National Standards Authority of Ireland

STANDARD RECOMMENDATION

S.R. CR 1404:1994

ICS 13.040.40

National Standards
Authority of Ireland
Glasnevin, Dublin 9
Ireland

Tel: +353 1 807 3800
Fax: +353 1 807 3838
http://www.nsai.ie

Sales
http://www.standards.ie

DETERMINATION OF EMISSIONS FROM APPLIANCES BURNING GASEOUS FUELS DURING TYPE-TESTING

This Standard Recommendation was published under the authority of the National Standards Authority of Ireland and comes into effect on: 18 March 2007

Price Code R

Údarás um Chaighdeáin Náisiúnta na hÉireann

This page is intentionally left BLANK.

REPORT
RAPPORT
BERICHT

CR 1404:1994

March 1994

English version

Determination of emissions from appliances burning gaseous fuels during type-testing

BASIC DOCUMENT

This CEN REPORT has been established by MARCOGAZ under the supervision of the CEN/PC3 "Gas" and has been approved by CEN on 1993-10-28.

CEN members are the national standards bodies of Austria, Belgium, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Luxembourg, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom.

CEN

European Committee for Standardization
Comité Européen de Normalisation
Europäisches Komitee für Normung

Rue de Stassart 36, B - 1050 Brussels

Ref. no. CR 1404:1994 E

DETERMINATION OF EMISSIONS FROM APPLIANCES BURNING GASEOUS FUELS DURING TYPE-TESTING

A. INTRODUCTION

This draft describes test methods and automatic measuring equipment for the determination of NO_x($NO + NO_2$), CO, CO_2 and O_2 emissions in the flue gases including the sampling system and the calibration gases. The document should be introduced in the relevant gas appliances TC.

Gas cookers, flueless appliances and appliances especially designed for use in industrial processes carried out on industrial premises are excluded from the scope.

According to their principles of analysing the combustion products, the analyzers are classified into following families :

- analyzers based on the chemiluminescent effect : NO an NO_2,
- analyzers based on the absorption of infra-red and ultra-violet radiation : NO and NO_2 for concentrations > 100 ppm, CO and CO_2,
- analyzers based on the paramagnetic principle : O_2,
- electrochemical analyzers : they are considered to be inadequate for laboratory testing procedures.

The conversion of measured levels to reference conditions is given in appendix 1.

B. REFERENCE

ISO/DIS 10849

Stationary source emission.
Determination of the Mass Concentrations of Nitrogen Oxides.
Performance Characteristics and Calibration of Automated Measuring Systems.

ISO 10396

Stationary source emission.
Sampling for the Automated Determination of Gas Concentration.

ISO 3534 - Vocabulary and Symbols

ISO 6976 - Natural gas - Calculation of calorific value, density and relative density.

ISO 6142 - Gas Analysis - Preparation of calibration Gas Mixtures - Weighing Methods - July 1989

ISO 6141 - Gas Analysis - Calibration Gas Mixtures - Certificate of Guarantee

WECC Doc. 19-1990 - Guidelines for the expression of the uncertainty of measurement in calibrations.

VEG - 9201(23/6/92) - Practical guide for the calculation of uncertainties of measurements.

C. UNCERTAINTY OF DETERMINATION

1. General

With the intention to calculate the overall tolerance on NO_X measurements, the following elements are to be taken into consideration :

- the probe systems,
- the accuracy of the analyzers, NO, NO_2, CO_2, CO, O_2,
- the calibration procedures,
- the test conditions.

2. Estimation of the total uncertainty in the determination of NO_X and CO

For the determination of the NO_X - and CO - emission the measured levels have to be converted to reference conditions. For that reason and in order to calculate the dilution factor CO_2 or O_2 shall be measured simultaneously.

The maximum tolerances on the determination of NO_X and CO emissions, including tolerances which occur during the CO_2 or O_2 measurements and the characteristics of the fuel necessary for the conversion of measured levels to reference conditions, is as given in graph 1, curve A.

The total uncertainty as given by curve A is important. There are no requirements for the individual uncertainties, except for the total systematic error.

The calculation of the uncertainty shall be done according to WECC doc - 1990 and VEG doc 9201 (annex 2). An example of the uncertainty calculation is given in annex 3. That document contains also typical values for the different uncertainties. If each individual uncertainty is equal to or better then the typical value curve A will be met. In other cases the uncertainty should be calculated.

3. Total systematic error

Systematic errors can be caused by temperature, pressure, absorption of NO_2, interference and non-linearity. If the total systematic error exceeds 2% of the measured value, then the cause of it shall be investigated and corrected. Correction should be made to limit the systematic error to 2%.

4. Reproducibility of the NO_X and CO emission

A number of factors such as relative humidity and temperature of the combustion air and gas, could affect the level of NO_X emission. For the latter, aformulae for correction derived from the BCR Programme is proposed in annex 1 "NO_X and CO conversion".

D. MAIN PERFORMANCE CHARACTERISTICS OF THE ANALYZERS

(NO, NO_2, O_2, CO and CO_2)

General

The characteristics should be checked for each range by the testing company, the certified manufacturer, or a certified institute.

1. Linearity

For linear calibration curves a check at 4 points 0/30/60/90% is sufficient.

An exact mathematical method to test the hypothesis of linearity is given in ISO 9169.

In the case of an non linear calibration curve, at least 10 measuring points are required. The linearity has to be checked at least once a year or after repairs of the analyzer.

2. Drift

Differentiation should be made between zerodrift and spandrift, and between drift with time and temperature.

The evaluation of the drift should be made according to ISO/DIS 10849, Annex B.

The estimation of the drift with time should cover a period of 8 hours, by measurement each hour.

The permissible ambient temperature range, given by the manufacturer of the equipment, shall at least cover the range from 10 to 35°C.

3. Interference

Interference with other components than N_2 present in the combustion products is possible, depending on their concentration, it shall be declared by the manufacturer.

The effect of interfering compounds shall be determined according to Annex A of doc. ISO/DIS 10849.

For the chemiluminescence method of measuring NO and NO_2, interference can be expected from CO_2, O_2 and H_2O. For CO and CO_2 analyzers interference from all components of combustion products can be determined by applying calibration gases.

4. Response time

The time between applying the calibration gas mixture and reaching 90% of the recorded mass concentration shall not exceed 20s.

5. Measuring range

The total uncertainty depends mainly on the lower limit of the measuring range. This is caused by a number of uncertainties which are expressed as a percentage of the full scale.

E. CALIBRATION GASES

1. Materials

General

Following materials have proven to be successful for measurement of emissions from gas appliances.