side SPL MAX.
- SPL left and right auto detection using GPS heading.

BB

- Performance Monitor Software detects distance travelled is 22m (rear of bike has cleared point BB) and outputs speed, RPM, gear, AWOT and time taken.
- AWOT refers to average acceleration through the trap in m/s/s.
- Performance Monitor sends results to DASH4PRO display on bike.

Race Technology
www.race-technology.com

Scripting Language

Introduction

Performance editor comes with simple, yet powerful script editor. You can "program" the test to be done. Script editor features:

- It has very simple, but complete set of keywords to automate your tests
- All operators which supported by the Math Parser can be used in your scripts
- Keywords and variables are not case sensitive to minimize the syntax errors
- Nested If statements are supported
- Nested loops are supported

Description of the Pass-by Noise test script and how it works:

1) Open window to display text size 50
2) Start test
3 Display "Drive through gate" in window
% means to ignore line and is used to input notes
****Start point****
4) Wait until distance is between 0 and 0.001
5) Create a name for the value of time at this point (StartTime)
- This will be used to calculate time taken at end of test
6) Create a name for the value of speed at this point (StartSpeed)
- This will be used to calculate average acceleration at end of test
7) Output results in performance monitor display screen
- Label, variable, decimal places, unit
****Mid point****
8) Wait until distance is more the 10meters
9) Output results in performance monitor display screen
- Label, variable, decimal places, unit
****End point****
10) Wait until distance is more than 22 meters
11) Create a name of the value of time at this point
12) Create a name of the value of speed at this point
13) Output results in performance monitor display screen
- Label, variable, decimal places, unit
14) If heading is less than 0 output sound meter values left and right
- This enables automatic detection of left and right
15) Output average acceleration
16) Output time taken
17) End test

The script can be made specific to a particular motorcycle or test to give pass or fail results based on it. Since the R41 final result is a combination of multiple tests this script is left universal outputting the required parameters for all test which then can be entered into a spreadsheet to avoid wasting valuable test time due to the wrong script being selected.

Script:

```
OpenPromptWindow 50
StartTest
   Prompt "Drive through gate"
%************ Start point***********
Wait (VAR_0017>0 and VAR_0017<0.001)
Declare StartTime
StartTime = VAR_0001
Declare StartSpeed
StartSpeed = VAR_0015
RecordResult "AA speed   ",(VAR_0015),1,"KPH"
RecordResult "AA RPM     ",(VAR_0010),1,"RPM"
%************ MID POINT************
Wait (VAR_0017>0.010)
RecordResult "PP speed  ",(VAR_0015),1,"KPH"
RecordResult "PP RPM     ",(VAR_0010),1,"RPM"
RecordResult "PP Throttle     ",(VAR_3000),1,"%"
%************ MID POINT************
Wait (VAR_0017>0.010)
RecordResult "PP speed  ",(VAR_0015),1,"KPH"
RecordResult "PP RPM     ",(VAR_0010),1,"RPM"
RecordResult "PP Throttle     ",(VAR_3000),1,"%"
%**************END POINT************
Wait (VAR_0017>0.022)
Declare EndTime
EndTime = VAR_0001
Declare EndSpeed
EndSpeed = VAR_0015
RecordResult "BB speed  ",(VAR_0015),1,"KPH"
RecordResult "BB RPM     ",(VAR_0010),1,"RPM"
RecordResult "GEAR  ",(VAR_2025),0,"-"
If(VAR_0403<0)
RecordResult "Left SPL MAX   ",(VAR_7032),1, "db"
RecordResult "Right SPL MAX   ",(VAR_7033),1, "db"
Else
RecordResult "Left SPL MAX   ",(VAR_7033),1, "db"
RecordResult "Right SPL MAX   ",(VAR_7032),1, "db"
%Endif
RecordResult "awot   ",
((((EndSpeed/3.6)^2)-((StartSpeed/3.6)^2)))/(44),1,"awot"
RecordResult "Time taken     ",(EndTime - StartTime),1,"s"
Prompt "TEST PASS"
EndTest
```

Example Single Gear Results

WOT Speed Test

Left					
Speed AA	Speed PP	Speed BB	Noise	Noise pre cal	Accel
40.19	50.1	61.41	78.9	77.9	3.8
40.1	50.3	61.6	79.1	78.1	3.8
40.5	51.0	62.2	79.1	78.1	3.9
Left wot Ave		78.0			
Left Accel ave		3.8			
Lwot Result		78.8			

Right					
Speed AA	Speed PP	Speed BB	Noise	Noise pre cal	Accel
40.2	50.1	61.4	80.0	79.0	3.8
40.1	50.3	61.6	79.6	78.6	3.8
40.5	51.0	62.2	79.9	78.9	3.9
Right wot Ave		78.8			
Right accel ave		3.8			

*** Result is the highest left or right averaged result

Constant Speed Test

Left	
Speed PP	Noise
49.7	74.5
50.5	74.4
50.3	74.8
Left cnst Ave	74.6
Lcrs Result	74.8

Right	
Speed PP	Noise
49.67	74.7
50.47	75.3
50.26	74.1
Right cnst Ave	74.8

*** Result is the highest left or right averaged result

Partial power factor Kp	0.5		Partial Power factor Kp	0.5

Left urban noise	76.2		Right urban noise	76.7
Noise Final (Lurban)	76.7			

*** L urban = (L WOT - (kp * (L WOT - L CRS)))

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