f-Chart Monthly Solar Fraction for Liquid, Air and Water Systems

Monthly fraction of a heating or hot-water load met by an active solar system from the f-chart X and Y groups, with storage, airflow and load exchanger corrections.

Input parameters

Unit system: SI

Parameter	Value	Unit
System type	Air, space and water heating (pebble bed)	
Collector area	30.000	m²
Collector F_R(τα)_n	50.000	%
Collector F_R U_L	2.9000	W/(m²·K)
Heat exchanger and pipe factor	100.00	%
Monthly average to normal (τα) ratio (one cover 0.96, two 0.94)	93.000	%
Monthly average daily radiation on the collector	15.800	MJ/m²
Days in the month	31.000	
Monthly average ambient temperature	1.0000	°C
Monthly heating and hot-water load	20.000	GJ
Storage per m² of collector, litres of water (liquid; standard 75)	75.000	
Load heat exchanger parameter (liquid space heating; standard 2)	2.0000	
Air flow per m² of collector, L/s (air; standard 10)	15.000	
Pebble bed per m² of collector, m³ (air; standard 0.25)	0.30000	
Hot water delivery temperature (water only)	60.000	°C
Mains water temperature (water only)	11.000	°C

Calculated results

Parameter	Value	Unit
Loss group X	1.1535	
Gain group Y	0.34164	
Corrected X	1.2234	
Corrected Y	0.34164	
Fraction of the month's load met by solar	25.965	%
Solar energy delivered in the month	5.1929	GJ

Notes for this case

- For the year, repeat for each month and divide the sum of f·L by the sum of L.

Formula and method

$$X = F_R U_L \frac{F'_R}{F_R}(T_{ref} - \bar{T}_a)\Delta t \frac{A_c}{L}, \quad Y = F_R(\tau\alpha)_n \frac{F'_R}{F_R}\frac{(\bar{\tau\alpha})}{(\tau\alpha)_n}\bar{H}_T N \frac{A_c}{L}, \quad T_{ref} = 100\,^{\circ}\mathrm{C}$$

$$f_{liquid} = 1.029Y - 0.065X - 0.245Y^2 + 0.0018X^2 + 0.0215Y^3, \quad f_{air} = 1.040Y - 0.065X - 0.159Y^2 + 0.00187X^2 - 0.0095Y^3$$

$$\frac{X_c}{X} = \left(\frac{V_s}{75}\right)^{-0.25}, \quad \frac{Y_c}{Y} = 0.39 + 0.65e^{-0.139(UA)_h/\varepsilon_L C_{min}}, \quad \frac{X_c}{X} = \frac{11.6 + 1.18T_w + 3.86T_m - 2.32\bar{T}_a}{100 - \bar{T}_a}$$

Variables

system	System type	-
A_c	Collector area	m²
$F_R(\tau\alpha)_n$	Collector F_R(τα)_n	-
$F_R U_L$	Collector F_R U_L	W/(m²·K)
F'_R/F_R	Heat exchanger and pipe factor	-
$(\bar{\tau\alpha})/(\tau\alpha)_n$	Monthly average to normal (τα) ratio (one cover 0.96, two 0.94)	-
$\bar{H}_T$	Monthly average daily radiation on the collector	J/m²
N	Days in the month	-
$\bar{T}_a$	Monthly average ambient temperature	K
L	Monthly heating and hot-water load	J
V_s/A_c	Storage per m² of collector, litres of water (liquid; standard 75)	-
$\varepsilon_L C_{min}/(UA)_h$	Load heat exchanger parameter (liquid space heating; standard 2)	-
$\dot{V}/A_c$	Air flow per m² of collector, L/s (air; standard 10)	-
V_p/A_c	Pebble bed per m² of collector, m³ (air; standard 0.25)	-
T_w	Hot water delivery temperature (water only)	K
T_m	Mains water temperature (water only)	K
X	Loss group X	-
Y	Gain group Y	-
X_c	Corrected X	-
Y_c	Corrected Y	-
f	Fraction of the month's load met by solar	-
fL	Solar energy delivered in the month	J

Method and standards

f-chart correlations of Klein, from TRNSYS simulations.

Assumptions and limits

- Standard system configurations; monthly averages; X and Y within the fitted range.

Report details

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Calculator	f-Chart Monthly Solar Fraction for Liquid, Air and Water Systems
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Release checks	5 reference cases of this calculator, computed independently, are checked on every release

Results are for engineering estimation. Verify critical designs against the referenced standards and your own data.

This calculator online

https://calc.firecad.com/environmental/solar-thermal/f-chart-solar-fraction

Open this case on calc.firecad.com →

Reopens the calculator with the inputs of this report.