

## Technical Data

### Industrial Solar linear Fresnel collector LF-11

The Industrial Solar linear Fresnel collector LF-11 is a linear focussing solar system for generating process heat in the range of 100 kW to 10 MW at pressures up to 120 bar (standard 40 bar) and temperatures up to 400°C. Different heat transfer fluids can be used like pressurized water or thermal oil, but it is also possible to directly generate or even super-heat steam. The Industrial Solar LF-11 includes all necessary components for generating process heat.

The use of high quality safety glass mirrors and optimized row spacing results in a high thermal peak output of 562 W/m<sup>2</sup> (under reference conditions, see p.3) in terms of primary reflector aperture area, and 375 W/m<sup>2</sup> in terms of installation area usage.

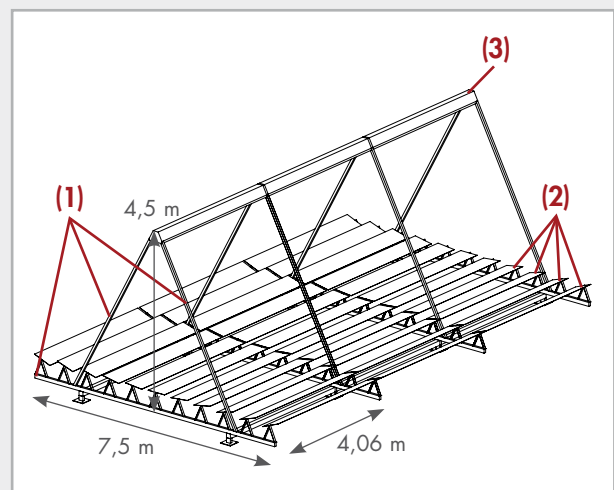
The lightweight, modular system, in combination with the high heat gain per installed area, makes it optimal for rooftop installation for industrial and utility facilities.

#### Main components of the system are:

- supporting structure <sup>(1)</sup>
- primary reflectors <sup>(2)</sup>
- receiver, consisting of secondary reflectors and vacuum absorber tubes <sup>(3)</sup>
- control systems for the primary reflector tracking and the solar array output.

#### Optional components are:

- package for monitoring of the collector performance
- hydraulic circuit designed to meet the customers' needs



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## General description

The LF-11 process heat collector uses individually tracked reflector rows to concentrate direct solar irradiance on a stationary linear receiver.

### Advantages are:

- simple power control
- optimized stow positions for various weather conditions, i.e. protection during hail and sand storms
- self-cleaning position in rain
- easy maintenance access to individual rows, thereby allowing continued operation of the plant

The basic module for the Industrial Solar LF-11 consists of 11 primary reflector units with a total mirror surface area of 22 m<sup>2</sup> and 1 receiver unit (= 1 Schott PTR absorber tube plus secondary mirrors).

The basic modules are combined in a longitudinal direction to form collector rows. These rows can be arranged in parallel to form a solar array of any size, with a maximum packing density (aperture area/ground area) of 67%.

### Recommended minimum row length:

- 8 modules, 32.5 m in length

### Standard row length:

- 16 modules, 65 m in length

### Economically recommended array:

- multiple of 16 modules

### Orientation:

- optimal orientation for maximum gain is north-south, but any orientation is possible
- foundation spacing adaptable to existing infrastructure (e.g. roof trusses spacing)

## General data of the basic module

Module width	7.5 m
Module length	4.06 m
Aperture surface of primary reflectors	22 m <sup>2</sup>
Receiver height above primary reflector	4.0 m
Height of primary reflector above ground level	0.5 m
Recommended minimum clearance between parallel rows	0-0.5 m
Specific weight (related to installation surface area)	27 kg/m <sup>2</sup>
Maximum operational wind speed	100 km/h
Maximum wind speed stowed	180 km/h
Life expectancy	+20 years

## Thermal performance characteristics

Due to the vacuum absorber, thermal performance is independent of wind speed.

**Maximum operating temperature:** 400°C

**Thermal loss per m<sup>2</sup> of primary reflector:**

$$u_1 = 0.00043 \text{ W/(m}^2\text{K}^2\text{)}$$

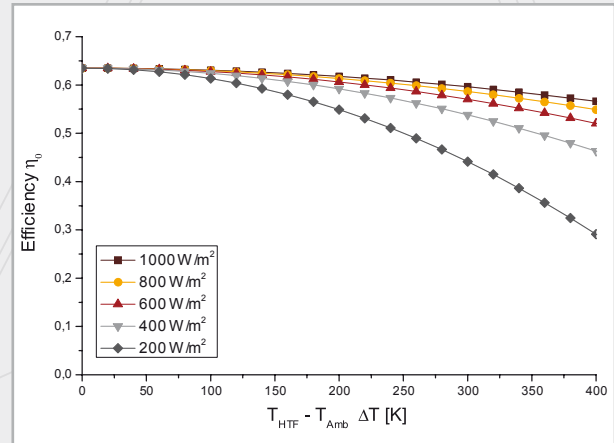
(according to DLR)

**Thermal output** (under reference conditions\*)

12.3 kW per standard module

562 W/m<sup>2</sup> in terms of aperture surface area of primary reflectors

377 W/m<sup>2</sup> in terms of total installation surface area



Characteristic collector curve

### \*reference conditions:

30°C ambient temperature

160°C inflow temperature

180°C outflow temperature

900 W/m<sup>2</sup> direct normal radiation

Azimuth angle 90°

Zenith angle 30°

## Optical performance characteristics

### Angle-independent optical efficiency

(with 100% clean primary and secondary reflectors and receiver glass tube)

$$\eta_0 = 0.635 \text{ (for sun in zenith)}$$

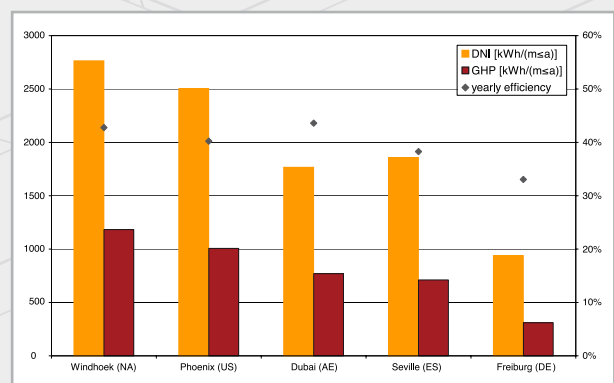
$$\eta_{\max} = 0.663 \text{ (for sun at } 5^\circ \text{ transversal zenith angle)}$$

**Mirror reflectivity** 95%

**Schott PTR<sup>®</sup>70 Receiver:**

thermal emittance (@380°C): 9%

solar absorptance direct: 95%

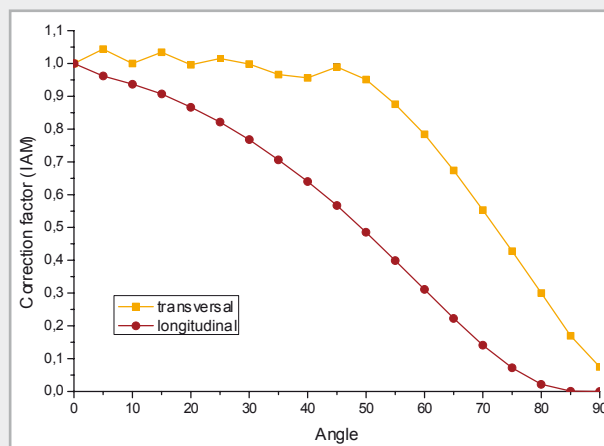


Yearly sum of direct normal irradiance (DNI), gross heat production (GHP) as well as the yearly efficiency for various locations.

## Technical Data Industrial Solar LF-11

### Correction factor (IAM)

Angle	Transversal	Longitudinal
00	1.000	1.000
05	1.044	0.962
10	1.000	0.937
15	1.034	0.907
20	0.996	0.867
25	1.015	0.821
30	0.998	0.768
40	0.956	0.640
50	0.951	0.485
60	0.784	0.311
70	0.553	0.141
80	0.300	0.022
90	0.075	0.000



Correction factor

### Control

The individual control of each mirror row allows perfect stow and cleaning positions, integrated maximum temperature protection and shutdown procedures.

A touch-screen with graphical user interface allows comfortable operation and easy monitoring.

Remote control via internet is possible.

### External piping and hydraulic system

Stainless steel hydraulic components are recommended, but other steel types are possible, too.

Pressure class PN16 - PN160.

Piping diameter optimised for individual field size requirements.

### Electrical

Electrical connection: 220/110 VAC

Electrical peak consumption (16 Modules): < 600 W

Typical electrical consumption:

Touch-screen and switchboard: 200W

Tracking system per 8 Modules: 50 W

### Monitoring package

Temperature sensors, 2 per row, PT100

Mass flow measurement

Pressure sensors

Irradiance measurement

Webcam