

# **BRAKE PARTICLE EMISSIONS**

## **BRAKE EMISSION TASK FORCE 2 FUTURE OUTLOOK**

### **DEVELOPMENT OF A COMMONLY ACCEPTED METHOD FOR MEASURING BRAKE PARTICLE EMISSIONS**

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# DISCUSSION ON TESTING PARAMETERS

## BACKGROUND CONCENTRATION – NOT SOLVED

### 2. Background/blank concentration check

~~Valid measurements only when quantity of emissions collected/measured during testing is at least five times the corresponding overall blank value. Each Lab shall report the applied method for the blank evaluation.~~ Each Lab shall follow the recommendations described below.

- i. The cooling air entering the brake enclosure during a brake particle emission test shall pass through a medium capable of reducing particles of the most penetrating particle size in the filter material by at least 99.95%, or through a filter of at least class H13 as specified in EN 1822.
  - **No further comments to this recommendation**

# DISCUSSION ON TESTING PARAMETERS

## BACKGROUND CONCENTRATION – NOT SOLVED

- ii. It is encouraged that the cooling air entering the brake enclosure during an emission test passes through a charcoal (or activated carbon) filter with the aim of removing volatile organic species.
- **It is recommended to install the filter upstream of the H13 (or equivalent) filter**
  - **The lab should ensure that the installation will have no impact on the flow and the flow distribution**
  - **The option will be evaluated during the RR exercise in order to assess if it will become a recommendation**

### Additional Information

- ✓ The benefit/need of this proposal is to avoid the possibility that artificially generated nanoparticles enter the enclosure and subsequently the measurement devices, affecting thus the PN measurement (less to do with PM measurement)
- ✓ This benefit can be achieved at relatively low cost and minimum effort
- ✓ Filters in brake emission measurements are expected to be much less contaminated compared to exhaust measurements, therefore applying similar specifications will ensure the proper utility of these filters within different labs

# DISCUSSION ON TESTING PARAMETERS

## BACKGROUND CONCENTRATION – NOT SOLVED

- iii. The BG concentration of each set up shall be defined on a PN basis (# particles/cm<sup>3</sup>). Each laboratory shall report their BG concentration over each emissions test (or block of tests). The BG concentration shall not exceed the maximum allowed value of X particles/cm<sup>3</sup>.
- **Need to properly define X (i.e. Total PN for ~~23- or~~ 10 nm CPC; Solid PN for ~~23- or~~ 10 nm CPC) - Both solid and total PN for BG estimation will be measured during RR. A final decision should be made after the RR**
  - **One suggestion is that the value X will be strict enough so no subtraction/correction is applied. Another suggestion is to apply correction anyway. The decision will be made after the RR**

### Additional Information

- ✓ High background concentrations might be a reason for high PN (and PM) emissions. We should make sure that the measurement is compromised due to high BG concentrations. In that sense the maximum allowed limit seems the most reasonable approach.

# DISCUSSION ON TESTING PARAMETERS

## BACKGROUND CONCENTRATION – NOT SOLVED

- iv. It is recommended to perform the BG measurement at two levels. The 1<sup>st</sup> level concerns the system installation and shall run without the brake assembly or fixture being mounted. The 2<sup>nd</sup> level foresees regular BG checks before and after the execution of a block of tests\*. The regular BG pre-test shall take place with the brake assembly mounted; however, with the disc/drum not rotating and the pads/shoes being fully retracted.
- **In all checks the incoming cooling air shall be conditioned to  $20\pm 2^{\circ}\text{C}$  and  $50\pm 5\%$  RH**
  - **BG measurement shall take place by means of the same instrumentation as for emission measurements**

### Questions

- ✓ \*Do we agree on the definition of block of tests as given by Link (i.e. series of burnishing and emissions measurement cycles on the same sample of friction material and disc/drum, under the same: setup, airflow/airspeed, set of sampling nozzles, and without removing the brake assembly from the dyno. Changes on Inertia and replacement of gravimetric sampling filters can be considered parts of the same test)?
- ✓ Shall the post-test BG check take place before or after the purge?

# DISCUSSION ON TESTING PARAMETERS

## BEDDING-IN PROCEDURE – NOT SOLVED

### 5. Definition of a common bedding-in procedure

**Appropriate bedding-in is very important when emission tests are performed. Therefore it is recommended:**

✓ *Application of at least five WLTP novel cycles before running emission tests*

### Open topics - Questions

- ✓ Possibility to shorten the bedding procedure? What recommendations are given for the purging between the cycles during the bedding procedure?
- ✓ Do we need different bedding procedures or criteria for different brake materials (ECE/NAO)?
- ✓ Criteria when the bedding is finished? What metric should be used (PN, PM,  $\mu$ )? HORIBA suggests using integrated PN values for the bedding. However, subsequent cycles needs to be taken into account when defining proper criteria
- ✓ What needs to be reported regarding the bedding procedure (if any)?