

# Introduction to the ISO Voluntary Performance Targets

ETHOS

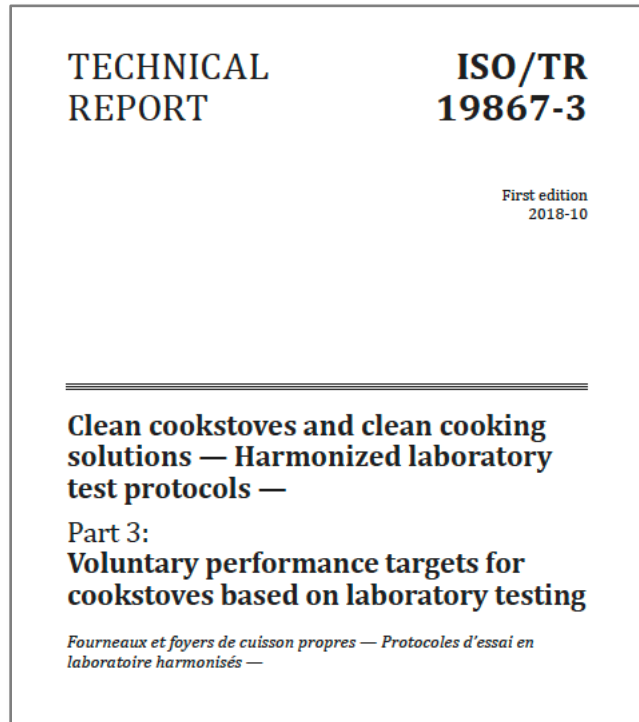
2019

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# ISO Voluntary Performance Standards



- Part three of the the laboratory protocols standard
  - Technical report
- Performance metrics are linked to ISO test protocols
  - Thermal efficiency
  - Emissions (PM2.5 and CO)
  - Safety
  - Durability
- Tiers system with performance ranging from simple/traditional stoves (0) to aspirational targets (5)
- Thermal efficiency and emission targets can be adapted for regional application



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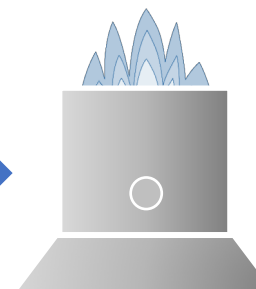
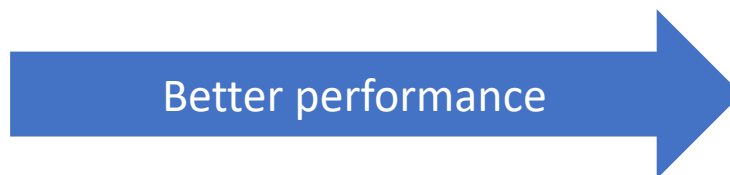
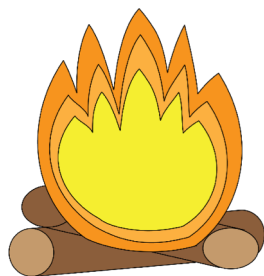
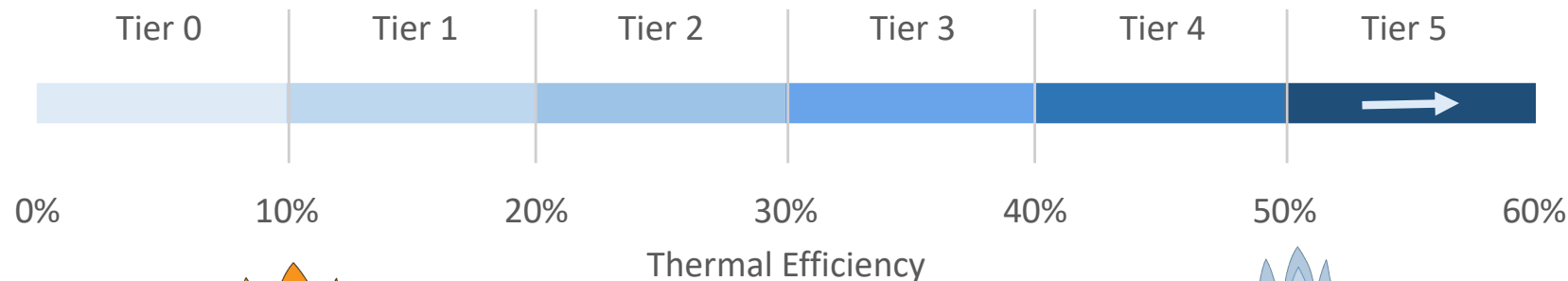


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# ISO 19867 Tiers

	Tier <sup>b</sup>	Thermal efficiency %	Emissions		Safety (score) <sup>c</sup>	Durability (score) <sup>d</sup>
			CO g/MJ <sub>d</sub>	PM <sub>2,5</sub> mg/MJ <sub>d</sub>		
Better performance 	5	≥50	≤3,0	≤5	≥95	<10
	4	≥40	≤4,4	≤62	≥86	<15
	3	≥30	≤7,2	≤218	≥77	<20
	2	≥20	≤11,5	≤481	≥68	<25
	1	≥10	≤18,3	≤1030	≥60	<35
	0	<10	>18,3	>1030	<60	>35



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# Thermal efficiency

	Tier	Thermal Efficiency
Better performance 	5	>50 %
	4	>40 %
	3	>30 %
	2	>20 %
	1	>10 %
	0	<10 %


Metric for helping understanding the potential energy/fuel savings

**Table 3 — Definitions of thermal efficiency tier categories**

Tier category	Tier	Definition
Highest	5	The thermal efficiency that is at a level representative of the best existing technology for fuel-combustion cookstoves
Intermediate	1-4	Mathematical division of range based on even spacing with five levels, with Tier 1 set to reflect performance observed with simple cookstove technology improvements
Lowest	0	The thermal efficiency observed with open fires and other simple solid fuel cookstove technologies



# ISO PM2.5 targets

	Tier	RR	mg/MJ <sub>d</sub>	Normalized Emission Rate mg/min	µg/m <sup>3</sup>	Percentage of homes meeting the tier level
Better performance 	5	1,0	≤5	≤0,2	≤10	≥90 %
	4	≤1,5	≤62	≤2,7	≤50	≥50 %
	3	≤2,5	≤218	≤9,5	≤170	≥50 %
	2	≤3,0	≤481	≤21	≤400	≥50 %
	1	≤3,15	≤1 031	≤45	≤800	≥50 %
	0	>3,15	>1 031	>45	>800	<50 %

NOTE Tier reporting is based on emission factor, and normalized emission rate is a derived property. Measured emission rates from laboratory testing are not used to determine tiers for reporting.


Each tier and corresponding emissions performance target is linked with a different level of risk

Emissions performance targets are in units of mg per megajoule delivered to the pot (same metric as the high power phase of the WBT)



# CO emissions performance


- Same model with same inputs is used as for PM2.5
- No equivalent relationship between CO concentrations and risk
- Targets determined by looking at different percentages of homes meeting the WHO 24 hour guideline (7mg/m<sup>3</sup>)

	Tier	Emission factor g/MJ <sub>d</sub> delivered	Emission Rate mg/min	24 hour concentration at 50 % coverage mg/m <sup>3</sup> (ppm)	Cooking event concentration at 50 % coverage mg/m <sup>3</sup> (ppm)	Percent of homes covered at 7 mg/m <sup>3</sup> daily average <sup>a</sup>	Percent of homes covered at 230 mg/m <sup>3</sup> during cooking <sup>b</sup>
Better performance 	5	≤3,0	≤133	2,3 (2,0)	13,6 (11,9)	≥90 %	≥99,9
	4	≤4,4	≤190	3,2 (2,8)	19,3 (16,8)	≥80 %	≥99,9
	3	≤7,2	≤315	5,4 (4,7)	32,6 (28,5)	≥60 %	≥99,3
	2	≤11,5	≤500	8,8 (7,7)	52,5 (45,8)	≥40 %	≥97,1
	1	≤18,3	≤800	14,0 (12,2)	84,1 (73,4)	≥20 %	≥90
	0	>18,3	>800	14,0 (12,2)	84,1 (73,4)	<20 %	<90



# Safety targets

- Determined with the ISO safety protocol
- Ratings are based on summing the score for the individual subtests
- Higher scores are better


	Tier <sup>b</sup>	Safety (score) <sup>c</sup>
Better performance 	5	≥95
	4	≥86
	3	≥77
	2	≥68
	1	≥60
	0	<60

Tier category	Tier	Definition
Highest	5	Based on the laboratory safety assessment score for cookstoves (according to ISO 19867-1:2018, Clause 7), the highest tier is associated with a very low (but not zero) risk of injuries, namely burns, scalds, and lacerations.
Intermediate	1-4	Intermediate safety tiers are evenly spaced mathematically and represent the range of scores observed for existing cookstove technologies.
Lowest	0	The lowest tier is based on safety scores observed with open fires and other simple solid fuel cookstove technologies.



# Durability targets

- Determined with the ISO durability protocol
- Ratings are based on summing the score for the individual subtests
- Lower scores are better

	Tier <sup>b</sup>	Durability (score) <sup>d</sup>
Better performance 	5	<10
	4	<15
	3	<20
	2	<25
	1	<35
	0	>35

Tier	Tier	Definition
Highest	5	Based on the durability assessment score for cookstoves (according to ISO 19867-1:2018, Clause 8), the highest tier is associated with durability of cookstove components and functioning which is at or close to the best achievable for this application.
Intermediate	1-4	Intermediate tiers have been set based on simple mathematical divisions to represent the range of durability scores observed for existing cookstove technologies.
Lowest	0	The lowest tier level is based on durability scores observed with solid fuel cookstove technologies with a relatively high risk of component failure.





# ISO 19867 Tiers

	Tier <sup>b</sup>	Thermal efficiency %	Emissions		Safety (score) <sup>c</sup>	Durability (score) <sup>d</sup>
			CO g/MJ <sub>d</sub>	PM <sub>2,5</sub> mg/MJ <sub>d</sub>		
Better performance ↑	5	≥50	≤3,0	≤5	≥95	<10
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ISO IWA total emissions tiers

## Key updates and simplifications for new tiers

- 5 tier levels
- Final rating for emissions and efficiency tiers are based on average of test phases for a given metric (not lowest score)
- CO and PM2.5 are reported separately (only one metric each)
- Only report thermal efficiency
- Includes durability

Table 1 — CO emissions

Tier	High power CO g/MJ <sub>d</sub> <sup>a</sup>	Low power CO g/min/l
Tier 0	>16	>0,20
Tier 1	≤16	≤0,20
Tier 2	≤11	≤0,13
Tier 3	≤9	≤0,10
Tier 4	≤8	≤0,09

<sup>a</sup> Grams per megajoule delivered to the pot.

Table 2 — PM<sub>2,5</sub> emissions

Tier	High power PM <sub>2,5</sub> mg/MJ <sub>d</sub> <sup>a</sup>	Low power PM <sub>2,5</sub> mg/min/l
Tier 0	>979	>8
Tier 1	≤979	≤8
Tier 2	≤386	≤4
Tier 3	≤168	≤2
Tier 4	≤41	≤1

<sup>a</sup> Milligrams per megajoule delivered to the pot.



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# Additional notes

- ISO Voluntary Performance Targets have built on prior guidance (WHO and IWA)
- Tier ratings should be reported separately (there is no such thing as a Tier 3 stove)
- The performance targets may be updated within the ISO system as more data becomes available
- Performance targets are one useful tool in an ecosystem of design, production, sales, user training, customer awareness, etc...
- A high-performing stove that does not get sold or displace baseline technologies will not have impact
- Tools for developing region-specific PM2.5, CO, and thermal efficiency targets



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# WHO Performance Target model (PT)

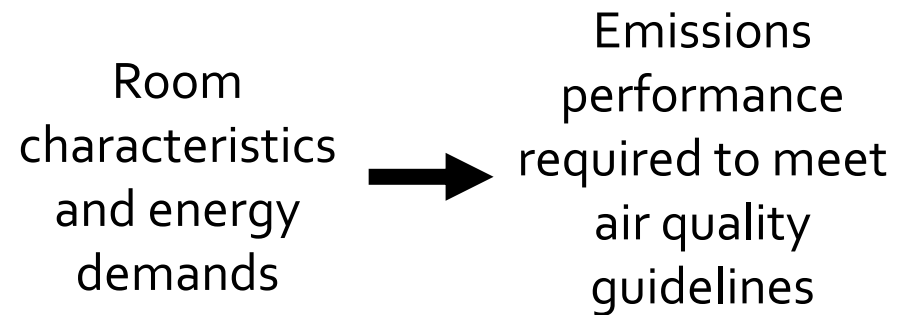
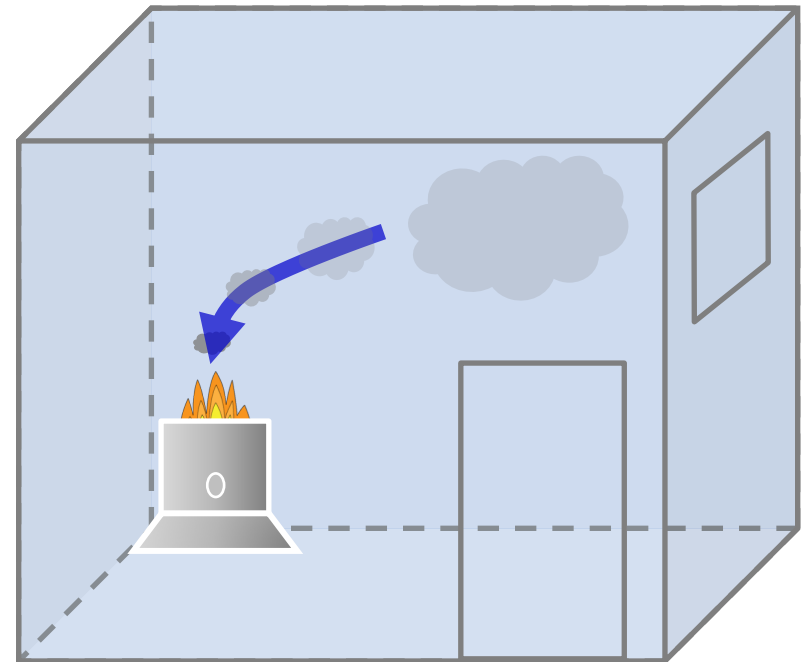
Provides way to estimate the performance needed for a given technology to meet air quality targets for a given context

Only focuses on a single device

No ambient contributions or multiple sources

Used for developing the WHO and ISO emissions performance guidance

Runs the Monte-Carlo approach to account for distributions of inputs



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Enter inputs for:

Inputs

Pollutant (PM or CO)

Cooking time

Fraction of emissions entering room (for chimney stoves)

Air exchange rate

Kitchen volumes

# WHO Performance Target Model

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**Input Parameters**

Select a Pollutant

**Daily Cooking Time.** Enter the arithmetic mean and standard deviation (if applicable, i.e. for Normal and Lognormal distributions) of daily cooking times in minutes.

Time (min)	SD	Distribution	Min	Max
<input type="text" value="252"/>	<input type="text" value="90.7"/>	<input type="text" value="Normal"/>	<input type="text" value="60"/>	<input type="text" value="480"/>

**Emissions Mixing in Room.** Enter arithmetic mean and standard deviation (if applicable, i.e. for Normal and Lognormal distributions) of the fraction of emissions mixing in the room (between 0 and 1).

Fraction	Distribution
<input type="text" value="1"/>	<input type="text" value="Fixed"/>

**Air Changes per Hour.** Enter arithmetic mean and standard deviation (if applicable, i.e. for Normal and Lognormal distributions) of the number of air changes per hour

Number	SD	Distribution	Min	Max
<input type="text" value="21"/>	<input type="text" value="10.8"/>	<input type="text" value="Lognormal"/>	<input type="text" value="4.2"/>	<input type="text" value="100.2"/>

**Kitchen Volume.** Enter the arithmetic mean and standard deviation (if applicable, i.e. for Normal and Lognormal distributions) of kitchen volumes in cubic meters.

Volume	SD	Distribution	Min	Max
<input type="text" value="28"/>	<input type="text" value="17"/>	<input type="text" value="Lognormal"/>	<input type="text" value="5"/>	<input type="text" value="100"/>



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Inputs

Run the Model

Downloads

Outputs emissions performance targets aligned with ISO Tiers

Can select a user-defined target such as a country PM2.5 guideline

### Households Meeting Targets

Tier	Emission Rate (mg/min)	Coverage	Emission Factor (mg/MJd)	Pollutant
User Input (10 µg/m <sup>3</sup> )	0.6	50%	13.7	PM
Tier 5 - RR 1 (10 µg/m <sup>3</sup> )	0.22	90%	5	PM
Tier 4 - RR 1.5 (50 µg/m <sup>3</sup> )	3	50%	68.7	PM
Tier 3 - RR 2.5 (170 µg/m <sup>3</sup> )	10.2	50%	233.7	PM
Tier 2 - RR 3 (400 µg/m <sup>3</sup> )	24	50%	549.8	PM
Tier 1 - RR 3.15 (800 µg/m <sup>3</sup> )	48.1	50%	1101.9	PM

Showing 1 to 6 of 6 entries

Coverage is the percent of modelled homes meeting the tier level. Please note that emission targets will vary slightly if you run the model multiple times, even when using the same input parameters. This variation occurs because the inputs for each of the thousands of simulations are randomly drawn from distributions based on your inputs. It is recommended that targets from the first model run from any given set of input distributions be used.

### Levels of Protection

**Level of Protection.** Users may enter a concentration target in µg/m<sup>3</sup>. For example, these can be from local or national air quality guidelines. The summary table above and the graph below will change to reflect any user input concentration. As long as input concentrations are the same, it is not necessary to re-run the model, and multiple different concentration targets can be entered.

Tier 5 - RR 1 (10 µg/m<sup>3</sup>)

**Summary.** To protect 50% of households at a 24 hour average PM concentration of 10 µg/m<sup>3</sup>, the maximum emission rate should be 0.6 mg/min or lower.



Thank you!  
Questions?

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