ABSOLICON
SOLAR COLLECTORS

Solar thermal for industries and district heating

Concentrating solar collectors efficiently produce high temperatures, providing heat and steam to replace fossil fuel

Made in Sweden

Solar Thermal | Solar Steam
Solar Cooling | Process Heat

inter solar award 2011 WINNER


SOLAR CONCENTRATOR

Welcome to Absolicon Solar Collector AB

We provide the industries with profitable, easy to install and trouble free solar energy. Our mission is to help the industry with the transition from fossil fuels to renewable energy. In 2050, most of the combustion of fossil fuel in the developed world must have seized. It is a daunting challenge, but taken step by step it can be done.

In the first years, it is not realistic to supply 100% of the energy from the sun. But as we continue to develop, we will offer methods that can replace all the industrial fossil fuel consumption.

Using solar energy instead of oil and gas has many advantages:

- Reduced energy cost and increased profit
- Energy security – stay safe from increasing cost and international crises
- Reduced particle, NOx and SOx emissions to the local surroundings
- Reduced global warming

Table of Content


ENERGIPARK

Core Technical Data

Solar collector data

Brand name: T160

Collector type: Parabolic trough collector with one-axis tracking device

Length: 5490 mm

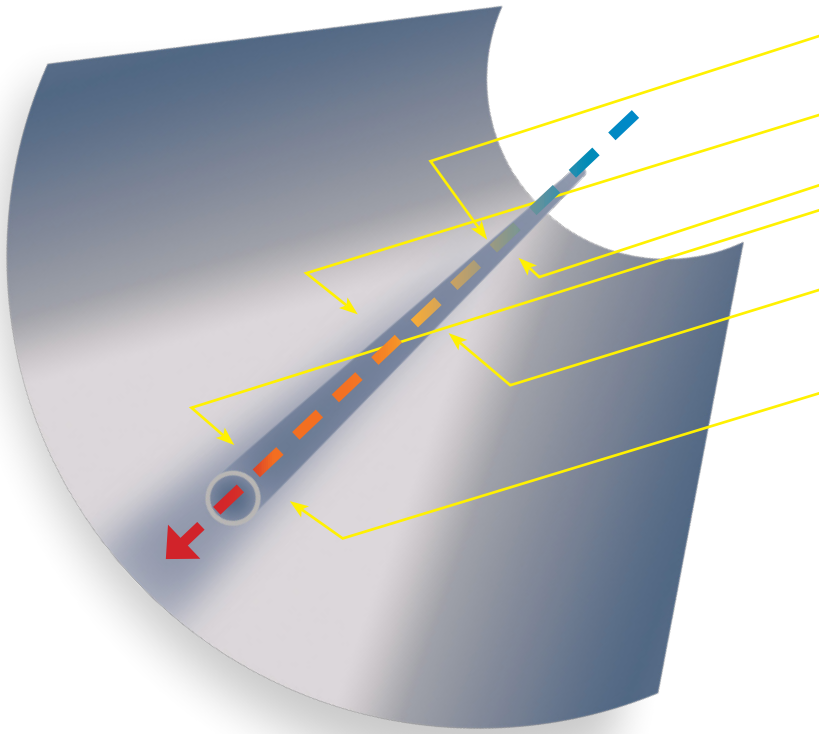
Width: 1056 mm

Weight (excl. tracking mechanism): 148 kg

Heat transfer fluid, recommended: Water, antifreeze

Operation temperature: 60-160°C

Operation pressure: 16 bar



Receiver data

Receiver material: Stainless steel

Receiver absorptance: 0.95

Receiver emissivity: 0.15

Glass data

Glass transmission: 0.95

Glass treatmeant: AR

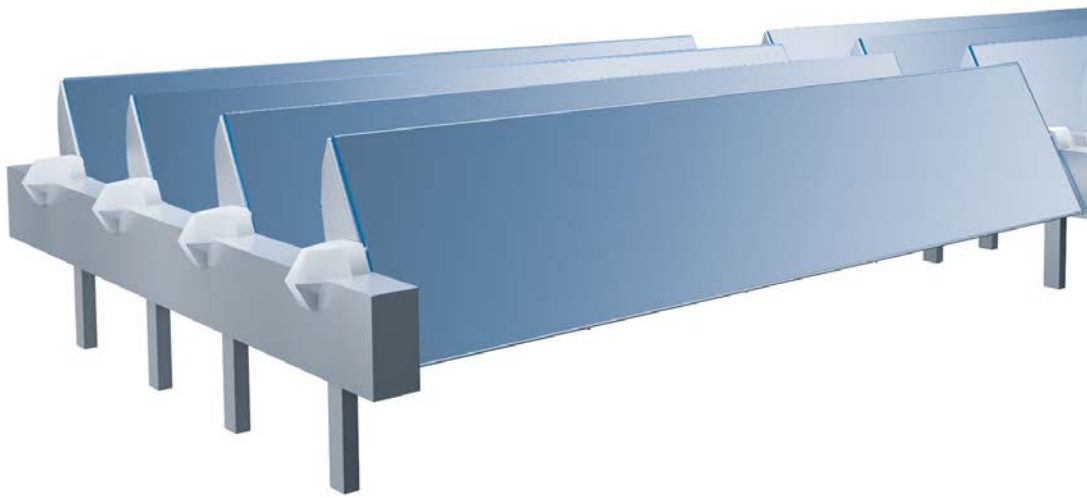
Solar tracking system

Actuator: Linear

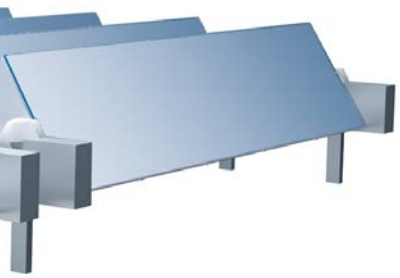
Control unit: Siemens distributed I/O system

Software: Siemens 1-Axis Solar Tracking

Precision: 0.1°



	Evacuated tube collector	CSP	T160	Comment on T160
Unbreakable glass and mirror	✗	✗	✓	The T160 is protected with 4 mm hardened glass
Safe from vacuum loss	✗	✗	✓	The T160 does not use vacuum but an enclosure with controlled enviroment
Thermal expansion	✓	✗	✓	Short pipes with small movements
Soiling and dirt	✗	✗	✓	Nano coated flat glass for T160 protection
Glass cleaning	✗	✗	✓	The T160 is very easy to clean
Stagnation and overheating	✗	✓	✓	Active overheating protection
25 years' lifetime	✗	?	✓	T160 has a protected reflector and no vacuum.
Rooftop mounting	✓	✗	✓	Low weight
Fixed pipe	✓	✗	✓	T160 has no rotational joints
Short installation time	✓	✗	✓	Easy deployment of readymade collectors
Medium temperature	✗	✓	✓	T160 operates up to 160°C



Performance Test Summary

Delivery of sample: 2016-08-25
Start of tests: 2016-08-25
End of tests: 2016-10-10
Test institute: SP Technical Research Institute of Sweden
Date: 2016-10-12

Test method:	Quasi-Dynamic Testing (QDT)
Latitude:	57.7°N
Collector tilt:	(One-axis tracking function)
Local time at solar noon:	12:07 (Stockholm 12:00)
Longitude:	12.9°E
Collector azimuth:	South
Fluid used during test:	Water
Fluid flow rate during test:	0.28 l/s
Collector aperture area[2]:	5.5 m^2

Collector thermal coefficients from quasidynamic testing based on aperture area

	Based on collector aperture area	
η_0	**76,6%**	Proportion of direct sunlight converted to heat
K_d	**8,586%**	Proportion of diffused light converted to heat
a_1	**0,3677**	Heat loss depending on working temperature of solar collector
a_2	**0,003224**	Heat loss depending on working temperature of solar collector squared

Incidence angle modifier in east-west direction (θ_{e-w})

θ	10	20	30	40	50	60	70	80	90
$K_b(0,\theta_{e-w})$	1.00	0.98	0.96	0.92	0.86	0.75	0.51	0.25	0

Test results for glazed liquid heating collectors under outdoor quasi dynamic conditions

Peak power (G = 1 000 W/m^2) per collector unit:
3 600 W_{peak}
Collector output record (W) for glazed liquid heating collectors with ambient temperature, ϑ_a, fixed at 25°C[3]

$\theta\vartheta_m$ [K]	Irradiance [W/m2]	
	1000 W/m^2 (G_b = 850 W/m^2, G_d = 150 W/m^2)	1100 W/m^2 (Gb = 1000 W/m^2, Gd = 100 W/m^2)
25	3 600	4 200
35	3 560	4 170
55	3 490	4 090
75	3 420	4 020
95	3 350	3 950
123[4]	3 250	3 850
160[5]	3 110	3 720

NOTE: The reported values are for normal incidence.

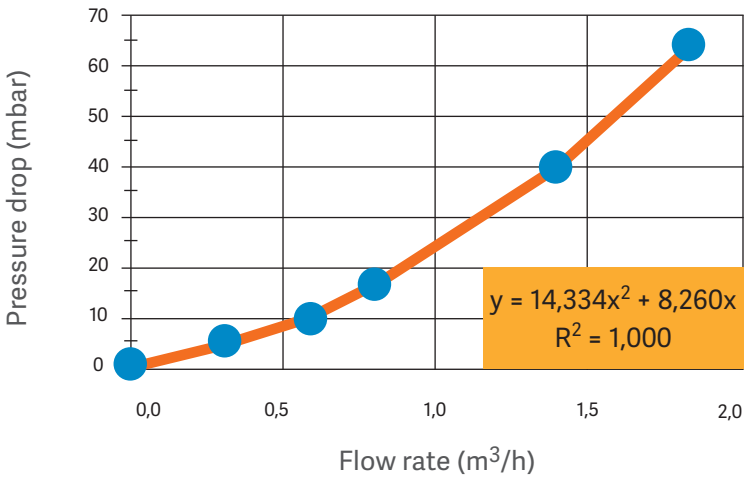
[3] Scenario with 1100 W/m^2 (G_b = 1000 W/m^2 and G_d = 100 W/m^2) represents clear sky conditions and is not a standardized case from ISO 9806:2013

[4] Maximum tested temperature difference +30 K

[5] N.B. Extrapolated results at ϑm=160'C are outside allowed range according to ISO 9806:2013

Pressure drop record
Test conditions
Outdoor testing
Test method: ISO 9806:2013, clause 28
Ambient temperature: 15 ± 2°C
Fluid temperature: 20 ± 0.5°C
Collector pressure drop record from measurement

Flow rate (m3/h)	0.0	0.3	0.6	0.8	1.4	1.8
Pressure drop (mbar)	0.0	4	9	16	40	63



Pressure drop over the collector as a function of flow rate, using water at 20°C
Pressure drop (mbar) at 20°C
y = 14.334 x2 + 8.260 x
(x = flow rate in m3/h)

Industry Today

The industrial sector accounts for about 54% of the world's total energy consumption.

Industries generally rely on an internal energy production, most typically steam boiler systems for heat production.

In larger industries, it is common to have an internal electricity production as well.

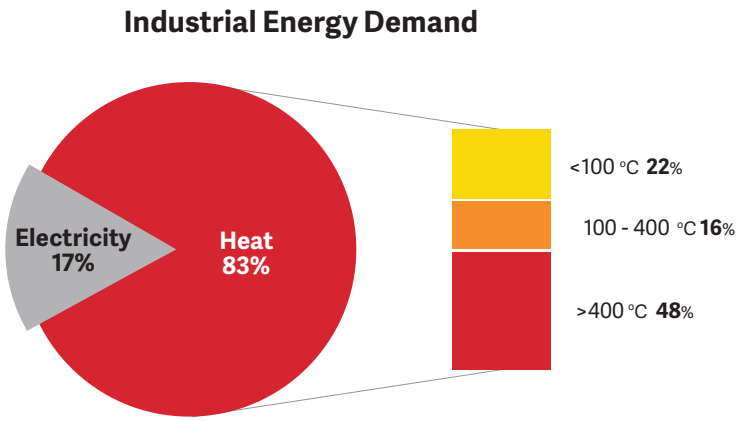
Whatever may be the energy demand of the industry, the most commonly used energy source is fossil fuels.

The growing awareness of the detrimental effects of fossil fuels has for decades pointed towards the necessity to bring forth alternate, non-exhaustible energy sources that can reduce the CO2 emissions.

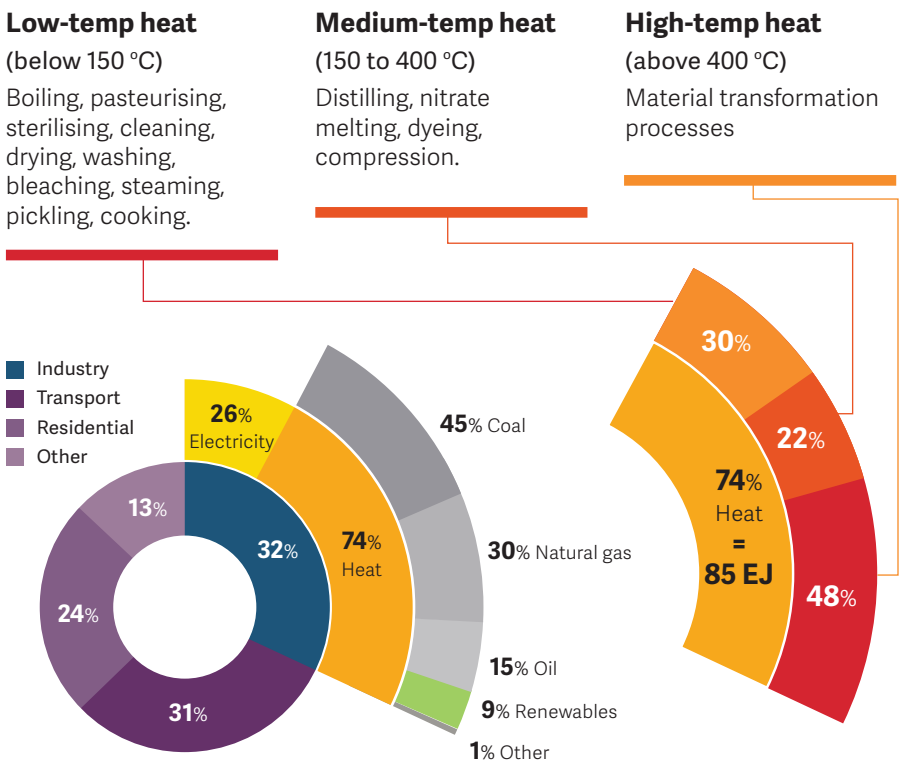
Oil prices have risen, with long-term forecasts predicting a steady price growth.

Similar forecasts have been presented for natural gas as well.

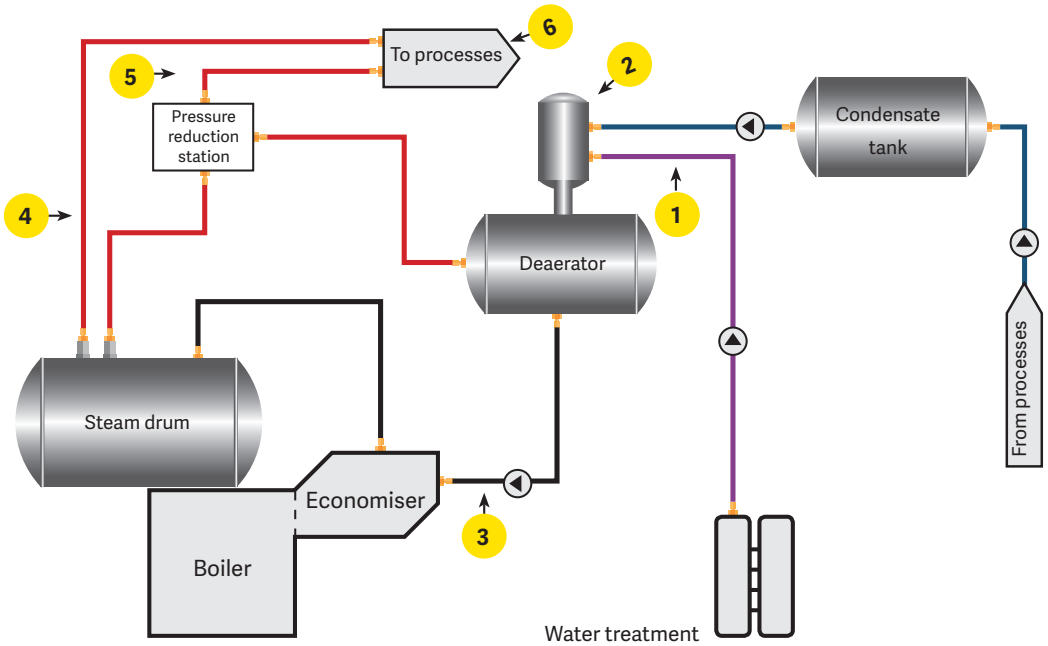
This, in addition to the increased governmental regulations on greenhouse gas emissions makes conventional fossil based systems increasingly unjustifiable.



Breakdown of the Industrial energy demand in EU-28 countries.



Total final energy consumption 2014: 260 EJ, Source IEA / IRENA, graphic from Solar Payback - promoting the use of Solar Heat for Industrial Processes (SHIP)



		Advantages	Disadvantages
1	**Make-up water**	• Low pressure and temperature (30 - 50°C)	• Demand dependent on discharge losses. Very low in some industries.
2	**Condensate**	• Continuous demand. • Low pressure and temperature (60 - 90°C).	-
3	**Feedwater**	• Continuous demand. • Low temperature (105 - 140).	• Economiser heating range can in some cases make solar preheating unviable. • High pressure
4	**HP steam**	• Continuous demand. • High energy demand.	• Steam generation • High pressure (>7 bar) • High temperature (>170°C)
5	**LP steam**	• Continuous demand. • Low pressure (2 - 5 bar). • Low temperature (120 - 150°C)	• Steam generation
6	**Processes**	• Low temperatures • Low pressures	• Demand varies depending on process. • Different integrations required depending on the process.

Typical industrial system along with potential integrations points.

Solution in Industries

After this brief walkthrough of industrial steam boiler systems, it is time to explain where solar heat can be integrated to achieve the highest efficiency in both systems.

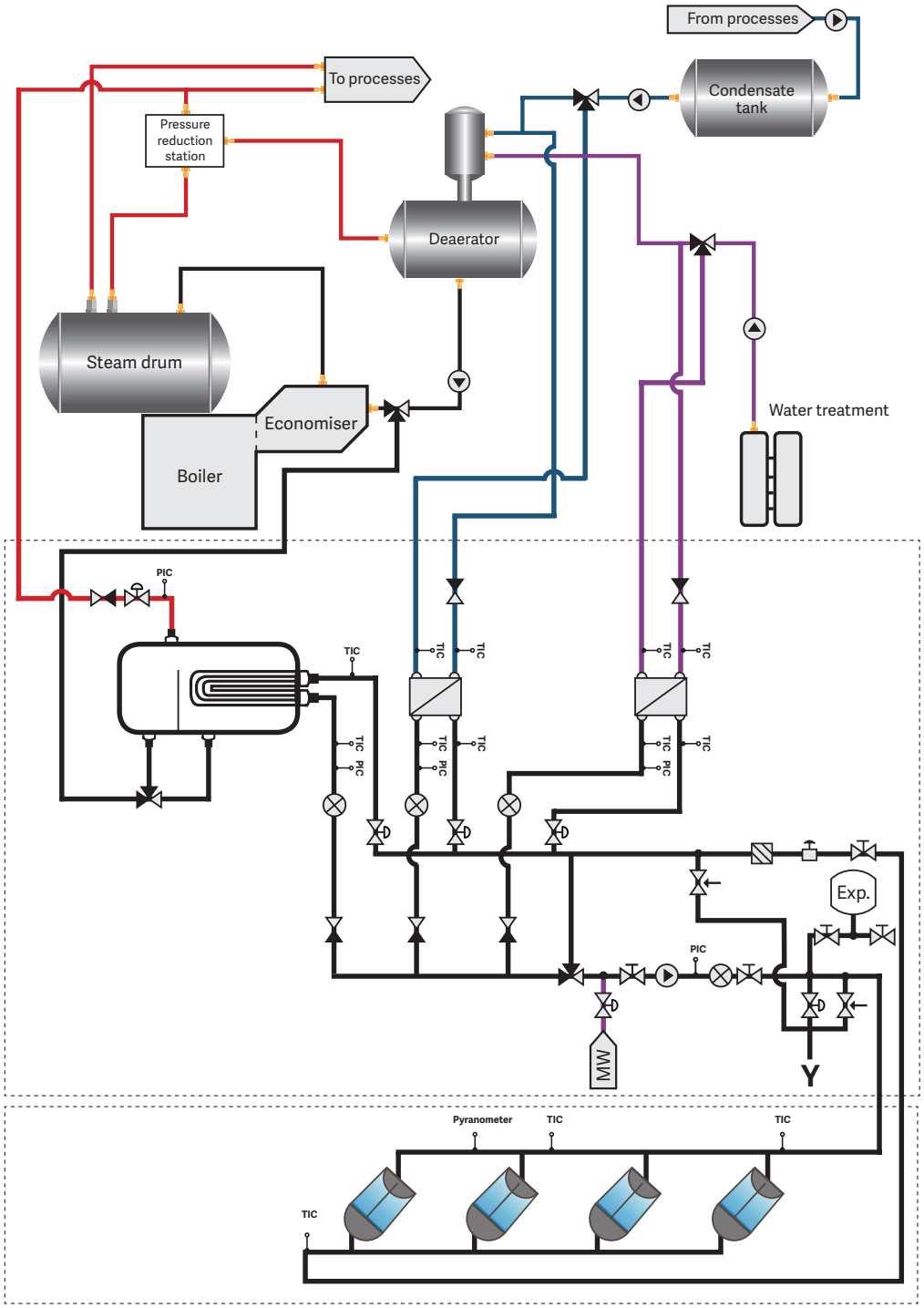
The integration points of highest interest are the make-up water (1), condensate (2), feedwater (3), low pressure steam (5), and processes (6).

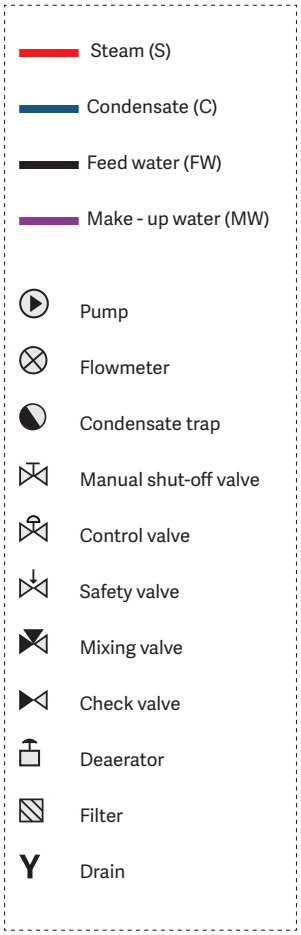
We offer a system-wide solution with maximum collector efficiency and reliable plant operation, which can supply all the above-mentioned processes with the same system.

The highest possible solar system efficiency is achieved by prioritizing low temperature integrations points.

Supply temperature (Steam pressure) (°C)	**Annual energy production** (kWh/m2)
50	1003
60	982
70	959
80	933
90	906
100	878
110 (1 bar)	845
120	814
130 (2 bar)	781
140 (3 bar)	747
150 (4 bar)	713
160 (5 bar)	678

Typical production capcaity for the given solar installation. Calculations are based on a 10 000 m^2 collector field in Zhangjiakou, China.





Integration concept suitable for a typical boiler system.

Solutions for the
Food & Beverage Industry

Heat intensive processes

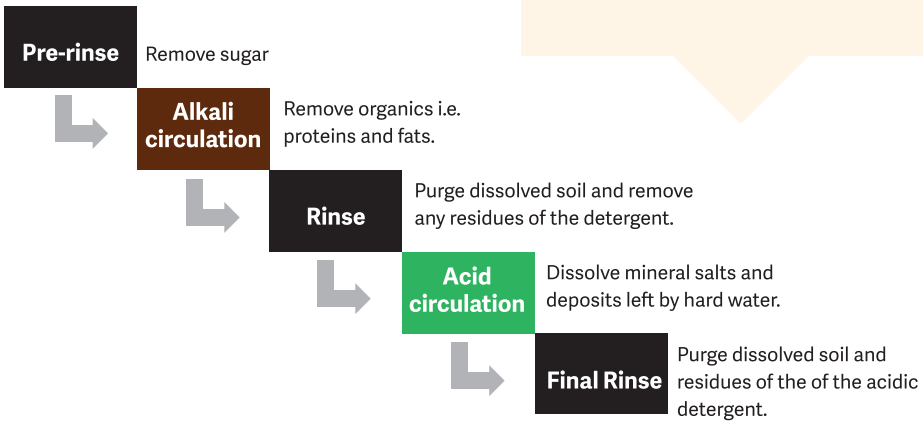
The food and beverage industry is a very heat intensive industry, with low temperature applications dominating the energy demand. The main heat carrier is low-pressure steam, generally below 5 bar.

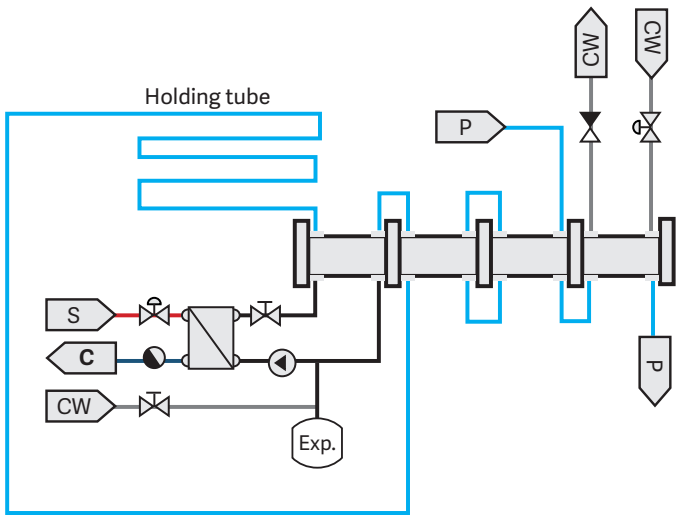
CIP

Cleaning in place, or CIP, refers to the cleaning of complete items of plant circuits without dismantling or opening the equipment. The CIP system can account for 10 20% of the total heat demand in dairy plants. This, in addition to the low temperature heat demand indicates high potential for solar heat integration.

Pasteurization

Pasteurization is a process where the product is heated to a set temperature for a certain time period in order reduce the number of pathogenic micro-organisms. The temperature varies depending on the product to be pasteurized and the pasteurization method, ranging from 60°C in tunnel pasteurization, to 150°C in UHT pasteurization. The pasteurization processes can account for 5 30% of the total energy demand in dairy plants.





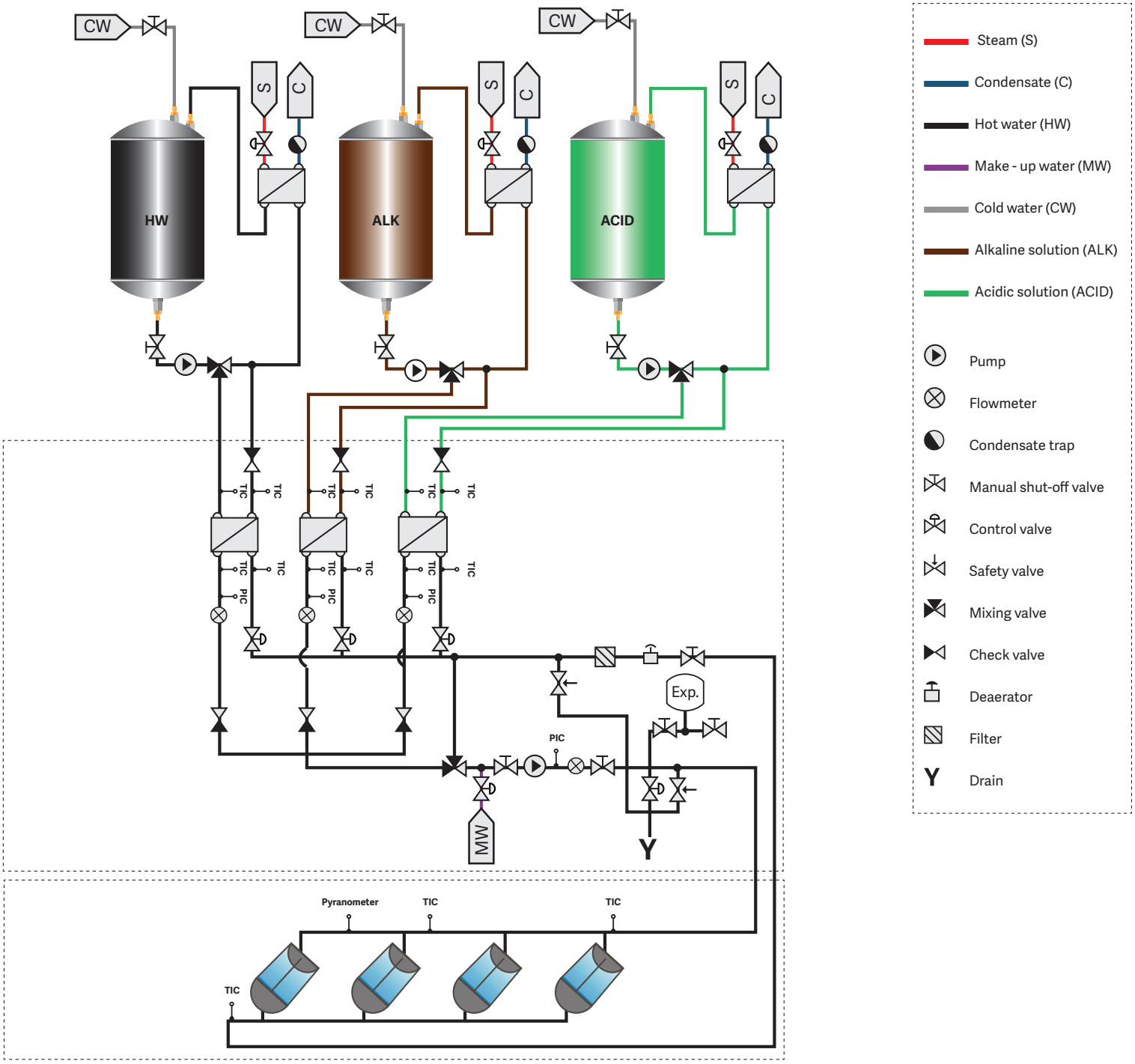
Solution CIP

Solar heat can be supplied indirectly through a heat exchanger to the circulating fluids in the CIP station.

The integration point is set prior to the conventional heat supply, thus ensuring that the set temperature of the CIP system is reached at all times.

Supply temperature (Steam pressure) (°C)	**Annual energy production** (kWh/m2)
40	1021
50	1003
60	982
70	959
80	933
90	906
100	878
110	845
120	814
130	781
140	747

Typical production capcaity for the given solar installation. Calculations are based on a 10 000 m^2 collector field in Zhangjiakou, China.



Integration concept suitable for a CIP-system.

Solution Pasteurization

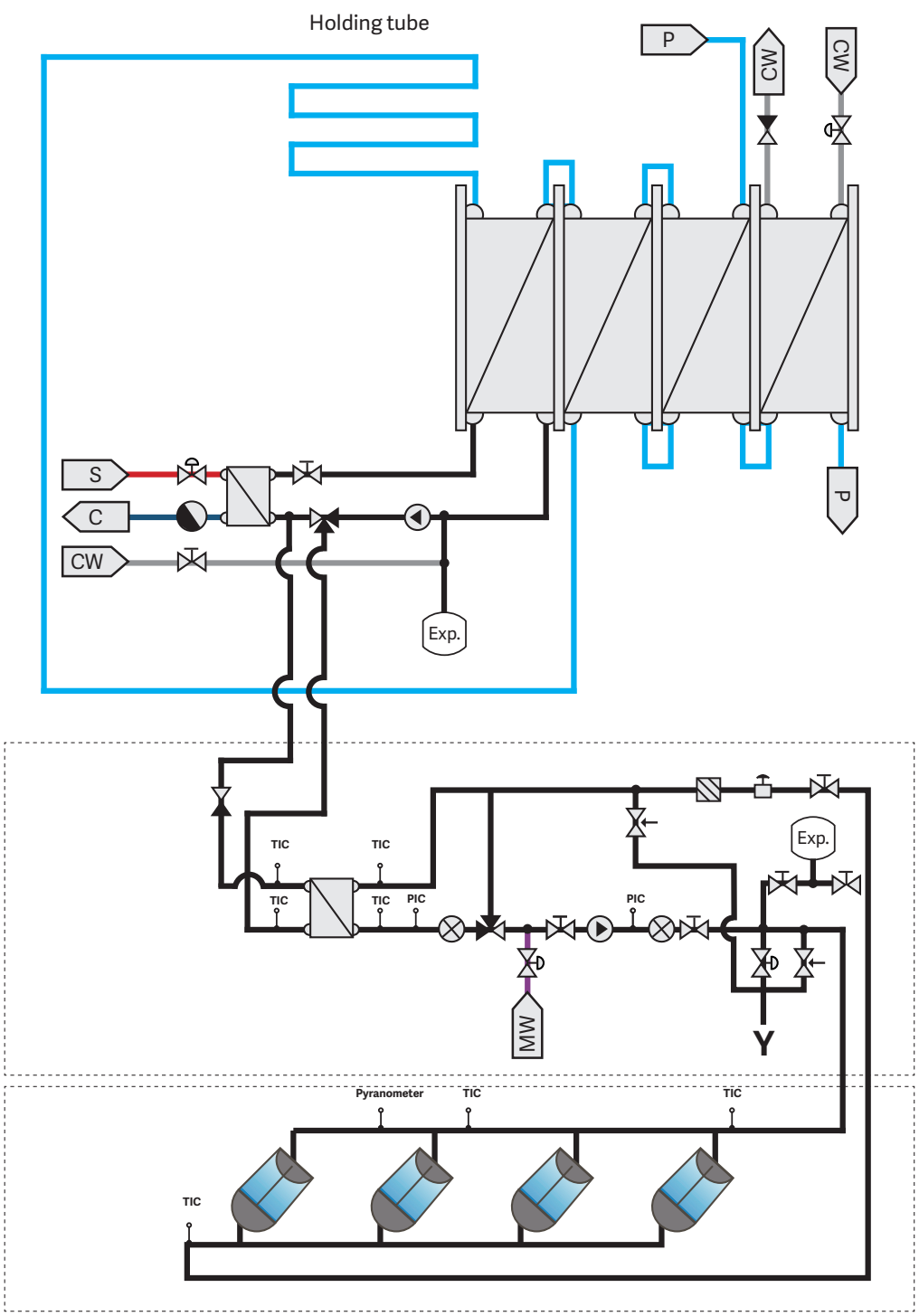
Solar heat can be supplied to the intermediate water circuit in the pasteurizer.

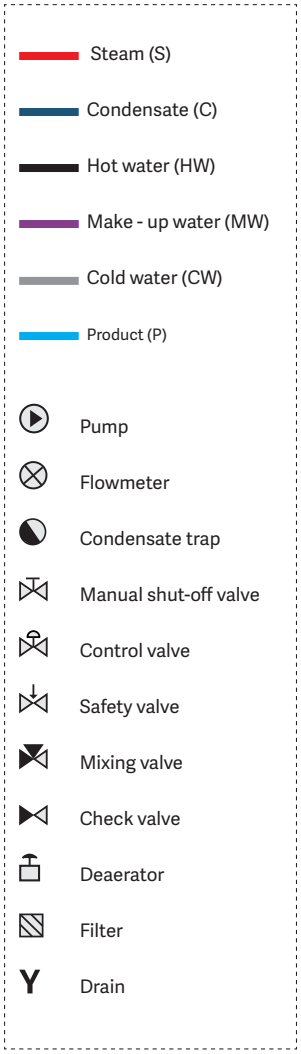
The set pasteurization temperature is achieved at all times by supplying the solar heat prior to the conventional steam supply.

This also ensures a high solar collector efficiency and safe production.

Supply temperature (Steam pressure) (˚C)	**Annual energy production** (kWh/m2)
60	982
70	959
80	933
90	906
100	878
110	845
120	814
130	781
140	747
150	713

Typical production capcaity for the given solar installation. Calculations are based on a 10 000 m^2 collector field in Zhangjiakou, China.





Integration concept for a flash pasteurizer.

Dryers

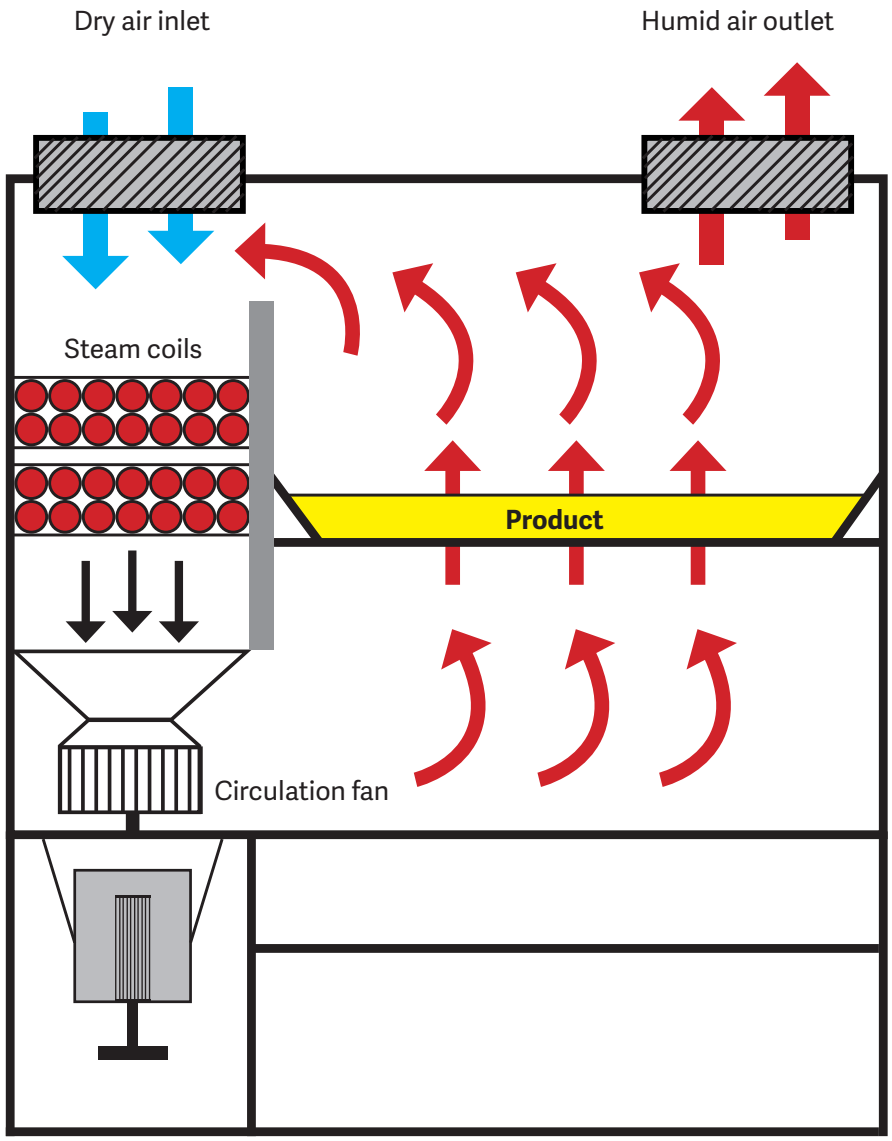
Drying processes plays a major role in the food processing chain.

Drying processes can account for up to 25% of the heat demand in a plant.

There are many different types of dryers available, varying widely in size, temperature range, and operation conditions.

A common trait is however that they require large amounts of heat, most commonly with steam or electric heating.

Large scale dryers are typically heated with steam, while small scale plants utilize electric heating

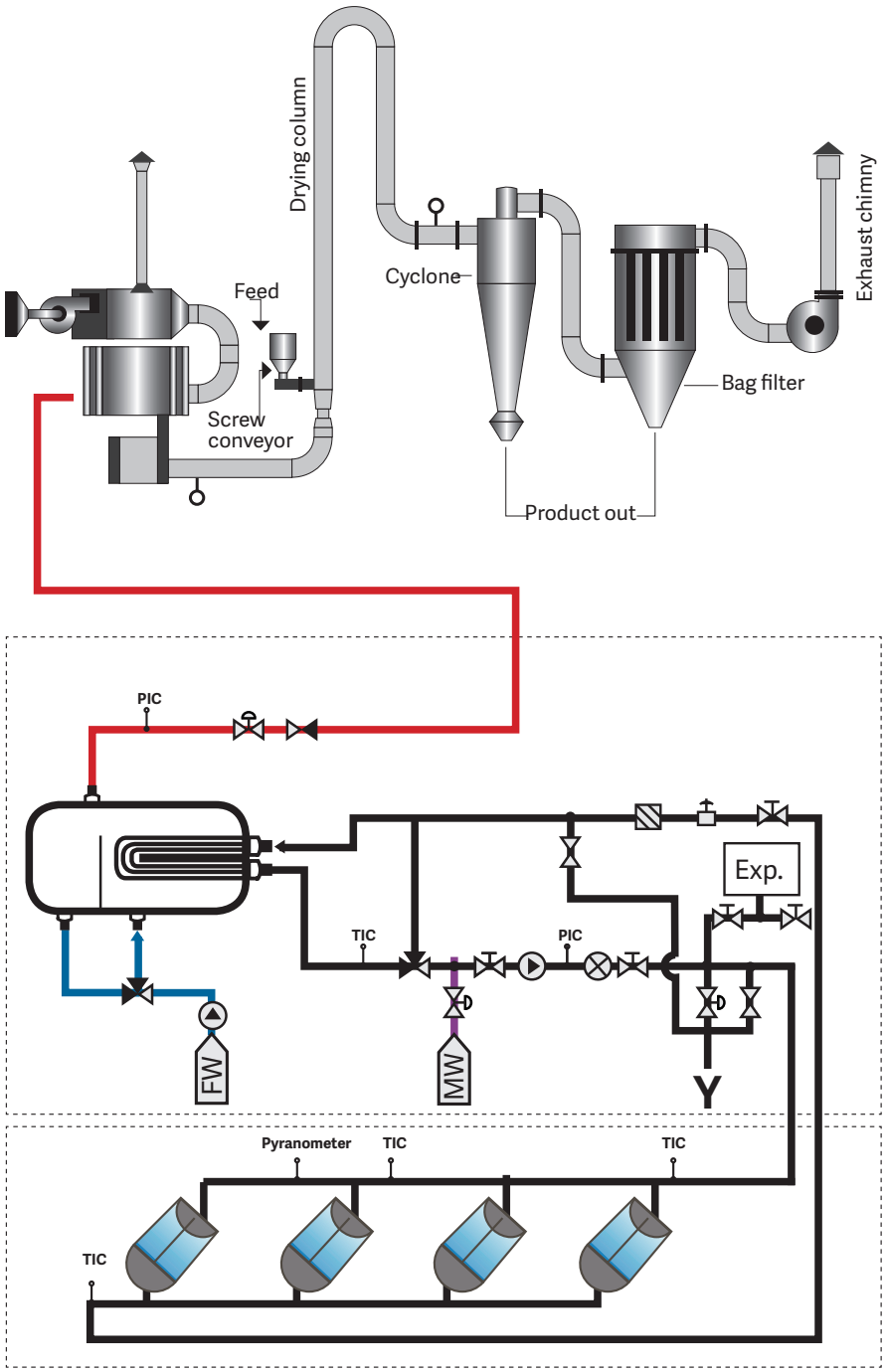


Solution Dryers

The incoming air can be heated with solar energy prior to the conventional heating supply.

This will ensure the highest possible collector efficiency, while ensuring that the set temperature of the air is reached.

This system is applicable for most industrial dryers.




Solutions for
the Pharmaceutical
Industry

High Sanitary Demands

The heat demand in the pharmaceutical industry is almost exclusively met with low-pressure steam. This is because distillation and sterilization, the applications with the highest energy demand, operate with steam. There are stringent requirements on equipment and heating media due to the high sanitary requirements on the end-products. Steam is therefore rarely injected directly to the processes, but rather used to heat intermediate circuits to minimize risks of contamination.

Multiple-Effect Stills

Multiple effect stills are comprised of several, serially connected, evaporation columns. Plant steam is supplied to the first effect where it heats incoming feedwater in a double tube sheet evaporator. The liquid-steam mixture exiting the evaporator is thereafter passed through a demister in order to remove the liquid and impurities from the steam. The pure steam generated in the first effect is thereafter condensed in the second effect and simultaneously used to evaporate the feedwater in the second effect at a lower temperature and pressure.

Distillation

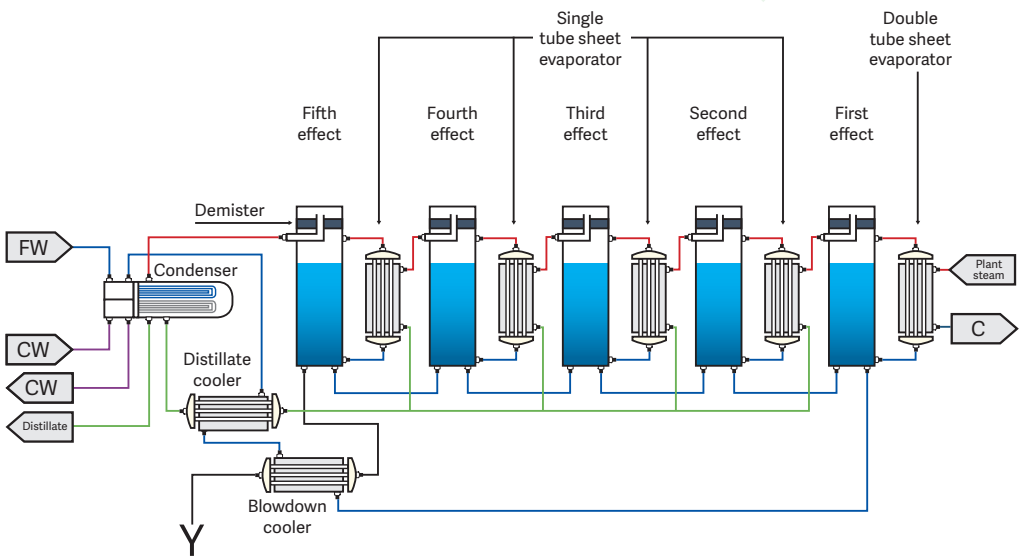
Purified water (PW) and water for injection (WFI) refers to standards that are set for water used in the production of medicinal products. Both PW and WFI are produced with multiple-effect distillers.

Pure Steam Generation

Clean steam is produced by evaporating purified water and pure steam is produced by evaporating water for injection. Both clean steam and pure steam are produced in pure steam generators.

Pure Steam Network

The clean steam and pure steam are almost exclusively used in the autoclaves and for sterilization in place (SIP). The steam network has a typical operating pressure of 3-4 bar.

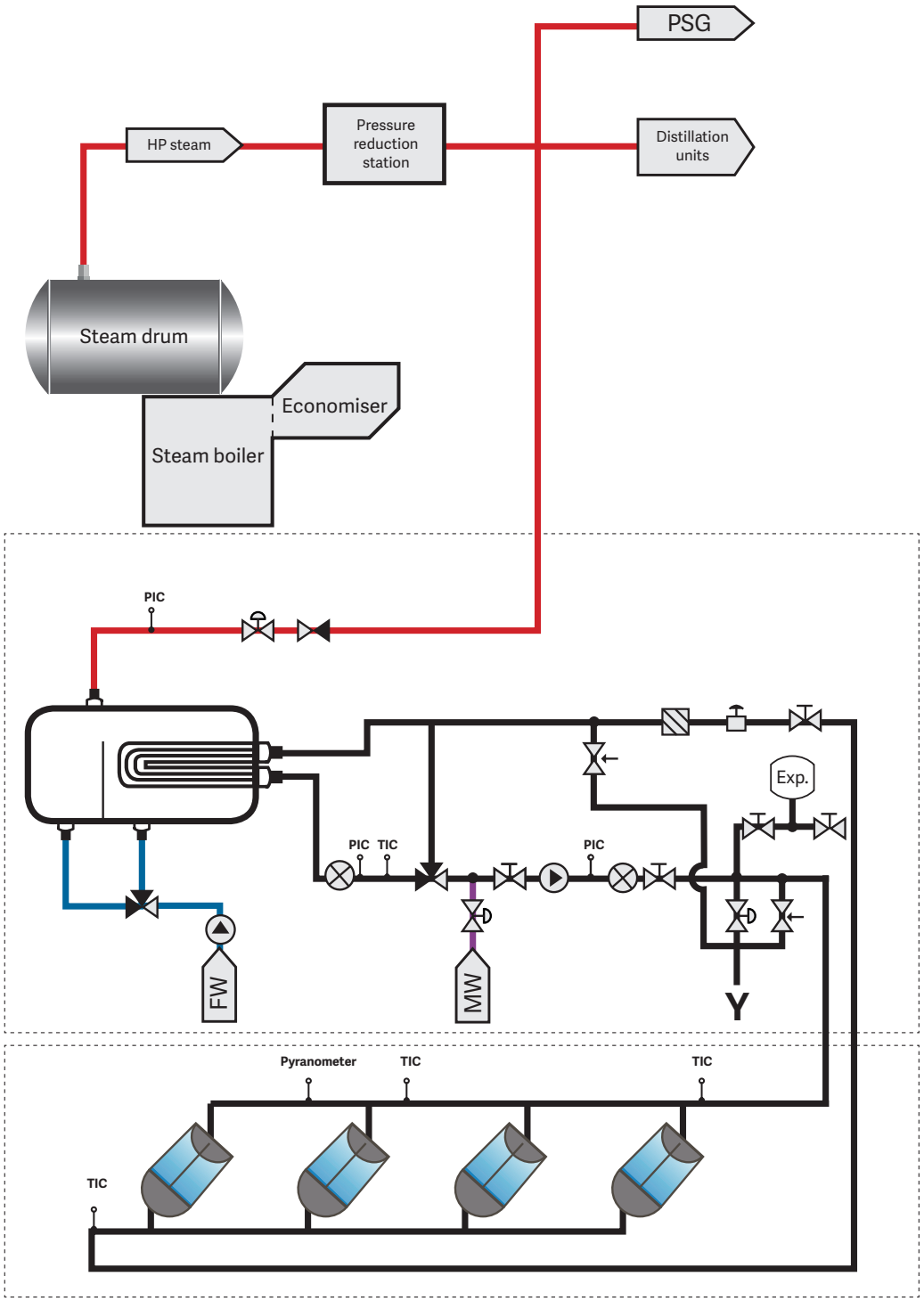


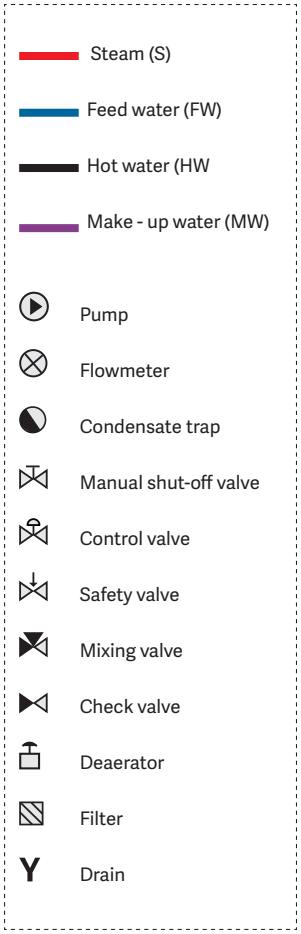
Solution Distillation & Pure Steam Generation

Solar steam can be supplied to the same steam line that provides the distillation units and the pure steam generators. The T160 can generate steam with pressures of up to 7 bar.

Supply pressure (bar)	**Annual energy production** (kWh/m2)
1	845
2	781
3	730
4	696
5	678
6	644
7	627

Typical production capcaity for the given solar installation. Calculations are based on a 10 000 m^2 collector field in Zhangjiakou, China.





Integration concept for pure steam generation and distillation.

Solution
Pure Steam Network

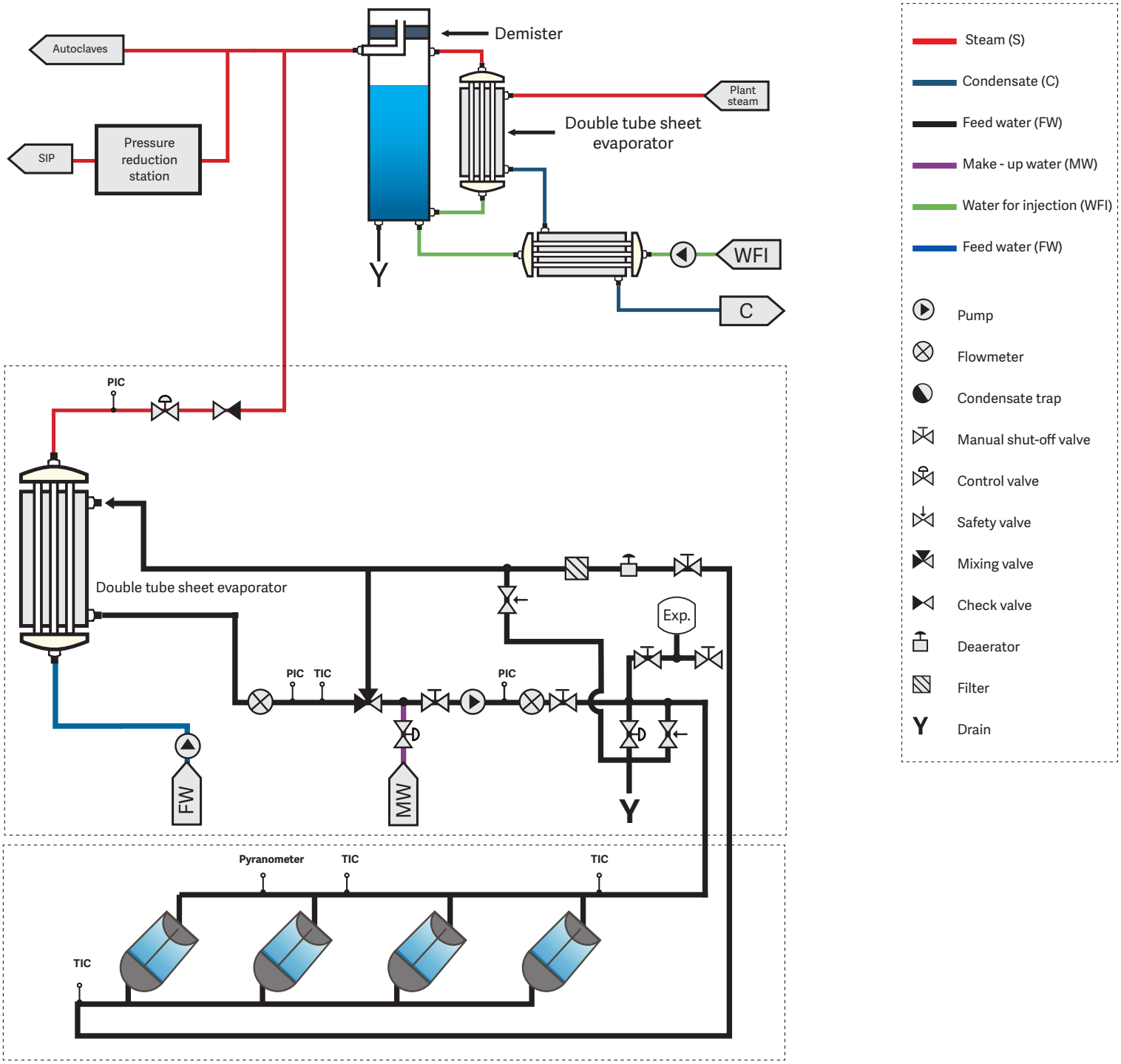
Pure steam can be generated in a PSG designated for the solar heating system.

The heat transfer medium in the solar circuit is separated from the WFI with a double tube sheet evaporator, in accordance with the standards set by the pharmacopeias.

The evaporator, the piping and the valves on the demand side is constructed with 316L stainless steel.

Supply pressure (bar)	**Annual energy production** (kWh/m2)
1	845
2	781
3	730
4	696

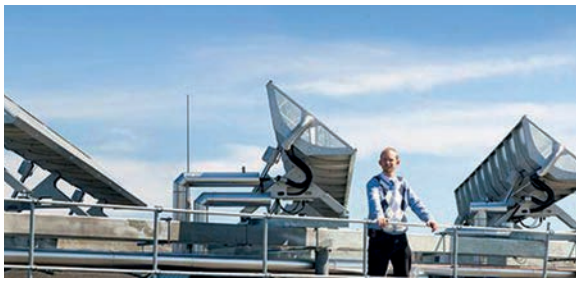
Typical production capcaity for the given solar installation. Calculations are based on a 10 000 m^2 collector field in Zhangjiakou, China.



Integration concept for generation of clean/pure steam.

Absolicon Installations

Total installed area:	3008 m^2
Operation time:	1-9 years
Installation sectors:	District heating - Hospital - Hotel - Pool - Research - Residential - Industry
Locations:	Europe - South America - Asia



About Absolicon Solar Collector AB

Absolicon is building on a Swedish research tradition starting in the 1970 and intensified during the referendum regarding the use of nuclear power in Sweden. In 2002, a group of entrepreneurs started to exploit the commercial possibilities and the first installation was commissioned in 2005. During 2005 to 2012, several pilot installations and commercial applications was developed. Absolicon in its current form was then formed in 2013 and was introduced on the Swedish stock exchange in 2016.

The business idea is to excel in the knowledge, product experience and production technology of small parabolic troughs and in systems that profitably can provide energy to industries, district heating and large buildings using concentrated solar energy.

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