SOLAR KEYMARK SCHEME RULES

ANNEX M. Solar Keymark Hydraulic Designation Code

Definition and Guideline for a Hydraulic Designation Code HDC {F}-{O}-{CL}-{A:Ø,L}-{C:Ø,L}-{D} for Solar Thermal Collectors

SCF VII Project: 7C10

Proposal to the SKN*

This project was partly financed by the Solar Certification Fund (SCF) of the Solar Keymark Network (SKN).
This document includes a proposal for the integration of the HDC into the Solar Keymark Scheme.

***) Note from SKN manager: The proposal was adopted by the Solar Keymark Network 6th March 2018**

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1 Introduction

Details about the hydraulic system of a collector are important for the design of a collector field. However also in other cases it would be helpful to have this information. Examples are
- to decide whether two collectors can be considered as “the same collector” within a collector family
- as a simple check whether a collector is distributed as tested.

Furthermore the hydraulic system is important with respect to the drainability of a system.

Professional planning software such as Polysun are using the hydraulic information to simulate the hydraulic behaviour of collector fields, to estimate the overall pressure drop and to provide proper dimensioning of the pumps. The proposed HDC can be used (decoded) automatically by simulation software.

The information about the hydraulic system of a collector is usually not easily available, especially it is not included in the public Solar Keymark information (i.e. data sheet). The hydraulic designation code presented in this document was developed to make this important information easily available in an unambiguous way and in an encoded form allowing also software tools to use it. The hydraulic designation code which includes the following parameters is a proposal for an encoding to make available this information in an unambiguous way:

- Hydraulic Configuration / Flow Scheme
- Length and inner diameter(s) of the absorber tube(s)
- Length and inner Diameter Collector tube(s)
- Drainability

The code was elaborated in the frame of a partly SCF funded project (SCF 7C10). It can be assumed that this code covers >>95% of all collectors on the market. There are of course innovative collector designs where the code may fail or is not applicable. In this case some or all required information is marked with an “X” to indicate that encoding is not possible or not clear, i.e. the manufacturer should be contacted to understand the hydraulic concept of a collector.

In Chapter 0 the code is explained and the individual designators are defined.

In Chapter 0 examples of most of the common collector designs are presented with a short explanation.

In Chapter 4 a proposal for including the HDC in the SK Datasheet

2 The Code Definition {F}-{O}-{CL}-{A:Ø,L}-{C:Ø,L}-{D}

2.1 General

The HDC consists of several fields providing encoded information. These fields are mandatory and must be given in the correct order. For the definition in this chapter, the code includes brackets {}, these brackets are omitted later. It is important to keep in mind, that the HDC is only describing the hydraulic design of a collector but not the absorber design itself. Collectors having different absorber designs (e.g. materials, fin or full plate, etc.) can have the same HDC.

2.2 {F} Hydraulic Flow Scheme Code

{F} Flow scheme: Number of Absorber elements

N = N parallel tubes (N ≥ 1)

1= Serpentine (usually)

12=Harp with 12 tubes

3,4,6 = Serial bundles of 3, 4 and 6 parallel tubes

X = Any other flow scheme

{F} is mandatory

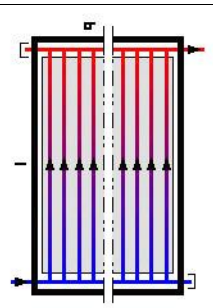
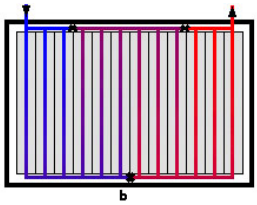
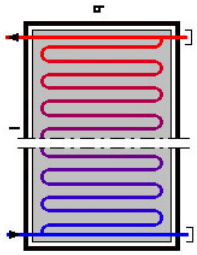
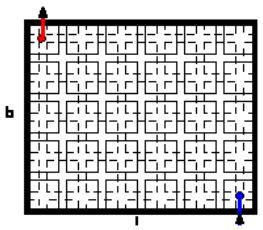
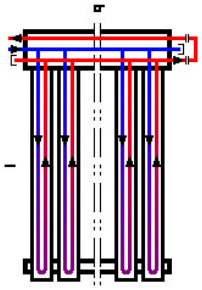
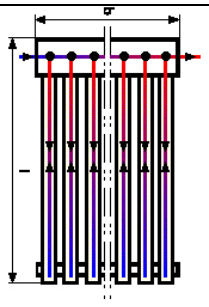
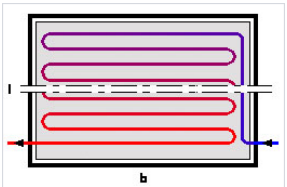
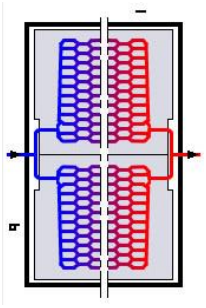
			
{F} = 10 (any number)	{F} = 3,3,3,3 (any numbers)	{F} = 1	{F} = X
	 Heatpipe		
{F} = 12 (any number)	{F} = 1	{F} = 1	{F} = X

Figure 1: Examples of {F}

2.3 {O} Orientation

{O} Orientation of the main flow elements (as tested):

V = Vertical
H = Horizontal
VH = Tested as V, can be installed H as well
HV = Tested as H, can be installed V as well
X = Cannot be described as V or H

Remark: The HDC is only dealing with the flows in connection with the hydraulic system of the heating system, e.g. heat pipes of evacuated tube collectors are not considered in the HDC.

The option to operate at 90° is not only depending on the hydraulics, but often by the collector design itself. Therefore the first letter always indicates "HOW IT WAS TESTED". The second letter – if available – must be given by the manufacturer: Is it allowed to install if rotated by 90°? If unclear, indicate only orientation as tested.

{O} is mandatory

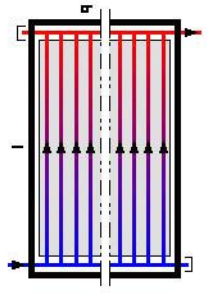
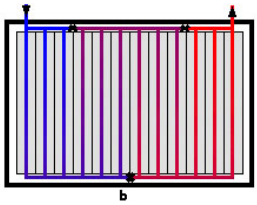
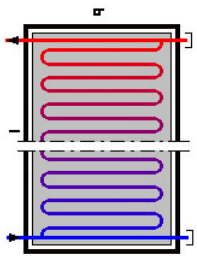
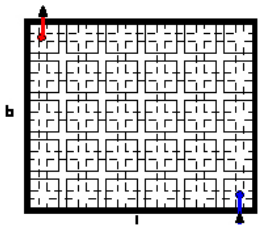
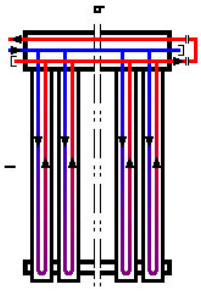
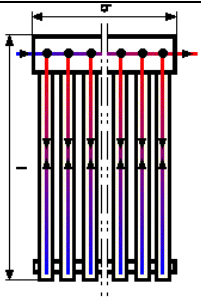
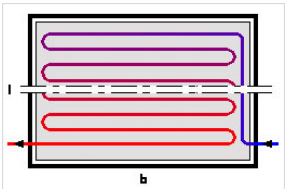
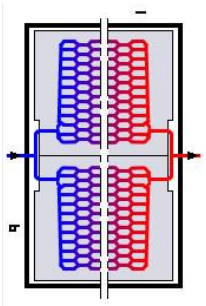
			
{O} = VH	{O} = V	{O} = H	{O} = VH
	 Heatpipe		
{O} = V	{O} = H	{O} = H	{O} = HV

Figure 2: Examples of {O}

2.4 {CL} Connectors location and direction

{CL} Connector is combination of location and direction

Location:

1,2,3,4	Corner number (Definition see graph)
T,B,L,R	If not in the corner but on the sides

Direction

S,R,V,F	Side, Rear, Vertical, Front

{CL} is minimum is 3 letters: 2-4 for location and the last one for direction.

In general the direction is the same for all connectors, then the last letter applies for all connectors. In the few cases of different directions: separate by commas Example: {CL} = 1F,3R = upper left corner flow in from front side and lower right corner flow out on the rear side.

{CL} is mandatory

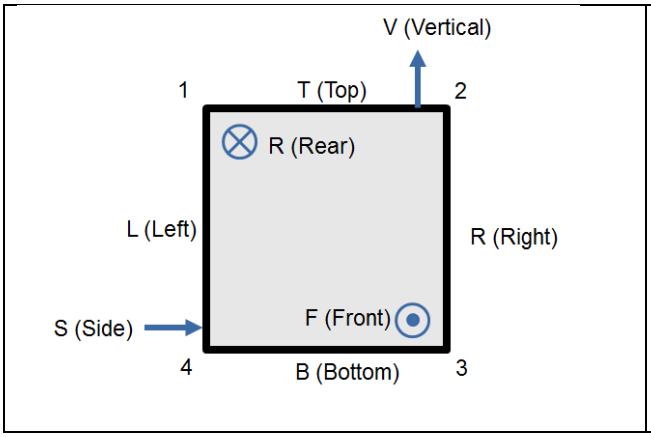
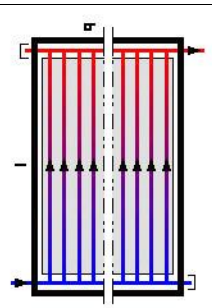
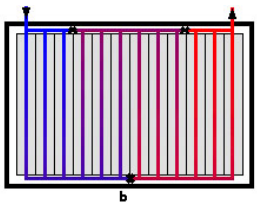


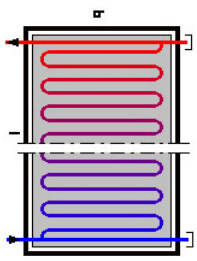
Figure 3
Definition of the locations and directions of the connectors. The corners are numerated from 1-4, starting in the upper left corner.



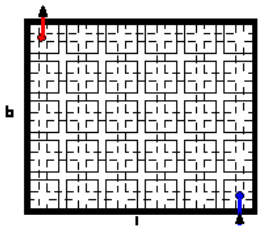
{CL} = 1234S



{CL} = 12V



{CL} = 1234S



{CL} = 13F

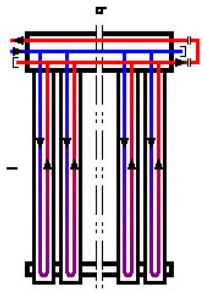
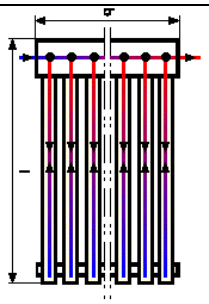
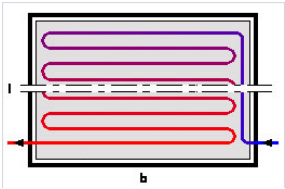
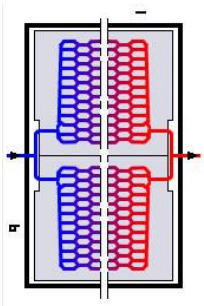
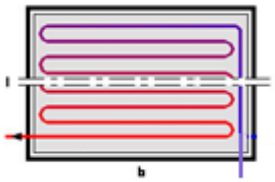
	 Heatpipe		
{CL} = 1122S	{CL} = 12S	{CL} = 34S	{CL} = LRS
			
{CL} = 3V,4S			

Figure 4: Examples of {CL}

2.5 {A:Ø,L} Absorber Element Details

The absorber element is the tube where the fluid is heated up

{A:Ø,L} Inner diameter [mm] and length of the main single absorber element(s) [mm]

8,23000: *8 mm inner diameter, length of 23 m*

10,1900: *10 mm inner diameter, length of 1.9 m*

It is assumed that this statement is valid for each of all tubes indicated in {F}.

If variable diameters: Indicate minimum diameter

If not round tube: Equivalent diameter giving the same area

If different lengths: Average value

If not clear what to write: Indicate A:X

Some collector have no {A:Ø,L} statement (e.g. heat pipe collectors)

2.6 {C:Ø,L} Collector Element Details

Collector is where the absorber elements are collected

{C:Ø,L} inner diameter [mm] and length of the collector element(s) [mm]

8,23000: *8 mm inner diameter, length of 23 m*

10,1900: *10 mm inner diameter, length of 1.9 m*

If variable diameter: Minimum diameter

If not round tube: Equivalent diameter

If different lengths: Average value

If not clear what to write: Indicate C:X

2.7 {D} Drainabilty

If a collector is draining (orientation as tested), then indicate D at the end of the HDC. If it is not draining or if it is not clear, do not indicate D (X is not allowed and not needed).

D Draining

No D Not draining OR not clear.

The drainability of a collector field is of course depending on the field and not only on the collector. Nevertheless the drainability of an individual collector is an important information that is given here.

2.8 Orthographic Rules

No Spaces in the whole code allowed

No {} and no spaces allowed

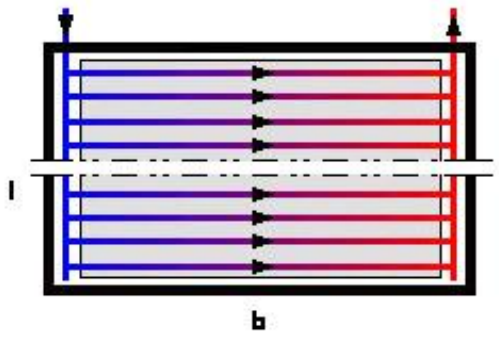
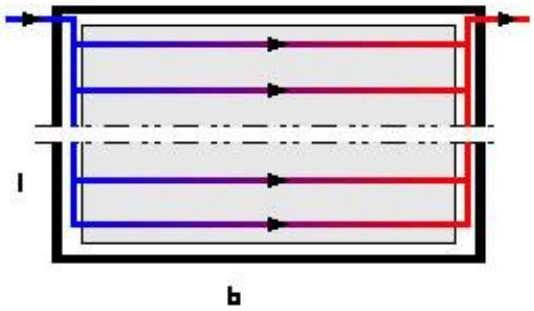
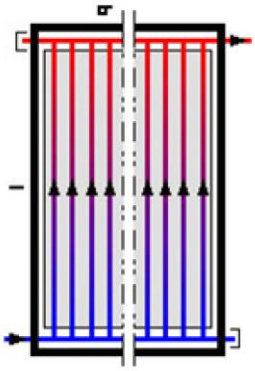
Between all indicators a dash '-' is required.

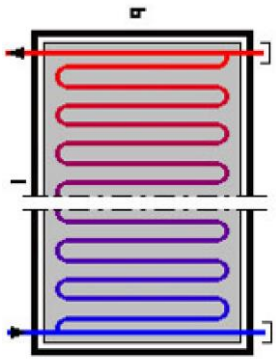
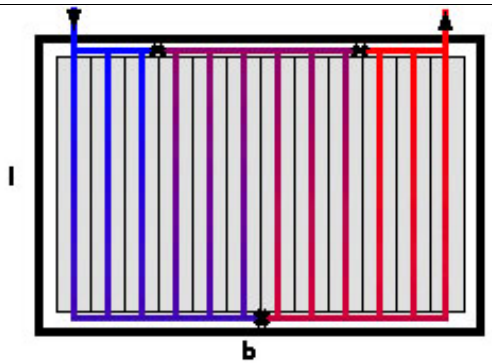
If different absorber/collector tubes: Several statements are possible such as C:22,900-C:22,3000 using a "-" between. However this should be avoided, in general this would probably better be "X".

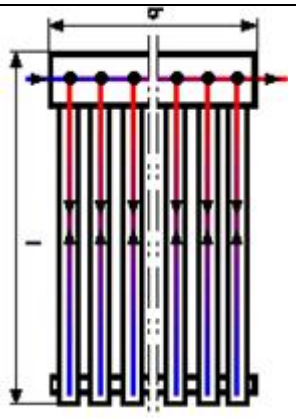
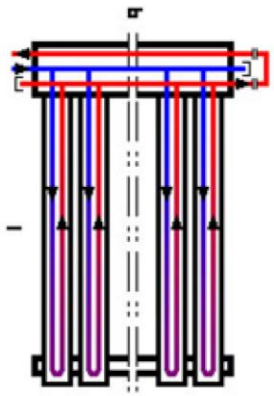
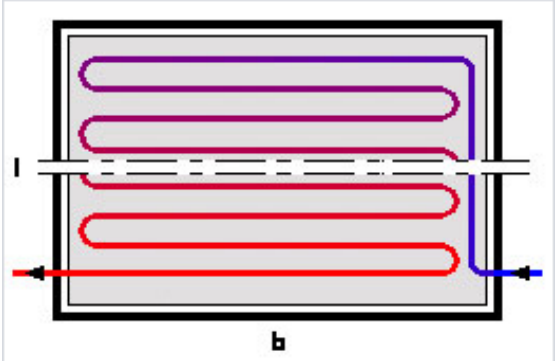
Either {A:Ø,L} or {C:Ø,L} must be indicated (or both). If {A:Ø,L} = {C:Ø,L} then indicate one {AC:Ø,L}

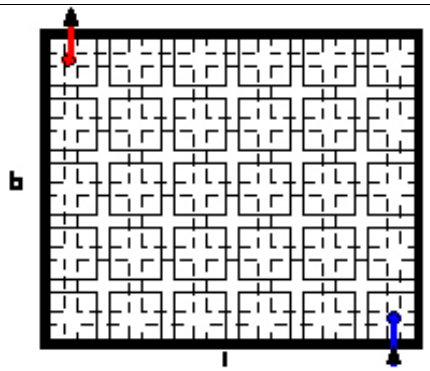
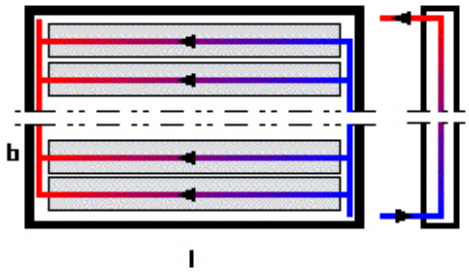
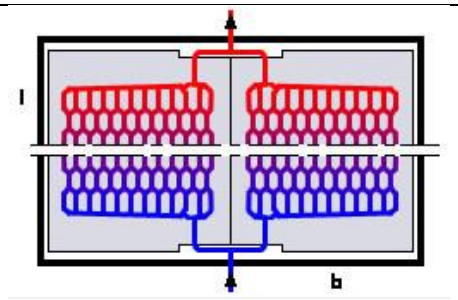
3 Full examples

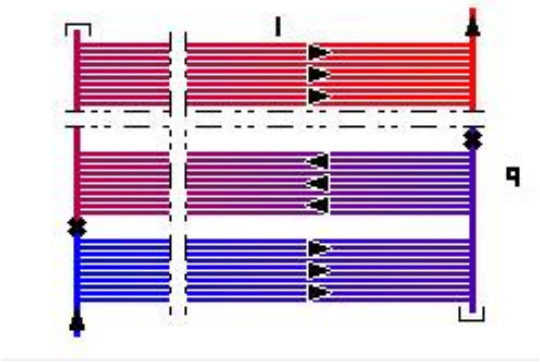
In this section examples are presented for illustration and training.

	**HDC=12-H-12V-A:8,1900-C:18,1000** 12 Number of absorber tubes H Tested Horizontal, shall not be operated vertical 12V Connectors in the upper corners, vertical out Absorber tube inner Ø 8 mm Absorber tube length 1900 mm Collector tube inner Ø 18 mm Collector tube length 1000 mm D missing Not draining
	**HDC=22-H-12S-A:8,5000-C:28,1900** 22 Number of absorber tubes H Tested Horizontal, shall not be operated vertical 12S Connectors in the upper corners, side out Absorber tube inner Ø 8 mm Absorber tube length 5000 mm Collector tube inner Ø 28 mm Collector tube length 1900 mm D missing Not draining
	**HDC=10-VH-1234S-A:10,1800-C:22,1000-D** 10 Number of absorber tubes VH Tested vertical, can be operated horizontal 1234S Connectors in the four corners, side out Absorber tube inner Ø 10 mm Absorber tube length 1800 mm Collector tube inner Ø 22 mm Collector tube length 1000 mm D Draining as tested

	**HDC=1-H-1234S-A:10,1800-C:22,1000-D** 1 Number of absorber tubes H Tested horizontal, cannot be operated vertical 1234S Connectors in the four corners, side out Absorber tube inner Ø 10 mm Absorber tube length 1800 mm Collector tube inner Ø 22 mm Collector tube length 1000 mm D Draining as tested
	**HDC=3,3,3,3-V-12V-A:8,1200-C:22,3000** 3,3,3,3 Number of absorber tubes, 4 sections a 3 tubes V Tested vertical, cannot be operated horizontal 12V Connectors in the upper corners, vertical out Absorber tube inner Ø 8 mm Absorber tube length 1200 mm Collector tube inner Ø 22 mm Collector tube length 3000 mm D missing Not draining

	**HDC=1-H-12S-C:17,800-D** 1 One tube H Tested horizontal, cannot be operated V 12S Connectors in the upper corners, side out Absorber tube inner Ø n.a. Absorber tube length n.a. Collector tube inner Ø 17 mm (minimum diameter) Collector tube length 3000 mm D Draining **Standard Heat pipe collector with sleeves in the collector tube for the hat pipe condensers**
	**HDC=10-VH-1122S-A:8,2200-C:20,1000** 10 10 U-tubes VH Tested vertical, can be operated H 1122S Connectors in the upper corners, side out* Absorber tube inner Ø 8 mm Absorber tube length 2200 mm ** Collector tube inner Ø 20 mm (minimum diameter) Collector tube length 1000 mm D missing Not draining (as tested) * Third pipe is dummy, hydraulic function ** Sum of down und up
	**HDC=1-H-34S-A:8,22000-D** 1 1 Tube H Tested H, shall not be operated V 34S Connectors in the lower corners, side out Absorber tube inner Ø 8 mm Absorber tube length 22000 mm (one very long tube) Collector tube inner Ø NA Collector tube length NA D Draining (as tested)

	**HDC=X-VH-13F-AC:X** X Does not fit into the designation scheme* VH Can be used in both directions 13F Connectors in 1,3 corners, front out AC:X Absorber and Connector: Cannot be described by this scheme* D missing Not draining * The information cannot be described by the designation code: Special designs -> Ask manufacturer.
	**HDC=8-HV-13B-A:10,2000-C:22,1000-D** 8 8 tubes HV Tested H can be installed V 13B Connectors in 1,3 corners, back out Absorber tube inner Ø 10 mm Absorber tube length 2000 mm Collector tube inner Ø 22 mm Collector tube length 1000 mm D Draining
	**HDC=X-VH-13F-AC:X** X Does not fit into the designation scheme* VH Can be used in both directions 13F Connectors in 1,3 corners, front out AC:X Absorber and Connector: Cannot be described by this scheme* D missing Not draining * The information cannot be described by the designation code: Special designs -> Ask manufacturer.



HDC=10,10,10-HV-1234V-A:4,2000-C:20:1200-D

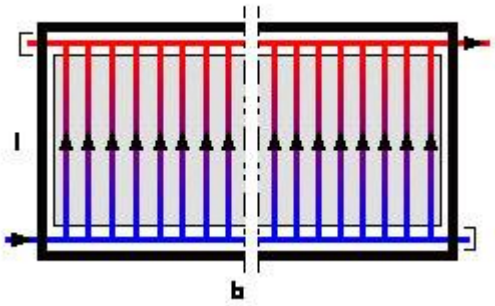
10,10,10 3 times 10 parallel tubes in packages

HV Can be used in both directions

1234V Connectors in all corners, vertical out
A:X Absorber and Connector:
Cannot be described by this scheme*

D Draining

* The information cannot be described by the designation code: Special designs -> Ask manufacturer.



HDC=20-V-1234S-A:8,1800-C:22,1000-D

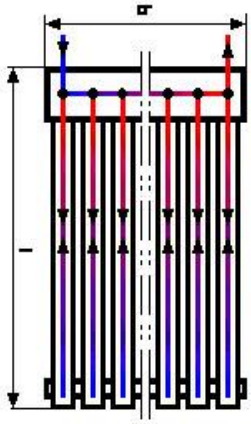
20 Number of absorber tubes

V Tested horizontal, cannot be operated vertical

1234S Connectors in the four corners, side out
Absorber tube inner Ø 8 mm
Absorber tube length 1800 mm
Collector tube inner Ø 22 mm

Collector tube length 1000 mm

D Draining in tested orientation



HDC=1-H-12V-C:20,1000

1 One tube

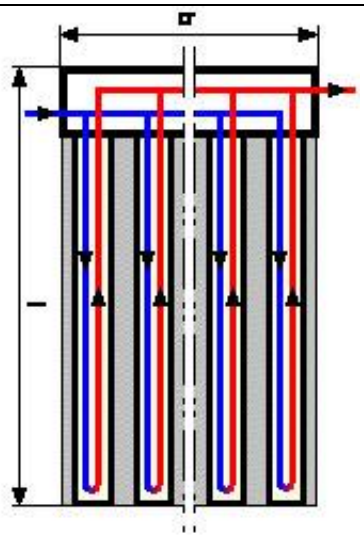
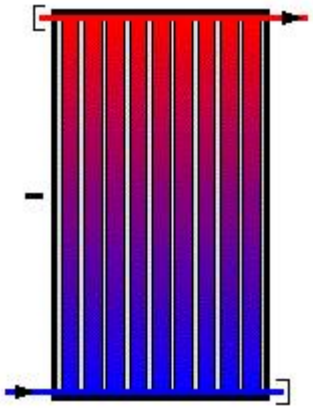
H Tested horizontal, cannot be operated V

12V Connectors in the upper corners, vertical out
Absorber tube inner Ø n.a.
Absorber tube length n.a.
Collector tube inner Ø 20 mm (minimum diameter)

Collector tube length 1000 mm

No D Not Draining

Standard Heat pipe collector with sleeves in the collector tube for the hat pipe condensers

	**HDC=4-V-12S-A:8,3600-C:20,800** 4 4 tubes H Tested vertical, cannot be operated H 12S Connectors in the upper corners, side out Absorber tube inner Ø 8 mm Absorber tube length 3600 mm (2 x 1800 mm). Collector tube inner Ø 20 mm (minimum diameter) Collector tube length 800 mm No D Not Draining **U tube or coaxial tube**
	**HDC=4-VH-1234S-AC:X-D** 4 4 tubes V Tested vertical, can be operated H 1234S Connectors in all corner, side out Absorber tube inner Ø ? Absorber tube length ? Collector tube inner Ø ? Collector tube length ? D Draining **e.g. Swimming pool collector with unclear hydraulic setup**
	**HDC=1-H-LRS-AC:20,12000** 1 1 tube H Tested H, cannot be operated V LRS Connectors left and right, side out Absorber tube inner Ø 20 mm Absorber tube length 12 m Collector tube inner Ø A=C? Collector tube length A=C D missing Draining not clear

4 Suggestion for inclusion of HDC in SKN Datasheet

Annex to Solar Keymark Certificate	Licence Number	CXXX 1234
Supplementary Information	Issued	2012-11-24

Annual collector output in kWh/collector at mean fluid temperature ϑ_m, based on ISO 9806:2013 test results

Standard Locations		Athens			Davos			Stockholm			Würzburg		
Collector name	ϑ_m	25°C	50°C	75°C	25°	50°C	75°C	25°C	50°C	75°C	25°C	50°C	75°C
FRA20 CV		1,760	1,234	743	1,33	879	485	985	620	335	1,070	670	356
FRA25 CV		2,266	1,590	957	1,71	1,132	625	1,268	798	432	1,378	862	459
FRA30 CV		2,324	1,631	981	1,76	1,161	641	1,301	819	443	1,413	885	471
FRA40 CV		2,606	1,828	1,100	1,97	1,302	719	1,458	918	497	1,584	992	528
FRA20 CV		2,937	2,060	1,240	2,22	1,467	810	1,643	1,035	560	1,785	1,118	595
Annual output per m² gross area		1,162	815	491	881	581	321	650	409	221	707	442	235
Fixed or tracking collector		Fixed (slope = latitude – 15°; rounded to nearest 5°)											
Annual irradiation on collector plane		1765 kWh/m²			1714 kWh/m²			1166 kWh/m²			1244 kWh/m²		
Mean annual ambient air temperature		18.5°C			3.2°C			7.5°C			9.0°C		
Collector orientation or tracking mode		South, 25°			South, 30°			South, 45°			South, 35°		

The collector is operated at constant temperature ϑm (mean of in- and outlet temperatures). The calculation of the annual collector performance is performed with the official Solar Keymark spreadsheet tool Scenocalc Ver. 5.01 (March 2016). A detailed description of the calculations is available at www.solarkeymark.org/scenocalc

Additional Information

Collector heat transfer medium	Water-Glycole	
Hybrid Thermal and Photo Voltaic collector	No	
The collector is deemed to be suitable for roof integration	No	
The collector was tested under the following conditions:		
Climate class (A+, A, B or C)	A	--
Maximum tested positive load	2400	Pa
Maximum tested negative load	2400	Pa
Hail resistance using steel ball (maximum drop height)	2	m

	Reference Area, A_{sol} (m^2)	Hydraulic Designation Code
FRA20 CV	1.51	10-V-1234S-A:10,1800-C:22,1000-D
FRA25 CV	1.95	12-V-1234S-A:10,1800-C:22,1200-D
FRA30 CV	2.00	16-V-1234S-A:10,1800-C:22,1500-D
FRA40 CV	2.24	12-H-1234S-A:10,1800-C:22,1200-D
FRA20 CV	2.53	16-H-1234S-A:10,1800-C:22,1500-D

Data required for CDR (EU) No 811/2013 – Reference Area A_{sol}

Collector efficiency (η_{col})	57%

Remark: Collector efficiency (η_{col}) is defined in CDR (EU) No 811/2013 as collector efficiency of the solar collector at a temperature difference between the solar collector and the surrounding air of 40 K and a global solar irradiance of 1000 W/m², expressed in % and rounded to the nearest integer.

Deviating from the regulation η_{col} is based on reference area (A_{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806:2013.

Data required for CDR (EU) No 812/2013 – Reference Area A_{sol}

Zero-loss efficiency (η_0)	0.735	--
First-order coefficient (a_1)	3.24	W/(m²K)
Second-order coefficient (a_2)	0.025	W/(m²K²)
Incidence angle modifier IAM (50°)	0.93	--

Remark: The data given in this section are related to collector reference area (A_{sol}) which is aperture area for values according to EN 12975-2 or gross area for ISO 9806. Consistent data sets for either aperture or gross area can be used in calculations like in the regulation 811 and 812 and simulation programs.

5 Summary and next steps

The comments received from the experts were integrated.

This document will be presented to the Solar Keymark Network in Spring 2018 / Madrid (24th SKN meeting). If approved by the SKN, the system can be installed immediately.

- The basis for this document is a presentation to the SKN and a decision taken in the Cyprus meeting (Item 33 of the 23rd SKN Meeting)

6 Proposal for resolution

The Hydraulic Designation Code as defined in the document "Definition and Guideline for a Hydraulic Designation Code HDC: {F}-{O}-{CL}-{A:Ø,L}-{C:Ø,L}-{D} for Solar Thermal Collectors" dated 31.12.2017 (this document) is included in the Solar Keymark Datasheets for collectors as a mandatory supplementary information, starting from the next revision of the data sheet. The mentioned document will be listed as Annex to the SK scheme Rules.

A. Bohren
SPF Testing
31.12.2017

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