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**NATIONAL STANDARD OF THE
PEOPLE'S REPUBLIC OF CHINA**

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**Determination the heat of combustion for hydrocarbon fuels -
Bomb calorimeter method**

烃类燃料热值的测定 氧弹量热计法

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1 Scope

This document describes the method for determining the gross calorific value, net heat of combustion, bomb heat of combustion of hydrocarbon fuels, using an oxygen bomb calorimeter.

This document applies to the determination of the calorific value of liquid hydrocarbon fuels, such as. gasoline, jet fuel, diesel, biofuels, heavy oil, marine fuel oil, residual fuel oil, etc.

2 Normative references

GB/T 4756
GB/T 11140
GB/T 17040

GB/T 27867

GB/T 34100

3 Terms and definitions

The following terms and definitions apply to this document.

3.1 Bomb heat of combustion

The heat released, when a unit mass of specimen is completely combusted in a constant-volume bomb calorimeter which is filled with high-pressure oxygen, except for water which condenses into a liquid state, nitrogen oxides and sulfur oxides which dissolve in water to form nitric acid and sulfuric acid, respectively, the remaining substances (oxygen, nitrogen, and carbon dioxide) of combustion are in a gaseous state.

Note. The sample contains only carbon, hydrogen, oxygen, nitrogen, sulfur elements. The initial temperature of the specimen and oxygen, and the final temperature of the products, are both 25 °C.

3.2 Gross heat of combustion

The heat released, when a unit mass of specimen undergoes complete combustion in a constant-volume bomb calorimeter filled with high-pressure oxygen, producing gaseous oxygen, nitrogen, carbon dioxide, nitrogen oxides, sulfur dioxide, while water condenses into a liquid state.

Note. For liquid fuels, only the heat of combustion of carbon, hydrogen, nitrogen, oxygen, sulfur is calculated.

3.3 Net heat of combustion

The heat released when a unit mass of specimen undergoes complete combustion under constant pressure, producing gaseous oxygen, nitrogen, carbon dioxide, nitrogen oxides, sulfur dioxide, water.

3.4 Energy equivalent

Energy equivalent for water The energy required to raise the temperature of the calorimeter system by 1 °C.

Note. The unit is megajoules per degree Celsius (MJ/°C).

4 Principle

A known mass of fuel is placed in a sealed oxygen bomb; oxygen is introduced and ignition

is performed to ensure complete combustion. The bomb heat of combustion is calculated based on temperature observations before, during, after combustion, with appropriate corrections made for heat transfer (see 11.1 or 11.2) and thermochemistry (see 11.3.2 and 11.3.3). The gross heat of combustion is obtained by subtracting the heat of formation of sulfuric acid (see 11.3.4) and nitric acid (see 11.3.5) from the bomb heat of combustion. The net heat of combustion is obtained by subtracting the heat released by water vapor liquefaction from the gross heat of combustion. Highly volatile samples are sealed using pressure-sensitive tape or gelatin capsules/mineral oil (hereinafter referred to as "accessories").

5 Reagents or materials

Warning - Oxygen strongly accelerates combustion. Use shall comply with the requirements of A.1 in Appendix A.

Warning - 2,2,4-Trimethylpentane is extremely flammable. Harmful if inhaled.

Vapors may cause flash fire. Use shall comply with the requirements of A.2.

Unless otherwise specified, all reagents used in this document are of analytical grade; the test water is distilled or deionized water.

5.1 Benzoic acid standard sample. Certified standard sample with specific calorific

value.

5.2 2,2,4-Trimethylpentane (isooctane) standard sample. Purity not less than 99.75%. 5.3 Gelatin capsules. 5.4 Mineral oil.

5.5 Oxygen. It shall not contain hydrogen or other flammable impurities; electrolytic

oxygen shall not be used. Commercially available oxygen produced from liquid air can be used without purification.

5.6 Pressure-sensitive tape. Celluloid tape, free of chlorine and sulfur.

6.2 Isothermal automatic testing system. This includes the testing chamber, oxygen

bomb, calorimeter, jacket, thermometer, accessories. The requirements shall meet those outlined in B.2.

Note. An isothermal automatic calorimeter can be used.

6.3 Ignition wire. Ni-chromium alloy, iron wire, copper wire, or other ignition wire with a diameter not exceeding 0.2 mm, cut into equal segments of 60 mm ~ 120 mm (depending on the structure of the oxygen bomb accessories and the ignition wire system). Weigh a bundle of 10 ~ 15 wires to determine the mass of each metal wire;

automatic instruments generally use 100 mm long ignition wires.

6.4 Oxygen bomb, pressure gauge, and oxygen connection tubing. These shall be tested

under hydrostatic pressure as needed, at least once a year. The oxygen bomb shall be tested at a pressure of 9.81 MPa (100 kg/cm²). Lubricating grease is strictly prohibited on the connecting parts of compressed oxygen equipment. If the oxygen bomb or oxygen connection equipment becomes oily due to contact with lubricating oil or other oils during testing or handling, it shall be carefully washed with gasoline first, then with ethanol or ether. 6.5 Metal clamps. 6.6 Pipette. 1 mL. 6.7 Stopwatch. 6.8 Syringe.

6.9 Analytical balance. Graduation value 0.1 mg.

6.10 Conventional balance. Load 5 kg, graduation value 0.5 g.

6.11 Volumetric flasks. 1000 mL and 2000 mL.

6.12 Desiccator. Contains concentrated sulfuric acid or phosphorus pentoxide.

6.13 Thermometer. Platinum resistance thermometer, with a resolution of not less than

0.001 °C, short-term repeatability not exceeding 0.01 °C, long-term drift not exceeding 0.05 °C within 6 months. A general calorimeter with a graduation of 0.01 °C or a Beckman thermometer may also be used; it shall be checked by a national metrology authority every 1 °C; its calibration error shall not exceed 0.005 °C.

7 Test conditions

The laboratory for determining the bomb heat of combustion shall meet the following conditions.

- The room temperature shall be relatively stable; the temperature change during the test shall not exceed 5 °C;
- There shall be no strong air convection indoors; there shall be no strong heat sources, cold sources, fans, or other equipment. Doors and windows shall be kept closed during the test;
- The test instruments shall be protected from direct exposure to sunlight.