COUNTERFLOW PLATE HEAT EXCHANGERS

PCF

DESIGN HANDBOOK

Version 1.5, 23/03/2026

CONTENTS

1. INTRODUCTION

Welcome to ERI Corporation and thank you for your interest in our product range. We are proud that our company is today one of the largest and leading manufacturers of high efficiency, low energy consumption, air-to-air energy recovery equipment for air conditioning and ventilation systems in the world.

As a market leader, we strive to provide state-of-the-art products that accommodate our clients' individual needs and appreciate your continuous feedback regarding all aspects of our products and services. If you have any questions or feedback, please don't hesitate to reach out.

2. GENERAL INFORMATION

2.1. THE IMPORTANCE OF HEAT RECOVERY

Heat recovery is a crucial component in **Heating, Ventilation and Air Conditioning (HVAC)** systems.

The main goal of an HVAC system is to ensure **healthy and comfortable conditions for the occupants of a building** and/or provide **closely controlled and conditioned air for process applications**. To achieve their goal, these systems **consume a large portion of the total energy** used within a building or system.

By using heat recovery effectively, the **heating and cooling costs can be significantly reduced**, while not compromising the indoor air quality (IAQ) within the ventilated spaces.

Including heat recovery in your HVAC system can provide many benefits, such as:

- Allowing for high air change rates required for good IAQ without incurring in massive energy losses
- Reducing cooling and heating energy usage
- Downsizing heating and cooling plant
- Reducing need for active humidification/dehumidification

2.2. ECODESIGN REGULATION

The **Eco-design Regulation (EU) 1253/2014** for ventilation units has been in force since 2016 and sets requirements for bidirectional ventilation units in both residential and non-residential applications. The regulation states that, with very few exceptions, **all non-residential bidirectional ventilation units (BVU's) must be fitted with heat recovery systems (HRS)**.

The regulation also sets the minimum requirement for the **dry heat recovery efficiency of plate heat exchangers at 73%** and demands a **thermal bypass to be included in every HRS,** in order to avoid freezing during the heating season and provide a summer bypass during the cooling season. Compliance with this regulation is required for conformity with the CE marking and placing of the products in the EU market.

With high heat recovery efficiencies and plenty of options for bypass sections, the **PCF counterflow plate heat exchangers from ERI Corporation can help our customers easily meet or exceed the requirements of this regulation.**

2.3. EUROVENT CERTIFIED PERFORMANCE

ERI Corporation is a **member of Eurovent** and our counterflow plate heat exchangers are certified under the **Air to Air Plate and Tube Heat Exchangers (AAHE) programme** and the **Eurovent Association**.

This means **ERI is regularly audited** to assess the quality of the products and processes in our facilities, ensuring we stay current with the latest regulations and standards. Being certified also requires **regular testing of the products** and **validation of the selection software** for accuracy and consistency.

Distribution of Selection Software:

The selection software distributed to customers and partners is updated following approval by the Eurovent Certification Company (ECC). The new version is made available on the ERI Corporation website and communicated to relevant users within a maximum of one month from the official ECC approval date.

The **Eurovent Certified Performance is a mark of excellence and quality** which assures customers of our continued efforts to deliver state-of-the-art heat recovery products.

2.4. COUNTERFLOW PLATE HEAT EXCHANGERS

ERI Corporation **Plate Counter Flow (PCF)** air to air heat exchangers are recuperative heat recovery products.

The heat exchanger consists of a **core** manufactured by interlocking a large number of **thin metal lamellas**, designed to separate the warm and cold air streams. The interlocked stack of lamellas is then **housed and sealed** within a metal casing which ensures **rigidity and airtightness**.

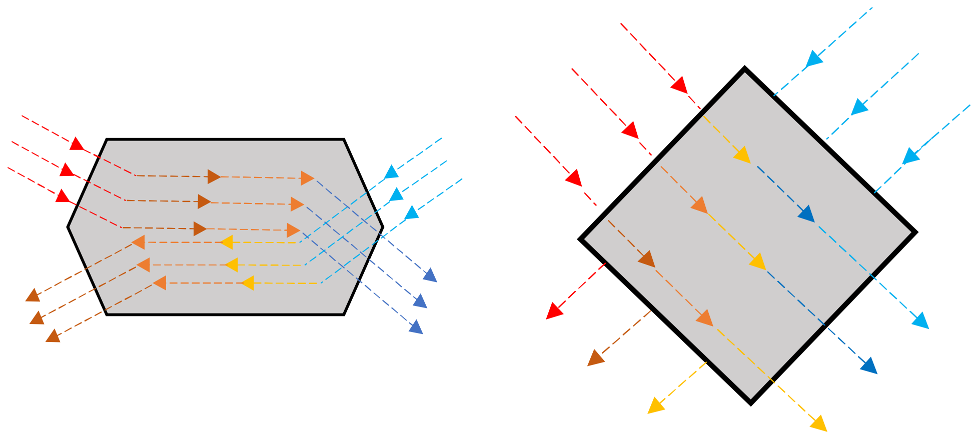
The working principle of a counterflow plate heat exchanger is quite simple. In the heat exchanger core, the two air streams are driven along the contiguous lamellas in a counter-cross flow direction, as shown in the illustration below.

Air flow diagram of PCF counterflow heat exchanger

The thin and highly conductive lamella material allows **heat to be transferred between the two air streams** without much resistance. When a temperature differential is present, the warm air stream flowing through the heat exchanger transfers a large portion of its sensible heat energy to the cold air stream via conduction and **without the need for air mixing**.

In the counterflow section of the heat exchanger **the temperature delta** between the cold and warm air streams **is kept uniform throughout the whole heat transfer process**. This allows for **high heat recovery efficiencies** (90%+ depending on the conditions) to be achieved with **reduced plate dimensions** when compared to pure crossflow heat exchangers. The crossflow portion of the exchanger is only necessary to achieve separate air stream connections.

In a crossflow heat exchanger, the air streams are not heated and cooled evenly, therefore the temperature delta is not uniform throughout the heat transfer process. This leads to a lower heat recovery efficiency and the need for larger plates to achieve the same performance as an equivalent counterflow.



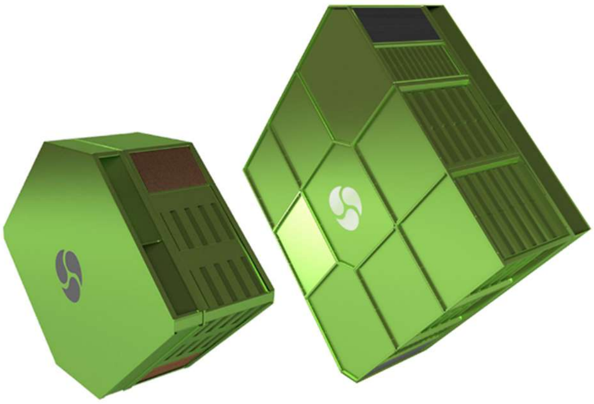
Counterflow vs Crossflow air temperature distribution

2.5. ADVANTAGES OF COUNTERFLOW PCF

Counterflow plate heat exchangers are the **right choice for most applications** when compared to crossflow equivalents and other heat recovery systems such as rotary heat exchangers.

Some of the key advantages of counterflow heat exchangers are:

- Very high heat recovery efficiency (90%+ depending on conditions).
- Smaller dimensions versus pure crossflow solutions.
- Nearly zero leakage and cross contamination (odours, moisture, VOC, etc).
- No moving parts (reduced maintenance, no downtime).



PCF counterflow heat exchangers

Additionally, our counterflow heat exchangers are state of the art products built to the highest specifications.

Some features of our PCF plate heat exchangers:

- Manufactured from corrosion resistant aluminium as standard.
- Strong construction resistant to differential pressures up to 1700Pa.
- Very low internal leakage (guaranteed <0.5% of the nominal airflow @ 250Pa).
- No combustible elements (no fire hazard) unlike plastic equivalents.
- Damper and bypass options.
- Vast range of material options to suit most environments.
- Modular delivery option in larger sizes.

2.6. APPLICATION

PCF heat exchangers are intended for installation in **residential** (single and communal housing, student accommodations, etc), **commercial** (offices, shopping centres, hospitals, etc) and **process** (food processing, storage, data centre, etc) air conditioning and ventilation systems.

Some examples of these systems are **mechanical ventilation and heat recovery units (MVRHU)**, **compact and bespoke air handling units (AHU's)** and other ventilation products that make use of heat recovery.

Most often the heat exchangers are integrated in the ventilation product, but on rare occasions they can be installed directly in the ductwork system.

Compact Air Handling Units & MVHRU

Bespoke Air Handling Units

3. PRODUCT RANGE

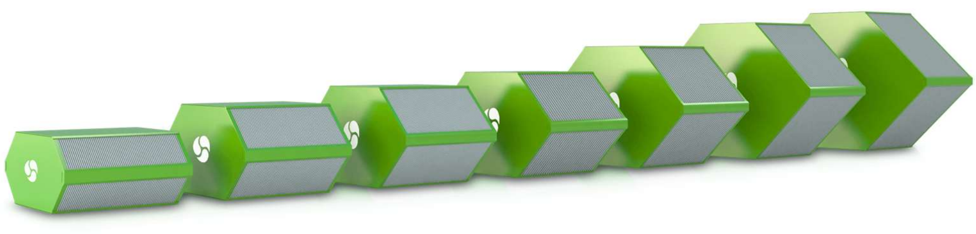
Our PCF heat exchangers are available in different constructions to suit customer needs and allow a variety of options including, but not limited to, different materials, coatings, bypass sections and air flow control dampers.

3.1. ARCHITECTURE

The PCF heat exchangers are manufactured in two main model architectures, known as:

- **Base** or single heat exchangers.
- **Kombi** or combination heat exchangers.

Base heat exchangers are simple exchangers made of lamella stacks that range from model 18 to 62.

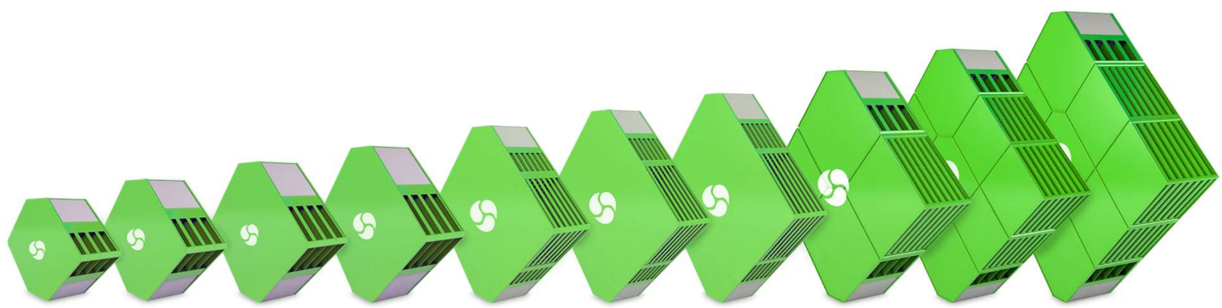


Single/Base exchanger range (model 18 to 62)

Kombi heat exchangers are manufactured using a combination of **single lamella stack heat exchangers** and **airflow dividers**.

The airflow dividers ensure airflow is distributed evenly and with minimal turbulence to each base heat exchanger. This allows the use of multiple base exchangers to form a larger combination unit, capable of handling higher airflows while maintaining high performance and the overall heat exchanger dimensions as small as possible.

Kombi heat exchangers range from model 65 to 372.



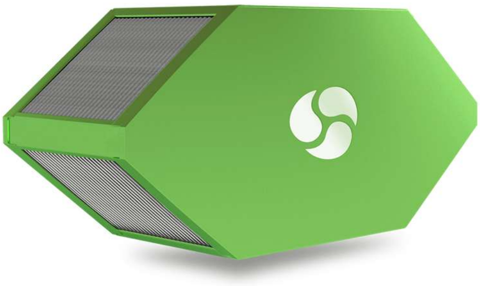
Kombi exchanger range (model 65 to 372)

3.2. CASING CONSTRUCTION

3.2.1. STANDARD

The **PCF Standard** (**PCF**) casing construction option includes heat exchangers with **standard casing construction** (standard side flanges). These are designed to minimize the impact of the side flanges in the effective face area of the heat exchanger, lowering face velocity, reducing pressure drop and maximizing efficiency.

Bypass sections are **optionally available** for this range. However, **air flow control dampers are not available** due to the reduced size of the side flanges.



PCF Standard construction (PCF)

3.2.2. LIGHT INDUSTRIAL

The **PCF Light Industrial (PCF-I)** casing construction option includes heat exchangers with **wider side flanges** intended for **installing air flow control dampers** directly to the heat exchanger frame**.**

Both **bypass** sections and **dampers** are **optionally available** for this range.

PCF Light Industrial construction (PCF-I)

3.2.3. HEAVY INDUSTRIAL

The **PCF Heavy Industrial (PCF-N)** casing construction option includes heat exchangers with **external flanges** designed to facilitate handling of the product while also allowing for modular installation in tight spaces.

Both **bypass** sections and **dampers** are **optionally available** for this range. A **modular option** (exchanger split into small blocks) is also available.

PCF Heavy Industrial Construction (PCF-N)

3.2.4. REVERSE

The **PCF Reverse (PCF-R)** construction option includes heat exchangers with **special airflow dividers** designed to achieve airflow arrangement **suitable for use in datacentre applications,** or other applications where **air paths are required to not cross over but rather are parallel (similar to rotary heat exchangers)**.

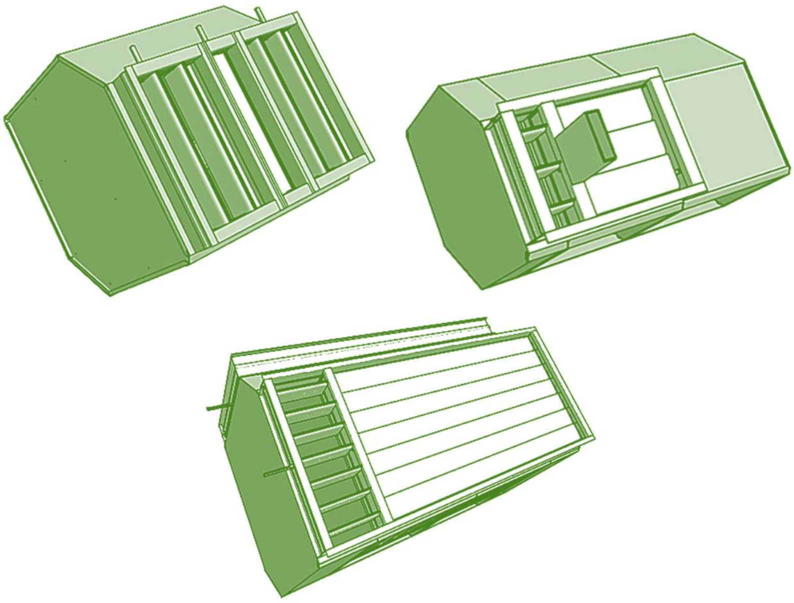
The **bypass**, **damper** and **modular installation** options that are available for the **PCF Light Industrial (PCF-I)** and **PCF Heavy Industrial (PCF-N)** ranges are **also available for this range**.

PCF Reverse Construction (PCF-R)

3.2.5. CUSTOM

The **PCF Custom (PCF-C)** casing construction options are **bespoke heat exchanger products** manufactured according to the customer specifications.

Customization may include, but is not limited to, different variations and layouts of bypasses, dampers, additional sheet metal parts, etc.



PCF Custom Construction (PCF-C)

3.3. MODEL SIZES

The PCF range consists of **nineteen model sizes** that are suitable for various applications and airflows.

Base models are available in sizes **18, 25, 30, 35, 45, 55** and **62**.

Kombi models are available in sizes **65, 80, 95, 110, 124, 140, 180, 220, 248, 270, 330** and **372**.

PCF models 18 to 372

Model Size availability depends on the casing construction type. The available sizes for each casing construction type are listed in the following table.

MODEL SIZE	CASING CONSTRUCTION				
	Standard (PCF)	Light Industrial (PCF-I)	Heavy Industrial (PCF-N)	Reverse (PCF-R)	Custom (PCF-C)
18	✓	✗	✗	✗	✓
25	✓	✗	✗	✗	✓
30	✓	✗	✗	✗	✓
35	✓	✗	✗	✓	✓
45	✓	✓	✗	✓	✓
55	✓	✓	✗	✓	✓
62	✓	✓	✗	✓	✓
65	✗	✓	✗	✓	✓
80	✗	✓	✗	✓	✓
95	✗	✓	✗	✓	✓
110	✗	✓	✗	✓	✓
124	✗	✓	✗	✓	✓
140	✗	✓	✓	✓	✓
180	✗	✓	✓	✓	✓
220	✗	✓	✓	✓	✓
248	✗	✗	✓	✓	✓
270	✗	✗	✓	✓	✓
330	✗	✗	✓	✓	✓
372	✗	✗	✓	✓	✓

Casing Construction vs Model Size availability

3.4. PLATE SPACING

Plate Spacing is a key factor in determining the heat exchanger performance.

A wider plate spacing will **reduce pressure drop**, **weight and cost** but also the **overall surface of heat transfer** and therefore **lower the efficiency of the plate heat exchanger**.

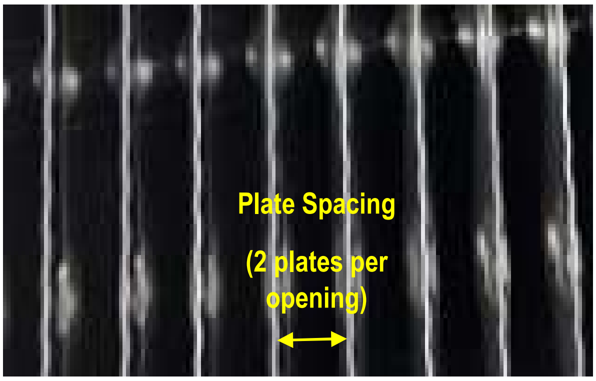


Plate spacing

All PCF models are available on both **2.1mm, 2.9mm and 3.0mm** plate spacing (except model 18 which is available only on 2,1 mm).

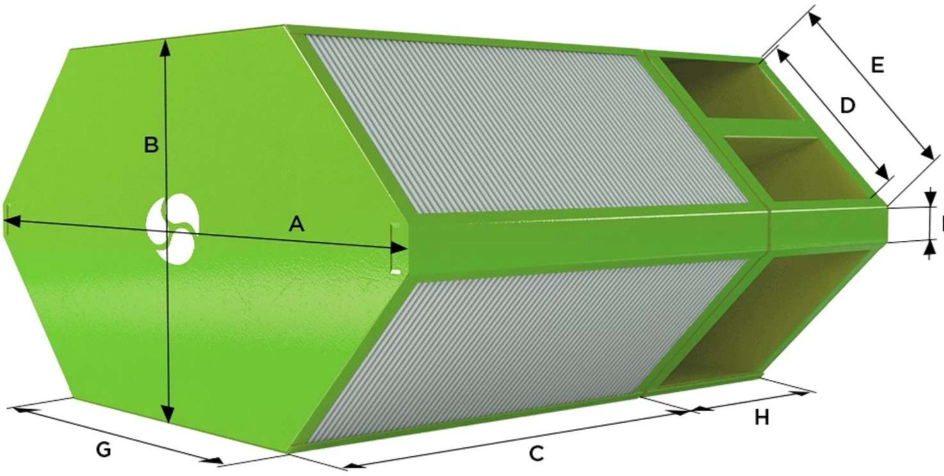
Model size availability for each plate spacing is listed in the following table.

SPACING	MODEL SIZE																		
	18	25	30	35	45	55	62	65	80	95	110	124	140	180	220	248	270	330	372
2.1mm	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
2.9mm	✗	✗	✗	✓	✓	✓	✓	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
3.0mm	✗	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Plate Spacing vs Model Size

3.5. EXCHANGER DIMENSIONS

The main dimensions that define a PCF heat exchanger model are illustrated below.



PCF heat exchanger dimensions

- Dimensions **A, B, D, E, F, G** are fixed and defined by the selected model size.
- **Dimension C** indicates the **width of the heat exchanger** and **Dimension H** the **width of bypass section**.
- Only **these two dimensions (C and H)** are variable and can be **specified manually in 1mm increments**.

The following table shows the overall dimensions for all available PCF models without dampers.

PLEASE NOTE: For overall dimensions including dampers please refer to our selection software or request detail drawings from your sales representative.

MODEL SIZE	A [mm]	B [mm]	D [mm]	E [mm]	F [mm]	G [mm]
18	397	172	90	106	22	248
25	454	230	131	147	22	248
30	496	271	160	176	22	248
35	537	312	189	205	22	248
45	619	394	247	263	22	248
55	700	477	305	321	22	248
62	758	534	346	362	22	248
65	774	550	352	368	30	254
80	899	674	440	456	30	254
95	1040	815	540	556	30	254
110	1182	959	641	657	30	254
124	1314	1089	734	750	30	254
140	PCF-I = 1600 PCF-N = 1607	PCF-I = 1376 PCF-N = 1352	PCF-I = 936 PCF-N = 939	PCF-I = 952 PCF-N = 955	30 0	254
180	PCF-I= 1887 PCF-N = 1886	PCF-I = 1662 PCF-N = 1632	PCF-I = 1139 PCF-N = 1137	PCF-I = 1155 PCF-N = 1153	30 0	254
220	PCF-I = 2165 PCF-N = 2170	PCF-I = 1945 PCF-N = 1920	PCF-I = 1337 PCF-N = 1341	PCF-I = 1353 PCF-N = 1357	30 0	254
248	2435	2180	1516	1540	0	254
270	2702	2448	1714	1730	0	254
330	3130	2880	2020	2036	0	254
372	3525	3270	2296	2312	0	254

PCF model dimensions

PLEASE NOTE: Dimensions for PCF-R are available on request.

Exchanger width limits

The **heat exchanger width dimension (C)** must be specified by the customer in any increment of 1 mm. This dimension refers to the **external width of the heat exchanger including any external flanges**.

Due to manufacturing requirements and to facilitate packaging and handling, each exchanger block is limited to a **minimum and maximum block width**. If exchangers exceed the maximum block width, they are **delivered in multiple blocks for assembly by the customer**.

An overview of the **minimum and maximum width per single block heat exchanger**, as well as the **maximum width of a complete heat exchanger** (assembled from multiple blocks) is shown in the table below.

CASING CONSTRUCTION	Minimum width (C) [mm]	Maximum width (C) single block [mm]	Maximum width (C) overall [mm]
Standard (PCF)	50	1000	5000*
Light Industrial (PCF-I)	200	1000	
Heavy Industrial (PCF-N)	250	1050	

* Maximum selectable in software, there is theoretically no maximum limit for the overall width of the exchanger.

Maximum and minimum exchanger width

3.5.1. EXCHANGER BLOCKS AND DELIVERY

Pre-assembled exchangers

For casing construction option **Standard (PCF)** and **Light Industrial (PCF-I)** when the number of exchanger blocks does not exceed 1 and if a bypass/damper section is also ordered, these can be **pre-assembled from the factory**.

This makes the heat exchanger easier to install directly into the ventilation unit with no additional assembly required. This is not possible for casing construction type **Heavy Industrial (PCF-N)** due to the design of the external flanges.

Exchangers delivered in blocks

All heat exchangers exceeding 1 block are delivered **in separate blocks to be installed in parallel by the customer**. If any dampers and bypass sections are required those will also be **delivered separately**.

Exchangers delivered in multiple blocks

Bypass position and number of exchanger blocks

The bypass position also determines the number of blocks the exchanger will be delivered in.

Should the bypass be located on the **Side (A/B)** the exchangers will be divided into a number of blocks with identical dimensions which results from the **overall exchanger width divided by the maximum exchanger width for a single block**.

Should the bypass be located in the **Middle/Centre (C)** the exchangers will be divided into an **even number of blocks** with **identical dimensions**.

A summary of these rules for each casing construction type is displayed in the below tables.

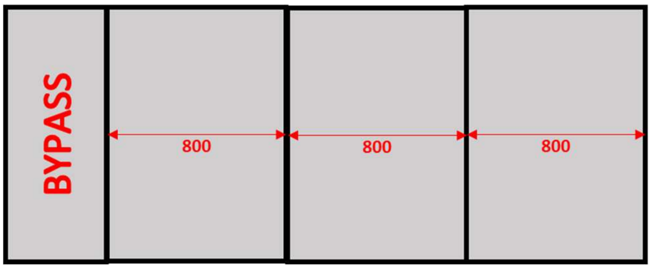
Exchanger width (C) [mm]	Side bypass (A/B)	Central bypass (C)
<=1000	1	2
>1000<=2000	2	2
>2000<=3000	3	4
>3000<=4000	4	4
>4000<=5000	5	6

Number of blocks by exchanger width (casing construction PCF and PCF-I)

Exchanger width (C) [mm]	Side bypass (A/B)	Central bypass (C)
<= 1050	1	2
> 1050 <= 2100	2	2
> 2100 <= 3150	3	4
> 3150 <= 4200	4	4
> 4200 <= 5000	5	6

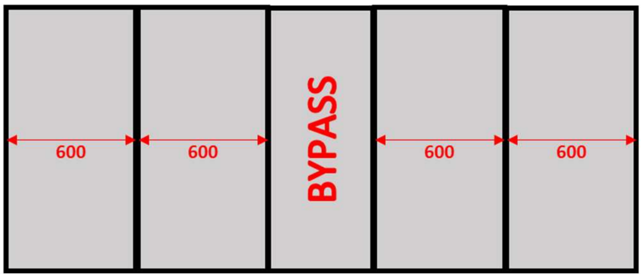
Number of blocks by exchanger width (casing construction PCF-N)

As an example, for a casing construction type **Light Industrial (PCF-I)** model with **exchanger width dimension** (C) of **2400mm,** if the **bypass is located on the side** the exchanger will be divided into **3 blocks of 800mm**.



C = 2400mm, Side Bypass, 3 Blocks x 800mm

However, if the **bypass is located in the middle/centre** then the exchanger will be divided into **4 blocks of 600mm**.



2400mm, Central Bypass, 4 Blocks x 600mm

3.6. MATERIALS

3.6.1. THE BENEFITS OF ALUMINIUM

Aluminium alloys have **high thermal conductivity**, **excellent corrosion resistance** and are **lightweight,** which makes them the most appropriate and cost-effective material for manufacturing heat exchangers.

Additionally, by the end of their lifetime aluminium alloys can be **fully recycled** ensuring environmental sustainability.

Coiled aluminium foil at ERI facilities

All PCF heat exchangers (plates and casing) are manufactured from **high grade aluminium alloy**. The foil used to form the exchanger lamellas is made of a special aluminium alloy developed specifically for HVAC applications.

The main properties of this alloy are its **good resistance against corrosion** processes, due to the low content of alloying elements such as iron and copper, **good workability and formability,** which avoids foil forming issues and **excellent plastic properties** which reduce the risk of holes on the lamellas.

By using the right raw material, we grant the best product to our customers, avoiding hidden problems may occur after the installation of the exchangers.

Besides the advantages of aluminium plate heat exchangers we already mentioned it's also worth noting that unlike plastic heat exchangers:

- Aluminium is inert and highly hygienic.
- At ambient temperatures there is no embrittlement of the material.
- At freezing point, the aluminium plate heat exchanger can continue to operate safely and without significant changes to its mechanical properties.
- Aluminium heat exchangers are highly conductive and don't accumulate high electrostatic charges.

3.6.2. MATERIAL OPTIONS

The PCF heat exchangers are suitable for a vast range of applications and requirements due to the multiple material options available.

3.6.2.1. ALUMINIUM

Aluminium (AL) is the standard material option and is recommended for most HVAC applications.

Exchangers of this variant include **plates and casing manufactured from plain aluminium foil.**

Aluminium (AL) material option

Plates	Plain aluminium
Casing	Plain aluminium, aluminium fixings
Bypass	Plain aluminium, aluminium fixings
Airtightness	Standard sealing (leakage <0.5% of NAF @250Pa) Extra sealing option available (leakage <0.25% of NAF @250Pa)
Damper (PCF-I, PCF-N)	Plain aluminium with plastic gears, stainless fixings Full metal (no plastic parts) option available
Adhesives & Sealants	1k PU adhesive VDI 6022 compliant (casing & bypass) 2k PU system VDI 6022 compliant (exchanger) EPDM rubber gasket (closed cell) 4x10 (dampers)

Aluminium (AL) material option specification

3.6.3. ALUMINIUM COATED (AC)

Aluminium Coated (AC) is a material option mainly selected for hygienic applications in the United Kingdom.

Exchangers of this variant include **plates manufactured from plain aluminium foil** and casing from **double side powder coated aluminium sheet**.

Aluminium Coated (AC) material option

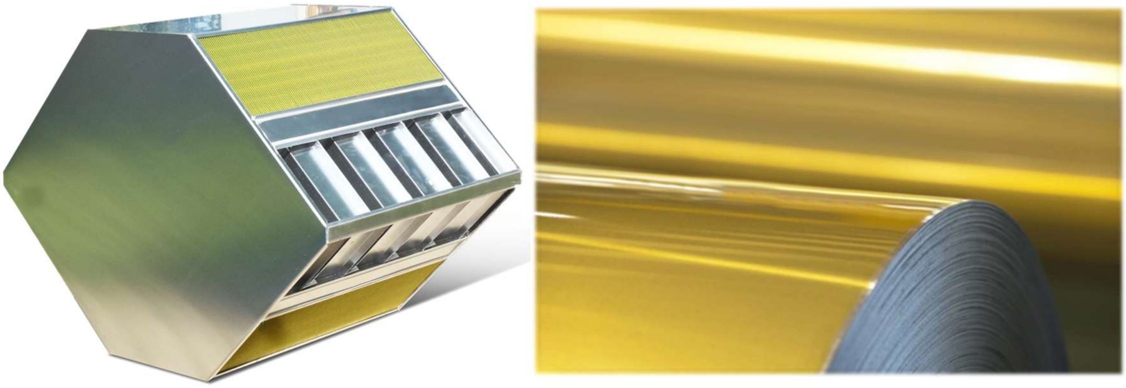
Plates	Plain aluminium
Casing	Powder coated aluminium foil, RAL 9010, coated aluminium fixings
Bypass	Powder coated aluminium foil, RAL 9010, coated aluminium fixings
Airtightness	Standard sealing (leakage <0.5% of NAF @250Pa) **Extra sealing** option available (leakage <0.25% of NAF @250Pa)
Damper (PCF-I, PCF-N)	Anodized aluminium with plastic gears, stainless fixings **Full metal** (no plastic parts) option available
Adhesives & Sealants	1k PU adhesive VDI 6022 compliant (casing & bypass) 2k PU system VDI 6022 compliant (exchanger) EPDM rubber gasket (closed cell) 4x10 (dampers)

Aluminium Coated (AC) material option specification

3.6.4. GOLD EPOXY (GE)

Gold Epoxy (GE) is a material option mostly used in **coastal areas or industrial applications** that require protection of the heat exchanger finned block from corrosive elements.

Exchangers of this variant include plates manufactured from **double side coated gold epoxy aluminium foil** and casing from **plain aluminium sheet**.



Gold Epoxy (GE) material option

Plates	Gold epoxy coated aluminium foil
Casing	Plain aluminium, aluminium fixings
Bypass	Plain aluminium, aluminium fixings
Airtightness	Standard sealing (Leakage <0.5% of NAF @250Pa) **Extra sealing** option available (leakage <0.25% of NAF @250Pa)
Damper (PCF-I, PCF-N)	Plain aluminium with plastic gears, stainless fixings **Full metal** (no plastic parts) option available
Adhesives & Sealants	1k PU adhesive VDI 6022 compliant (casing & bypass) 2k PU system VDI 6022 compliant (exchanger) EPDM rubber gasket (closed cell) 4x10 (dampers)

Gold Epoxy (GE) material option specification

The benefits of epoxy coated aluminium

Aluminium is a very reactive metal and easily surface oxidized. This results in the formation of an protective aluminium oxide layer. As long as this hard layer remains intact the aluminium in the substrate will remain resistant to corrosion.

However, highly corrosive environments can damage the oxide layer at such a high rate that it might not be able to regenerate quickly enough to protect the substrate.

Epoxy coatings are one of the most economical and effective methods for protection of metal surfaces exposed to corrosive elements, such as humid and salt laden air in regions near the coastline and exhaust chemicals from some industrial applications.

The gold epoxy coating creates a **water-repelling (hydrophobic)** layer that repels water from its surfaces, rendering them **easy to clean and minimizing the possibility of chemical deposits on the plate**.

Tests performed to international standards have shown that epoxy coated aluminium surface have a corrosion resistance that allows them to last approx. 4 to 7 times as long as non-coated, regular aluminium in corrosive environments.

3.6.5. GOLD PROTECTED (GP)

Gold Protected (GP) material option extends the epoxy protection from the exchanger plates to the casing and bypass section.

This option is recommended for increased corrosion protection in **heavy industrial applications**.

Gold Protected (GP) material option

Plates	Gold epoxy coated aluminium foil
Casing	Powder coated aluminium foil, RAL 9010, coated aluminium fixings
Bypass	Powder coated aluminium foil, coated aluminium fixings
Airtightness	Standard sealing (Leakage <0.5% of NAF @250Pa) Extra sealing option available (leakage <0.25% of NAF @250Pa)
Damper (PCF-I, PCF-N)	Anodized aluminium with plastic gears, stainless fixings Full metal (no plastic parts) option available
Adhesives & Sealants	1k PU adhesive VDI 6022 compliant (casing & bypass) 2k PU system VDI 6022 compliant (exchanger) EPDM rubber gasket (closed cell) 4x10 (dampers)

Gold Protected (GP) material option specification

3.6.6. GOLD COMPLETE (GC)

Gold Complete (GC) is the highest level of protection available for the PCF exchanger and includes extra sealing of the heat exchanger as default.

This option is recommended in **very demanding industry applications, highly corrosive environments, high humidity and constantly moist rooms, indoor swimming pools, offshore applications**, etc.

Gold Complete (GC) material option

Plates	Gold epoxy coated aluminium foil
Casing	Powder coated aluminium foil, RAL 9010, coated aluminium fixings
Bypass	Powder coated aluminium foil, RAL 9010, coated aluminium fixings
Airtightness	**Extra sealing** (<0.25% NAF @ 250Pa)
Damper (PCF-I, PCF-N)	Anodized aluminium with plastic gears, stainless fixings **Full metal** (no plastic parts) option available
Adhesives & Sealants	1k PU adhesive VDI 6022 compliant (casing & bypass) 2k PU system VDI 6022 compliant (exchanger) EPDM rubber gasket (closed cell) 4x10 (dampers)

Gold Complete (GC) material option specification

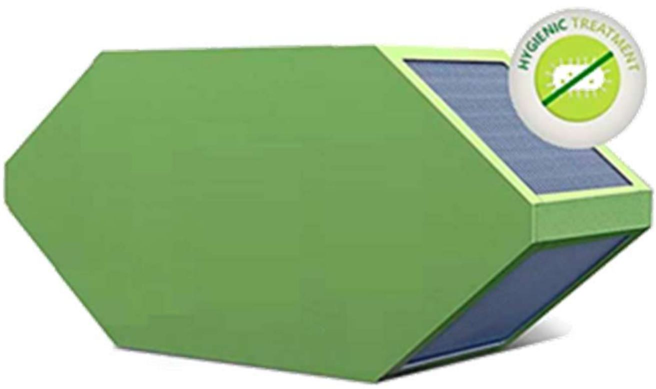
3.6.7. HYGENIC COMPLETE

Hygienic Complete (HC) material option includes all the benefits of the **Gold Complete** (**GC**) option, but the plates are manufactured from an aluminium material coated with **antimicrobial lacquer** suitable to be used in **HVAC systems with high-end requirements for cleanliness**.

This type of protection coating creates an **unfavourable environment to the growth of bacteria** (ISO 22196:2011), **mould and fungi** (ASTM G21–13).

Some of the bacteria tested: Escherichia coli, Staphylococcus aureus, Listeria monocytogenes, Salmonella thyphimurium, Legionella pneumophila etc.

Further documentation on tested bacteria is available on request.



Hygienic Complete (HC) material option

Plates	Antimicrobial coated aluminium foil
Casing	Powder coated aluminium foil, RAL 9010, coated aluminium fixings
Bypass	Powder coated aluminium foil, RAL 9010, coated aluminium fixings
Airtightness	Extra sealing (<0.25% NAF @ 250Pa)
Damper (PCF-I, PCF-N)	Anodized aluminium with plastic gears, stainless fixings **Full metal** (no plastic parts) option available
Adhesives & Sealants	1k PU adhesive VDI 6022 compliant (casing & bypass) 2k PU system VDI 6022 compliant (exchanger) EPDM rubber gasket (closed cell) 4x10 (dampers)

Hygienic Complete (HC) material option specification

3.7. EXCHANGER OPTIONS

Additional options are available for the PCF heat exchangers:

- **Extra Sealing (T)**
- **Plastic Handle (P)**

3.7.1. EXTRA SEALING

Extra Sealing (T) ensures that the maximum allowed internal air leakage of the heat exchanger is **0,25% of NAF (nominal air flow) at 250 Pa**.

This is achieved by having the exchanger lamellas **sealed on all 4 faces**

This option is available for all PCF model sizes **with the exception of sizes 18, 25, 30 and 65**.

When to use

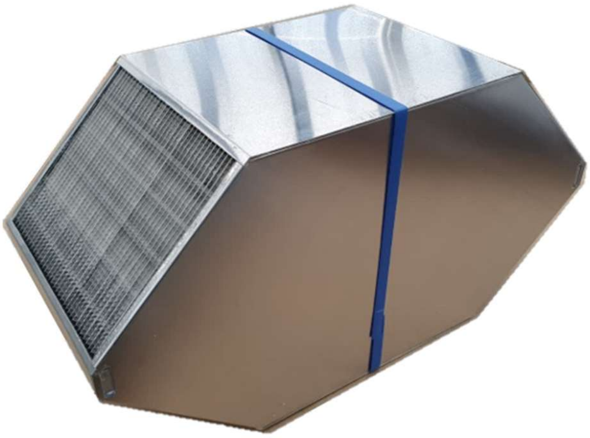
This is recommended whenever **high amounts of condensation are expected** (e.g. pool application), the exchanger is installed in **horizontal orientation** (can lead to condensation build up) or it is necessary to **reduce air leakage** as much as possible (e.g. hygienic applications).

Extra sealing (T) option

3.7.2. PLASTIC HANDLE

Plastic Handle (P) is available only for small PCF exchangers **up to model 62**.

This plastic strap handle allows for **easier handling, installation and removal** of small PCF exchangers into compact AHUs and MVHR's.



Plastic Handle (P) option

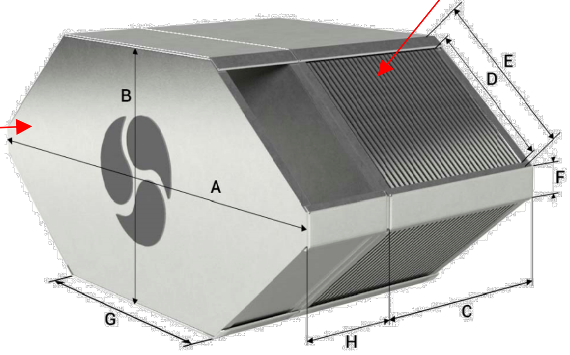
A summary of the available options depending on the model size selected is listed below.

	MODEL SIZE																		
	18	25	30	35	45	55	62	65	80	95	110	124	140	180	220	248	270	330	372
Extra Sealing (T)	✘	✘	✘	✓	✓	✓	✓	✘	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓
Plastic Handle (P)	✓	✓	✓	✓	✓	✓	✓	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘	✘

Exchanger Options vs Model Size availability

3.8. BYPASS SECTION

A bypass is an empty section installed parallel to the heat exchanger with mainly two functions.



Bypass section

<u>**Supply air temperature control**</u>

A bypass section allows the **exchanger performance to be modulated** by diverting some of the cold or hot air, therefore **reducing the overall heat transfer between airflows**. This allows the **supply air temperature to be trimmed** to the required setpoint and **avoids overheating/cooling** of the supply airflow.

<u>**Frost prevention**</u>

The bypass section can also be used as a method to **avoid frosting of the heat exchanger** in cold climates, by diverting some, or all of the cold air. This allows the temperature of the air stream being cooled to remain above the freezing point. Additional detail on frost prevention can be found here.

<u>**Bypass availability**</u>

The bypass option is **available for all PCF ranges and models sizes**.

<u>**Bypass identification code**</u>

A bypass is fully defined with following parameters: **Bypass Type**, **Bypass Width** in mm and **Bypass Position**. The **size and material of the bypass** are determined by the options selected for the PCF exchanger model.

As an **individual product supplied on its own** the bypass is identified with a product code which consists of **Bypass Type**, followed by **Casing Construction**, **Model Size**, **Bypass Width** in mm, **Bypass Position**, and **Material Option**.

e.g. BP-N-140-258-A-GE

3.8.1. BYPASS WIDTH

Bypass Width (H) is the only variable dimension for bypasses. **Dimension H** always refers to the **outside width of the bypass (including any outside flanges)**.

The **bypass dimension rules** are dependent on the selected <ins>**Casing Construction**</ins> type as described in the table below.

<table>
<tr><th>CASING CONSTRUCTION</th><th>Minimum H (mm)</th><th>Maximum H (mm)</th></tr>
<tr><td>Standard (PCF)</td><td>50</td><td rowspan="3">1000*</td></tr>
<tr><td>Light Industrial (PCF-I)</td><td>110</td></tr>
<tr><td>Heavy Industrial (PCF-N)</td><td>160</td></tr>
<tr><td colspan="3">* Maximum selectable in software, there is theoretically no maximum limit for the overall width of the bypass.</td></tr>
</table>

Maximum and minimum bypass width

<ins>**Bypass sizing**</ins>

The width of the bypass should generally be sized so that **pressure loss through the bypass section**, when the full volume of air is being diverted, **is roughly equivalent to the pressure loss through the heat exchanger** at the same conditions. The size of the bypass is automatically calculated by the ERI Counterflow Selection Software based on these guidelines.

PLEASE NOTE: It is possible to define the bypass width manually however this should be done carefully since significantly reducing the bypass section width can result in increased pressure drop, potential noisy operation or poor operation during bypass mode.

Please contact ERI should you require a reduced or increased bypass section width.

3.8.2. BYPASS TYPE

The bypass can be supplied in the two following arrangements:

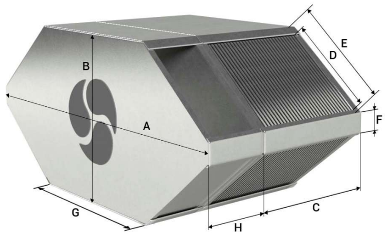
- **Fixed Bypass (BP)**
- **Loose Bypass (BR)**

3.8.2.1. FIXED BYPASS

Fixed Bypass (BP) means that the bypass is **fixed with rivets and adhesive to the exchanger block** and thus **cannot be removed** without damaging it.

This is available only when exchanger is **supplied in one block** (see guidance on exchanger width and number of blocks).

If the exchanger is supplied in **more than 1 block** then the bypass must be supplied as **Loose Bypass** (**BR**).



Fixed Bypass (BP)

3.8.2.2. LOOSE BYPASS

Loose Bypass (BR) means that the bypass **is not fixed to an exchanger block** and it's **supplied loose** as an individual part (to be installed by the customer in parallel with the exchanger).

If the exchanger is selected with bypass position **= Middle/Center (C)** the bypass is always delivered as a **Loose Bypass (BR)**.

Due to manufacturing restrictions, bypasses for **PCF models 248 to 372** and any models with casing construction type **Heavy Industrial (PCF-N)** are always **Loose Bypass (BR).**

Loose Bypass (BR)

	MODEL SIZE																		
	18	25	30	35	45	55	62	65	80	95	110	124	140	180	220	248	270	330	372
Fixed Bypass (BP)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗	✗
Loose Bypass (BR)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓

Bypass Type vs Model Size availability

BYPASS TYPE	Number of exchanger blocks	
	1	>1
Fixed Bypass (BP)	✓	✗
Loose Bypass (BR)	✓	✓

Bypass Type vs number exchanger blocks

BYPASS TYPE	BYPASS POSITION	
	Side (A/B)	Central (C)
Fixed Bypass (BP)	✓	✗
Loose Bypass (BR)	✓	✓

Bypass Type vs Bypass Position availability

PLEASE NOTE: If the exchanger must be assembled on site and you want to receive all elements as individual parts, please select **Bypass Loose (BR)** option and neither bypass nor bypass damper will be preassembled from the factory.

For **Heavy Industrial (PCF-N)** casing construction you can also select the modular installation (UO) option to receive the exchangers divided into small individual sections.

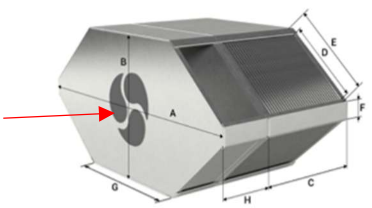
3.8.3. BYPASS POSITION

Bypass Position can be selected as follows:

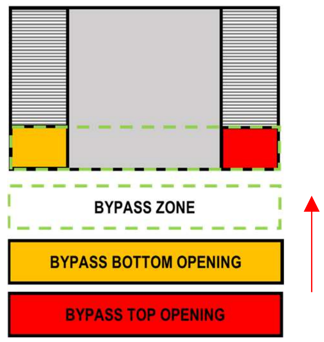
- **Side A (A)** - Bypass is located on the **side**, **open on top-right** and **bottom left** (looking from the top on bypass side face).
- **Side B (B)** - Bypass is located on the **side**, **open on top-left** and **bottom right** (looking from the top on the bypass side face).
- **Central (C)** - Bypass is located on the **centre/middle** (exchanger width is split in two identical parts/half's)

BYPASS POSITION

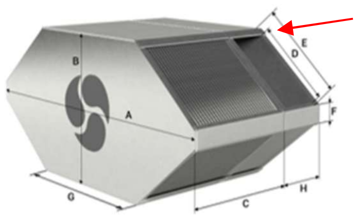
SIDE A (A)



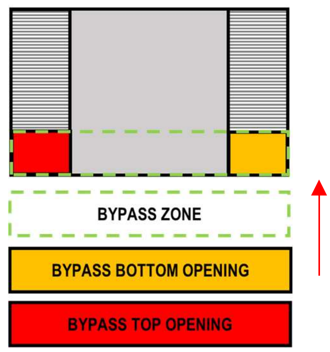
TOP VIEW



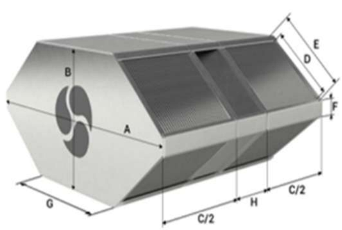
SIDE B (B)



TOP VIEW



CENTRAL (C)



Central bypass is always delivered loose and can be rotated to achieve the desired position for the openings

Bypass Position

Bypass position rules

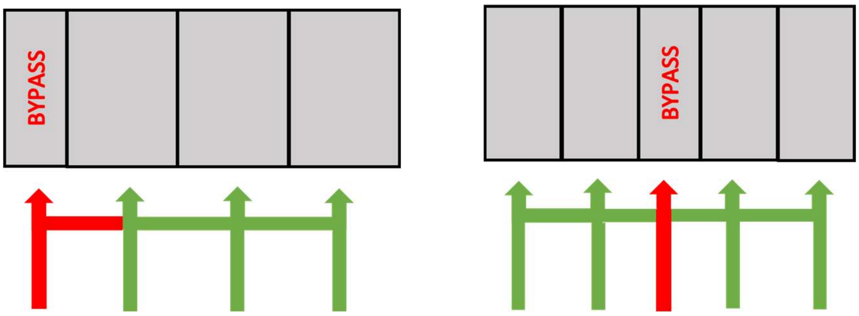
If the overall exchanger width is **up to 2500mm**, the bypass position can be selected as **Side (A), Side (B) or Central (C).**

For exchangers **exceeding this limit,** the bypass is always selected in position **Central (C)** in order to avoid a poor airflow path.

When in bypass mode, a **side bypass can cause unfavourable flow conditions** and **poor air mixing** in downstream components (heating and cooling coils, humidifiers, etc).

Whenever possible the bypass should be located in the centre to avoid this.

We recommend position Central (C) for products with an overall exchanger with **over 2000mm**.



Airflow path for side and central bypass

BYPASS POSITION	Overall Width [mm]	
	<=2.5m	>2.5m
Side (A)	✓	✗
Side (B)	✓	✗
Central (C)	✓	✓

Bypass Position vs Exchanger Width availability

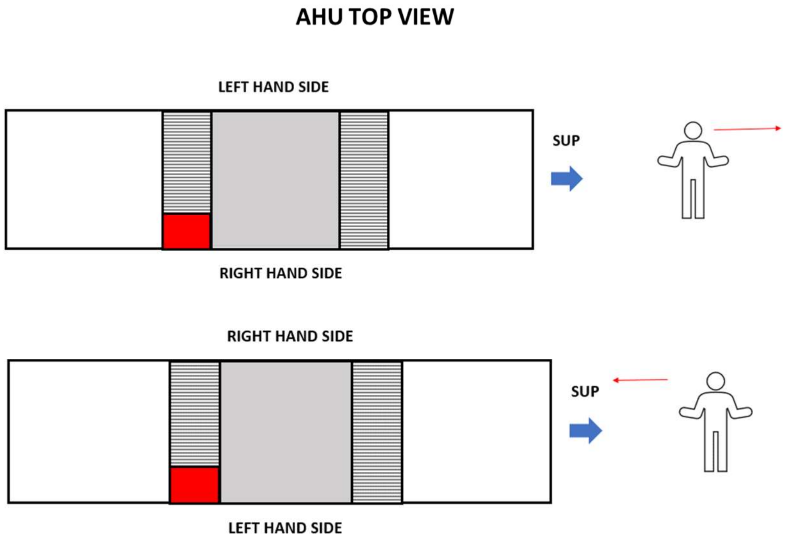
3.8.4. SELECTING THE BYPASS POSITION

When selecting the **Bypass Position** it is important to consider the following:

1. The **handing** of the air handling unit
2. The **location of the bypass** either on the **supply airstream** or the **exhaust airstream**
3. The **arrangement of airflows** in the air handling unit
4. The **bypass position option** from ERI

1. Air Handling Unit handing

The handing of the air handling unit is defined by the AHU manufacturer. Often this is determined by **looking away from the supply airflow** (airflow in your back) as depicted below but it **can also be determined by looking at the supply airflow instead.**



Two methods of determining air handling unit handing

Since its impossible for ERI to know which method the customer will use **it is important that the AHU manufacturer determines the handing themselves** before selecting the bypass position.

2. Bypass location

Whether the bypass will be located in the **supply or exhaust airflow** should also be determined by the AHU manufacturer.

Locating the bypass in either airflow will allow for **control of the outlet supply air temperature**. However, locating the **bypass on the exhaust generally offers better temperature control** since the supply air section is not subject to air mixing downstream of the exchanger.

Locating the bypass in the exhaust airflow will **make defrosting the heat exchanger impossible**. Since warm air is being diverted through the bypass, cold air will continue to pass over the heat exchanger on the supply air side. This means that the exchanger surface will not warm up and any frost formed in the exhaust air section will remain. While this **can reduce the amount of condensation being generated** and **prevent further frosting, it will not defrost the heat exchanger** until the fresh air temperature increases.

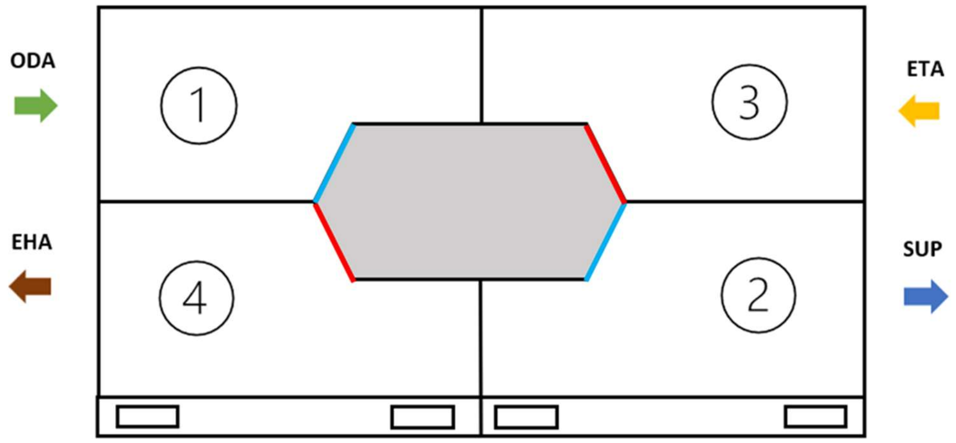
Alternatively with the **bypass located in the supply air side**, should there be a need to defrost, cold air can be diverted through the bypass **creating an excess of warm air in the exchanger which will gradually defrost the plates.**

Bypass Location	Heat Recovery Modulation	Frost Prevention	Defrosting
Supply Air	Possible	Possible (recommended)	Possible
Exhaust Air	Possible (recommended)	Possible	Not possible

Bypass location

3. Airflow Arrangement

The **actual airflow arrangement** of the air handling unit **must also be considered by the AHU manufacturer** before determining the correct position of the bypass.



Example AHU arrangement with bypass on SUPPLY or EXHAUST

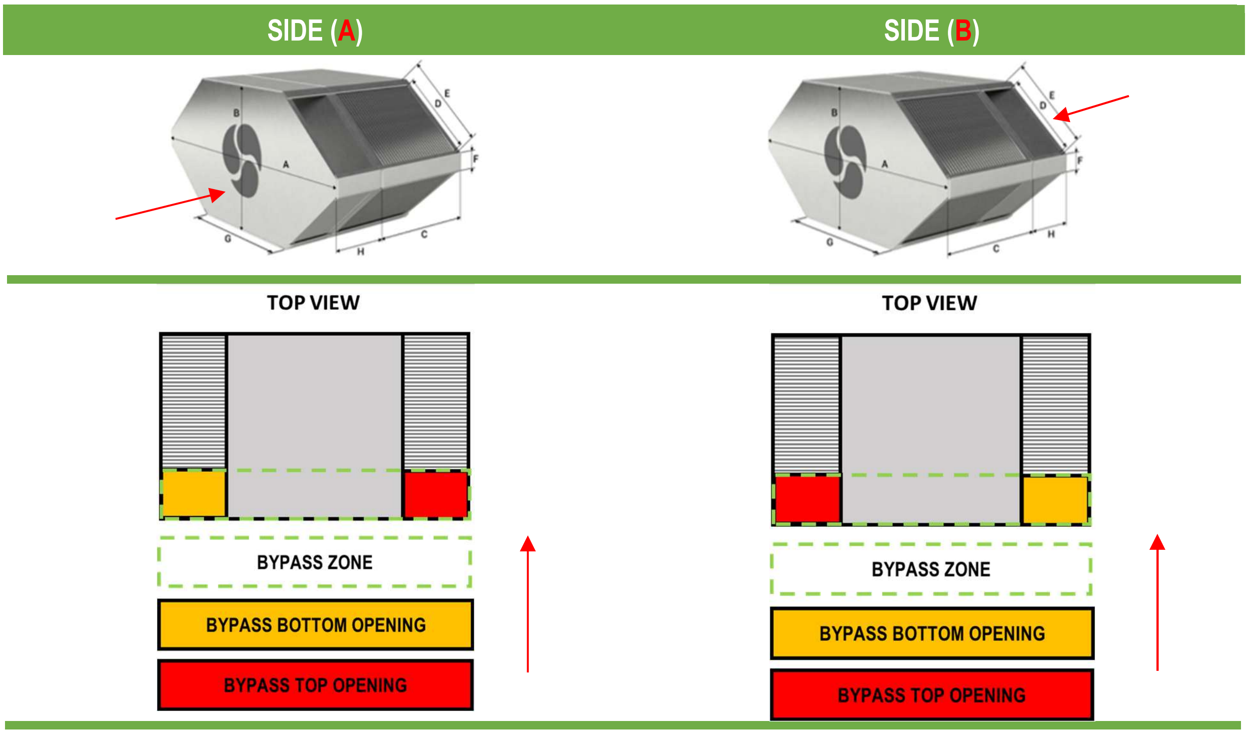
4. The bypass option from ERI

In order to determine the correct bypass position:

a) Consider the **handing of the AHU**, the **airflow arrangement** and the **intended location** for the bypass section (**supply or exhaust**).

b) If the bypass type is selected as **Bypass Loose (BR)** it can re-arranged in any orientation to suit your requirements. For bypass position **Central (C)**, **PCF models 248 to 372** and casing construction type **Heavy Industrial (PCF-N)** the bypass is always delivered loose.

c) If the bypass type is selected as **Bypass Fixed (BP)** you must consider whether **Side (A)** or **Side (B)** is required. The diagrams below indicate the **position of the bypass openings when looking from the top of the bypass face side**.

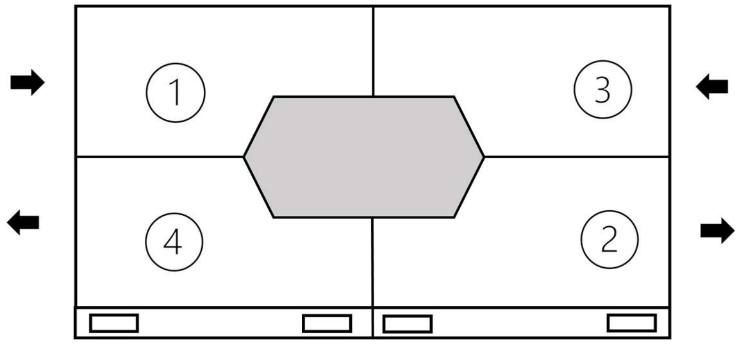


Example diagrams for side bypass position

d) **Rotate the bypass diagram into position in your air handling unit drawing** and determine which option **has the openings in the correct place**.

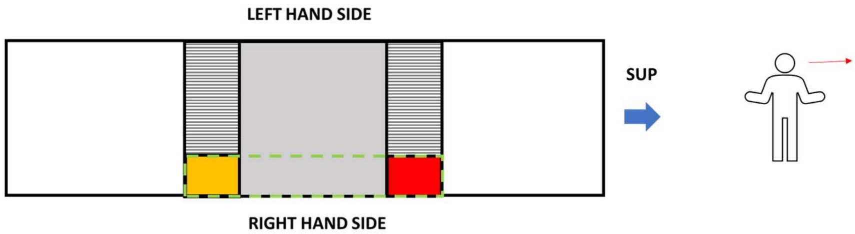
The following illustrates the above process.

AHU PLAN VIEW



1	2	3	4	DESIRED HANDING	DESIRED LOCATION	BYPASS POSITION
ODA	**SUP**	ETA	EHA	LHS	SUPPLY	**A**
ODA	**SUP**	ETA	EHA	LHS	EXHAUST	**B**
ODA	**SUP**	ETA	EHA	RHS	SUPPLY	**B**
ODA	**SUP**	ETA	EHA	RHS	EXHAUST	**A**

AHU TOP VIEW



Example of bypass position selection

3.9. DAMPERS

The main purpose of the **face and bypass dampers** is to allow **control of the airflow** through the exchanger and bypass sections.

Face and bypass airflow control dampers

As standard, ERI PCF dampers are manufactured from **extruded aluminium profiles** and **hidden plastic gears** with **opposite blade operation** to ensure smooth control of the airflow. Depending on the selected **material option** the profiles can also be **anodized to improve corrosion protection**.

The standard damper has a **blade pitch of 100 mm** and **frame depth of 125 mm**. The dampers are rated **leakage class 2 to EN 1751** but can be **fitted with additional seals** to achieve **class 3** to the same standard.

The dampers are divided into 2 sections – the **bypass section** and **exchanger section**. Both dampers are rotated in tandem so that by opening one damper section the other section is proportionally closed.

Damper position

We recommend that the face and bypass damper is installed in the **inlet side of the heat exchanger**. This will **prevent warm/cold air entering the bypass or heat exchanger** during full bypass or full heat recovery operation, which can lead to undesired temperature differentials across the bypass and heat exchanger sections.

Damper availability

Dampers are available for all PCF models of the casing construction type **Light Industrial (PCF-I)** and **Heavy Industrial (PCF-N)** are **mounted directly to the flange of the heat exchanger**.

Damper pre-assembly

If the bypass is fixed and pre-assembled in the factory the damper will be as well.

Damper identification code

A damper is fully defined with following parameters: **Damper Type** **and** **Damper Shaft Type**. The **size and material of the damper** are determined by the options selected for the PCF model. Additionally, a **Return Air Damper** and other additional options can be selected separately.

As an individual product supplied on its own the damper is identified with a corresponding product code.

Damper code designation consists of abbreviation DP, followed by **Model Size**, **Exchanger Width** in mm, **Material Option**, **Bypass Type**, **Bypass Width** in mm, **Bypass Position**, **Damper Type**, **Damper Shaft Type** and any additional damper options (including if it is for an installation with horizontal orientation of lamellas).

e.g. DP-140-1600-GC-B-258-A-SL-R-HO

3.9.1. DAMPER ACTUATION TYPE

The main parameter defining the damper is damper actuation type.

Dampers can be supplied with **Side Shaft left/right** or **frontal Motor Bracket**. The selected **bypass position** is always considered as a reference when selecting damper type.

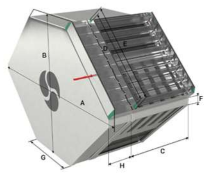
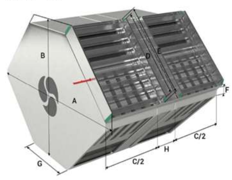
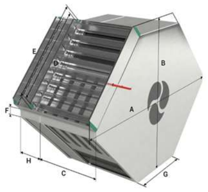
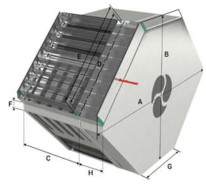
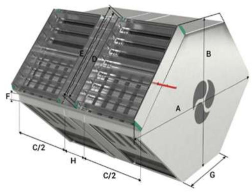
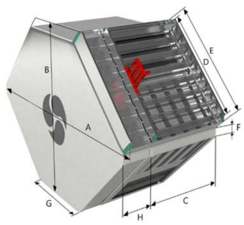
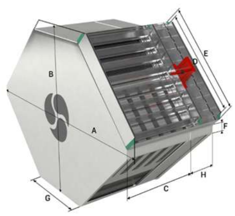
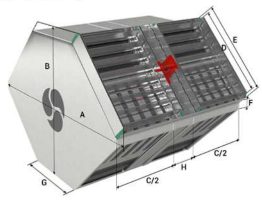
- **Bypass Side (A)**
  - **Side Shaft (SL)** same side as bypass
  - **Side Shaft (SR)** opposite side to bypass
  - **Motor Bracket (SM)**
- **Bypass Side (B)**
  - **Side Shaft (SL)** opposite side to bypass
  - **Side Shaft (SR)** same side as bypass
  - **Motor Bracket (SM)**
- **Bypass Central (C)**
  - **Side Shaft left side (CL)**
  - **Side Shaft right side (CR)**
  - **Motor Bracket (CM)**

Side shaft options (SL / SR / CL / CR) are designed to be **driven through the AHU casing and operated externally**.

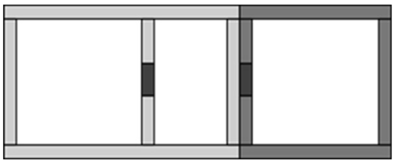
Motor bracket options (SM / CM) are designed to be **operated from within the AHU casing**.

Damper actuation rules

All dampers **over 2500 mm are required to have a Central Motor Bracket (CM)**, shaft actuators left/right are unavailable. **Models Sizes 270 or larger** are required to have a **Motor Bracket** (**SM/CM**).

	Side Shaft (SL)		Side Shaft (CL)
LEFT (SL/CL)	**BP Pos: A**  **Same side as bypass**	**BP Pos: B**  **Opposite to bypass**	**BP Pos: C** 
	Side Shaft (SR)		**Side Shaft (CR)**
RIGHT (SR/CR)	**BP Pos: A**  **Opposite to bypass**	**BP Pos: B**  **Same side as bypass**	**BP Pos: C** 
	Motor Bracket (SM)		**Motor Bracket (CM)**
MOTOR BRACKET (SM/CM)	**BP Pos: A** 	**BP Pos: B** 	**Mandatory over Exchanger Width (C) > 2500mm** **BP Pos: C** 
	Mandatory for model sizes 270 and larger		

Summary of damper actuation type options



PLEASE NOTE: Maximum single damper width, exchanger and bypass included, is 2500 mm. All dampers for PCF Industrial units up to this limit are produced in one part except models 330 / 372 which require two individual dampers (parallel in height) to cover the large exchanger face heights. All dampers above this limit are produced as segmented. One damper segment covers one half of exchanger and bypass section and another segment covers the other exchanger half. This design allows us to provide dampers for PCF units with widths up to 5000 mm. All dampers above 2500 are required to have CM option (side shaft unavailable) and require actuators for each damper section. Segments are independent, not connected in-between!

3.9.2. DAMPER SHAFT TYPE

The damper shaft type allows the customer to select the **type of shaft or motor bracket** most appropriate for their application.

For Side Shaft (SL / SR / CL / CR) type dampers:

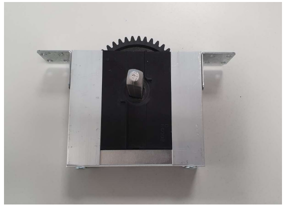
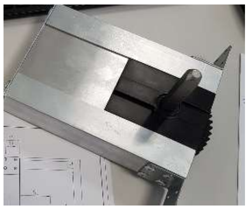
- **Side Aluminium Shaft Square (N) – Square,** 12x12mm, total shaft length 270 mm, available shaft length 215mm
- **Side Aluminium Shaft Round (R) – Round,** diameter 12mm, total shaft length 220mm, available shaft length 165mm, 150 mm is round

For Motor Bracket (SM / CM) type dampers:

- **Regular Mounting Bracket (V)** -, **Regular**, Square Aluminium Shaft **12x12x90mm**, available length 55mm, bracket height 180mm
- **Compact Mounting Bracket (H)**, **Compact**, Square Aluminium Shaft **12x12x90mm**, available length 55mm, bracket height 100mm
- **Heavy Mounting Bracket (W) - Heavy**, Square Aluminium Shaft **12x12x135mm**, available length 100mm, bracket height 200mm
- **Mounting Bracket (DE) - Regular**, Square Aluminium Shaft **12x12x145mm**, available length 110mm, bracket height 180mm

SIDE SHAFT DAMPER OPTIONS (SL/SR/CL/CR)	**Side Aluminium Shaft Round (R)**	Round diameter 12mm Total shaft length L=220mm Available shaft length= 165mm Round shaft length portion L=150mm	
	Side Aluminium Shaft Square (N)	Square 12x12mm Total shaft length L=270mm Available shaft length L=215mm	

Summary of side shaft options

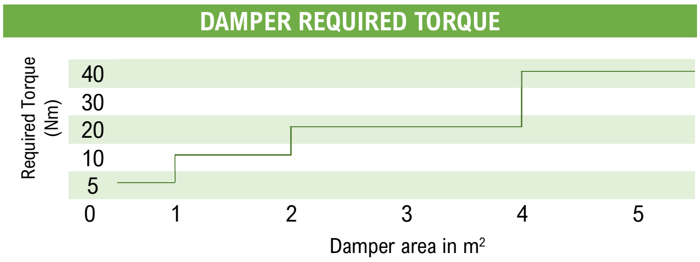
MOTOR BRACKET DAMPER OPTIONS (CM/SM)	**Regular Mounting Bracket (V)**	Square aluminium shaft 12x12x90mm Total shaft length L=90mm Available shaft length L=55mm Motor bracket height H=180mm	
	Compact Mounting Bracket (H)	Square aluminium shaft 12x12x90mm Total shaft length L=90mm Available shaft length L=55mm Motor bracket height H=100mm	
	Heavy Mounting Bracket (W)	Square aluminium shaft 12x12x135mm Total shaft length L=135mm Available shaft length L=100mm Motor bracket height H=200mm	
	Mounting Bracket (DE)	Square aluminium shaft 12x12x145mm Total shaft length L=110mm Available shaft length L=100mm Motor bracket height H=180mm	

Summary of motor bracket options

3.9.3. ACTUATOR SIZING

Motorization of face and bypass dampers is required. The type of shaft or motor actuator bracket must be considered when selecting the actuator.

The following table can be used as a reference for the **required actuator torque as a function of damper area**.



Required actuator torque in function of damper area

Use the following table for sizing of damper actuators (widths are up to, round to higher width).

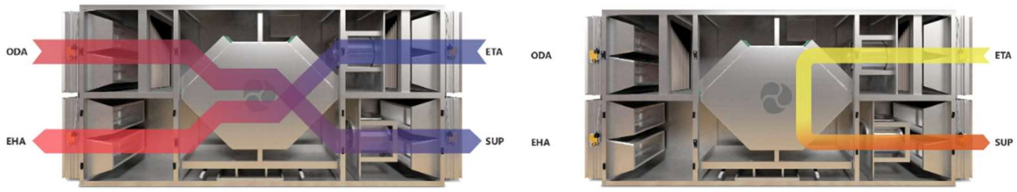
MODEL	Overall Width in mm and Damper Surface Area (m²)									
	250	500	750	1000	1200	1500	1750	2000	2250	2500
45	0,07	0,14	0,20	0,27	0,33	0,40	0,47	0,53	0,60	0,66
	5 Nm									
55	0,09	0,17	0,25	0,33	0,41	0,49	0,57	0,65	0,73	0,81
	5 Nm									
62	0,1	0,19	0,28	0,37	0,46	0,55	0,64	0,73	0,82	0,91
	5 Nm									
80	0,12	0,23	0,35	0,46	0,57	0,69	0,8	0,92	1,03	1,14
	5 Nm								10 Nm	
95	0,14	0,28	0,42	0,56	0,7	0,84	0,98	1,12	1,26	1,39
	5 Nm							10 Nm		
110	0,17	0,33	0,5	0,66	0,83	0,99	1,15	1,32	1,48	1,65
	5 Nm						10 Nm			
124	0,19	0,38	0,57	0,75	0,94	1,13	1,32	1,5	1,69	1,88
	5 Nm					10 Nm				
140	0,24	0,48	0,72	0,96	1,19	1,43	1,67	1,91	2,15	2,38
	5 Nm				10 Nm				20 Nm	
180	0,29	0,58	0,87	1,16	1,45	1,74	2,03	2,31	2,6	2,89
	5 Nm			10 Nm			20 Nm			
220	0,34	0,68	1,02	1,36	1,7	2,03	2,37	2,71	3,05	3,39
	5 Nm		10 Nm				20 Nm			
248	0,39	0,78	1,16	1,55	1,93	2,32	2,7	3,09	3,47	3,86
	5 Nm		10 Nm			20 Nm				
270	0,44	0,87	1,3	1,74	2,17	2,6	3,03	3,47	3,9	4,33
	2 x 5 Nm		2 x 5 Nm		2 x 10 Nm					2x20 Nm
330	0,51	1,02	1,53	2,04	2,55	3,06	3,57	4,07	4,58	5,09
	1 x 5 Nm & 1 x 10 Nm						1 x 10 Nm & 1 x 20 Nm			
372	0,58	1,16	1,74	2,32	2,89	3,47	4,05	4,63	5,21	5,78
	1 x 5 Nm & 1 x 10 Nm					1 x 10 Nm & 1 x 20 Nm				

Required actuator torque in function of Model Size and Overall Width (C+H)

3.9.4. RETURN AIR DAMPERS

A **return** or **recirculation air damper** can be used in conjunction with a face and bypass damper to allow **mixed air** or **full recirculation** operation of the heat exchanger.

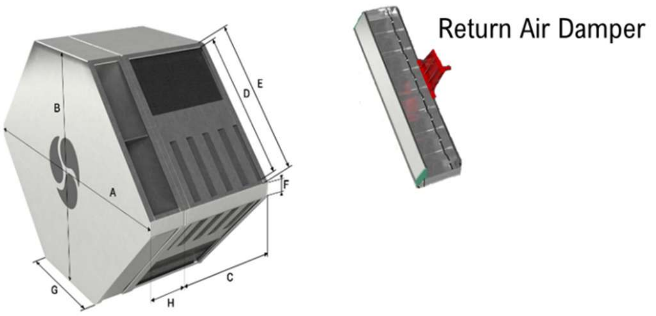
This **effectively replaces the function of a mixing box** allowing the air handling unit to be made smaller.



Operation with full fresh air and full recirculation via return air damper

The return air damper can be installed either in the **exhaust air side** or the **supply air side**.

To achieve this, a **standard bypass section** and **face and bypass damper** must be installed in the plate heat exchanger (in the middle or on the side). One of the side walls of the bypass section is then replaced with the additional recirculation damper.



Return Air Damper

The **return air damper inherits the same characteristics as the face and bypass damper**. This includes the Damper Type, Damper Actuation Type and **damper material** defined by the selected Material Option.

Therefore, there are **2 types of return air damper available**:

- **Return air damper with side shaft (RN)**
- **Return air damper with frontal motor bracket (RM)**

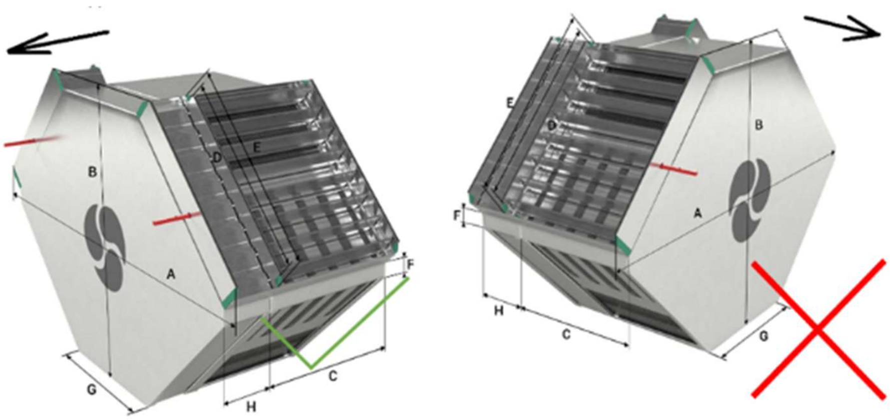
Return air damper pre-assembly

If the bypass is fixed to the heat exchanger, the return air damper is also preassembled from the factory.

3.9.4.1. SIDE SHAFT RETURN AIR DAMPER

If the **face and bypass dampers** have a [Damper Actuation Type] of **Side Shaft Square (N)** or **Side Shaft Round (R)** the same option is applied to the **return air damper shaft**.

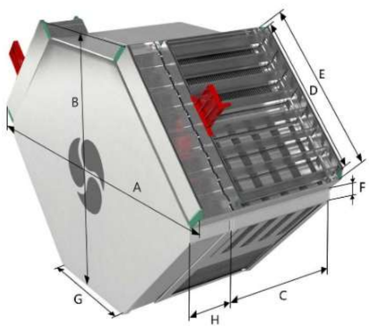
However, if the shaft points in the opposite direction to the bypass side, as this would require an extension to operate the return air damper or the actuator could obscure the face of the exchanger. Contact ERI to agree final design configuration.



Return Air Damper with side shaft

3.9.4.2. MOTOR BRACKET RETURN AIR DAMPER

Return air dampers with **frontal motor bracket (RM)** inherit **the same properties of the face and bypass damper motor bracket.**



Return Air Damper with motor bracket

3.9.4.3. RETURN AIR DAMPER OPERATION

The **position of the return air damper (supply or exhaust)** determines how the heat exchanger operates in **full fresh air, full recirculation and mixed air operation mode**.

The position of the return air damper should be indicated at the time of the order.

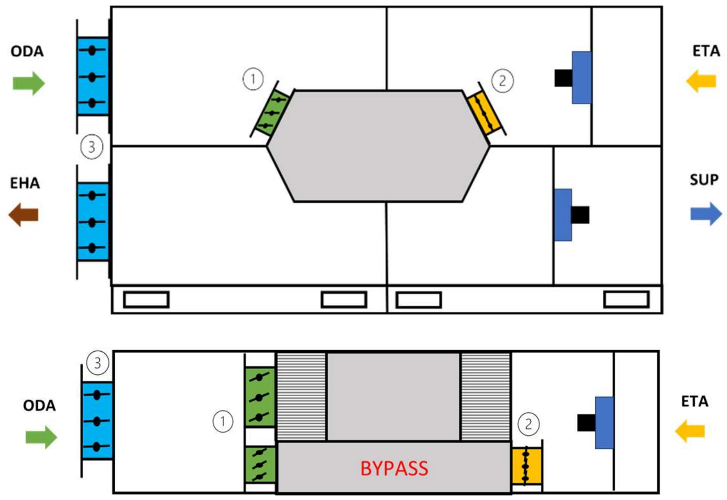
Operation	Damper	Return air damper on exhaust	Return air damper on supply
Full Fresh Air	Return (2)	Closed	Closed
	Exhaust/Fresh Air (3)	Open	Open
	Bypass (1)	Modulating	Modulating
	Face (1)	Modulating	Modulating
Full Recirculation	Return (2)	Open	Open
	Exhaust/Fresh Air (3)	Closed	Closed
	Bypass (1)	N/A	Open
	Face (1)	N/A	Closed
Mixed Air	Return (2)	Modulating	Not possible
	Exhaust/Fresh Air (3)	Modulating	
	Bypass (1)	Closed	
	Face (1)	Open	

Modes of operation for return air damper

For operation in the **Full Recirculation** and **Mixed Air** operation mode the **exhaust air fan must be in a blow-through position** and the **supply air fan in a draw through position.**

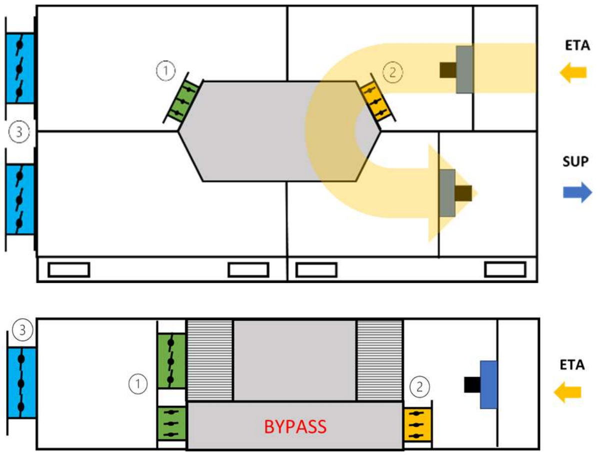
<u>**Return air damper on exhaust (recommended)**</u>

During **Full Fresh Air operation** the **return air damper (2) is closed**, the **shut off dampers for fresh and exhaust air (3) are open** and the **face and bypass damper (1) is used to modulate** the heat recovery.



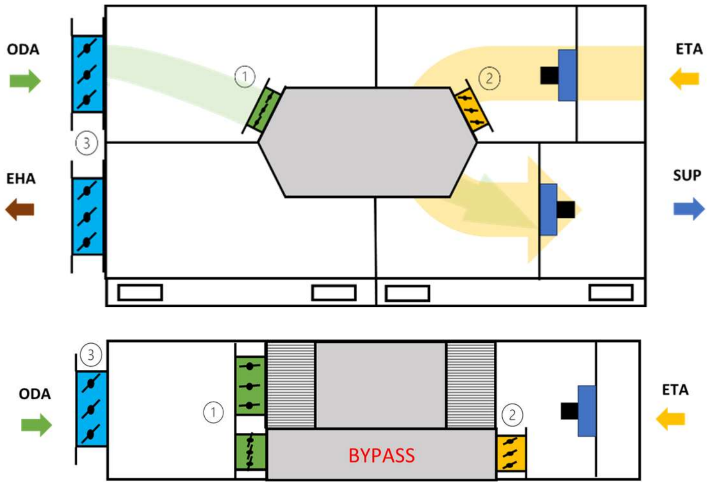
Full fresh air operation with return air damper (exhaust)

During **Full Recirculation operation** the **return air damper (2) is open**, the **shut off dampers for fresh and exhaust air (3) are closed**, the **bypass damper (1) is fully closed** and the **face damper (1) fully open**.



Full recirculation operation with return air damper (exhaust)

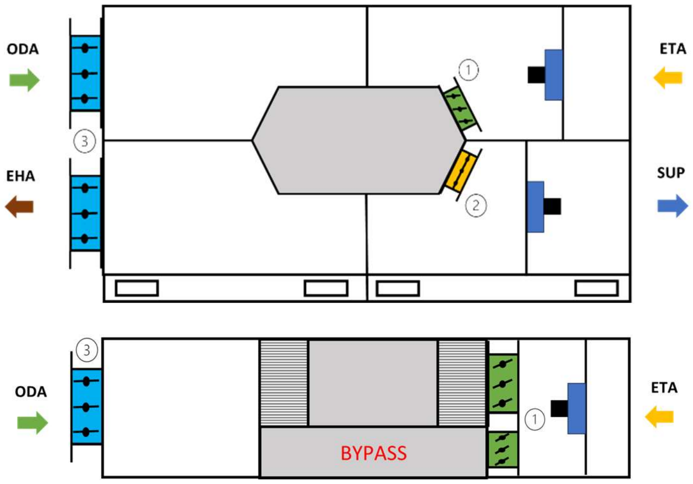
During **Mixed Air operation all the dampers are partially open** in accordance with the requirement for air mixing. The **bypass damper (1) is closed** and **face damper (1) is open** to maximize the efficiency of heat recovery.



Mixed air operation with return air damper (exhaust)

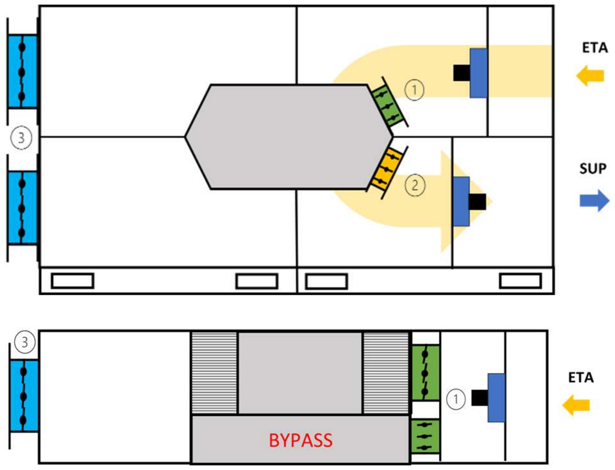
Return air damper on supply

During **Full Fresh Air operation** the **return air damper (2) is closed**, the **shut off dampers for fresh and exhaust air (3) are open** and the **face and bypass damper (1) is used to modulate** the heat recovery.



Full fresh air operation with return air damper (supply)

During **Full Recirculation operation** the **return air damper (2) is open**, the **shut off dampers for fresh and exhaust air (3) are closed**, the **bypass damper (1) is fully open** and the **face damper (1) fully closed**.



Full recirculation operation with return air damper (supply)

Mixed Air operation is not possible with this arrangement.

3.9.5. DE-ICING DAMPERS

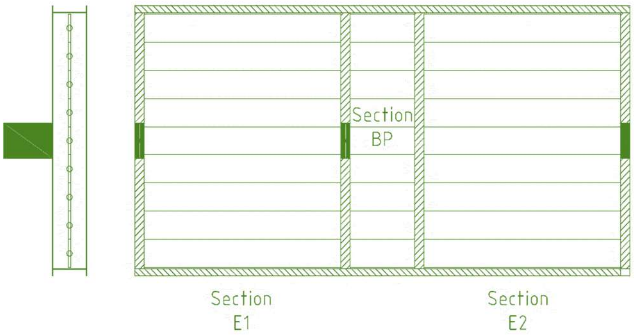
De-icing dampers are a special type of dampers designed for PCF units **to be installed in regions with a very cold climate**. These dampers allow for a **segmented defrosting of the heat exchanger** which increases the average annual heat exchanger efficiency.

The exchanger and face dampers are **split into independently controlled sections with equal width**. Each damper **requires its own actuator** in order to be individually controlled.

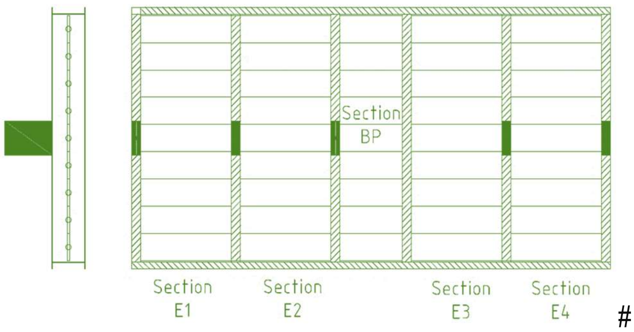
De-icing dampers are always supplied with Bypass Position **Central (C)** and **motor brackets**.

De-icing dampers are available in 2 options:

- **De-icing 3 Sections Motor Bracket (DM3) – Deicing unit with 2 heat exchanger blocks and 1 bypass section**; dampers split into 3 individually controlled sections, fitted with motor brackets.
- **De-icing 5 Sections Motor Bracket (DM5) – Deicing unit with 4 heat exchanger blocks and 1 bypass section**; damper split into 5 individually controlled sections, fitted with motor brackets.



De-icing dampers with 2 defrost sections and 1 bypass section (DM3)

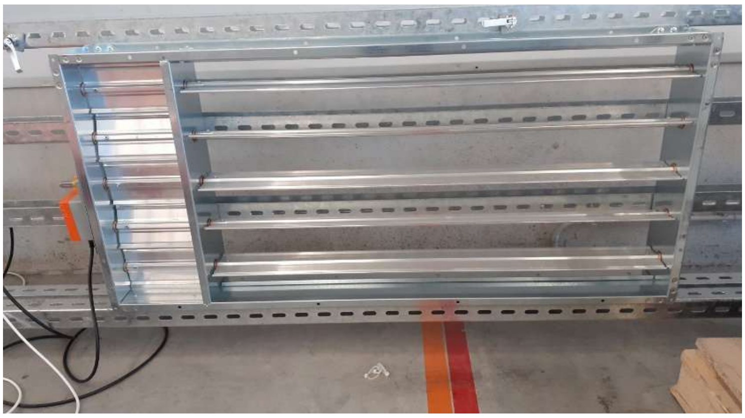


De-icing dampers with 4 defrost sections and 1 bypass section (DM5)

3.9.6. FULL METAL DAMPER

Dampers can optionally be manufactured **without any plastic parts**. In this case the damper plastic gears are replaced by equivalent aluminium gears.

The remainder damper materials are the same as the standard damper.



Full metal damper without plastic parts (MET)

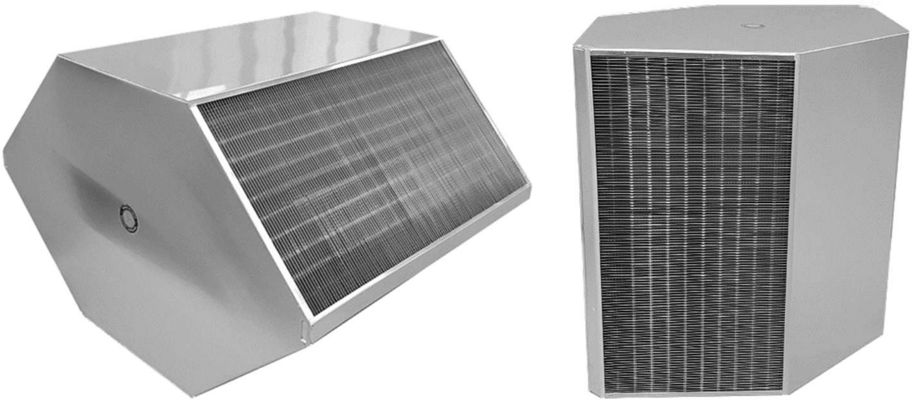
3.10. INSTALLATION OPTIONS

3.10.1. HORIZONTAL INSTALLATION

PCF units can be installed in the air handling units (AHU) in a few different layouts and orientation.

The main determining factor is **lamella orientation** which can be:

- **Vertical lamella orientation –** lamellas are perpendicular to the AHU floor
- **Horizontal lamella orientation** – lamellas are parallel to the AHU floor

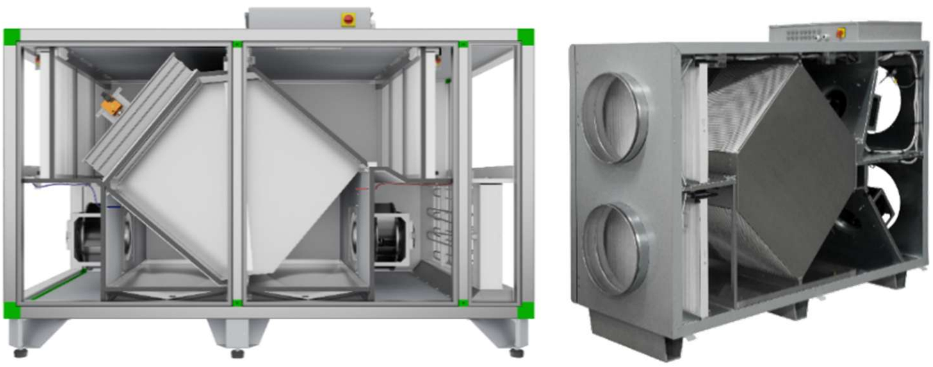


Vertical (left) and Horizontal (right) orientation of plates

Normally the exchanger shall be installed with **vertical lamella orientation** to avoid problems with condensation drainage from the exchanger.

Horizontal lamella orientation (HO) is possible as an option. This is **not available for models size 270 and larger** due to the potential for retention of condensate in the plates in such large exchangers.

Horizontal position of PCF unit (horizontal lamella orientation)



Vertical position of PCF unit (vertical lamella orientation)

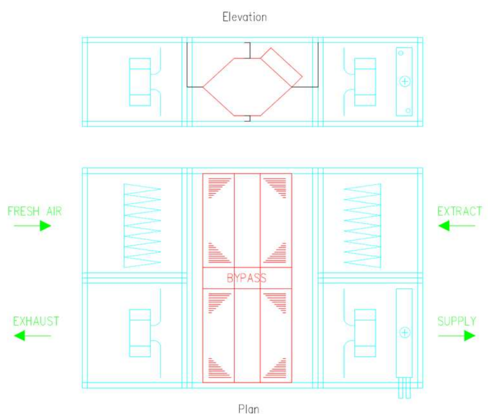
3.10.1.1. HORIZONTAL INSTALLATION CONSIDERATIONS

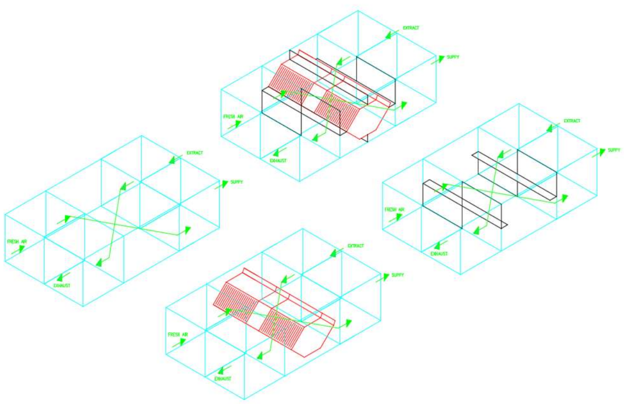
Installing the heat exchanger with a horizontal lamella orientation (lamellas parallel to the floor of the AHU or ductwork) can lead to **condensate being retained in the heat exchanger**. This can increase **pressure drop**, the **risk or freezing** and the **risk of water transfer** between airflows.

To avoid issues with horizontal installation follow these recommendations and share AHU drawing with ERI

- A **layout drawing of AHU must be provided by the customer** to ERI for identification of fresh air inlet and exhaust air outlet positions.
- Maximum **overall width of PCF-I heat exchanger (not including bypass)** must not exceed **2000mm**.
- Maximum **overall width of PCF-N heat exchanger (not including bypass)** must not exceed **3150mm**.
- The **bypass section** must be always on the **top of the exchanger** for condensate flow
- The exchanger must be installed in with a **minimum inclination of 3 degrees in the direction of exhaust air outlet** (condensation to drain by gravity towards exhaust air side).
- Preferably there must be a **drain pan on all sides of the heat exchanger**.
- Horizontal units are produced as standard with **Extra Sealing (T)** option to provide a **more rigid construction of lamellas** and **reduce the potential for condensation to transfer between airflows**.
- For **kombi models**, the **first divider on bottom of each module in the exhaust air side will be open** so condensation can drain freely from the exchanger (AHU drawing required)
- **Dampers** where possible will be manufactured **with vertical blades**, exchanger heights over 1m including bypass with metal geared dampers may require special arrangement with horizontal blades and actuator brackets or side shafts
- **Exhaust air side** and **mounting directions** are labelled on the exchanger.

An alternative installation solution for side-by-side air handling units with vertical plate orientation is shown below. **This is a good option to avoid the issues with horizontal installation.**





Side by side air handling unit with vertical lamella installation

3.10.2. MODULAR INSTALLATION

Installation Option Modular (UO) means the exchanger will be delivered **unassembled in individual parts (Kombi modules + Dividers)** ready for assembly by the customer.

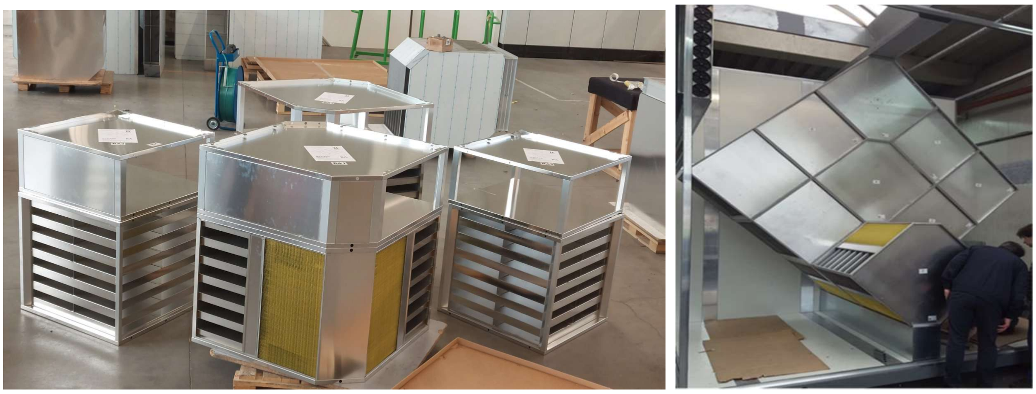
This is available only for exchangers of Casing Construction type **Heavy Industrial (PCF-N)**.

The exchangers are delivered in the following number of pieces.

Model Size	Number Kombi Modules	Number Divider Modules
140	2	2
180	2	2
220	2	2
248	2	2
270	3	6
330	3	6
372	3	6

Modular Installation number of pieces per Model Size

PLEASE NOTE: As standard all exchangers are delivered assembled in slices. Delivery unassembled is always optional.



Modular Installation (HO) option

	MODEL SIZE																		
	18	25	30	35	45	55	62	65	80	95	110	124	140	180	220	248	270	330	372
Horizontal Installation (HO)	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✓	✗	✗	✗
Modular Installation (UO)	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✗	✓	✓	✓	✓	✓	✓	✓

Installation Options vs Model Size availability

3.11. PACKAGING

PCF heat exchangers are delivered in **wooden pallets with chipboard base**, protected on all sides by **multilayered corrugated cardboard** with **reinforced edge profiles** and **secured with plastic straps**.

Upon request, packaging can be protected with **additional PE stretch film** to provide protection from moisture ingress.

PCF heat exchangers packaging

4. DESIGN AND OPERATIONAL LIMITS

When selecting a PCF plate heat exchanger please consider the following design limitations.

4.1. INTENDED USE

The product is intended for installation in air-conditioning and ventilation systems handling moist air that is free of heavy dust, grease, hazardous chemicals or other abrasive pollutants.

The product is not intended to handle air containing flammable or explosive mixtures, highly corrosive mixtures, heavy dust, grime, grease or air at very high temperatures (exceeding 90°C in continuous operation). Similarly, the product is not intended to be installed in environments having these characteristics.

4.2. CE MARKING

Counterflow plate heat exchanger products are not considered machines or partially completed machines under the scope of the EU Machinery Directive 2006 / 42 EG. The plate heat exchangers do not require a power drive or have moving parts.

It is the responsibility of the installer to ensure that the final assembled product complies fully with the requirements of Directive 2006/42/EC for completed machinery.

4.3. OPERATING FLUID

The heat exchanger is intended to be operated with moist air.

It is not recommended to use plate heat exchangers for exhaust air class ETA 4 according to EN16798-4:2017.

4.4. OPERATING LIMITS

Temperature	-40°C to +90°C It is recommended that frost protection is activated from approximately -4°C outside air temperature or approximately 2°C on the side where condensation takes place (typically exhaust air).
Relative Humidity	If exhaust air humidity > 28°C / 54% / 13 g/kg recommend use the **Extra Sealing (T)** option
Differential Pressure	1700 Pa

Operating limits for PCF heat exchangers

4.5. TOLERANCES

Stated testing tolerances are based on the **Eurovent AAHE certification programme** when tested under the procedures, conditions and requirements of **standard EN308**.

Test Criteria	Tolerance
Influence of pressure difference on pressure drop	+10% or at least 15Pa
Dry pressure drop at standard conditions	+10% or at least 15Pa
Temperature efficiency dry	-3%
Temperature efficiency wet	-5%
Air leakage	Max. 0.5% @ 250Pa

Testing tolerances for PCF heat exchangers

Note that any testing carried out under conditions deviating from those stated in EN308 are likely to yield results with larger tolerances than those stated above.

5. DESIGN ADVICE

The selection of a plate heat exchanger requires many considerations, such as:

- **The conditions of the warm and cold air streams** (temperature, moisture content).
- **The airflow quantity and the conditions at which it was calculated** (temperature, moisture, altitude and barometric pressure will affect mass flow).
- **The air quality** (air classification; how polluted is it; what chemicals are present; what is the potential for corrosion of the plate).
- **The space available to install the heat exchanger** (including the space for inspection, cleaning, removal, the installation of bypass, dampers, actuators and any required sensors; sufficient space for uniform airflow upstream/downstream from plate; good air temperature mixing downstream from plate)
- **The required efficiency of the heat exchanger** (does it need to be compliant with eco-design 1253/2014; other requirements)
- **Will bypass and dampers be required** (how large should bypass be; where will bypass be positioned; where will dampers by positioned; how will dampers be actuated)
- **The airflow arrangement** (is counterflow achieved; is the airflow direction in the plate and AHU as intended; does airflow and condensate flow in the same direction)
- **The fan arrangement** (differential pressures; potential for condensation retention; potential for cross contamination)
- **The potential for condensation** (will there be condensate in operation; how will condensate be collected and discharged; is there potential for condensation retention in the plates)
- **The potential for freezing** (is there potential for freezing; how will freezing by prevented; how will the plate be defrosted)
- **The material of the plate, casing, bypass and dampers** (is aluminium suitable for the application; is additional corrosion protection required)

The next few sections are intended to provide general advice about some of these considerations.

5.1. DESIGN CONDITIONS

It’s important that the design conditions for the plate heat exchanger are clearly defined before carrying out a selection.

As a minimum the following should be provided:

- **Supply and exhaust airflows**
- **Temperature and relative humidity of the outside air (ODA) and extract air (ETA)**

Additionally, its recommended to advise on the following:

- Conditions at which the airflows have been determined (standard 1.2 kg/m^3 or at specific conditions)
- Required temperature efficiency
- Available space to install the exchanger
- Requirements for bypass, control dampers and actuation
- Quality of the air and potential contaminants (especially if potentially corrosive)
- Required material for the plates and casing
- The installation position of the plate (vertical, horizontal, other)
- The AHU arrangement and position of the fans
- The estimated pressures at the plate heat exchanger section

Advising on all the above information will allow ERI to provide you with the best plate heat exchanger selection for your requirements.

PLEASE NOTE: It is important to remember that the heat recovery systems are not a substitute for an appropriately sized heating plant. The heat recovery device is always limited by the conditions of the return air. During a cold startup, or should the heat recovery fail, if the return air temperature decreases significantly it might be impossible to achieve the required room conditions.

5.2. PRESSURE DROP

Plate heat exchangers obstruct airflow and therefore cause pressure loss. **The higher the pressure loss, the more energy must be spent to operate the heat exchanger,** resulting in lower the overall energy efficiency and longer return on investment. It is therefore important to **minimize pressure drop as much as possible**. **Increasing the plate spacing** or **increasing the size of the plate** can both achieve this goal.

Recommended pressure loss values for plate heat exchangers range from 50 to 300Pa. If the selection of a plate heat exchanger results in pressure loss outside of these values, the selection should be carefully reviewed.

Heat exchanger pressure drop is tested in accordance with EN308. Additional pressure drop may be measured when testing in AHU as suggested in EN13053

5.3. MOISTURE TRANFER

ERI PCF plate heat exchangers are **sensible heat recovery products** and are **do not recover moisture**.

Although condensation will take place during operation, moisture is not intended to be transferred between airflows, and any condensation must be disposed of appropriately.

5.4. CONDENSATION

Condensation will take place whenever air is cooled sufficiently to become saturated with moisture (reaches its dew point) during the cooling process. The amount of condensation depends on the moisture content of the cooled airflow and how much it is cooled below its dew point. This generally takes place on the **exhaust airflow during winter operation**, but it can also happen on the supply airflow during summer, especially in countries with very hot and humid climates.

5.4.1. EFFECT ON HEAT RECOVERY AND PRESSURE DROP

Condensation will influence the heat transfer capacity and efficiency of the heat exchanger.

A **large amount of latent heat is exchanged during the phase change process of the moisture contained in the exhaust airflow** being cooled. Due to this, the exhaust air temperature does not drop as much, and the **heat transfer capacity of the heat exchanger is greatly increased**.

The efficiency of the plate heat exchanger under ‘dry’ (no condensation) and ‘wet’ (condensation) conditions is stated whenever you carry out a selection in the ERI Counterflow Heat Exchanger Calculator software.

Condensation can also partially restrict the free area of the heat exchanger plates, narrowing the channels and therefore **increasing pressure drop**. However, this effect can be considered **negligible** if the heat exchanger is installed in such a way that the **condensation can be drained effectively**.

5.4.2. HIGH HUMIDITY APPLICATIONS

The ERI Counterflow Heat Exchanger Calculator software will estimate the amount of condensation.

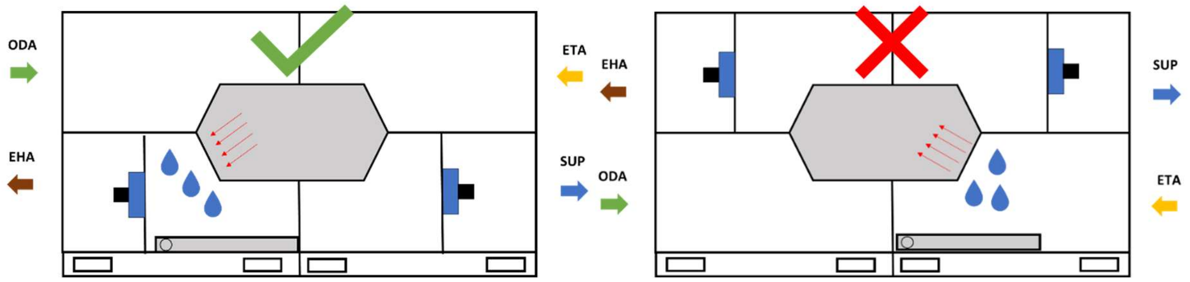
High exhaust air humidity conditions and **selections with significant cooling,** can lead to **large amounts of condensation**, it is recommended that a **drain tray is installed on all sides of the heat exchanger** and **extra sealing option** is applied to the heat exchanger to **reduce the potential for water transfer between airflows**.

If the **heat exchanger is installed with plates horizontal** to the floor of the AHU the same recommendations apply. See **HORIZONTAL INSTALLATION CONSIDERATIONS** for additional information.

5.4.3. HANDLING CONDENSATION IN AHU

The plate heat exchanger should be **installed and oriented so that condensation can easily drain by gravity**. It is recommended that the heat exchanger is installed with a **gradient of 3% towards the exhaust air outlet** to aid drainage of condensation.

The side of the exchanger through which the condensation will leave must be arranged in such a way that the **flow of condensate is downwards and not obstructed or retained**. Ideally the **airflow should flow in the same direction as the condensate**.



Airflow direction and condensation

Drain tray design

Drain trays should be sized sufficiently large to capture condensation from the full face of the plate heat exchanger.

The drain tray should not be designed to retain water but rather to discharge condensate effectively. This means that, if possible, **the drain tray should be sloped towards the discharge connection on all sides** with a **gradient no less than 1:20** and the **discharge connection** should be **large enough not to clog up during operation** (recommended DN40).

<u>**Droplet carryover**</u>

Droplet carryover is **unlikely to happen at face velocities lower than 2.5 m/s.** If the velocity exceeds this limit some water droplets might be carried over by the airflow. If the plate heat exchanger is installed **vertically** and as long as the **airflow is directed downwards and towards the drain tray** this will not be an issue.

However, if the **plate is horizontal** (see **HORIZONTAL INSTALLATION CONSIDERATIONS**) we recommend that the **drain tray is oversized** (cover the full heat recovery section) to ensure that any stray water droplets are captured. An alternative solution is to **install a droplet eliminator** downstream of the heat exchanger, although this is **not recommended** due to the **high-pressure loss and associated energy costs**.

5.5. FREEZING

Due to the high efficiency of counterflow plate heat exchangers **high amounts of moisture condensation can occur during operation**. When the outside temperature is low enough, the exhaust air can be cooled significantly below its dew point and moisture will condensate in significant amounts.

If the outside air is cold enough, the **exhaust air can be cooled close or below the freezing point**. This can also happen if the **cold air volume is far in excess of the hot air volume** (unbalanced airflow operation).

If this happens for long periods, a **frost layer will form on the exchanger lamellas** which will lead to **increased pressure drop**. Left unattended this can ultimately lead to the failure of the exchanger, fans or the air handling unit casing.

There are many methods to prevent frost from forming on heat exchangers.

<u>**Bypass section**</u>

A bypass section can be used to divert some or all of the cold air being passed through the exchanger.

This **raises the exhaust air temperature** and **avoids frosting** issues but will **reduce the efficiency of the plate heat exchanger**. This is usually done by monitoring when the **exhaust air temperature downstream of the heat exchanger reaches approximately 2^{o}C** to account for variations in measured temperature. A more effective method is to use a **frost thermostat directly in contact with the coldest area of the exchanger** although this might be difficult to determine without testing.

The bypass can also be controlled based on the **fresh air temperature** and start gradually diverting cold air when it reaches **approximately -4^{o}C,** although this is **far less reliable and efficient** than using exhaust air temperature as the frost control parameter.

Defrost cycle

An alternative method to achieve frost protection while maximizing the heat exchanger's efficiency is to **allow frost to build up** while monitoring the **exchanger pressure drop** via a **pressure differential sensor or switch**. When the **pressure exceeds a certain threshold**, the **bypass can be used to divert cold air** and allow the exchanger to be defrosted for a period of time.

To achieve either of these solutions the bypass must be fitted with **face and bypass dampers** which control the amount of air passing through the heat exchanger and the bypass sections.

For **frost prevention** the **bypass can be located on either the fresh or exhaust air side** however to allow for **defrost operation** the **bypass must always be located on the fresh air side**.

Sectional defrost

Sectional defrost of the heat exchanger is also possible. To achieve this the heat exchanger is divided **into 2 or 4 sections plus a bypass section**. Each **section can then be closed in sequence** in order to defrost over a period of time. This allows the remainder sections to remain active therefore increasing the energy efficiency of the exchanger.

Pre-heater

The **most reliable but least efficient solution** is to use a pre-heater to prevent freezing.

Control of this pre-heater can be achieved much in the same way as described for the bypass section above. Its preferable to use the exhaust air temperature as the control parameter.

5.6. DIFFERENTIAL PRESSURE

The **differential pressure** in the heat exchanger section can be defined as the **difference in pressures between any two sections of the plate heat exchanger**.

It is important that the **expected differential pressure** between any two sections **does not exceed the design limits of the heat exchanger**. If this happens, the **plates can become permanently deformed increasing pressure loss, seals might be compromised** leading to **higher leakage** and, in a worst-case scenario, the exchanger plates can burst.

For all PCF exchangers the **maximum recommended differential pressure is 1700Pa**.

5.6.1. CALCULATING DIFFERENTIAL PRESSURE

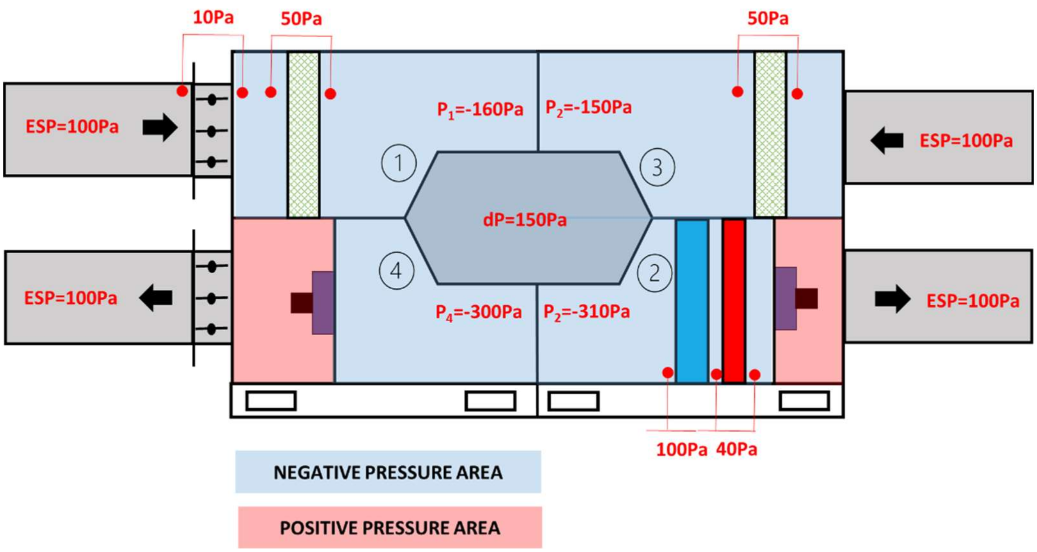
The resulting pressures in each of the heat exchanger sections depends on the **pressure loss of the components in the air handling unit**, the **duct system** (**external static pressure**) and the **position of the fans upstream or downstream of the plate heat exchanger**.

Fans can be arranged **downstream of the heat exchanger – a draw through arrangement** – or **upstream of the heat exchanger** – a **blow through arrangement**.

For any given fan configuration, **the exchanger can be under positive pressure** or **negative pressure** on the supply and the exhaust side.

In the below example, both fans are downstream of the heat exchanger therefore in a **draw-draw arrangement**.

To determine the pressure differential, we must first determine the pressure at each section of the heat exchanger. We will assume that the AHU is ducted on both sides and ESP is evenly distributed.



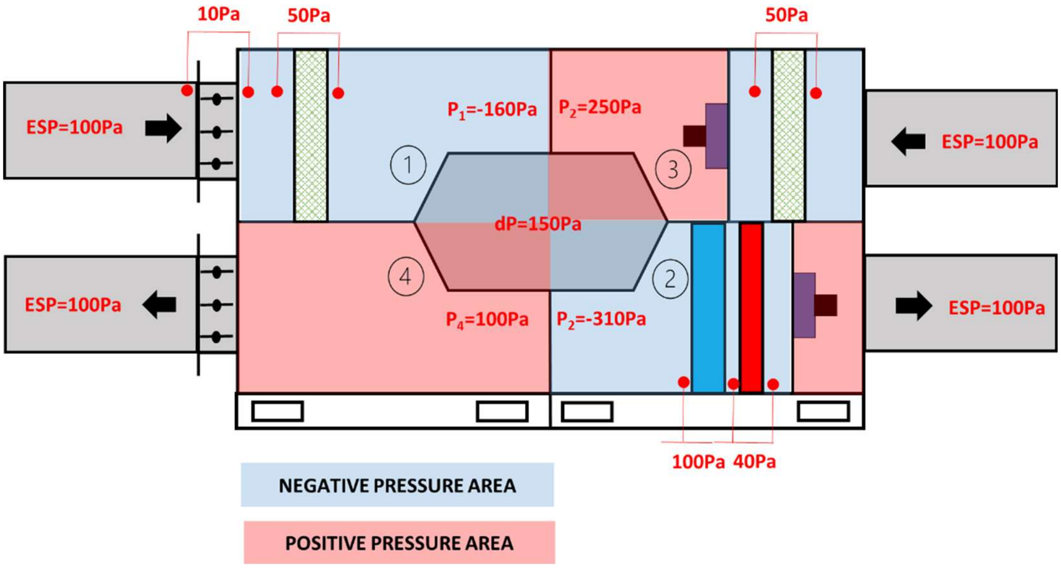
Pressure differential in heat exchanger section (draw-draw arrangement)

From the example above it should be evident that the pressure differentials between each section are as follows:

Sections	Pressure Differential
1-2	150Pa
3-4	150Pa
1-3	10Pa
1-4	140Pa
2-3	160Pa
2-4	10Pa

A draw-draw arrangement is generally the best to minimize the pressure differential.

If instead the fans are arranged in a draw-blow arrangement the differential pressures will be significantly higher.



Pressure differential in heat exchanger section (draw-blow arrangement)

Sections	Pressure Differential
1-2	150Pa
3-4	150Pa
1-3	410Pa
1-4	260Pa
2-3	560Pa
2-4	410Pa

5.6.2. INFLUENCE ON PRESSURE DROP

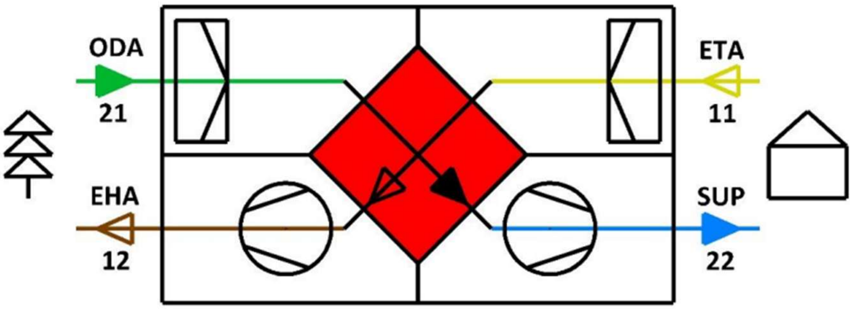
Any pressure differential will slightly deform the plates (not permanently) and therefore affect the size of the plate channels. This will lead to an **increase in pressure drop on one side** of the plate and a **similar decrease on the other side**.

The changes in pressure drop can range **from less than 1% at pressure differentials <300Pa** to **14-15% at the maximum pressure differential of 1700Pa**.

This pressure influence is calculated in the ERI Counterflow Heat Exchanger Calculator software when the pressure differential option is selected.

EN308 pressure differential definition

The pressure differential as defined by EN308 refers to the difference between the pressure at the supply air outlet (22) and exhaust air inlet (11).

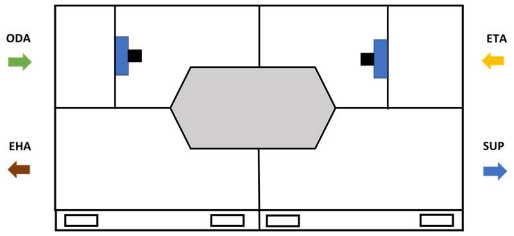


EN 308		EN 13053, EN 13141-7, EN 16798-3		
Sub.	Term	Term	Abbreviation	Colour
11	Exhaust air inlet	Extract air	ETA	Yellow
12	Exhaust air outlet	Exhaust air	EHA	Brown
21	Supply air inlet	Outdoor air	ODA	Green
22	Supply air outlet	Supply air	SUP	Blue

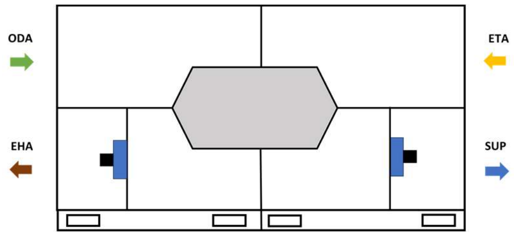
EN308 definition of pressure differential

5.6.3. FAN ARRANGEMENT CONSIDERATIONS

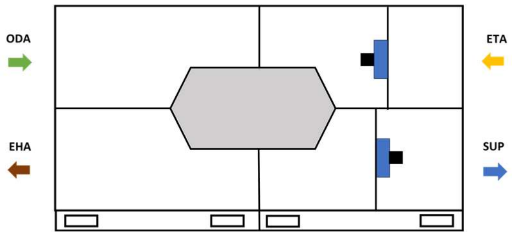
The pressure differential in the heat exchanger section is also important to the **potential for cross contamination** (leakage from exhaust to supply). The following table summarizes the considerations for all possible fan arrangements, with regards to **overall pressure differential** and the **potential for exhaust to supply air leakage.**



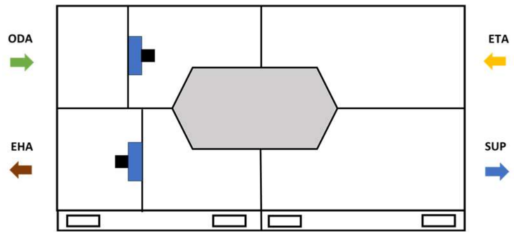
- Both sides under positive pressure
- Low pressure differential between supply and extract
- Positive pressure on the exhaust side increases potential for cross contamination



- **Preferred arrangement**
- Both sides under negative pressure
- Low pressure differential between supply and extract
- Low potential for cross contamination



- **Not recommended**
- Extract under positive pressure, Supply under negative pressure
- High pressure differential from extract to supply
- High potential for cross contamination



- Extract under negative pressure, Supply under positive pressure
- High pressure differential from supply to extract (not recommended)
- No potential for cross contamination

Fan arrangements

5.7. LEAKAGE

In assessing the leakage of plate heat exchangers it's important to understand how leakage rates are normally depicted.

The **leakage rate** of a plate heat exchanger is defined as the **flow of leakage air divided by the nominal air flow declared by the manufacturer**.

The **nominal airflow** can be any airflow the manufacturer has declared. Normally nominal airflows are declared at a **nominal pressure drop of 50Pa, 100Pa, 150Pa or 200Pa**.

Furthermore, the **differential pressure** at which leakage is reported is also important. Normally leakage rates are **declared at 250Pa between the airstreams**.

So, when a % leakage rate is presented for two different products it's not immediately evident which product has lower leakage. **The nominal airflow and differential pressure for the indicated leakage rate must also be considered.**

Internal Leakage

Plate heat exchangers are not completely leak free and usually this is not necessary for most HVAC applications. It would be exceedingly costly to make the heat exchangers completely airtight.

ERI plate heat exchangers are folded and sealed with the aim to achieve a **maximum leakage of 0.30% of the nominal airflow volume (NAF) at a pressure differential of 250 Pa**.

The guaranteed leakage rate, in line with Eurovent AAHE certification rules, is **0.50% of the NAF at a pressure differential of 250 Pa**.

Additional sealing can be added in some models to bring the guaranteed leakage rate to **0.25% of the NAF at a pressure differential of 250 Pa**.

Every single counter-flow produced by ERI is strictly tested for airtightness before being shipped to our customers**.** Any non-compliant products are put through the rework process until they are in compliance with the stated maximum leakage rates.

Leakage tests are carried out at 250Pa but other conditions can be tested upon request. Leakage test reports are also available on request.

Leakage testing

External leakage

Any air bypassing the heat exchanger can affect its performance. Additionally cross contamination between the exhaust and supply airflow can impair the effectiveness of the filtration systems and have a detrimental effect on IAQ.

Its therefore crucial to have a **good seal between the heat exchanger casing** and **the air handling unit casing**. It is also preferable that if a differential in pressures exists between the airflows this runs from the **supply to the exhaust** especially if there is an high amount of condensate being generated in the exchanger.

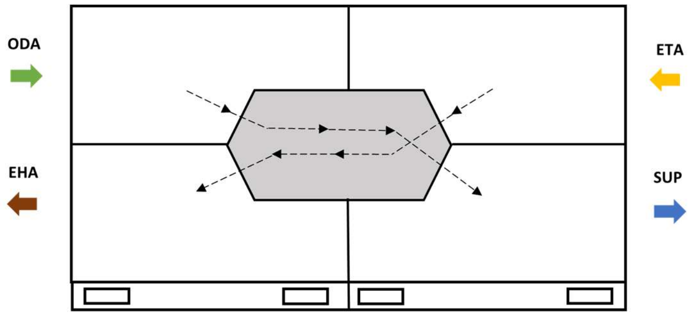
5.8. FILTRATION

The recommended class of filtration before the heat recovery device is **ISO ePM10 >= 50% on the fresh air side** and **ISO ePM2.5 >= 50% on the extract air side**.

Moreover, minimum filter classes depend on outdoor air quality (ODA) and the requirements for room air (IDA). The choice of air quality class in accordance with ISO 16890 should be specified in line with the requirements of the application and the recommendations of EN13053 and EN16798.

5.9. COUNTERFLOW OPERATION

As opposed to crossflow plate heat exchangers, **airflow direction in a counterflow exchanger is very important**. If the exchanger is operated in **parallel flow**, instead of counterflow, the **loss of performance can be in excess of 25%.**

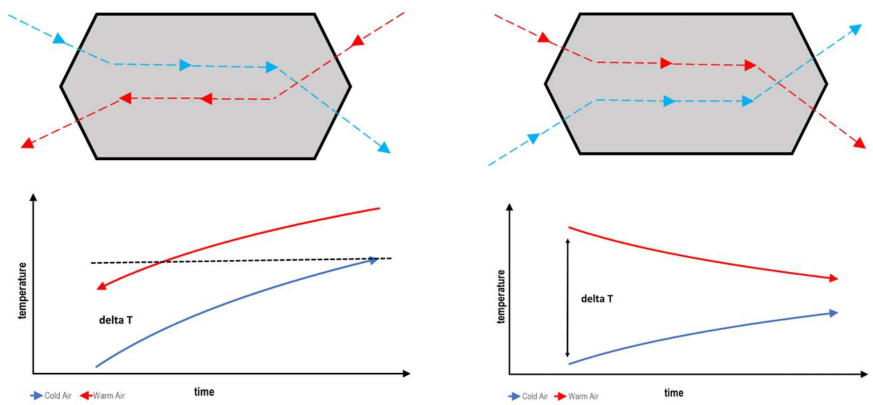


Counterflow exchanger arrangement in crossflow AHU

The reason for this loss of performance can be seen in the illustrations below.

The **counterflow operation** is very efficient because the **temperature differential is kept reasonably uniform throughout the whole process**. Additionally, the outlet temperature of the cold air can be higher than the outlet temperature of the warm air.

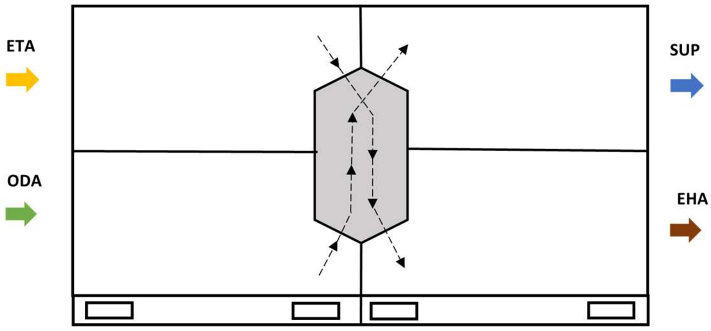
In **parallel flow operation** this is not the case, **temperature differential peaks at the inlet of the exchanger** and decreases over time. This also means the outlet temperature of the cold air is limited by the outlet temperature of the warm air. **The result is a less efficient operation of the heat exchanger.**



Counterflow and Parallel operation

We understand that, at times, the AHU must be arranged in such a way that parallel airflow is required. Should this be the case, the **heat exchanger can be arranged on its side** (turned 90degrees) in order to **retain the counterflow operation** in the heat exchanger **while achieving parallel flow in the AHU**.

It's important that in this arrangement **the side of the exchanger where condensation is expected to happen** is **at the bottom** in order to ensure that **airflow and gravity will help drain the condensation**.



Counterflow exchanger arrangement in parallel flow AHU

5.10. AIRFLOW DISTRIBUTION

Plate heat exchangers are tested for performance in ideal technical conditions in accordance with standard EN308.

When installed in an air handling unit, the **airflow distribution over the plate heat exchanger should be as even as possible,** to ensure that mass flow over each channel is nearly identical. Any arrangements resulting in an **uneven airflow over the plate heat exchanger** can have a **detrimental effect on the performance**, which can only be determined by testing under the installed conditions.

When installing the plate heat exchanger:

- Avoid bends and obstructions immediately upstream and downstream of the heat exchanger.
- Avoid changes in geometry before and after the plate heat exchanger (e.g. extended/reduced width casing sections, control back panels, etc).
- Avoid areas of potential turbulence around the inlet and outlet of the exchanger (e.g. other components too close to exchanger).
- If components sensitive to temperature (e.g. heating and cooling coils especially DX, humidifiers, etc) are located downstream of the heat exchanger with bypass, ensure the distance to the component is sufficient to allow air mixing. The same applies for the location of temperature/humidity sensors.
- Preferably arrange both fans in a draw-through (pulling, sucking) arrangement. If the fans must be arranged in a blow-through arrangement, it's recommended to fit an airflow diffuser before the exchanger.
- If fans are installed immediately upstream or downstream of the heat exchanger it is recommended that the fan is installed at a distance that allows an angle of no less than 45 degrees from the centre of the fan inlet/outlet to the largest dimension of the heat exchanger section.

5.11. CORROSIVITY AND MATERIAL OPTIONS

The materials selected for the manufacture of a plate heat exchanger product should be adapted to the conditions of the air being handled. ***Eurovent recommendation REC 6-16 – 2021: Corrosion Protection of Air Handling Units*** provides guidance on the **appropriate materials for plate heat exchangers** in environments with different corrosivity potential. **Corrosivity categories** and examples are defined below as per **ISO 9223**:

Corrosivity category	Corrosion level	Typical indoor environment	Typical outdoor environment
C1	Very Low	Heated spaces with low relative humidity and insignificant pollution, e.g. offices, schools, museums.	Dry or cold zone, atmospheric environment with very low pollution and time of wetness, e.g. certain deserts, Central Arctic / Antarctica.
C2	Low	Unheated spaces with varying temperature and humidity. Low frequency of condensation and low pollution, e.g. storage, sports halls	Temperate zone, atmospheric environment with low pollution (SO_2 < 5 µg/m^3), e.g. rural areas, small towns. Dry or cold zone, atmospheric environment with short time of wetness, e.g. deserts, subarctic area.
C3	Medium	Spaces with moderate frequency of condensation and moderate pollution from production processes, e.g. food processing plants, laundries, breweries, dairies.	Temperate zone, atmospheric environment with medium pollution (SO_2: 5 to 30 µg/m^3) or some effect of chlorides, e.g. urban areas, coastal areas with low deposition of chlorides. Subtropical and tropical zone, atmosphere with low pollution
C4	High	Spaces with high frequency of condensation and high pollution from production processes, e.g. industrial processing plants, swimming pools	Temperate zone, atmospheric environment with high pollution (SO_2: 30 to 90 µg/m^3) or substantial effect of chlorides, e.g. polluted urban areas, industrial areas, coastal areas, without spray of salt water or, exposure to strong effect of de-icing salts. Subtropical and tropical zone, atmosphere with medium pollution.
C5	Very High	Spaces with very high frequency of condensation and/or with high pollution from production processes, e.g. mines, caverns for industrial purposes, unventilated sheds in subtropical and tropical zones.	Temperate and subtropical zone, atmospheric environment with very high pollution (SO_2: 90 to 250 µg/m^3) and/or significant effect of chlorides, e.g. industrial areas, coastal areas, sheltered positions on coastline.
CX	Extreme	Spaces with almost permanent condensation or extensive periods of exposure to extreme humidity effects and/or with high pollution from production processes, e.g. unventilated sheds in humid tropical zones with penetration of outdoor pollution including airborne chlorides and corrosion stimulating particulate matter.	Subtropical and tropical zone (very high time of wetness), atmospheric environment with very high SO_2 pollution (higher than 250 µg/m^3) including accompanying and production factors and/or strong effect of chlorides, e.g. extreme industrial areas, coastal and offshore areas, occasional contact with salt spray.

ISO 9223 Corrosivity Classes

The recommendations for plate heat exchangers are stated in the below table.

Corrosivity category	Recommended material		
	Plates	Housing	Dampers
Up to C3	Aluminium plates or Polymer membrane (enthalpy)	Aluzinc, galvanised steel or aluminium	Coated steel sheet in RC3 category according to EN 10169 (coating 25 μm) Aluminium zinc-coated steel sheet AZ150 according to EN 10346
Up to C4	Epoxy coated aluminium plates	Powder coated galvanised steel or powder coated aluminium	Aluminium zinc-coated steel sheet AZ185 according EN 10346 Aluminium alloys according to EN 573 Stainless steel sheet 304 according to AISI Coated steel sheet in RC4 category according to EN 10169 (coating > 25 μm) Powder coated steel sheet, paint system for C4 according to EN ISO 12944
Up to C5	Stainless steel 1.4571, 1.4404 (316L or 316Ti)	Stainless steel 1.4571, 1.4404 (316L or 316Ti)	Zinc-Magnesium-coated steel sheet ZM310 according to EN 10346 Powder coated steel sheet, paint system for C5 according to EN ISO 12944
Up to CX	Polypropylene	Polypropylene	Composite materials Stainless steel sheet 316L according to AISI

Eurovent REC 6-16 plate heat exchanger and damper material recommendations

Additionally, Eurovent makes some additional recommendations for **common applications**.

Application	Recommendation
Coastal	In case of a longer distance (e.g. more than 10 km) from the sea, the corrosion effect by marine atmosphere is negligible. Shorter distances need corrosion protection measures to protect metallic materials in air handling units. The easiest way to protect air handling unit casing components is to have a coating on them, which can fulfil the requirements for corrosion class C5. Stainless steel needs to be at least quality 316L (1.4571). Normally special corrosion protection measures are necessary only on the supply air side and in case of weatherproof units for the whole casing system outside. Air handling units in offshore applications need to be fully protected.
Swimming Pool	The heat recovery device is exposed to all the airstreams in the unit. It is also the partition between the defined unit parts. Utilised materials must be corrosion resistant for the exhaust air (most aggressive air) or outdoor air if the corrosivity category outdoors is extremely high. Stainless steel, suitable for corrosivity category C5 and CX, is however not appropriate for the exhaust air from swimming pools. Suitable materials for heat recovery components are specified below: - Plate heat exchangers with epoxy coated aluminium plates and powder coated galvanised steel housing (C4 coating with high durability) - Plate heat exchangers with plates, frame and housing made of plastic
Industrial and Agricultural	In the food industry, the main consideration is the use of materials which are easily cleanable and highly resistant to disinfectants. Stainless steel or powder coated galvanised steel fulfil those requirements. Especially in the extract air from smoked meat end products, corrosion protection based on stainless steel or non-metallic components is recommended.
Laboratories	Ventilation of laboratories is mandatory. The extract air from such applications can be expected to be polluted and special protection measures should be applied. In this case, stainless steel 304 is not the best solution if chlorides can occur in the air. The use of non-metallic components or a good coating on metallic materials are the options for corrosion protection in this application.

Eurovent REC 6-16 plate heat exchanger and damper material recommendations

Based on the Eurovent recommendations and our own experience **ERI advises the following material options**.

Application	Corrosion Level	PCF Material Option
C1	Very Low	**ALUMINIUM (AL)**
C2	Low	
C3	Medium	
C4	High	**GOLD COMPLETE (GC)**
C5	Very High	**PLEASE CONTACT ERI**
CX	Extreme	**PLEASE CONTACT ERI**
Coastal		**GOLD PROTECTED (GP)**
Swimming Pool		**GOLD COMPLETE (GC)**
Laboratories		**GOLD PROTECTED (GP)**
Healthcare/Hygiene		**HYGENIC COMPLETE (HC)**

ERI PCF material recommendations

These recommendations are provided as guidance only. The specific environment and conditions of the application for each project should be checked in order to select the most appropriate materials.

5.12. SOUND INSERTION LOSS

Plate heat exchangers provide some sound attenuation when installed in the air handling unit or ductwork. It is impossible to know the magnitude of this effect unless measured in a specific installation.

However, based on prior reports and testing we believe the below table provides a reasonable estimation of the insertion loss provided by our plate heat exchangers.

Model	Octave Band							
	63 Hz	125 Hz	250 Hz	500 Hz	1000 Hz	2000 Hz	4000 Hz	8000 Hz
PCF 18	1.4	3.0	4.1	5.2	6.1	7.1	7.7	8.3
PCF 25	1.4	3.0	4.1	5.2	6.1	7.1	7.7	8.3
PCF 30	1.4	3.0	4.1	5.2	6.1	7.1	7.7	8.3
PCF 35	1.4	3.0	4.1	5.2	6.1	7.1	7.7	8.3
PCF 45	1.4	3.0	4.1	5.2	6.1	7.1	7.7	8.3
PCF 55	1.4	3.0	4.1	5.2	6.1	7.1	7.7	8.3
PCF 62	1.7	3.5	4.8	6.1	7.2	8.3	9.2	9.9
PCF 65	1.7	3.5	4.8	6.1	7.2	8.3	9.2	9.9
PCF 80	1.7	3.5	4.8	6.1	7.2	8.3	9.2	9.9
PCF 90	1.7	3.5	4.8	6.1	7.2	8.3	9.2	9.9
PCF 110	1.8	3.6	5.0	6.4	7.5	8.6	9.5	10.2
PCF 124	1.8	3.6	5.0	6.4	7.5	8.6	9.5	10.2
PCF 140	1.8	3.6	5.0	6.4	7.5	8.6	9.5	10.2
PCF 180	1.8	3.6	5.0	6.4	7.5	8.6	9.5	10.2
PCF 220	1.9	3.7	5.3	6.6	7.8	9.0	9.9	10.6
PCF 248	1.9	3.7	5.3	6.6	7.8	9.0	9.9	10.6
PCF 270	2.0	3.9	5.4	6.9	8.1	9.3	10.3	11.0
PCF 330	2.0	3.9	5.4	6.9	8.1	9.3	10.3	11.0
PCF 372	2.0	3.9	5.4	6.9	8.1	9.3	10.3	11.0

5.13. ATEX

ERI PCF plate heat exchangers are not specifically certified for use in ATEX environments. Furthermore, there is little guidance available on the suitability of plate heat exchangers for ATEX environments.

The best guidelines available are from the German AHU Manufacturers Association (Herstellerverband Raumlufttechnische Geräte e. V.) in ***RLT-Guideline 02 – Explosion protection requirements for Air Handling Units***. The relevant portions of the guideline directly or indirectly relating to heat recovery systems are transcribed below.

"(…)

4.6. Heat recovery unit

- *With heat recovery units it is important to* ***ensure that all conductive metal parts are included in the equipotential bonding measure.***
- *Electrical components, such as drives must have a suitable proof of conformity for the corresponding EX-zone.*
- *Drive belts, such as for thermal wheels, shall be made so that they are conductive.*

(…)"

"(…)

4.2. Coatings

Coatings of metallic surfaces *must be conductive with a* ***surface resistance < 10^9 Ω****. Alternatively, with gas group IIC, the paint layer thickness should be limited to a maximum of 0.2 mm and with gas group IIB to a maximum of 2 mm.*

(...)"

"(…)

4.1. Unit housing

- *(…)* ***Exposed plastic parts*** *in an EX-zone must comply with the area restrictions as specified in EN 80079-36, Table 8, with* ***a surface resistance < 10^9Ω electrostatic discharge*** *or a charge test as specified in EN 80079-36, Annex D should be conducted.*

(...)"

"(…)

4.4. Covers

(…)

- *For installation of **actuators** in potentially explosive atmospheres (inside or outside), the actuator **must be suitable for the corresponding zone, comply with the requirement of the corresponding category and have a corresponding proof of conformity.***
- *For potentially explosive atmosphere zone 2 on the inside of the AHU and mounted on the outside of the AHU standard actuators may be used, if it is guaranteed that the enclosure leakage under normal conditions of use does not allow a potentially explosive atmosphere to be carried over to the outside.*
- *When the outside is a potentially explosive atmosphere zone 2 and installation is internally, standard actuators may also be used.*

(…)"

Furthermore, the above guideline also recommends **minimizing the quantity of plastics in the product to reduce the risk of static charges** and that **air control dampers are connected to the protective conductor system (equipotential bonding)**.

Our recommendations

The **aluminium** used to manufacture our plate heat exchangers is considered **non-sparking and highly conductive**. Therefore, there is low to no risk of explosion due to sparks or accumulated static charges. **Coatings on the exchanger or casing should be avoided** due to their insulating properties.

We recommend **dampers** used in ATEX environments **have aluminium gears** rather than plastic gears. As with the plates coatings should be avoided.

The selection of ATEX compliant actuators is the responsibility of the AHU manufacturer.

5.14. GENERAL DESIGN RECOMMENDATIONS

The following is a summary of the design recommendations and requirements from multiple standards in the ventilation industry.

Recommendation	Origin
Air handling units with supply and extract air and heating function should be fitted with heat recovery systems.	EN13053:2019 (6.5.1) VDI 3803 (4.3.1)
When positioning heat recovery equipment, care shall be taken to minimize air leakage and unacceptable recirculating air flows.	EN13053:2019 (6.5.1) VDI 3803 (5.2.6)
The heat recovery system shall have a thermal bypass facility.	EN13053:2019 (6.5.1)
To reduce the need for the use of mechanical cooling in the summer, in addition to heat recovery, evaporation cooling should be considered on the extract air side.	EN13053:2019 (6.5.1) VDI 3803 (5.2.6)
Pressure tapping points shall be installed in all 4 sides of the heat exchanger.	EN13053:2019 (6.5.2)
A drain pan for condensate should be installed.	EN13053:2019 (6.5.2) VDI 3803 (5.2.6)
For hygienic reasons plate heat exchangers with a fin space of 3 mm should be installed in a manner that enables cleaning (e.g. installation in segments) when the depth exceeds 1 200 mm. In case of larger distances between the fins the maximum depth can be expanded linearly.	EN13053:2019 (6.5.4)
Transfer of fire between exhaust air and inlet air must be excluded (e.g. fire-protection dampers, separated heat exchangers, non-combustible materials) or other suitable preventative measures.	EN 1886:2006 (10.7) VDI 3803 (4.4.7)
It's important to consider fan temperature rise (approximately 1K to 2K) and its impact in cooling and heating recovery.	VDI 3803 (5.2.6)
When rating preheater capacity, anti-icing protection and start-up operation must be taken into account. Reheater must be rated without considering the effects of condensation in the exhaust air.	VDI 3803 (5.2.6) EN16798-3 (9.6.4) EN16798-4 (9.6.4)
For plate heat exchangers from a construction depth of 900 mm, referred to 4 mm lamellae distance, special measures are required (for example divided). For larger lamellae-distances, the admissible construction depth can be chosen proportionally and linearly larger.	VDI 3803-1 (5.2.6)
Condensate tray on supply air and extract air side in stainless steel or aluminium, drainage outlet DN 40, drainage behaviour in accordance with section 3.	DIN 1946-4 (6.5.5)

Recommendation	Origin
In rooms where no cross-room air recirculation is permitted only such systems are permitted that will not allow the transfer of particles from the extract air to the supply air.	DIN 1946-4 (6.5.5)
Heat recovery systems should be placed on the outdoor air side downstream of the first filter stage. Extract air filter min. ePM10 ≥ 50%. When indirect evaporation cooling is used, filter class ePM1 ≥ 50% is recommended.	DIN 1946-4 (6.5.9)
The heat recovery shall be controlled to avoid overheating of supply air during warm weather conditions when heat recovery cannot be used feasibly.	EN16798-3 (9.6.2)
In order to avoid icing of the condensation on the extract air side when low temperature outside air the heat recovery shall be controlled.	EN16798-4 (9.6.4)
Recommendations in accordance to exhaust air class. ETA 1: Leakages to be calculated into nominal volume flow. ETA 2: Overpressure desirable on the air inlet side of heat recovery. ETA 3: Overpressure on the air inlet side required with max. 5 % leakage. ETA 4: Cross contamination must be avoided. Systems with an intermediate medium shall be used.	EN16798-4 (9.6.5)
Intake and exhaust flow chambers shall be considered with minimum inflow angle from previous component to heat recovery system α = 35°and minimum outflow angle from heat recovery system to following component β = 25°.	RLT-01
[extended hygiene requirement] Surface finish of rotary and plate heat exchangers: - frame made of hot-dip galvanized steel sheeting and coated. - Lamella/plates coated or made of aluminium or made of microbial materials not replaceable with plastic.	RLT-01
[extended hygiene requirement] Installation rails in stainless steel or aluminium.	RLT-01
Condensate tray must have a slope to all sides and have a drain. Draining is considered sufficient where any water remaining due to surface tension can be dried off completely by running the system dry. This requirement is deemed to have been met when, after adding 5 l of water for each 1 m^2 of tray base area, at least 95% of the water will drain away within 10 minutes.	RLT-01
No plastic heat exchanger or dampers allowed.	HTM 03-01
Cleaning access should be available to both sides of heat recovery device.	HTM 03-01

Recommendation	Origin
In coastal areas stainless steel construction is preferred.	HTM 03-01
Extract side to be protected by ISO ePM10 >=50% filter and drainage system.	HTM 03-01
Account for the heat recovery capacity in the heating/cooling coil capacity calculation.	HTM 03-01
Elements requiring routine service (e.g. heat recovery) with access doors 500mm wide minimum. For unit height < 1m doors 600mm wide minimum.	HTM 03-01
Heat recovery section with a drain tray - must have: − view ports at suitable height; − internal illumination by IP55 rated fittings, LED lights preferred.	HTM 03-01
Drain manufactured of corrosion resistant material, stainless steel is preferred.	HTM 03-01
Drain slope should be app. 1:20 in all directions.	HTM 03-01

6. PRODUCT SPECIFICATION

The air-to-air heat recovery plate heat exchanger shall operate in a counter-cross flow arrangement to achieve maximum heat recovery efficiency with the least amount of pressure loss.

Construction

The plate heat exchanger shall consist of a single or multiple plate stacks with a specified plate distance of [OPTION] 2.1mm / 3.0mm.

The plate stacks shall be housed in a rigid casing and sealed for airtightness. Where necessary to handle high airflows, aerodynamic airflow dividers shall be installed in the casing to allow the use of multiple parallel plate stacks.

[OPTION] The plate heat exchanger casing will include a plastic strap to facilitate handling.

[OPTION] The plate heat exchanger shall be fitted with a parallel bypass section, located at the [OPTION] side/ centre, to allow diverting airflow for temperature modulation, frost prevention and defrost operation.

[OPTION] The plate heat exchanger casing and optional bypass section shall include external flanges to facilitate handling of large modules.

[OPTION] The plate heat exchanger and bypass section shall be fitted with opposite blade face and bypass dampers driven by a [OPTION] square/round [OPTION] side shaft / motor bracket actuator to allow smooth control of airflow through each section. The dampers shall be ready to be assembled directly to the plate heat exchanger casing.

[OPTION] The plate heat exchanger and bypass section shall be fitted with opposite blade segmented dampers divided into [OPTION] 3/5 sections driven by individual motor bracket actuators to allow segmented defrost and smooth control of airflow through each section. The dampers shall be ready to be assembled directly to the plate heat exchanger casing.

[OPTION] The optional bypass section will be fitted with an additional return air damper with the same characteristics as the face and bypass damper.

Materials

Aluminium (AL)

The plates, casing, airflow dividers and optional bypass section shall be manufactured from plain aluminium and assembled with aluminium fixings.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and plastic gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and aluminium gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

The plate stack shall be sealed with a solvent and silicone free, two component, polyurethane based adhesive compliant with the requirements of standard VDI 6022. Sealing shall ensure internal leakage is limited 0.5% of nominal air flow [NAF] at a differential pressure of 250Pa.

[OPTION] The plate stack shall be additionally sealed on all 4 sides to limit leakage to 0.25% of nominal air flow [NAF] at a differential pressure of 250Pa.

The casing, airflow dividers and optional bypass section shall be sealed with a solvent and silicone free, single component, hybrid polymer adhesive.

[OPTION] Face and bypass dampers shall be sealed with a closed cell EPDM sponge rubber gasket.

[OPTION] Aluminium Coated (AC)

The plates shall be manufactured from plain aluminium.

The casing, airflow dividers and optional bypass section shall be manufactured from double side pre powder coated aluminium and assembled with coated aluminium fixings.

[OPTION] The face and bypass dampers shall be manufactured from anodized aluminium profiles and plastic gear mechanism. Shafts or motor brackets shall be manufactured from anodized aluminium. Damper fixings shall be stainless steel.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and aluminium gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

The plate stack shall be sealed with a solvent and silicone free, two component, polyurethane based adhesive compliant with the requirements of standard VDI 6022. Sealing shall ensure internal leakage is limited 0.5% of nominal air flow [NAF] at a differential pressure of 250Pa.

[OPTION] The plate stack shall be additionally sealed on all 4 sides to limit leakage to 0.25% of nominal air flow [NAF] at a differential pressure of 250Pa.

The casing, airflow dividers and optional bypass section shall be sealed with a solvent and silicone free, single component, hybrid polymer adhesive.

[OPTION] Face and bypass dampers shall be sealed with a closed cell EPDM sponge rubber gasket.

[OPTION] Gold Epoxy (GE)

The plates shall be manufactured from hydrophobic precoated gold epoxy lacquered aluminium.

The casing, airflow dividers and optional bypass section shall be manufactured from plain aluminium and assembled with plain aluminium fixings.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and plastic gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and aluminium gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

The plate stack shall be sealed with a solvent and silicone free, two component, polyurethane based adhesive compliant with the requirements of standard VDI 6022. Sealing shall ensure internal leakage is limited 0.5% of nominal air flow [NAF] at a differential pressure of 250Pa.

[OPTION] The plate stack shall be additionally sealed on all 4 sides to limit leakage to 0.25% of nominal air flow [NAF] at a differential pressure of 250Pa.

The casing, airflow dividers and optional bypass section shall be sealed with a solvent and silicone free, single component, hybrid polymer adhesive.

[OPTION] Face and bypass dampers shall be sealed with a closed cell EPDM sponge rubber gasket.

[OPTION] Gold Protected (GP)

The plates shall be manufactured from hydrophobic precoated gold epoxy lacquered aluminium.

The casing, airflow dividers and optional bypass section shall be manufactured from double side pre powder coated aluminium and assembled with coated aluminium fixings.

[OPTION] The face and bypass dampers shall be manufactured from anodized aluminium profiles and plastic gear mechanism. Shafts or motor brackets shall be manufactured from anodized aluminium. Damper fixings shall be stainless steel.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and aluminium gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

The plate stack shall be sealed with a solvent and silicone free, two component, polyurethane based adhesive compliant with the requirements of standard VDI 6022. Sealing shall ensure internal leakage is limited 0.5% of nominal air flow [NAF] at a differential pressure of 250Pa.

[OPTION] The plate stack shall be additionally sealed on all 4 sides to limit leakage to 0.25% of nominal air flow [NAF] at a differential pressure of 250Pa.

The casing, airflow dividers and optional bypass section shall be sealed with a solvent and silicone free, single component, hybrid polymer adhesive.

[OPTION] Face and bypass dampers shall be sealed with a closed cell EPDM sponge rubber gasket.

[OPTION] Gold Complete (GC)

The plates shall be manufactured from hydrophobic precoated gold epoxy lacquered aluminium.

The casing, airflow dividers and optional bypass section shall be manufactured from double side pre powder coated aluminium and assembled with coated aluminium fixings.

[OPTION] The face and bypass dampers shall be manufactured from anodized aluminium profiles and plastic gear mechanism. Shafts or motor brackets shall be manufactured from anodized aluminium. Damper fixings shall be stainless steel.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and aluminium gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

The plate stack shall be sealed with a solvent and silicone free, two component, polyurethane based adhesive compliant with the requirements of standard VDI 6022. The plate stack shall be additionally sealed on all 4 sides to limit leakage to 0.25% of nominal air flow [NAF] at a differential pressure of 250Pa.

The casing, airflow dividers and optional bypass section shall be sealed with a solvent and silicone free, single component, hybrid polymer adhesive.

[OPTION] Face and bypass dampers shall be sealed with a closed cell EPDM sponge rubber gasket.

[OPTION] Hygienic (HC)

The plates shall be manufactured from precoated antimicrobial lacquered aluminium.

The casing, airflow dividers and optional bypass section shall be manufactured from double side pre powder coated aluminium and assembled with coated aluminium fixings.

[OPTION] The face and bypass dampers shall be manufactured from anodized aluminium profiles and plastic gear mechanism. Shafts or motor brackets shall be manufactured from anodized aluminium. Damper fixings shall be stainless steel.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and aluminium gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

The plate stack shall be sealed with a solvent and silicone free, two component, polyurethane based adhesive compliant with the requirements of standard VDI 6022. The plate stack shall be additionally sealed on all 4 sides to limit leakage to 0.25% of nominal air flow [NAF] at a differential pressure of 250Pa.

The casing, airflow dividers and optional bypass section shall be sealed with a solvent and silicone free, single component, hybrid polymer adhesive.

[OPTION] Face and bypass dampers shall be sealed with a closed cell EPDM sponge rubber gasket.

[OPTION] Hydro (HB)

The plates shall be manufactured from precoated hydrophilic lacquered aluminium.

The casing, airflow dividers and optional bypass section shall be manufactured from plain aluminium and assembled with plain aluminium fixings.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and plastic gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

[OPTION] The face and bypass dampers shall be manufactured from plain aluminium profiles and aluminium gear mechanism. Shafts or motor brackets shall be manufactured from plain aluminium. Damper fixings shall be stainless steel.

The plate stack shall be sealed with a solvent and silicone free, two component, polyurethane based adhesive compliant with the requirements of standard VDI 6022. The plate stack shall be additionally sealed on all 4 sides to limit leakage to 0.25% of nominal air flow [NAF] at a differential pressure of 250Pa.

The casing, airflow dividers and optional bypass section shall be sealed with a solvent and silicone free, single component, hybrid polymer adhesive.

[OPTION] Face and bypass dampers shall be sealed with a closed cell EPDM sponge rubber gasket.

<u>Installation</u>

The plate heat exchanger shall be installed in vertical orientation with plates perpendicular to the floor.

[OPTION] The plate heat exchanger shall be installed in horizontal orientation with plates parallel to the floor. The bottom section of the airflow dividers shall be open to facilitate water drainage. Optional bypass sections shall be located on top. Overall exchanger width shall be limited to 2000mm. Any dampers shall be manufactured with vertical blades.

Delivery

The plate heat exchanger, optional bypass sections and optional face and bypass dampers shall be delivered loose, ready for customer assembly.

[OPTION] Single plate heat exchanger blocks, optional bypass sections and dampers shall be pre-assembled from the factory.

[OPTION] Large plate heat exchangers, optional bypass sections and dampers shall be delivered in modules ready for customer assembly.

Internal Leakage

Each individual plate heat exchanger shall be tested for internal leakage between air streams. Internal leakage shall be limited to no more than [OPTION] 0.5%/0.25% of the declared nominal airflow (NAF) at a pressure differential of 250Pa between air streams.

Operating Limits

The plate heat exchanger shall be suitable to operate up to a differential pressure of 1700Pa between air streams.

The plate heat exchanger shall be suitable to operate continuously with an airflow temperature range of -40°C to 80°C.

Certification

The plate heat exchanger performance and selection software shall be certified under the Eurovent certification programme for Air-to-Air Plate and Tube Heat Exchangers (AAHE).

The plate heat exchanger selection software shall be certified by TÜV SÜD under RLT-RICHTLINIE Zertifizierung:2017-11.

Hygiene

The plate heat exchanger shall be manufactured in compliance with the hygiene requirements for ventilation systems of standard VDI 6022, VDI3803, DIN 1946-4 and Ö-Norm H 6020.

7. ORDER CODE

ERI CORPORATION
Issued by: M Parker

PCF MARKING RULES

Version: v.1.8a
Date of issue: 20/03/2026

CODE:	PCF	I	3	140	750	GE	T	BP	140	C	CM	W	RM	DM3	HO

PRODUCT
Plate Counterflow Heat Exchanger

CONSTRUCTION TYPE
"Blank" - Standard (default)
I - Light Industrial
N - Heavy Industrial
R - Reverse
C - Customized

PLATE SPACING
2.1 - H=2.1 mm (default - if blank = 2.9mm)
2.9 - H=2.9 mm
3 - H=3.0 mm

MODEL SIZE
Base: 18, 25, 30, 35, 45, 55, 62
Kombi: 65, 80, 95, 110, 124, 140, 180, 220, 248, 270, 330, 372

EXCHANGER WIDTH, mm
Min.: **18-62** = 50; **45-220 (I)** = 200; **140-220 (N)** = 250
Max.: 5000 in software larger sizes possible

MATERIAL OPTIONS
AL - Plain Aluminum Lamellas and Casing (default)
AC - Plain Aluminum Lamellas, Coated AL Casing
GE - Gold Epoxy AL Lamellas, Plain Aluminium Casing
GP - Gold Epoxy AL Lamellas, Coated AL Casing
GC - Gold Epoxy AL Lamellas, Coated AL Casing, Fully Protected
HB - Hydrophilic AL Lamellas, Plain Aluminium Casing, Adiabatic Cooling
HC - Antimicrobial AL Lamellas, Coated AL Casing, Fully Protected, Hygienic

GENERAL OPTIONS
T - Extra Inner Sealing, Leakage < 0,25% NAF@250Pa
P - Plastic Handle

BYPASS TYPE
BP - Fixed bypass (fixed to exchanger, cannot be removed)
BR - Loose bypass (separate part)

BYPASS WIDTH, mm
Min.: **18-62 (S)** = 50; **45-220 (I)** = 110; **140-220 (N)** = 160
Max.: 1000

BYPASS POSITION
A - Bypass on the side is open on top-right
B - Bypass on the side is open on top-left
C - Bypass in the middle of the exchangers

BYPASS DAMPER (I AND N CONSTRUCTION ONLY)
SL - Damper w/ Side Shaft Left (BP A or BP B - Side)
SR - Damper w/ Side Shaft Right (BP A or BP B - Side)
SM - Damper w/ Actuator Mounting Bracket (BP A or BP B - Side)
CL - Damper w/ Side Shaft Left (BP C - Middle)
CR - Damper w/ Side Shaft Right (BP C - Middle)
CM - Damper w/ Actuator Mounting Bracket (BP C - Middle)

BYPASS DAMPER SHAFT/BRACKET OPTIONS (I AND N CONSTRUCTION ONLY)
N - Shaft square (default) SL/SR/CL/CR
R - Shaft round (optional) SL/SR/CL/CR
V - Damper Actuator Mounting Bracket, Regular, Square Shaft 12x12x90mm, L=55mm H=180mm, SM/CM [DP-01] (default if missing)
H - Damper Actuator Mounting Bracket, Compact, Square Shaft 12x12x90mm, L=55mm, H=100mm, SM/CM [DP-02]
W - Damper Actuator Mounting Bracket, Heavy, Weger, Square Shaft 12x12x135mm, L=100mm, H=100mm, SM/CM [DP-03]
D - Damper Actuator Mounting Bracket, Regular, Daikin, Square Shaft 12x12x145mm, L=110mm, H=180mm, SM/CM

RETURN AIR DAMPER (I AND N CONSTRUCTION ONLY)
RN - Return Air Damper w/ Side Shaft - **confirm drawing details with factory**
RM - Return Air Damper w/ Actuator Bracket - **confirm drawing details with factory**

DAMPER OPTIONS (I AND N CONSTRUCTION ONLY)
DM3 - Deicing damper 3 indvidual sections (1 bypass section, Position C) - with Motor Brackets
DS3 - Deicing damper 3 indvidual sections (1 bypass section, Position C) - with Side Shaft
DL3 - Deicing damper 3 individual sections (1 bypass section, Position C) - with Linkage System
DM5 - Deicing damper 5 indvidual sections (1 bypass section, Position C) - with Motor Brackets
DM5 - Deicing damper 5 indvidual sections (1 bypass section, Position C) - with Side Shaft
DL5 - Deicing damper 5 individual sections (1 bypass section, Position C) - with Linkage System
MET - All metal damper (without any plastic parts)
DC3 - Damper class 3 tightness (with spec.plastic parts) - Only for standard damper (NOT FOR ALL METAL)
OX - Damper anodized profiles (NOT FOR ALL METAL)

ASSEMBLY AND DELIVERY OPTIONS
HO - Horizontal assembly, Horizontal lamella orientation - **confirm drawing details with factory**
UO - Delivery unassembled, in individual parts (Modular Style, PCF N Only)

ERI CORPORATION
ENERGY RECOVERY AND VENTILATION COMPONENTS

Energy Recovery Industries Limited

Via Modigliani 81031 Aversa, CE Italy

Email: info@ericorporation.com

Web: www.ericorporation.com