

# ISO 19867-1:2018 (E)

## Clean cookstoves and clean cooking solutions — Harmonized laboratory test protocols — Part 1: Standard test sequence for emissions and performance, safety and durability

---

### Contents

	Foreword
	Introduction
1	Scope
2	Normative references
3	Terms and definitions
4	Symbols and abbreviated terms
5	Laboratory-based measurements of emissions and performance
5.1	General
5.2	Testing conditions
5.3	Measurements
5.3.1	Required measurements for standard test sequence
5.3.2	Required metrics for standard test sequence
5.3.3	Continuous emission data
5.3.4	Optional measurements
5.3.5	Optional metrics
5.3.6	Measurement quality objectives
5.3.7	Measurement of carbon monoxide and carbon dioxide
5.3.7.1	System operation
5.3.7.2	Verification
5.3.8	Total-capture dilution-tunnel gravimetric method for measurement of PM <sub>2,5</sub>
5.3.8.1	General
5.3.8.2	Equipment and supplies
5.3.8.2.1	Sampling train
5.3.8.2.1.1	Probe
5.3.8.2.1.2	Particle size-selective sampling device
5.3.8.2.1.3	Filter holder
5.3.8.2.1.4	Metering system
5.3.8.2.2	Air flow measurement device
5.3.8.2.3	Dilution tunnel gas temperature measurement
5.3.8.2.4	Hood for collecting emissions from cookstoves without tall chimneys
5.3.8.2.5	Hood for collecting total emissions from cookstoves with tall chimneys
5.3.8.2.6	Hood for collecting fugitive (indoor) emissions from cookstoves with tall chimneys
5.3.8.2.7	Hood for collecting chimney emissions from cookstoves
5.3.8.2.8	90° Elbows
5.3.8.2.9	Straight duct
5.3.8.2.10	Mixing baffles
5.3.8.2.11	Blower
5.3.8.3	System preparation
5.3.8.3.1	Dilution tunnel assembly and cleaning
5.3.8.3.2	Draft determination for cookstoves with chimneys
5.3.8.3.3	Smoke capture
5.3.8.3.4	Air velocity measurements with an anemometric probe
5.3.8.3.5	Velocity traverse with an anemometric probe
5.3.8.3.6	Testing velocity measurements with an anemometric probe
5.3.8.4	Filter sample analysis
5.3.8.4.1	Filter sample analysis equipment and supplies

- 5.3.8.4.1.1 Desiccator or equilibration chamber
  - 5.3.8.4.1.2 Desiccant
  - 5.3.8.4.1.3 Hygrometer
  - 5.3.8.4.1.4 Temperature sensor
  - 5.3.8.4.1.5 Analytical balance
  - 5.3.8.4.1.6 Filters
  - 5.3.8.4.2 Pretest preparation
    - 5.3.8.4.2.1 Filter check
    - 5.3.8.4.2.2 Leak-check
    - 5.3.8.4.2.3 Preliminary determinations
    - 5.3.8.4.2.4 Sampling train operation
  - 5.3.8.4.3 Test
  - 5.3.8.4.4 Filter weighing
  - 5.3.9 Measurement of biomass fuel energy content
  - 5.4 Calculations
    - 5.4.1 Calculation of mass of PM<sub>2,5</sub>
    - 5.4.2 Useful energy delivered calculation
    - 5.4.3 Cooking power calculation
    - 5.4.4 Cooking thermal efficiency calculation with no energy credit for remaining char
    - 5.4.5 Cooking thermal efficiency calculation with energy credit for remaining char
    - 5.4.6 Char energy productivity
    - 5.4.7 Char mass productivity
    - 5.4.8 Emission factor calculation
    - 5.4.9 Emission rate calculation
  - 5.5 Determination of heating value
  - 5.6 Secondary dilution system methods
    - 5.6.1 Secondary dilution systems used in the standard test sequence
    - 5.6.2 Secondary dilution system calibration
  - 5.7 Carbon mass balance method
- 6 Standard test sequence for emissions and performance
- 6.1 General
  - 6.2 Phases of the standard test sequence
  - 6.3 Standard test sequence diagrams
  - 6.4 Limitations
  - 6.5 Cookstove system requirements
    - 6.5.1 Cookstove
    - 6.5.2 Cooking vessel
    - 6.5.3 Fuel
    - 6.5.4 Operating procedure
  - 6.6 Determination of cooking power levels
    - 6.6.1 Low power
    - 6.6.2 Medium power
    - 6.6.3 High power
  - 6.7 Procedure for standard test sequence
    - 6.7.1 Test preparation
    - 6.7.2 Test steps
    - 6.7.3 Emission testing
    - 6.7.4 Test replicates
  - 6.8 Specific procedures for cookstove types
    - 6.8.1 Plancha cookstoves
    - 6.8.2 Chimney cookstoves
    - 6.8.3 Charcoal-fuelled cookstoves
    - 6.8.4 Solar cookstoves
- 7 Safety measurements
- 7.1 Measurement equipment
  - 7.2 Taking measurements
    - 7.2.1 General
      - 7.2.2 Test 1: Sharp edges and points
        - 7.2.2.1 Equipment
        - 7.2.2.2 Procedure
        - 7.2.2.3 Scoring
      - 7.2.3 Test 2: Cookstove tipping

- 7.2.3.1 General
- 7.2.3.2 Equipment
- 7.2.3.3 Procedure for portable cookstoves
- 7.2.3.4 Scoring
- 7.2.4 Test 3: Containment of fuel
- 7.2.4.1 General
- 7.2.4.2 Equipment
- 7.2.4.3 Procedure
- 7.2.4.4 Scoring
- 7.2.5 Test 4: Obstructions near cooking surface
- 7.2.5.1 General
- 7.2.5.2 Equipment
- 7.2.5.3 Procedure
- 7.2.5.4 Scoring
- 7.2.6 Tests 5, 6, and 7
- 7.2.6.1 General
- 7.2.6.2 Equipment
- 7.2.6.3 Procedure
- 7.2.6.4 Scoring
- 7.2.7 Test 8: Chimney shielding
- 7.2.7.1 General
- 7.2.7.2 Equipment
- 7.2.7.3 Procedure
- 7.2.7.4 Scoring
- 7.2.8 Test 9: Flames surrounding cooking vessel
- 7.2.8.1 Equipment
- 7.2.8.2 Procedure
- 7.2.8.3 Scoring
- 7.2.9 Test 10: Flames exiting fuel chamber
- 7.2.9.1 Equipment
- 7.2.9.2 Procedure
- 7.2.9.3 Scoring
- 7.2.10 Overall safety score
- 7.2.11 Optional Test 11 for plancha (griddle) stoves
- 7.2.11.1 Equipment
- 7.2.11.2 Procedure
- 7.2.11.3 Scoring
- 7.3 Materials

## **8 Durability measurements**

- 8.1 Equipment for durability stress testing
- 8.2 Taking measurements
- 8.2.1 General
- 8.2.2 Test 1: Extended run
- 8.2.2.1 General
- 8.2.2.2 Equipment
- 8.2.2.3 Procedure
- 8.2.2.4 Scoring
- 8.2.3 Test 2: External impact
- 8.2.3.1 General
- 8.2.3.2 Equipment
- 8.2.3.3 Procedure
- 8.2.3.4 Scoring
- 8.2.4 Test 3: Internal impact
- 8.2.4.1 General
- 8.2.4.2 Equipment
- 8.2.4.3 Procedure
- 8.2.4.4 Scoring
- 8.2.5 Test 4: Corrosion
- 8.2.5.1 General
- 8.2.5.2 Equipment
- 8.2.5.3 Procedure
- 8.2.5.4 Scoring
- 8.2.6 Test 5: Coating adhesion

8.2.6.1	General
8.2.6.2	Equipment
8.2.6.3	Procedure
8.2.6.4	Scoring
8.2.7	Test 6: Quenching
8.2.7.1	Equipment
8.2.7.2	Procedure
8.2.7.3	Scoring
8.2.8	Test 7: Material failure temperature
8.2.8.1	General
8.2.8.2	Equipment
8.2.8.3	Procedure
8.2.8.4	Scoring
8.2.9	Limitations for durability stress tests
8.2.9.1	Cookstove age
8.2.9.2	Fuel variability
8.2.9.3	Evaluation ambiguity
8.2.9.4	Cookstove type
<b>9</b>	<b>Reporting test results</b>
9.1	General
9.2	Report contents
9.2.1	Administrative information
9.2.2	Tests and metrics
9.2.2.1	Description of the test and output metrics
9.2.2.2	Emissions and fuel performance testing
9.2.2.3	Testing and operational conditions
9.2.2.4	Tables and figures
9.2.2.4.1	Size
9.2.2.4.2	Tabular results
9.2.2.4.3	Graphical results
9.2.3	Reporting against performance targets
9.2.4	Quality assurance and quality control
9.2.4.1	Deviations
9.2.4.2	Unique or additional procedures
9.2.4.3	Conflicts of interest
9.2.4.4	Limitations
9.2.4.5	Authorization
9.3	Templates
<b>10</b>	<b>Marking and packaging</b>
<b>Annex A</b>	<b>(informative) Laboratory-based measurements of emissions and performance — Additional considerations</b>
A.1	General
A.2	Duct Reynolds number calculations
A.3	Calculation of minimum flow rate
A.4	Air pollutant emissions sampling and calculations
A.4.1	Isokinetic sampling of particulate matter
A.4.1.1	Sample tube diameter determination, dilution tunnel method
A.4.1.2	Sample tube diameter determination, carbon balance method
A.4.2	Aerosol mass concentration measurement
A.4.3	Sampling of gaseous pollutants
A.4.3.1	Integrated measures
A.4.3.2	Real-time measurements
A.5	Carbon balance method
A.6	Combustion efficiency
A.7	Leak test method
A.7.1	Application
A.7.2	Procedure
A.7.3	System test
A.8	Method for validating well-mixed emissions in a duct
A.8.1	General
A.8.2	Equipment

- A.8.3 Preparation
- A.8.4 Introduction of tracer to duct
- A.8.5 Procedure
- A.9 Guidance on filter media selection

**Annex B (normative) Total-capture dilution-tunnel gravimetric method for measurement of PM<sub>2,5</sub>**

**Annex C (informative) Standard test sequence — Additional considerations**

- C.1 Cooking vessel
- C.2 Low power
- C.3 High power
- C.4 Assembly of Mylar pot for testing plancha cookstoves
  - C.4.1 Materials
  - C.4.2 Mylar pot assembly process

**Annex D (informative) Cookstove family determination**

- D.1 General
- D.2 Fuelling process
- D.3 Heating surface(s)
- D.4 Exhaust type
- D.5 Fuel type
  - D.5.1 Solid-fuel
  - D.5.2 Liquid/gas-fuel
  - D.5.3 Solar
  - D.5.4 Electric

**Annex E (informative) Laboratory-based safety and durability measurements — Additional considerations**

- E.1 Safety considerations
  - E.1.1 General
  - E.1.2 Stability
  - E.1.3 Sharp edges and points
  - E.1.4 Obstructions near cooking surface
  - E.1.5 Chimney heat
  - E.1.6 Flames
  - E.1.7 Surface temperature test
  - E.1.8 Handle temperature test
  - E.1.9 Review of safety scoring
- E.2 Durability considerations
  - E.2.1 General
  - E.2.2 Durability testing order
  - E.2.3 Extended run test
  - E.2.4 Quenching test
  - E.2.5 Limitations to cookstove durability tests
    - E.2.5.1 Cookstove age
    - E.2.5.2 Fuel variability
    - E.2.5.3 Evaluation ambiguity
    - E.2.5.4 Cookstove type
- E.3 Safety and durability testing

**Annex F (informative) Scoring tables for safety and durability tests**

- F.1 Safety tests
  - F.1.1 Sharp edges and points test
  - F.1.2 Cookstove tipping test
  - F.1.3 Containment of fuel test
  - F.1.4 Obstructions near cooking surface test
  - F.1.5 Surface temperature test
  - F.1.6 Heat transfer to the environment test
  - F.1.7 Handle temperature test
  - F.1.8 Chimney shielding test
  - F.1.9 Flames surrounding cooking vessel test
  - F.1.10 Flames exiting fuel chamber test
  - F.1.11 Overall safety score
  - F.1.12 Plancha (griddle) stove weight test

- F.2 Durability tests**
- F.2.1 Extended run test**
- F.2.2 External impact test**
- F.2.3 Internal impact test**
- F.2.4 Corrosion test**
- F.2.5 Coating adhesion test**
- F.2.6 Quenching test**
- F.2.7 Material failure temperature test**

**Annex G (informative) Infrared thermometer calibration**

- G.1 Material emissivity**
- G.2 Calibration**
- G.3 Field of view/measurement area**

**Annex H (informative) Reporting template**

**Page count: 108**