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Calibration Specification for Electronic Capture Systems of Smoky Vehicles

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Calibration Specification for Electronic Capture Systems of Smoky Vehicles

1 Scope

This Specification applies to the calibration of stationary and mobile electronic capture systems of smoky vehicles.

2 Normative references

The following referenced documents are used for the application of this document.

HJ/T 398-2007, *Stationary source emission - Determination of blackness of smoke plumes - Ringelmann smoke chart*

HJ 845-2017，*In the use of diesel vehicles exhaust pollutant measurement methods and technical requirements (remote sensing detection method)*

For dated references, only the edition cited applies. For undated references, the latest edition of the referenced document (including any amendments) applies.

3 Terminology and measurement units

3.1 smoky vehicles

Motor vehicles that emit visible pollutants such as black smoke.

3.2 stationary electronic capture systems of smoky vehicles

A system that is fixedly installed on a gantry (or L-pole) on the road, automatically recognizes the black smoke emissions of vehicles in the detection area, and judges the degree of black smoke emissions from their exhaust.

3.3 mobile electronic capture systems of smoky vehicles

A system that uses mobile methods (handheld, portable, etc.) to adjust the position of the electronic capture system device's collection area, so that motor vehicle exhaust passes through this collection area, and the system can automatically determine the level of black smoke emitted from exhaust emissions.

NOTE: Including handheld smoky vehicle capture device, handheld black smoke recognition

device, handheld Ringelmann blackness meter, etc.

3.4 Ringelmann blackness

A smoke concentration representation method obtained by comparing the color of exhaust pollutants with the Ringelmann smoke blackness map. It is divided into levels 0, 1, 2, 3, 4, and 5. There are 6 types of corresponding Ringelmann smoke blackness maps. Except for all white and all black, which represent Ringelmann blackness levels 0 and 5, the remaining four levels are determined based on the percentage of black stripes occupying the entire area. The area of black stripes accounting for 20% is level 1, 40% is level 2, 60% is level 3, and 80% is level 4. The standard Ringelmann smoke blackness map consists of images with different blackness levels of 14cm × 21cm.

[Source: HJ 845-2017, 3.9; HJ/T 398-2007, 2.3; Modified]

3.5 standard blackness plate

It consists of ten standard boards with different blackness levels. The blackness levels are 0.00, 0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 3.00, 4.00, and 5.00, respectively. Each 0.25 level is converted to a black bar grid, which accounts for 5% of the total area.

NOTE: The principle of standard blackness plate is based on the Ringelmann smoke blackness chart. The standard blackness plate specifications are suitable for the working distance and shooting image of the electronic capture system of smoky vehicles. It is applied to calibrate the blackness of the electronic capture system for smoky vehicles.

4 Overview

The electronic capture system for smoky vehicles uses video image technology to collect and record the exhaust emissions of vehicles in the detection area. Using methods such as classifier design and neural networks, it automatically identifies the blackness of pollutants emitted by motor vehicles. The system usually consists of a camera acquisition unit, a video image processing unit, a data processing unit, etc.

The electronic capture system for smoky vehicles can be used to capture black smoke emitted by vehicles on the road, road inspections of diesel vehicles, and non-road mobile machinery inspections.

5 Metrological characteristics

5.1 Indication error

The indication error generally does not exceed the requirements given in Table 1.

7.3.3 Calculate repeatability according to formula (2).

$$s_A = \sqrt{\frac{\sum_{i=1}^{n}(x_i - \overline{x})^2}{n-1}} \qquad (2)$$

Where,

s_A - The repeatability (expressed as experimental standard deviation), level;

x_i - The i-th measured value, level;

$\overline{x}$ - The average value of 6 measurements, level.

8 Expression of calibration results

8.1 Calibration certificate

After calibration, the electronic capture system of smoky vehicle will be issued with a calibration certificate. The content included in the calibration certificate shall comply with the requirements of 5.12 of JJF 1071-2010. The recommended calibration certificate inner page format can be found in Annex C. The recommended calibration record format can be found in Annex B.

8.2 Evaluation of uncertainty in calibration results

The uncertainty of the Ringelmann blackness level indication error of the electronic capture system for smoky vehicles is evaluated based on JJF 1059.1. An example of its uncertainty assessment can be found in Annex D.

9 Recalibration time interval

The recommended time interval for the recalibration of electronic capture systems of smoky vehicles is one year.

The length of the time interval for recalibration is determined by many factors such as the usage of the instrument, the user, and the quality of the instrument itself. Therefore, the sending unit can independently determine the time interval for re calibration based on the actual situation.

Annex A

Style of standard blackness plate

A standard blackness plate is composed of 10 standard plates with different blackness levels. It is accurately made by fixing black lines with determined width and rectangular grids with intervals on a white background board. The chromaticity of the white background board is $L \geq 80$. The chromaticity of black stripes is $L \leq 30$. The remaining 8 levels (levels 0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 3.00, and 4.00) are determined based on the percentage of black stripes occupying the entire area, except for all white and all black representing the Ringelmann blackness levels of 0.00 and 5.00, respectively.

The standard blackboard size used in the stationary electronic capture systems of smoky vehicles is 600 mm × 600 mm. Except for levels 0.00 and 5.00, there are a total of 900 rectangular grids in each standard blackness plate for the other 8 levels (levels 0.75, 1.00, 1.25, 1.50, 1.75, 2.00, 3.00, and 4.00). Each grid is 20 mm long and 20 mm wide. The schematic diagram of the level 1.00 standard blackness plate (stationary type) is shown in Figure A.1. The extended uncertainty of the standard blackness plate U=1.6% (relative value of area ratio), k=2. The standard blackness plate used in the mobile electronic capture systems of smoky vehicles is also composed of 10 standard boards with different blackness levels. Due to changes in detection distance, its size is proportionally reduced. Each standard blackness plate has a size of 100 mm × 200 mm.

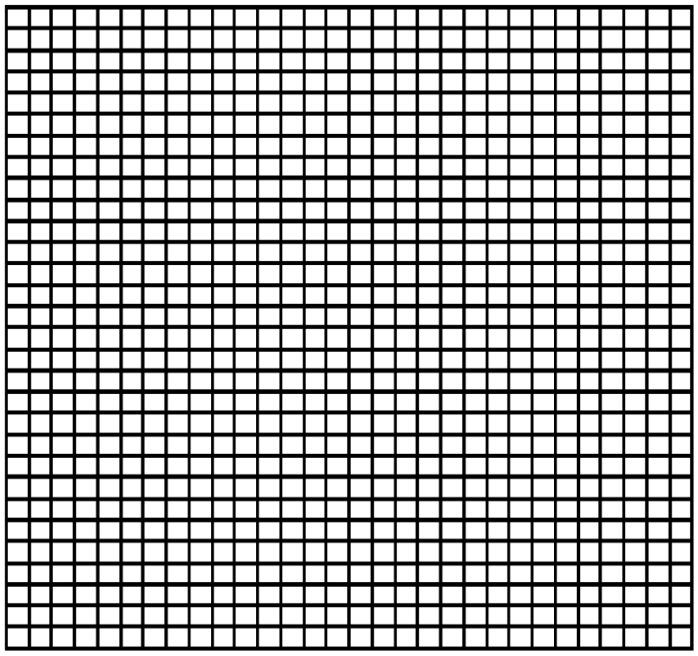

Figure A.1 -- Schematic diagram of level 1.00 standard blackness plate (stationary)

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