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DB11/T 540—2008

户用生物质炉具通用技术条件

General specifications for biomass household stoves

Published in March-28th-2008 Implementing in May-1th-2008

Quality and Technical Supervision Bureau of Beijing Municipality

Contents

Preface

This standard was made on the basis of the GB/T 1.1, and quotes the related standard, laws, regulations, rules and measures.

Appendix A, Appendix B, Appendix C and Appendix D are normative addenda.

The sponsor of this standard is the Quality and Technical Supervision Bureau of Beijing Municipality.

The drafter of this standard is the Quality and Technical Supervision Bureau of Beijing Municipality, Beijing Municipal Research Institute of Environmental Protection, China Association of Rural Energy Industry, Energy conservation and environmental protection service center of Beijing, Commodity Inspection Bureau of Chaoyang District of Beijing.

The rapporteurs of this standard: Xuetao Liu, Chuan Tian, Fangzhou Hao, Mingzhen Yang, Zhenhang Jia, Baijian Shen, Yan Cui, Jing Yan, Shenglin Yao.

This standard issued for the first time in 3.28.2008.

General specifications for biomass household stoves

1 Scope

This standard provides technology, manufacturing and safety requirements, test methods and inspection rules of household biomass stoves.

This standard is applicable to the biomass household cooking stove, heating stove, and cooking & heating stove.

2 Normative references

The following terms of the documents referenced in this standard are also the terms of this standard. Every other update versions of referenced standards with issuing date is inapplicability to this standard. However, it is encouraged that all parties involved discuss whether the update versions being used or not. For those standard referenced without issuing date, the latest version is applicable to this standard.

GB 16154	General technical specification of civil water heating coal stove
GB16155	Testing method for heating performance of civil water heating coal stove
GB/T 16157	Particulates measurement and sampling methods of gassy pollutants from stationary pollutant emission source
HJ/T 44	Stationary source emission-Determination of carbon monoxide-Non -dispersive infrared absorption method
HJ/T 57	Determination of sulphur dioxide from exhausted gas of stationary source Fixed-potential electrolysis method
HJ/T 56	Determination of sulphur dioxide from exhausted gas of stationary source Iodine titration method
DB11/139	Emission standard of air pollutants for boilers
DB11/T 541	Biomass molded fuel

3 Terms and definitions

3.1 Household biomass stoves

Household stove refers to stoves that have cooking or heating ability using biomass as fuel, and the power of stove is less than 50kW.

3.2 Rated heating capacity

The heating output within certain time when the biomass stove was working stable. For cooking stove, it means cooking fire intensity.

3.3 Cooking power (fire intensity)

Thermal energy absorbed by the water when the heated, indicating the power can be used from the stove for cooking.

3.4 Thermal efficiency

The ratio of thermal energy absorbed for temperature increase and evaporation of water in the pot over the thermal energy generated by fuel in the stove, indicating the percentage of energy can be used from the stove.

4 Representation of the model

4.1 Indicated by Bopomofo Arabic numerals and Roman numerals.

4.2 Model number is made by five parts

a) Part 1 means the main usage of biomass stove: C-cooking biomass stove, N-heating biomass stove, CN-cooking and heating biomass cooking stove;

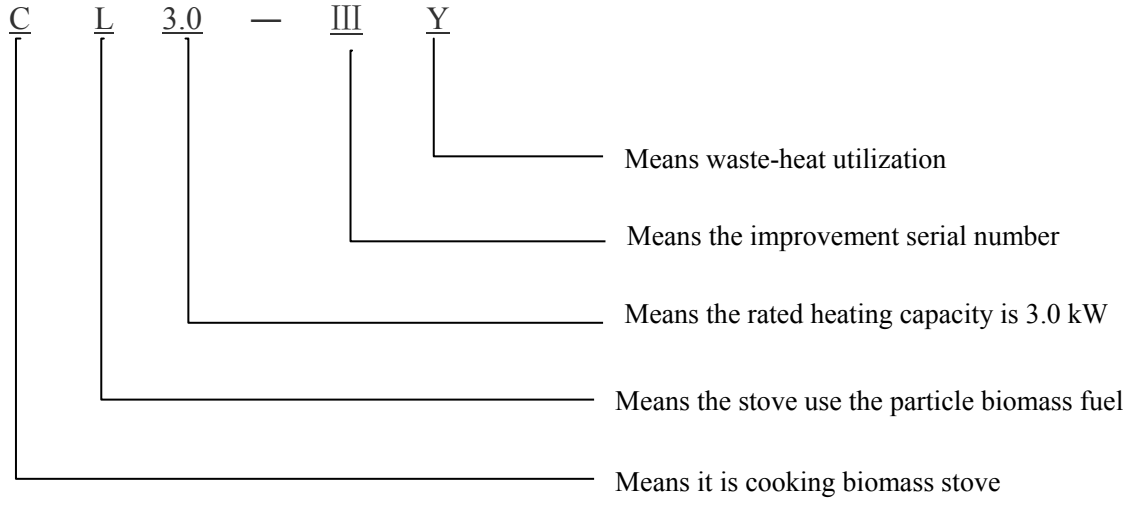
b) Part 2 means the fuel type of biomass stove: L-particle biomass fuel, K-pressed block-shaped biomass fuel, B-rod biomass fuel;

c) Part 3 means the rate heating load or cooking fire intensity of biomass stove, represented with bare digits, keep a decimal point, kW;

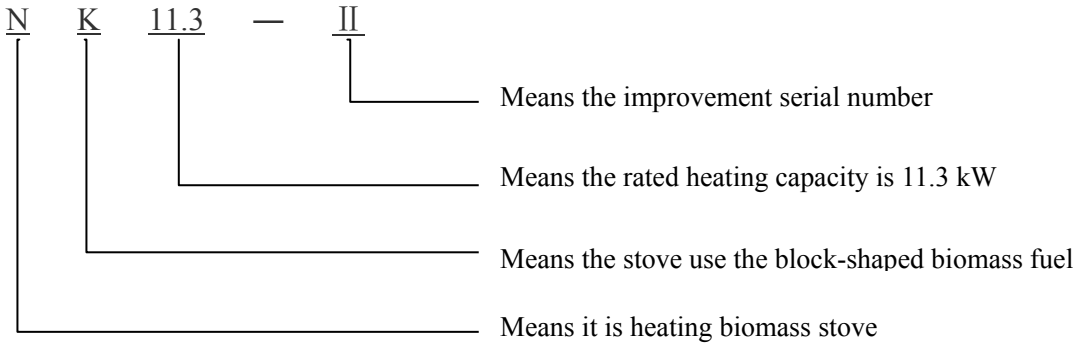
d) Part 4 means the version number of biomass stove in roman numerals; there is a "—"between part 3 and part 4;

e) The Y in part 5 means the biomass stoves can utilize surplus heat;

f) Typical examples.



The model above means this kind biomass stove is a cooking stove, the cooking power is 3.0 kW, and can utilize surplus heat.



The model above means this kind biomass stove is a heating stove, the rated heating capacity is 11.3.

5 Technical requirements

5.1 Basic requirements

5.1.1 Requirements of Structure

Stove structure should be reasonable designed, safe and convenient; not gasify, separated biomass stove.

5.1.2 Appearance requirements

The stove should have attractive appearance with smooth surface, without burr and rust outside, insulation materials should not exposure.

5.1.3 Thermal performance

a) The **r**ated heating capacity should be greater than the stove nominal value

b) Thermal efficiency

Cooking stove: $\eta_C \geqslant 35\%$

Heating stove: $\eta_N \geqslant 65\%$

Cooking and heating stove: $\eta_{CN} \geqslant 60\%$

c) Cooking power

Cooking stove: P>2kW

Cooking and heating stove: P>1.5kW

5.1.4 Emission limits of air pollutants

The emission limits of air pollutants (refer to Table 1)

Table 1 Emission limits of air pollutants

Item	upper limit	
	central area	Out of central area
Dust (mg/m3)	10	30
SO_2(mg/m3)	20	30
NO_X(mg/m3)	150	150
CO(mg/m3)	0.2	0.2
Ringelmann Black Degree	1	1
Remark: the concentration of dust, SO_2, NO_X, CO in operational test should be under the standard GB/T16157, the excess air factor as 1.8.		

5.2 Manufacturing requirements of stove body

5.2.1 Casting parts should be smooth without fissure and sand hole
5.2.2 Casting parts should be uniformity without burn through or lack of penetration parts
5.2.3 Stamping parts should not be fissured or wrinkled. etc.
5.2.4 Sheet metal parts should be smooth without fissure or wrinkle. Machining surface should not be knocked, scratched or corroded.
5.2.5 Riveting should firmly link
5.2.6 The surface should be stain proofing
5.2.7 Boiler furnace should be thermal-stable and unbroken, the shape and thickness can be decided by the maker.
5.2.8 Heat insulation materials should be thermal-stable and meet the national environmental requirements.
5.2.9 The stove with surplus heat utilization and water jacket should make sure it is not leaked.

5.3 Safety use requirement

5.3.1 A biomass stove should be equipped with a chimney emitting the smoke to outdoors, and the discharge outlet of chimney should be 3m or higher above ground. A ventilation device should be set in the room.
5.3.2 When a biomass stove is working normally, the temperature should be less than 60℃.
5.3.3 The safety requirement of stoves with surplus heat utilization and water jacket refer to the GB 16154
5.3.4 The stove with electrical machine should have safety electricity measures

6 Test method

6.1 The 5.11, 5.12, 5.2, 5.3 can be checked by naked eye and the thermometer

6.2 The 5.1.3 should be checked as appendix A, appendix B, appendix C

6.3 The upper limit of emissions

6.4 Dust
In accordance with the provisions of the Standard GB/T16157

6.5 SO_2
In accordance with the provisions of the Standard HJ/T56 or HJ/T57

6.6 NO_x
In accordance with the provisions of "Air And Waste gas Monitor Analysis method".

6.7 CO
In accordance with the provisions of the Standard HJ/T44.

6.8 Ringelmann Black Degree
See the provisions of "Air and Waste gas Monitor Analysis method".

The stove with surplus heat utilization and water jacket should be tested the water pressure in the water jacket. The water pressure should be greater than 0.2Mpa and no leaking can be found within at least 5min.

7 Inspection rule

7.1 Inspection method

Production test include the delivery inspection and the type approval test.

7.2 Delivery inspection

Each biomass stove should be tested before it sent out of the factory. The index and requires refer to Table 2

7.3 Type approval test

Biomass stove should do the type approval test in the following situations (Table 2). At least 2 stoves should be tested in every test term.

a) Quantity production should be tested every 2 years
b) After production started, if the structure, material or manufacturing technique changed.
c) New production and this model begin formally to put into production
d) After long shutdown, when the product being put back on production again
e) A big difference exists between the result of routine test and that of model test.
f) When State Administration of Quality Supervision requires model test.

7.4 Judgments

When one of the indexes in Table 2 does not meet the requirement, double amount of the stoves should be tested. If some unqualified productions still being found, then this batch of stoves is unqualified.

Table 2 Items and requires of routine test and type test

Serial number	Items	Delivery inspection	Type approval test Type test	Technical requirements	Test method
1	Structural requirements	√	√	5.11	6.1
2	Surface requirements	√	√	5.12	6.1
3	Stove body requirements	√	√	5.2.1～5.2.6	6.1
4	Security demands	√	√	5.3.1～5.3.4	6.1
5	Hydrostatic test	√	√	5.3.1～5.3.3	6.1
6	Thermodynamic test		√	5.1.3	6.2
7	Air pollutants emission		√	5.1.4	6.3
Note: “√” means need to do					

8 Mark, packing, storage and lifetime

8.1 Mark

8.1.1 The mark should be set in a clear position on the biomass stove.

8.1.2 The basic components of biomass stove mark as:

a) Name of the manufacturer
b) Name of production
c) Model number
d) Production Date
e) Manufacturing number
f) Standards Numbers

8.2 Packing

8.2.1 Packaging shall conform to the requirements of users.

8.2.2 Documents with production:

a) Manufacturer certificate
b) Product specification
c) Parts list
d) Product warranty

8.3 Storage

No leakage of rain or damp in the storage place.

8.4 Lifetime

If household biomass stove being used under normal operation, service lifetime should be at least 3 years.

Appendix A
(Normative addenda)
Biomass Cooking stove thermal performance test

A.1 Test equipment and instruments

A.1.1 Test equipment and instruments

a) Two buckets, 0.01m^3
b) One Scale 0-10kg, sensitivity 0.005kg
c) One Scale 0-50kg, sensitivity 0.02kg
d) One clock, daily deviation less than 1min
e) Two thermometers, 0-150℃, scale 0.2℃#
f) One psychrometer
g) One psychrometer, 0m/s-10m/s, scale 0.5m/s
h) One evaporation aluminum pot

A.1.2 The size of evaporation aluminum pot as Table A.1

Table A.1 The size of evaporation aluminium pot

Cooking fire intensity kW	Initial water kg	Diameter of evaporation pot mm	Biomass fuel quantity kg
<3.5	5	240	<2.0
3.5～7.0	7	280	2.0～4.0
>7.0	9	310	>4.0

A.2 Test condition and preparation

A.2.1 In accordance with the cooking power of the stove, the quantity of fuel, the initial quantity of water and the aluminum pot can be determine according to Table A.1 above

A.2.2 The thermometer is placed in the pot through a hole in the center of the pot cover; a thermometer hold rack is used to ensure that the sensor of the thermometer is 10mm from the bottom of the pot.

A.3 Test steps

A.3.1 Pour the water with initial weight of G_{c1}into the pot and place a cover on the pot. Record the temperature of water.

A.3.2 Light the fire and record the time when the fuel starts to burn in the stove T_{c1}.

A.3.3 When the water temperature in the pot increases to boiling point, remove the pot cover and record the temperature of the water t_c and the time T_2.

A.3.4 During the evaporation, record the temperature of water every 5 minute, calculate the average of temperature, until the water temperature reduce to 95℃, and record the time T_{c3}. End the test, and weigh the pot and water G_{C3}.

A.4 Calculation and evaluation of test results

A.4.1 Cooking power

$$P_c = \frac{4.18G_{s1}(t_{c2} - t_{c1}) + r(G_{c1} - G_{c3})}{(T_{c3} - T_{c1})}$$

A.4.2 Thermal efficiency

$$\eta_c = \frac{4.18G_{s1}(t_c - 25) + r(G_{s2} - G_{s3})}{BQ_{net.v.ar} + B_1Q_{net.v.arL}} \times 100$$

Where:

P_c—cooking fire intensity, kW;

G_{c1}— initial loading water, kg;

t_{c1}— the temperature of initial water, ℃

t_{c2}— the temperature of boiling point of the water in the pot, ℃

r—the latent heat of water vaporization at boiling point, kJ/kg;

4.18—the specific heat of water, kJ/ (kg•℃)##

T_{c1}—lighting time, h: min

T_{c2}—boiling time, h: min;

T_{c3}—ending time, h: min;

T_{c3}—T_{c1}-lighting time to ending time, s;

η_c — thermal efficiency, %;

B—mass of fuel, kg;

$Q_{net.v.ar}$ — low heating value of the biomass fuel, kJ/kg.

B_1— the mass of kindling air-dry wood

$Q_{net.v.ar1}$— low heating value of the kindling air-dry wood, kJ/kg.

A.5 Report

A.5.1 The form of original record refer to Table A.2, Table A.3

A.5.2 The form of record refer to Table A.4

Table A.2 Test record (fuel)

Test number	Granulated fuel		Kindling wood		Electricity consumption E/kW•h
	Mass B/kg	Calorific value $Q_{net.v.ar}$/kJ/kg	Mass B_1/kg	Calorific value $Q_{net.v.ar1}$/kJ/kg	
1					
2					
3					

Table A.3 Test record (cooking)

Test number	Water quantity		Temperature		Time		
	Initial water quantity G_{c1}	Water quantity remained in the pot G_{c3}	Temperature of initial water t_{c1}	Temperature at boiling point t_{c2}	Lighting, T_{c1}	Boiling, T_{c2}	Ending, T_{c3}
	kg		℃		H:min		
1							
2							

Table A.4 Test record

Name and model number of biomass stove:			Type of fuel:	
production unit:				
Test purpose and requirements:				
Test equipment and instruments				
	P_c	Cooking power	kW	
	η	Thermal efficiency	%	
Evaluation opinions				
Relative humidity Ψ/(%)			Electricity Consumption E/kW•h	
Experimental unit:				Test date
Test site				
Tester		Examine and verify		Sign and issue:

Appendix B
(Normative addenda)
Biomass heating stove thermal performance test

B.1 Test equipment and instruments

a) Two buckets, 0.01m3
b) One Scale 0-10kg, sensitivity 0.005kg
c) One Scale 0-50kg, sensitivity 0.02kg
d) One clock, daily deviation less than 1min
e) Two thermometers, 0-150°C, scale 0.2°C
f) One psychrometer
g) One psychrometer, 0m/s-10m/s, scale 0.5m/s

B.2 Test condition and preparation

B.2.1 Test condition

a) Environmental temperature, 10 °C～35°C
b) Relative humidity, <85%
c) Wind speed, <1.0m/s
d) Two tests should be far away from each other, if many stoves being tested at the same place, and the distance of different stoves should be more than 1m.

B.2.2 Test preparation

B.2.2.1 Calibrating instrument to specified requirements

B.2.2.2 Set up thermometers in the pipe of water inlet and outlet, the distance of thermometer and stove body should be at least three times of diameter of pipe

B.2.2.3 According to the rated heating load, choose appropriate fuel mass G_m (refer to Table B.1), and the biomass fuel should be able to burn about 4h.

B2.2.4 The mass of biomass fuel

Table B.1 The mass of biomass fuel

rated heating load kW	≤12	>15～25	>25～35	>35～45	>45～50
Mass of fuel kg	6～20	20～40	40～58	58～75	75～85

B.2.2.5 Weigh and record the mass of fuel (*B*) and the mass of kindling air-dry wood.

B.3 Test steps

B.3.1 Full fill the stove body of water, record the temperature of water, t_1.

B.3.2 Light the kindling and record the time.

B.3.3 Adjust the stove to stable heating status. When the water temperature increases to 75°C, turn on the switch and let the water come to the bucket. At the same time, observe the

temperature change of the water, adjust the valve and control the water temperature between 70℃ ~ 80℃. Record water temperature every 10mins. The test should be at least 3h, when the temperature of the water jacket did not rise again to 75°C, turn off the switch, and record the ending time T_{n2}. Calculate the water quantity of the whole test G_{n2}, average water temperature of inlet and outlet.

B.3.4 Measure the water capacity of water jacket *G* and its temperature t.

B.3.5 Record the electricity consumption of biomass stoves with a fan

B.4 Calculation and evaluation of test results

B.4.1 Rated heating capacity

$$P_n = \frac{4.18[G_{s1}(t_{c2} - t_{c1}) + G(t - t_1)]}{(T_{n2} - T_{n1})}$$

B.4.2 Thermal efficiency

$$\eta = \frac{4.18[G_{s1}(t_{c2} - t_{c1}) + G(t - t_1)]}{BQ_{net.v.ar} + B_1 Q_{net.v.arL}} \times 100$$

Where:

P_n—rated heating capacity, kW;

4.18—the specific heat of water, KJ/ (kg•℃)

T_{n2}—T_{n1}- test time, s

η— Thermal efficiency, %;

G_{n2}— total effluent water quality, kg;

t_{n1}— the average temperature of initial water, ℃

t_{n2}— the average temperature of effluent water, ℃

G—water capacity of water jacket

t—the water temperature of the water jacket at the ending of the test, ℃

t_1—the water temperature of the water jacket at the beginning of the test,#℃

B—mass of fuel, kg;

$Q_{net.v.ar}$— low heating value of the biomass fuel, kJ/kg.

B_1— the mass of kindling air-dry wood

$Q_{net.v.ar1}$— low heating value of the kindling air-dry wood, kJ/kg.

B.4.3 When the difference of two results of test is less than 5%, then the result is efficacious

B.5 Report

B.5.1 The form of original record refer to Table B.2, Table B.3

B.5.2 The form of record refer to Table B.4

Table B.2 Test record (fuel)

Test number	Granulated fuel		Kindling wood		Electricity consumption E/kW•h
	Mass B/kg	Calorific value $Q_{net.v.ar/kJ/kg}$	Mass B_1/kg	Calorific value $Q_{net.v.ar1/kJ/kg}$	
1					
2					
3					

Table B.3 Test record (heating)

Test number	Water quantity and temperature of water jacket			During the heating test		
	water quantity G/kg	temperature of initial water t_1/℃	Ending temperature of water t/℃	effluent water quality Gn2/kg	average temperature of initial water t_{n1}/℃	average temperature of effluent water T_{n2}/℃
1						
2						
3						

Table B.4 test record

Name and model number of biomass stove:			Type of fuel:	
production unit:				
Test purpose and requirements:				
Test equipment and instruments				
	P_n	Rated heating capacity	kW	
	η	Thermal efficiency	%	
Evaluation opinions				
Relative humidity Ψ/(%)			Electricity consumption E/kW•h	
Experimental unit:				Test date
Test site				
Tester		Examine and verify		Sign and issue:

Appendix C
(Normative addenda)
Biomass cooking and heating stove thermal performance test

C.1 Test equipment and instruments

a) Two buckets, 0.01m3
b) One Scale 0-10kg, sensitivity 0.005kg
c) One Scale 0-50kg, sensitivity 0.02kg
d) One clock, daily deviation less than 1min
e) Two thermometers, 0-150°C, scale 0.2℃#
f) One psychrometer
g) One psychrometer, 0m/s-10m/s, scale 0.5m/s

C.2 Test condition and preparation

Refer to appendix A and appendix B

C.3 Test steps

C.3.1 Light the fire and record the time $T_{c1}$when the fuel starts to burn. When the water temperature in the pot increases to the boiling point, remove the pot cover and record the temperature of the water t_c and the time T_2. During the evaporation of water, record the temperature of water every 5 minute, calculate the average of temperature until the water temperature reduce to 95℃, and record the time T_{c3}. End the test, weigh the and water G_{c3}. Keep the heating test.

C.3.2 Do the heating test and the cooking test at the same time, and the heating test refer to appendix B

C.3.3 Record the electricity consumption of biomass stoves with a fan

C.4 Calculation and evaluation of test results

C.4.1 Cooking power

$$P_c = \frac{4.18[G_{s1}(t_{c2} - t_{c1})] + r(G_{c1} - G_{c3})}{(T_{c2} - T_{c1})}$$

Where:

T_{c3}— The moment one hour after water boiling, h: min

C.4.2 Rated heating capacity

$$P_n = \frac{4.18[G_{s1}(t_{n2} - t_{n1}) + G(t - t_1) + G_{c1}(t_{c2} - t_{c1})] + r(G_{c1} - G_{c3})}{(T_{n2} - T_{n1})}$$

C.4.3 Thermal efficiency

$$\eta = \frac{4.18[G_{s1}(t_{c2} - t_{c1}) + G(t - t_1)]}{BQ_{net.v.ar} + B_1 Q_{net.v.arL}} \times 100$$

Note: the meaning of the letters refer to appendix A and appendix B

C.5 Report

C.5.1 The form of original record refer to Table C.1, Table C.2, Table C.3

C.5.2 The form of record refer to Table C.4

Table C.1 Test record (fuel)

Test number	Granulated fuel		Kindling wood		Electricity consumption E/kW•h
	Mass B/kg	Calorific value $Q_{net.v.ar/kJ/kg}$	Mass B_1/kg	Calorific value $Q_{net.v.ar1/kJ/kg}$	
1					
2					
3					

Table C.2 Test record (cooking)

Test number	Water quantity		Temperature		Time		
	Initial water quantity G_{c1}	Water quantity remained in the pot G_{c3}	Temperature of initial water t_{c1}	Temperature at boiling point t_{c2}	Lighting, T_{c1}	Boiling, T_{c2}	Ending, T_{c3}
	kg		℃		H:min		
1							
2							

Table C.3 Test record (heating)

Test number	Water quantity and temperature of water jacket			During the heating test		
	water quantity G/kg	temperature of initial water t_1/℃	Ending temperature of water t/℃	effluent water quality Gn2/kg	average temperature of initial water t_{n1}/℃	average temperature of effluent water T_{n2}/℃
1						
2						
3						

Table C.4 Test record

<table>
<tr><td colspan="3">Name and model number of biomass stove:</td><td colspan="3">Type of fuel:</td></tr>
<tr><td colspan="6">production unit:</td></tr>
<tr><td colspan="6">Test purpose and requirements:</td></tr>
<tr><td colspan="6">Test equipment and instruments</td></tr>
<tr><td rowspan="3"></td><td>P_c</td><td>Cooking power</td><td>kW</td><td colspan="2"></td></tr>
<tr><td>p_n</td><td>Rated heating capacity</td><td>kW</td><td colspan="2"></td></tr>
<tr><td>η</td><td>Thermal efficiency</td><td>%</td><td colspan="2"></td></tr>
<tr><td colspan="6">Evaluation opinions</td></tr>
<tr><td colspan="2">Relative humidity Ψ/(%)</td><td colspan="2"></td><td>Electricity consumption E/kW•h</td><td></td></tr>
<tr><td colspan="4">experimental unit:</td><td colspan="2">Test date</td></tr>
<tr><td colspan="6">Test site</td></tr>
<tr><td>Tester</td><td colspan="2"></td><td>Examine and verify</td><td></td><td>Sign and issue:</td></tr>
</table>

Appendix D
(Normative addenda)
Emissions sampling conditions and sampling location

D.1 Sampling condition

After the thermal performance test started, the samples should be collected under normal combustion phase of the stove.

D.2 Sampling site

The sampling site should be on the vertical chimney, 1.2m away from the exit of chimney outlet.

D.3 Sampling method

Refer to GB/T 16157.