

SOLAR HEATING & COOLING PROGRAMME  
INTERNATIONAL ENERGY AGENCY

# Guide to ISO 24194 Power Check

## SHC Task 68 Deliverable D.B2

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Task Duration: 01.04.2022 – 31.03.2025

Task 68 meeting Graz, 2024-04-08\_09

# ISO 24194 “Check of Performance”

**New ISO standard** for assessing performance of solar thermal collector fields / plants.

- **In-situ**, for plants in operation!
- Refers to ISO 9806 (single collector lab tests)
- Refers to ISO 9060 and ISO 9488

## Applicable **Collector Types**:

- Glazed flat plate collectors
- Evacuated tube collectors
- Tracking, concentrating collectors

Defines 2 **Methods** on paper:

- **Power Check** → *covered by “Guide”*
- Daily Yield Check

### Solar energy — Collector fields — Check of performance

(ISO 24194:2022)

Sonnenenergie — Kollektorfelder — Überprüfung der Leistungsfähigkeit  
(ISO 24194:2022)

Energie solaire — Champs de capteurs — Vérification de la performance  
(ISO 24194:2022)

#### Life cycle

Now

Published  
**ISO 24194:2022**  
Stage: 60.60 ▾

#### Corrigenda / Amendments

↳ Under development  
**ISO 24194:2022/Amd 1**

#### General information

Status : Published  
Publication date : 2022-05  
Stage : International Standard published  
**[60.60]**

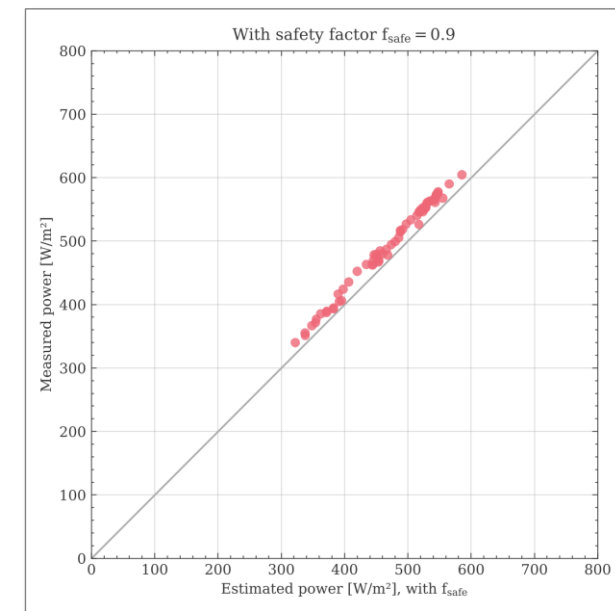
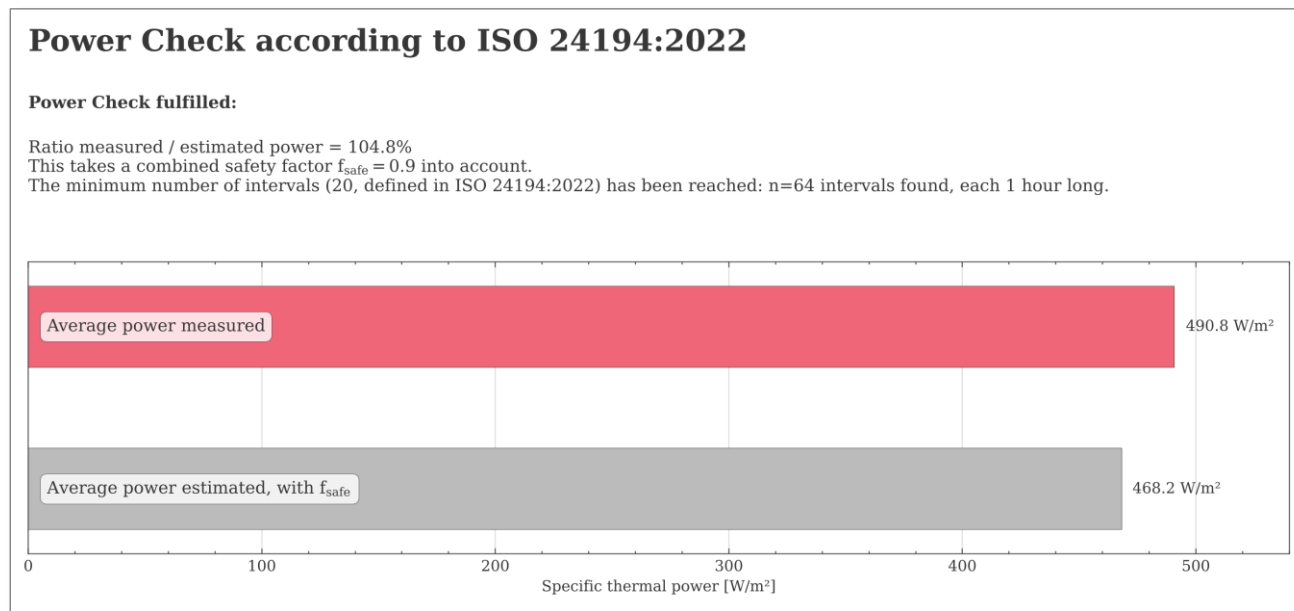
Edition : 1  
Number of pages : 30

Technical Committee : **ISO/TC 180/SC 4**  
ICS : **27.160**

# ISO 24194 “Power Check” method

- Usage: Can be used for **guarantee** procedures and for **ongoing monitoring**.
- History:
  - Previous versions developed in Denmark 10-20 years ago for SDH plants.
  - Further development in IEA SHC Task 45 & 55 (see fact sheets).

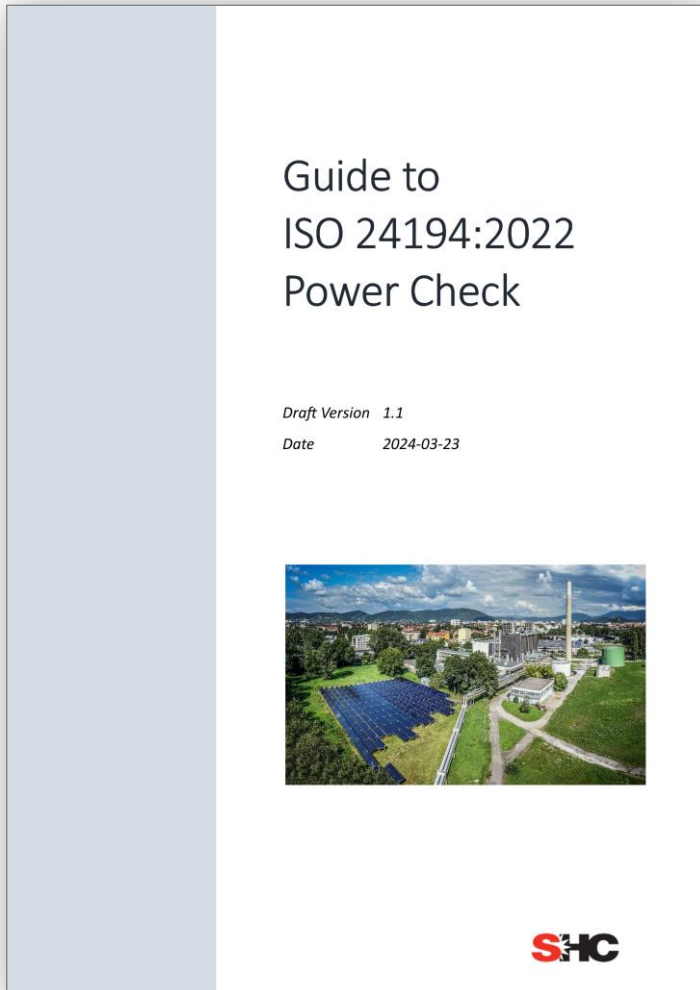
Example Output



# Guide Document: Motivation & Aims

- Motivation
  - ISO 24194 standard is the **first of its kind** to target solar collector fields.
  - Inspired by „Guide to Standard ISO 9806:2017“.
  - **Practical application & SunPeek** underpin the need for clarification, improvements, practical tweaks & how-tos, background info.
- Aims
  - Summarize **learnings & experiences** from international experts.
  - Outline implementation & application with **SunPeek** software.
  - Make ISO 24194 more **accessible** and more **widely used** in solar community.
  - Guide treats only **Power Check**, more established and mature work.

# Guide Document: Overview



## Cooperation from „IEA SHC Task 68“

- Part of Task 68 **Deliverable B2**, expect **High Impact**.
- Large number of **contributors**.
- Practical application of ISO 24194 Power Check.
- SunPeek software ISO 24194 Reference implementation

**Working group exists**, Task 68 + “associated”  
**Inputs welcome**, from industry & research.  
**Participate** as Contributor or Reviewer.  
**Contact us if interested!** [d.tschopp@aee.at](mailto:d.tschopp@aee.at)

# Guide: Current Status, Administration

- Current state of Guide document
  - Funding from Solar Certification Fund awarded, mainly publishing & promotion.
  - “Rough” draft version, ~50 pages
- Group of contributors & reviewers:
  - Currently 32 people confirmed: 11 industry, 13 research, incl SunPeek developers.
- 4 Editors: Daniel Tschopp, Stefan Mehnert, Lukas Feierl, Philip Ohnewein
- Timeline
  - Revised versions end of April & end of May 2024
  - Publication by end of June 2024
  - Dissemination by end of September 2024

# Guide: Practical Recommendations (examples)

## Conversion of Collector Data Sheets

Collector test	Source
<b>QDT (Quasi-dynamic test)</b> Given parameter: $\eta_{0,b}, K_b, K_d$ Derived parameter: $\eta_{0,hem}, K_{hem}$	
$\eta_{0,hem} = \eta_{0,b}(0.85 + 0.15 K_d)$	ISO 9806:2017 Annex B, Formula (B.2), (B.5)
$K_{hem}(\theta_L, \theta_T) = \frac{\eta_{0,b}}{\eta_{0,hem}} (0.85 K_b(\theta_L, \theta_T) + 0.15 K_d)$	Derived from ISO 9806:2017 Annex B Formula (B.2), (B.5)
<b>SST (Steady-state test)</b> Given parameter: $\eta_{0,hem}, K_{hem}$ Derived parameter: $K_b, K_d, \eta_{0,b}$	
$K_b(\theta_L, \theta_T) = K_{hem}(\theta_L, \theta_T)$	ISO 9806:2017 Annex B, Formula (B.1)
$K_d = \frac{1}{W} \sum_{\theta, \gamma=0^\circ}^{90^\circ} K_b(\theta, \gamma) \sin(\theta) \cos(\gamma)$ $W = \sum_{\theta, \gamma=0^\circ; steps=10^\circ}^{90^\circ} \sin(\theta) \cos(\gamma)$	ISO 9806:2017 Annex B, Formula (B.3), (B.4)
$\eta_{0,b} = \frac{\eta_{0,hem}}{0.85 + 0.15 K_d}$	ISO 9806:2017 Annex B (B.5)

## Automatic Data Processing & Filtering

SensorType	Compatible Unit	Associated datapoints	Replacement values					
			LOWER_REPLACE_MIN	LOWER_REPLACE_MAX	LOWER_REPLACE_VALUE	UPPER_REPLACE_MIN	UPPER_REPLACE_MAX	UPPER_REPLACE_VALUE
Fluid temperature	°C	$\vartheta_i, \vartheta_e$	-20	-	-	-	200	-
Ambient temperature	°C	$\vartheta_a$	-30	-	-	-	60	-
Global radiation	W/m <sup>2</sup>	$G_{hem}$	-10	0	0	-	1700	-
Direct radiation	W/m <sup>2</sup>	$G_b$	-10	0	0	-	1400	-
Diffuse radiation	W/m <sup>2</sup>	$G_d$	-10	0	0	-	1110	-
DNI	W/m <sup>2</sup>	$I_{DN}$	-10	0	0	-	1400	-
Thermal power	W	$Q_{pri}, Q_{sec}$	-10	0	0	-	-	-
Mass flow	kg/s	$\dot{m}_{pri}, \dot{m}_{sec}$	-100	0	0	-	-	-
Volume flow	m <sup>3</sup> /s	$\dot{V}_{pri}, \dot{V}_{sec}$	-0.1	0	0	-	-	-
Wind speed	m/s	$u$	-1	0	0	-	-	-
Temperature derivative	K/s	$d\vartheta_m/dt$	-100	-	-	-	100	-
Angle	°	$\theta_L, \theta_T$	-90	-	-	-	90	-

# Guide: Practical Recommendations (tbd)

- How to state, check and report a performance guarantee.
- How to apply to multiple collector fields, possibly with different orientation.
- How to apply to collector fields combining multiple collector types.
- How to treat insufficient measurement setup, calculating & modeling values.
- How to use heat transfer fluid properties.
- Enhanced shading calculation, e.g. on skewed ground
- Treatment of diffuse radiation masking
- And some more... 😊



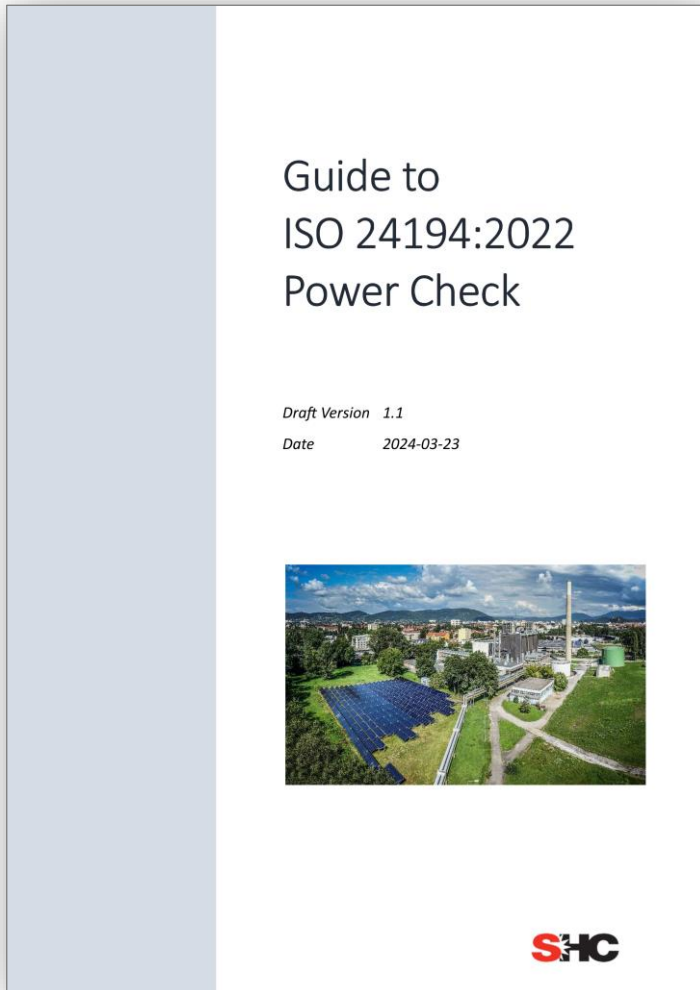
# SunPeek

<https://sunpeek.org>

- Role of **SunPeek Open-source software**
  - *Philosophy: Standardized ISO method demands open implementation, additionally to paper standard.*
  - **Transparency:** Will remain open, due to LGPL license.
  - **Planned:** Use & provide feedback to ISO 24194 / TC 180.
- **Open Dataset “FHW”**
  - Try SunPeek: <https://demo.sunpeek.org>
  - <https://doi.org/10.1016/j.dib.2023.109224>



# Guide Document: Participation



## Cooperation from „IEA SHC Task 68“

- Part of Task 68 **Deliverable B2**.


**Working group exists, Task 68 + “associated”**  
**Inputs welcome, from industry & research.**  
**Participate as Contributor or Reviewer.**  
**Contact us if interested! [d.tschopp@aee.at](mailto:d.tschopp@aee.at)**  
**Now / Today, or @ Deadline: Fri 2024-04-12**

Questions?  
Interested?  
Discussion! 😊



[www.iea-shc.org](http://www.iea-shc.org)

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 IEA Solar Heating and Cooling Programme  
(group 4230381)