	Technical Specification for Verification and Inspection of Vehicle Exhaust Emissions Analyzers	S/N	CNMV 99
		Rev.	2

1. This technical specification is enacted pursuant to Paragraph 2, Articles 14 and 16 of the Weights and Measures Act.
2. The revision, date of promulgations, document No, date of enforcement and content of the amendment are listed as follows:

Rev.	Date of Promulgation	Document No. (Ching-Piao-Szu-Tsu)	Date of Enforcement	Content of Amendment
1	92.05.21	NO.09240004850	92.07.01	
2	103.11.03	NO.10340009270	105.01.01	1.In order to enhance the accuracy of the vehicle exhaust emissions analyzers, the class II will be deleted and add class 00. According to the latest edition, analyzers will be divided into three classes, 00、0 、and I. The corresponding permissible errors inspection for verification and inspection are reversed. 2.According to Iteam3, Subsection 9, Act 3 of the Regulation Governing Verification and Inspection of Measuring Instruments, the vehicle exhaust emission analyzers for the motorcycle are excluded, Therefore, the latest edition of this specification delete the related articles. 3.Revised the requirements for the uncertainties of the standard gases. 4.Due to the low usage of the on-site verification for analyzers-in-use, delete the on-site verification and related articles. 5.According to this specification, the test for reproducibility has been covered by repeatability. Therefore, amend the requirements of repeatability. Meanwhile, the requirements of repeatability are reversed, as the requirements of OIML R 99:2008. 6.In order to specify the equipments and the test items for inspection clearly, the latest specification adds the related articles. 7.Considering might not meet the latest specification, the existing analyzers are allowed to be applied to the old edition to lower the impact to the users.

3. This specification is formulated with reference to the following international specifications: OIML R99 Instruments for measuring vehicle exhaust emissions (2008)

Date of Promulgation	Bureau of Standards, Metrology and Inspection, Ministry of Economic Affairs	Date of Enforcement
03.11.2014		**01.01.2016**

1. Scope: This specification applies to analyzers for measuring the emissions exhausted by vehicles with spark ignition engines.

2. Structure:

2.1 Vehicle Exhaust Emissions Analyzers (hereinafter referred to as the "analyzer(s)") shall have a permanent and easily readable label with following information:

(1) Manufacturer's name/trade mark;

(2) Year of manufacture;

(3) Class (00, 0 and Ⅰ);

(4) Serial number of the analyzer and the measuring transducer;

(5) Calibration flow rate, minimum and nominal sampling flow rate (SLPM);

(6) Nominal mains voltage, frequency and power required;

(7) Gas components and respective maximum measured value;

The label information specified above shall be correct, clear and uneasy to be erased.

2.2 The value of the propane/hexane equivalency factor and the warm-up time for each analyzer shall be marked permanently on the front panel of the analyzer or shall be displayable on the indicating device, the resolution of the equivalency factor shall be not larger than 0.001.

2.3 For analyzers with software-controlled metrological function, the identification of the legitimacy of the relevant software shall be marked permanently on the front panel of the analyzer or shall be displayable on the indicating device.

2.4 The measured result of the gas components shall be unambiguously expressed as "% vol. CO", "% vol. CO_2" and "ppm vol. HC". HC: the concentration of hydrocarbons that expressed as n-hexane equivalency via equivalency factor.

2.5 The gas handling system of the analyzer shall contain a filter unit with replaceable element capable of removing particles. It shall be able to observe the degree of a filter's contamination without removed, and it shall also be able to replace this filter easily without special tools.

2.6 The gas handling system of the analyzer shall contain a water separator that prevents water condensation from forming on the measuring transducer.

2.7 In addition to the gas sampling port, the analyzers shall have a calibration port. Analyzers with an HC channel shall have a port for drawing in ambient air or other gas without hydrocarbons, to provide a reference for zero-setting of the of the analyzers. If used, ambient air shall pass through a charcoal filter or equivalent system.

2.8 The pump conveying the exhaust gas shall be mounted so that its vibrations do not affect the measurements and it shall not be possible to make a measurement when the pump is switched off.

2.9 The minimum measuring range of analyzers for different gases shall be as given in Table 1.

Table 1

Measurand	CO % vol	CO_2 % vol	HC ppm vol
Minimum Measuring Range	0~5	0~16	0~2000

2.10 The minimum scale intervals of analyzers are specified as below:

The digits of indicator of analyzers shall be at least 5 mm high, and the minimum scale intervals of analyzers shall be as given in Table 2.

Table 2

Measurand	CO % vol	CO_2 % vol	HC ppm vol
Minimum Scale Value	0.01	0.1	1

2.11 A battery-operated the analyzer shall either be able to continue to function correctly and not be able to indicate any value whenever the voltage is lower than the manufacturer's specified value.

2.12 The analyzer shall be equipped with the gas handling system for sampling, the function for the alarm of blocked and the necessary for purge.

2.13 The analyzer shall be equipped with the interface device for RS-232 or any other type of interface to read the raw test data of the sampling and calibrating for output.

3. Verification

3.1 The requirements of verification and inspection equipment are as follows:

(1) Standard gases: They should be traceable to national or international standard. Except hydrocarbons, the relative expanded uncertainty U of all other gases shall be 1% or less. The relative expanded uncertainty U of is shown below.

For HC below 1000 ppm, U is 2 % or less, while for HC between 1000 ppm to 2000 ppm, U is 1 % or less. However, for class 00, U shall be lower 1%.

U: The relative expanded uncertainty under 95 % reliable levels and the coverage factor is 2.

(2) zero gas: Highly purified nitrogen that makes the reading of the analyzer is zero.

(3) Stopwatch: The stopwatch shall be able to measure over at least 8 hours and the minimum resolution of indication is 0.1 sec or less.

(4) Thermometer: The rangeability of the thermometer shall at least include 5 to 40 °C and the minimum resolution of indication is 0.5 °C or less. The uncertainty of the thermometer shall be 1 °C or less.

(5) Pressure meter: The rangeability of the pressure meter shall at least include 80 to 106 kPa and the minimum resolution of indication is 2 kPa or less. The uncertainty of the pressure shall be 5 kPa or less.

(6) Flow controller: The rangeability of the flow controller shall at least include 0-10 SLPM, the minimum resolution of indication shall be than 10 SCCM (Standard Cubic Centimeters per Minute) or less, and the uncertainty of the flow controller shall be 300 SCCM or less.

3.2 The verification and inspection procedure shall include the following items:

（1） Structure,

（2） Warm-up test (in use analyzers need not perform this item),

（3） Response time test,

（4） Accuracy and repeatability test,

（5） Leakage test,

（6） HC residue test (in use analyzers need not perform this item) and

（7） Low flow test.

3.3 The testing specified above shall meet the following condition:

3.3.1 The tests shall be performed using the standard gases given in Table 3.

Table 3

Gas component, concentration and number of standard gases				
Concentration	No. 1 gas	No. 2 gas	No. 3 gas	No. 4 gas
CO % vol	0.5±10%	1.0±10%	3.5±10%	4±10%
CO_2 % vol	6.0±10%	10±10%	14±10%	14±10%
HC ppm vol	100±15%	300±15 %	1000±15%	1600±15%

3.3.2 After the warm-up, the analyzers shall be tested immediately.

3.3.3 The calibration for span reading shall use the No. 4 gas, the span gas.

3.3.4 Prior the verification and inspection procedure performed in laboratory, analyzers shall be injected with span gas via calibration port with the labeled flow-rate for adjustment.

3.3.5 The test data shall not be taken until after injecting the testing gas for 20 sec. The test data of CO, CO2 and HC shall be taken simultaneously for three times and use the arithmetic mean of readings as the testing result.

3.3.6 When performing calibration and verification via the sampling port and calibrating port with standard gases, the flow-rate of gases shall be greater than the labeled flow-rate as manufacturer's requirement, and make unnecessary test-gas can be vented out from the manifold.

3.3.7 The capillary–type calibration inlet shall be taken off the tube from calibration port and connect to the standard gas system to do the verification and inspection test if the analyzer is equipped with capillary type calibration inlet.

3.3.8 When sampling the test gas via the sampling port, the sampled gas shall flow through the gas handling system and filter unit.

3.4 Warm-up test:

Immediately after either the analyzers warm-up period completed, perform a measurement adjusting with No. 3 gas and then three more measurements at time intervals of 2 min, 5 min and 15 min after warm-up, respectively. The difference between any of the four measured values shall not exceed the modulus of the maximum permissible error of initial verification.

3.5 Response time test:

After purged with zero gas, the analyzer shall be injected with No.1 gas. The reading of CO, CO_2 and HC shall be 95 % of final value within 15 seconds after changing the gas from zero gas.

3.6 Accuracy test and Repeatability test

(1) Accuracy test

After zero reading and span reading calibrated by No. 4 gas, under rated operating condition, inject standard gases No. 1, 2 and 3 for once, respectively. Take the reading for three times for each gas. Use the arithmetic mean as the accuracy testing data for different standard gases. The difference between the results and the concentration of standard gases shall not exceed the maximum permissible errors.

(2)Repeatability test

Inject standard gas No. 1 gas into the analyzer under test and take the reading then purge the analyzer under test with zero gas. The difference between the reading and standard shall not be greater than maximum permissible error of verification. Repeat the procedure for five times. Use the arithmetic mean of the results as the result of the repeatability test. The result of the repeatability test shall not be greater than one third of the maximum permissible errors of verification.

3.7 Leakage Test:

(1) Connect a flow-rate adjustable manifold to the gas handling system near the sampling port, and inject into the No. 1 gas from the sampling port to conduct the leakage test. Increase the flow-rate passing the manifold. When the difference of the indication of the leakage test flow-rate and the normal verification flow-rate is greater than the half of the maximum permissible errors for verification, stop the test and take the reading of the flow-rate.

(2) Initiate the analyzer's leakage test function with the flow-rate taken in 3.7(1). The whole system shall be air-tight. During the leakage test, there is no measurement allowed to conduct.

3.8 HC residue test.

(1) After the sampling at least 5 min with No. 4 gas, purge the analyzer immediately. The purge procedure shall be terminated by 30 seconds and take HC reading. Repeat the procedure for three times to conduct the HC residue test. All of the readings shall be less than 20 ppm vol. If one of the readings is over 20 ppm vol, the accuracy test procedure shall not be implemented.

(2) The HC residue test shall be followed by an accuracy test with No.3 gas. The result of the accuracy test shall not be greater than the maximum permissible errors for verification.

3.9 Low flow test:

Inject No. 1 gas to the gas handling system by the sampling port with the flow-rate greater than the minimum flow-rate of the analyzer under test. Decrease the flow-rate gradually. When the difference of the indication of the leakage test flow-rate and the normal verification flow-rate is greater than the half of the maximum permissible errors for verification, the analyzer shall indicate the signal of low flow-rate and the analyzer shall prevent

measurements form being carried out.

4. Inspection

4.1 The equipments for inspection：The equipments for inspection are as same as the equipments for verification.

4.2 Inspect items：The inspection items could be the whole items or part of the items listed in this specification.

5. The maximum permissible error of verification and inspection

The maximum permissible errors shall be as given in Table 4

Table 4

Class	Error types	The maximum permissible error of verification and inspection under different gas concentrations		
		CO % vol	CO_2 % vol	HC ppm vol
00	Absolute error	±0.02	±0.3	±4
	Relative error	±5 %		
0	Absolute error	±0.03	±0.5	±10
	Relative error	±5 %		
I	Absolute error	±0.06	±0.5	±12
	Relative error	±5 %		

Permissible errors：Absolute or relative whichever is greater.

Absolute error：indication of measuring analyzer－standard values

Relative error：（indication of measuring analyzer－standard values）/ standard values×100%

6. The verification compliance marks

6.1 The validity of the verification for the analyzers is one year, from the first day of following month after the verified conformity mark attached to the following year.

6.2 Even the validity of the verification is not expired, the analyzers shall be applied for re-verification when replaced the sensor, reversed software or repaired.

6.3 The verification compliance mark of analyzers shall be on the front of the analyzer and be easy to spot.

6.4 After the analyzer passed verification, a verification certificate shall be issued to the applicant.

6.5 The certificate of verification shall describe the items as follow: Applicant, address of applicant, brand of analyzer, specification, model, serial number (including mainframe and the sensor), the version of the software, category, class, the number of the verification compliance marks, date of verification, validity, and other necessary information.

7. The revision enters to force on January 1, 2015. However, analyzers that have passed the initial verification prior to January 1, 2015, are allowed to apply the existing edition.