AHRI Standard 1261 (SI)

2017 Standard for

Performance Rating of Portable Flue Gas Combustion Analyzers

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Note:

This is a new standard.
For I-P ratings, see AHRI Standard 1260 (I-P)-2017.

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PERFORMANCE RATING OF PORTABLE FLUE GAS COMBUSTION ANALYZERS

Section 1. Purpose

1.1 *Purpose.* The purpose of this standard is to establish for Portable Flue Gas Combustion Analyzers; definitions; test requirements; minimum performance requirements; nomenclature; minimum data requirements for Published Ratings; marking and nameplate data; and conformance conditions.

1.1.1 *Intent.* This standard is intended for the guidance of the industry, including manufacturers, engineers, installers, contractors and users.

1.1.2 *Review and Amendment.* This standard is subject to review and amendment as technology advances.

Section 2. Scope

2.1 *Scope.* This Standard specifies requirements for performance rating of portable flue combustion analyzers measuring specific combustion flue gas products of heating appliances for residential and light commercial applications using fuels including at minimum natural gas, propane, light and heavy fuel oil.

2.2 *Exclusion*. This Standard is not intended for performance rating of portable analyzers monitoring ambient Carbon Monoxide (CO) or ambient Carbon Dioxide (CO_2), or for use as an environmental emissions compliance tool.

Section 3. Definitions

All terms in this document will follow the standard industry definitions in the ASHRAE Wikipedia website (https://www.ashrae.org/resources--publications/free-resources/ashrae-terminology) unless otherwise defined in this section.

3.1 *Adjustment.* Process of tuning the analyzer to return the calibration deviation to within the allowed error.

3.2 *Ambient Air.* Normal atmosphere surrounding the analyzer, with a CO level of under 1 ppm.

3.3 *Battery Powered.* Analyzer powered from batteries whether disposable or rechargeable.

3.4 *Certified Test Gases.* Test gases (also known as calibration gases) used for testing, certified within 2% accuracy traceable to NIST

3.5 *Clean Air.* Ambient Air free of any cross interfering gases (e.g. CO).

3.6 *CO Undiluted*. A calculation normalizing the CO concentration from a diluted value of CO due to Excess Air to the undiluted value at theoretical 0% oxygen, also known as CO air free.

3.7 *Combustion Efficiency*. A calculation of useful heat extracted from the fuel used by an operating heating appliance expressed as a percentage. (i.e. 100% minus the losses). It is calculated from the instantaneous measurements of a combustion analyzer and may not be the same as heating appliance efficiency factors, such as the Annual Fuel Utilization Efficiency (AFUE).

3.8 *Excess Air.* Extra air supplied to the combustion process that is in addition to the quantity required for stoichiometric combustion.

3.9 *Gas Concentration.* Amount of a specified gas present in the flue gas sample, expressed as parts per million (ppm) or percent (%) by volume.

3.10 *Portable Gas Analyzer.* A portable electronic instrument that measures specific combustion flue gas products of heating appliances for residential and light commercial applications.

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3.11 *Probe.* Part of the system placed in the heating appliance stack or flue to sample gas, measure temperature and/or pressure.

3.12 *Reference Analytic Equipment.* The equipment used to determine emissions during tests to CEN CR 1404-1994, *Determination of Emissions from Appliances Burning Gaseous Fuels During Type-Testing*.

3.13 *Sensor.* A device that detects or measures a physical property and records, indicates, or otherwise responds to it. (e.g. an electro-chemical gas sensor).

3.14 *Shall. "Shall" or "Should".* "Shall" or "should" shall be interpreted as follows:

3.14.1 *Shall.* Where "shall" or "shall not" is used for a provision specified, that provision is mandatory if compliance with the standard is claimed.

3.14.2 *Should.* "Should" is used to indicate provisions which are not mandatory but which are desirable as good practice.

3.15 *Stoichiometric Point.* The ratio between two or more chemical substances undergoing a chemical change where the chemical reaction ends or stabilizes.

3.16 *Warm Up Period.* Time taken from switch on for the analyzer to reach a ready-state.

Section 4. Test Requirements

4.1 *Testing Requirements.* All standard ratings shall be verified by tests conducted in accordance with the provisions set forth in Appendix C to this standard.

Section 5. Minimum Performance Requirements

5.1 *Minimum Performance Requirements.* The required performance shall be as indicated in Table 1 determined by the method of test in Appendix C.

5.2 *Display.* All values shall be indicated on a display with characters not less than 8 mm high unless adequate provision is made for enhancing the legibility (e.g. backlighting) in which case the minimum character height shall be 4 mm. Displayed measured values shall be refreshed at intervals no greater than 3s. The analyzer shall provide a means to display the following**.**

5.2.1 Measured parameters and their values
5.2.2 Indication when measured values are outside of range
5.2.3 Low battery warning
5.2.4 Mode of operation or instrument status (e.g. warm-up, run, hold)
5.2.5 Software version

5.3 *Sampling system.* The sampling system of the apparatus shall be so constructed as to prevent damage to the sensor(s) and pump by particulate matter and liquids that may be expected during normal operation of the apparatus.

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Table 1. Minimum Performance Requirements				
Parameter[1]	Indication Range	Measurement Resolution	Tolerance (Measurement Accuracy)	Response Time (t_{90}) [2]
Oxygen (O_2)	0 –20.9% O_2	0.1% O_2	± 0.3% O_2	30 s
Carbon Monoxide (CO)	0 –2000 ppm CO	1 ppm CO	± 20 ppm CO or ± 5% rel[1, 3]	90 s
Carbon Dioxide (CO_2)	0 – 20% CO_2	0.1% CO_2	± 0.3% CO_2	50 s
Flue Gas Temperature	0 – 400°C	1°C	± 3°C or ± 2% rel[1, 3]	50 s
Draft Pressure	(-2.5)—10.0 kPa	2 Pa	7 Pa or ± 5% rel[1, 3]	10 s
Combustion Efficiency Calculations	-	-	± 1%[4]	-

Note:
1. Relative to the standard test condition reading and only for those analyzers which are equipped to provide the particular measurement.
2, Time interval with the apparatus in a warmed-up condition, between the time when an instantaneous variation of the parameter to be measured is produced at the apparatus inlet, and the time when the response reaches and remains beyond 90% of the final indication
3. Whichever is greater
4. Example: If the calculated efficiency is 90%, then the analyzer's displayed efficiency must be within 89% to 91%)

Section 6. Nomenclature

6.1 *Nomenclature*. All of the nomenclature for this standard is listed in Table 2.

Table 2. Nomenclature		
Variable	Description	Units
C_{eff}	Condensing efficiency	%
CO	Carbon Monoxide (measured value)	ppm
$CO_{(undiluted)}$	Carbon monoxide referenced to 0% O_2	ppm
CO_2	Carbon dioxide (calculated or measured value)	%
DFL	Dry flue gas loss, gross basis	%
EA	Excess Air	%
EFF	Combustion Efficiency (gross basis)	%
HHV	Higher heating value of the fuel, see Table E1	kJ/kg
HR_a	Theoretical maximum humidity ratio as a function of inlet air temperature	$kg_{moisture}/kg_{dry\ air}$
HR_{fg}	Theoretical maximum humidity ratio as a function of flue gas temperature	$kg_{moisture}/kg_{dry\ air}$
$K1$	Dry flue gas loss constant, gross basis, see Table E1	-
$K2$	Carbon dioxide proportion in dry flue gases at the stoichiometric point, see Table E1	-
$K3$	Wet flue gas loss constant, gross basis, see Table E1	-
$K4$	Unburnt carbon loss constant, gross basis, see Table E1	-
M_{as}	Mass of combustion air at stoichiometric combustion as a ratio of the mass of the fuel, see Table E1	$kg_{dry\ air}/kg_{fuel}$ (stoichiometric)

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