



Güntner Knowledge

Recommendations for Material Selection

Güntner Knowledge for Different Applications and Ambient Conditions

Avoid corrosion
by selecting the ideal material



Recognise and understand corrosive atmospheres

Corrosion and protection against corrosion are very important topics in refrigeration and air conditioning technology. To avoid damage due to corrosion on heat exchangers and other system components, it is important to recognise the reasons for corrosion. Heat exchangers are used in different ambiances that have a more or less corrosive effect on metal.

On this page we give examples of corrosive ambiances that have an impact on the materials used. The most important substances having a detrimental impact on metal are carbon dioxide, ammonia, nitrogen oxide, hydrocarbons, sulphur compounds, fluorides, chlorine, carbon monoxide and their reaction products. The emission of fluorides is among others caused by power plants, aluminium, iron and steel industries as well as brick and stoneware industries.

But not only industrial plants cause corrosive atmosphere with their emissions. Also nature can affect materials. For example in proximity to the ocean, high concentrations of chlorides occur. These chlorides affect among others aluminium and lead to pitting corrosion. Without protective coating, heat exchangers are destroyed after a certain duration of exposure.

In practice additional environmental influences, such as heat, humidity, dirt, etc. can increase this detrimental effect. Especially humid fouling on heat exchangers leads on a long-term basis to corrosion.

Sensible protection against corrosion starts with the selection of the right material for maintaining the functionality of the heat exchanger and the leak tightness of the refrigerating system.

In this brochure you will find recommendations for different applications. We are at your disposal if you have questions.

Fluorides, chlorine, sulphur, carbon monoxide



Salt



Installation in coastal regions



Ammonia, carbon dioxide, nitrogen oxide



Vinegar



Smoke



Cleaning agents



Acids and gases caused by fermentation



In this brochure we compiled the most important application situations where a special corrosion protection is required. We give recommendations concerning the optimal material selection for your Guntner heat exchanger.

This brochure helps you to determine the specific material combination, corresponding optimally to your application situation.

We distinguish between air coolers, installed in cold rooms and condensers/drycoolers that are set up outside.

Selecting the suitable material

The resistance of the materials used in a heat exchanger is exposed to severe conditions from inside and outside. From inside, the refrigerant affects the tubes or profiles with its chemical properties, pressure and temperature; from outside the more or less aggressive ambient air influences the heat exchanger's materials.

Experience, extensive tests and analyses at Güntner have led to the use of various different combinations of materials. With the selection of the corresponding materials, every heat exchanger can be designed optimally for almost any application situation. Ask us, we will be glad to assist you.

Material	Resistant against	Price	Thermal conductivity
Copper	Cu	Drinking water, chlorides, bases, ...	↑
Aluminium	Al	Drinking water, ammonia, ...	↑
Aluminium AlMg3	AlMg3	Drinking water, ammonia, ...	↑
Aluminium Epoxy	Al/Epoxy	Weak acids, weak bases, cleaning agents, ammonia, ...	↗
Stainless steel AISI 304	AISI 304	Smoke, cleaning agents, ammonia, chlorides, various acids	→
Stainless steel AISI 316L	AISI 316L	Smoke, cleaning agents, ammonia, chlorine, vinegar, chlorides, various acids	→
Steel, galvanised	StZn ¹	Smoke, cleaning agents, vinegar, chlorides, various acids	↗
Steel sedzimir-galvanised	StZn ²	Drinking water, chlorides, ...	↗

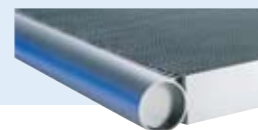
The indicated resistances are examples and depend on the concentration, temperature and duration of exposure to aggressive substances.

Examples of products with different material combinations:

Air cooler made of AISI 304



microox® aluminium heat exchanger**



Sample coil with 4 different fin materials (AISI 316L, Cu, Al/Epoxy, Alu)



Heat exchanger made of steel, casing steel galv., for use in breweries



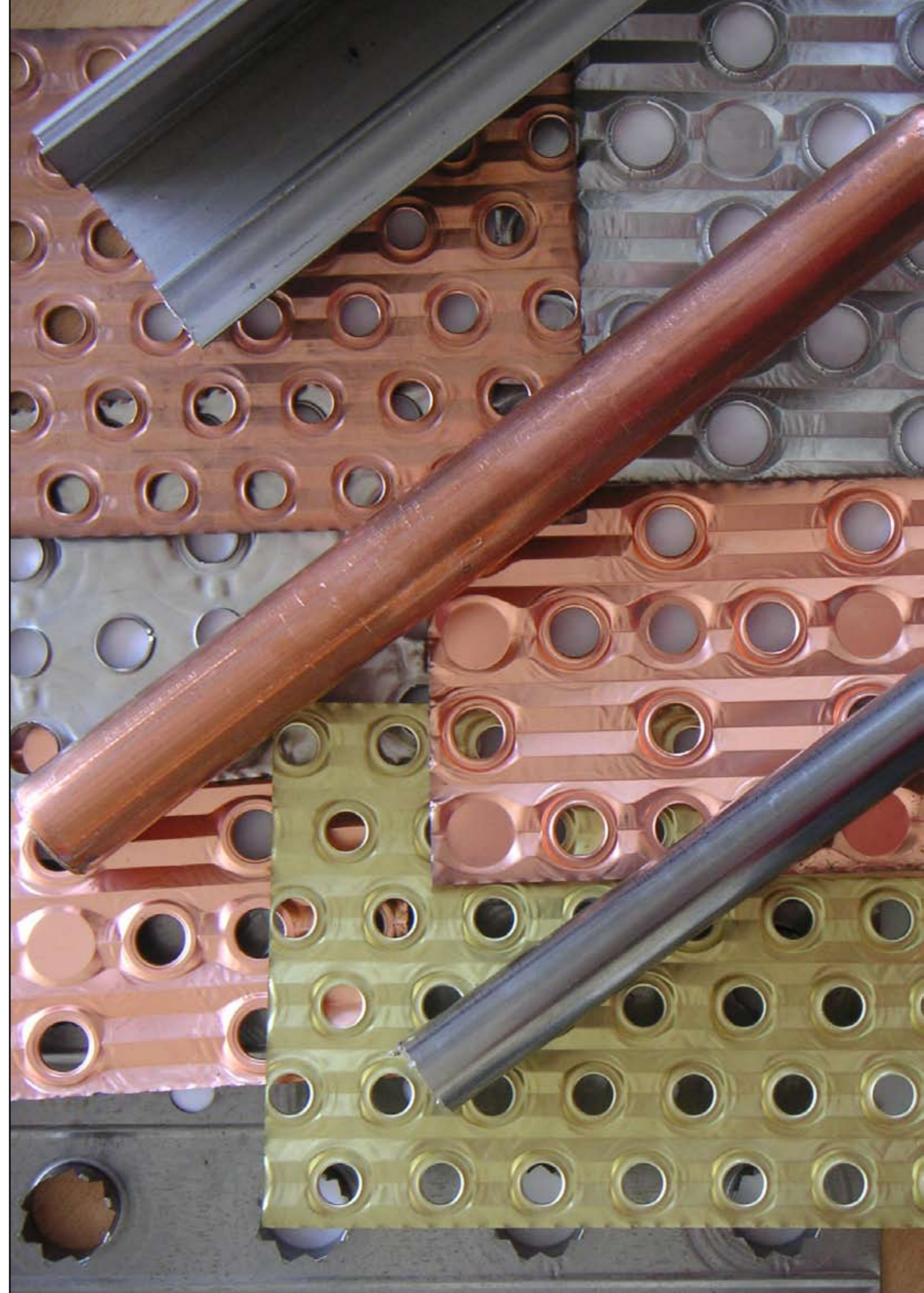
V-shaped coil condenser with aluminium epoxy fin for installation in coastal regions



Drycooler with copper tubes and copper fins



** Special selection criteria have to be observed for microox®. Please refer to our special microox® leaflet.



Recommendations for Evaporators and Air Coolers

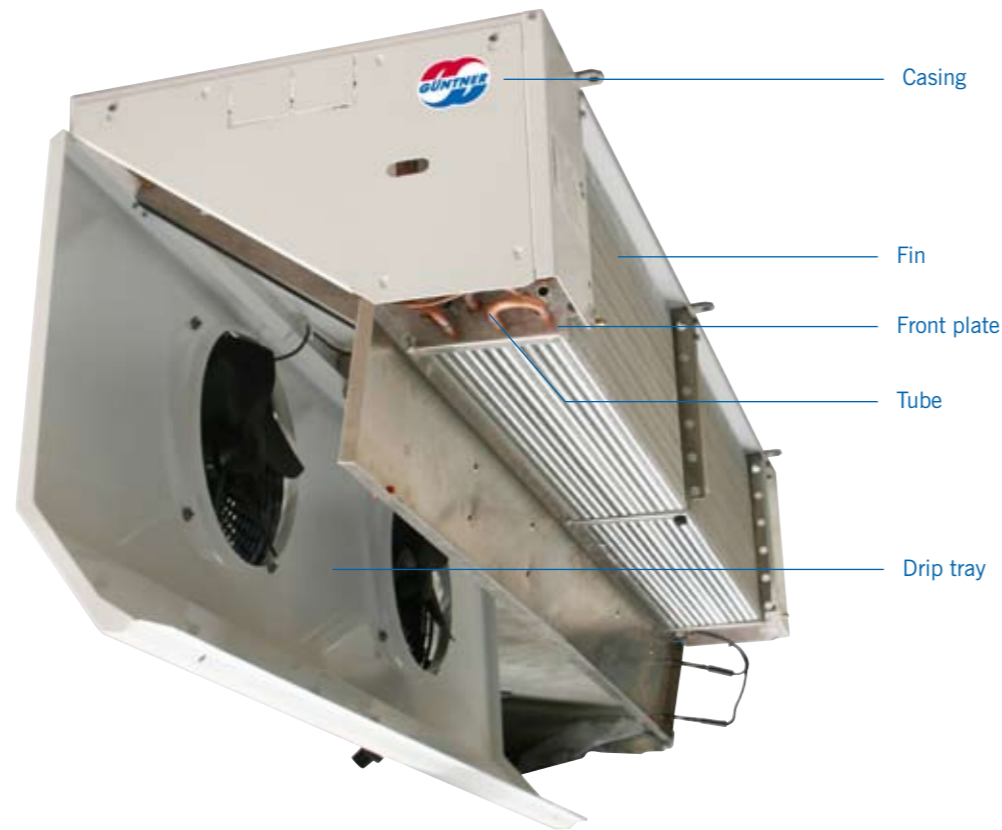
Evaporator
Casing AISI 316L



Standard application situations

If no aggressive components are to be expected in the ambient air and if the heat exchangers do not have to be cleaned frequently with aggressive cleaning agents, the proven standard material combinations can be used.

	Refrigerant	Tube	Fin	Front plate	Casing	Drip tray
Evaporator	HFC	Cu	Al	AlMg3/StZn ²	AlMg3/StZn ²	AlMg3
Evaporator	NH ₃	StZn ¹	StZn ¹	StZn ¹	AlMg3	AlMg3
Evaporator	NH ₃	AISI 304	Al	AISI 304	StZn ²	AlMg3
Evaporator DX	CO ₂	Cu	Al	AlMg3/StZn ²	AlMg3/StZn ²	AlMg3
Evaporator pump	CO ₂	AISI 304	Al	AlMg3/AISI 304	AlMg3/StZn ²	AlMg3
Air cooler	Glycol	Cu	Al	AlMg3/StZn ²	AlMg3/StZn ²	AlMg3



StZn ¹	Steel galvanised
Epoxy	Aluminium fin, epoxy resin coated
StZn ²	Steel sedzimir-galvanised
AISI 304	Stainless steel 1.4301 /AISI 304
Zista	Steel tube, zinc-plated
AISI 316L	Stainless steel 1.4404 /AISI 316L***
Al	Aluminium AlFeSi W8
AlMg3	Aluminium 3.3535.10

Application cases with aggressive ambient air Evaporators (HFC) / Air coolers (glycol)

	Application case	Tube	Fin	Front plate	Casing	Drip tray
	Fruit					
	Bananas	AISI 304	Al	AISI 304/AlMg3/StZn ²	AlMg3/StZn ²	AlMg3
	Citrus fruits	Cu	Epoxy	AlMg3/StZn ²	AISI 304/AlMg3/StZn ²	AISI 304/AlMg3
	Meat					
	Precooling room half carcasses***	AISI 304	Epoxy	AISI 304	AlMg3/StZn ²	AlMg3 **
	Precooling room half carcasses	Cu	Epoxy	AlMg3/StZn ²	AlMg3/StZn ²	AlMg3 **
	Processing rooms	Cu	Epoxy	AlMg3	AlMg3/AISI 304	AlMg3/AISI 304
	Processing rooms***	AISI 304	Epoxy	AISI 304	AlMg3/AISI 304	AlMg3/AISI 304 **
	Smoke room***	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L
	Smoke room	AISI 304	Epoxy	AISI 304	AlMg3/AISI 304	AlMg3/AISI 304
	Cold room smoked foods	Cu	Epoxy	AlMg3	AlMg3/AISI 304	AlMg3/AISI 304
	Curing cellar***	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L
	Curing cellar	AISI 316L	AISI 304/Epoxy	AISI 304	AISI 304	AISI 304
	Cold room for salted products	AISI 304	Epoxy	AISI 304	AlMg3/AISI 304	AlMg3/AISI 304
	Pickled products	AISI 304/AISI 316L	AISI 304/Epoxy	AISI 304	AISI 304	AISI 304 **
	Slaughterhouse waste	AISI 304	Epoxy	AISI 304	AISI 304	AISI 304
	Fish					
	Wet fish	Cu	Epoxy	AlMg3/StZn ²	AlMg3/StZn ²	AlMg3
	Salting room	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L
	Salads, pickled products	AISI 316L	Epoxy	AISI 316L	AISI 316L	AISI 316L
	Smoke room	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L
	Cold room smoked products***	AISI 304	Epoxy	AISI 304	AlMg3/AISI 304	AlMg3/AISI 304
	Cold room smoked products	Cu	Epoxy	AlMg3	AlMg3/AISI 304	AlMg3/AISI 304
	Farinaceous products					
	Fermentation interrupter***	AISI 304	AISI 304/Epoxy	AISI 304	AlMg3/StZn ²	AlMg3
	Fermentation interrupter	Cu	Epoxy	AlMg3/StZn ²	AlMg3/StZn ²	AlMg3
	Dairy produce					
	Cheese ripening (long-time)	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L
	Cheese (cream cheese)	AISI 316L	Epoxy	AISI 304	AISI 304	AISI 304
	Wood					
	Kiln drier (softwood)	AISI 304	Epoxy	AISI 304	AlMg3/AISI 304	AlMg3/AISI 304
	Kiln drier (oak, tropical timber)	AISI 316L	AISI 316L	AISI 316L	AlMg3/AISI 316L	AlMg3/AISI 316L
	Beverages					
Wine cellar	AISI 304	Epoxy	AISI 304	AlMg3/StZn ²	AlMg3	

Depending on the unit type, the material combinations can differ from the information given in the table.

** frequent, very short cleaning intervals with air contamination due to aggressive components of cleaning agents
*** at high concentration, temperature and duration of exposure to aggressive substances

NH₃ Evaporator
Casing AISI 316L



Evaporator (NH₃)

Application case	Tube	Fin	Front plate	Casing	Drip tray	
Fruit						
Bananas	AISI 304	AL	AISI 304	StZn ²	AlMg3	
Citrus fruits	StZn ¹	StZn ¹	StZn ¹	AlMg3/StZn ²	AlMg3	
Citrus fruits	AISI 304	Epoxy	AISI 304	AlMg3/StZn ²	AlMg3	
Meat						
Precooling room half carcasses	AISI 304	Epoxy	AISI 304	AlMg3/StZn ²	AlMg3	**
Processing room	StZn ¹	StZn ¹	StZn ¹	AlMg3/AISI 304	AlMg3/AISI 304	**
Processing room	AISI 304	Epoxy	AISI 304	AlMg3/AISI 304	AISI 316L	**
Smoke room	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L	
Cold room smoked foods	StZn ¹	StZn ¹	StZn ¹	AlMg3/AISI 304	AlMg3/AISI 304	
Cold room smoked foods	AISI 304	Epoxy	AISI 304	AlMg3/AISI 304	AISI 316L	
Salt store room	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L	
Curing cellar	AISI 304	Epoxy/AISI 304	AISI 304	AISI 304	AISI 304	
Cold room for salted products	AISI 304	Epoxy	AISI 304	AlMg3/AISI 304	AlMg3/AISI 304	
Pickled products	AISI 304/AISI 316L	AISI 304/Epoxy	AISI 304	AISI 304	AISI 304	
Slaughterhouse waste	AISI 304	Epoxy	AISI 304	AISI 304	AISI 304	
Fish						
Wet fish	StZn ¹	StZn ¹	StZn ¹	AlMg3/StZn ²	AlMg3	
Wet fish	AISI 304	Epoxy	AISI 304	AlMg3/StZn ²	AISI 316L	
Salting room	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L	
Salads, pickled products	AISI 316L	Epoxy	AISI 316L	AISI 316L	AISI 316L	
Smoke room	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L	
Cold room smoked products	StZn ¹	StZn ¹	StZn ¹	AlMg3/StZn ²	AlMg3/AISI 304	
Cold room smoked products	AISI 304	Epoxy	AISI 304	AlMg3/StZn ²	AlMg3/AISI 304	
Dairy produce						
Cheese ripening (long-time)	AISI 316L	AISI 316L	AISI 316L	AISI 316L	AISI 316L	
Cheese (cream cheese)	AISI 316L	Epoxy	AISI 304	AISI 304	AISI 304	
Wood						
Kiln drier (softwood)	AISI 304	Epoxy	AISI 304	AlMg3/AISI 304	AlMg3/AISI 304	
Kiln drier (oak, tropical timber)	AISI 316L	Epoxy	AISI 316L	AlMg3/AISI 316L	AlMg3/AISI 316L	
Beverages						
Wine cellar	AISI 304	Al/Epoxy	AISI 304	AlMg3/StZn ²	AlMg3	
Malthouses	StZn ¹	StZn ¹ /Al	StZn ¹	AlMg3/StZn ²	AlMg3	
Malthouses	AISI 304	StZn ¹ /Al	AISI 304	AlMg3/StZn ²	AlMg3	

Depending on the unit type, the material combinations can differ from the information given in the table.

** frequent, very short cleaning intervals with air contamination due to aggressive components of cleaning agents
*** at high concentration, temperature and duration of exposure to aggressive substances

Recommendations for Condensers and Drycoolers



Condenser,
made entirely
of stainless steel

Standard application situations

If no aggressive components are to be expected in the ambient air and if the heat exchangers do not have to be cleaned frequently with aggressive cleaning agents, the proven standard material combinations can be used.

	Refrigerant	Tube, MPE profile	Fin	Front plate	Casing
Condenser finoox®	HFC	Cu	Al	StZn ²	StZn ²
Condenser microox®	HFC	Al	Al		StZn ²
Condenser finoox®	NH ₃	Zista*	Al	StZn ²	StZn ²
Condenser microox®	NH ₃	Al	Al		StZn ²
Drycooler	Glycol	Cu	Al	StZn ²	StZn ²

Application cases with aggressive ambient air Condensers (HFC) / Drycoolers (glycol)

Application case	Tube	Fin	Front plate	Casing	
Industrial atmosphere	Cu AISI 304	Cu/Epoxy AISI 304	StZn ² /AlMg3 StZn ² /AlMg3	StZn ² /AlMg3 StZn ² /AlMg3	
Waste disposal Sewage plant	Cu AISI 316L	Epoxy AISI 316L	StZn ² /AISI 304 StZn ² /AISI 304	StZn ² /AlMg3 StZn ² /AlMg3	***
Installation in coastal regions (up to 20 km distance)	Cu AISI 304	Epoxy/Cu Epoxy/Cu	StZn ² /AISI 304 StZn ² /AISI 304	StZn ² /AlMg3 StZn ² /AlMg3	
Sea air, high concentration Ships, offshore drilling platforms	Cu AISI 316L	Cu AISI 316L	StZn ² /AISI 316L StZn ² /AISI 316L	StZn ² /AISI 316L StZn ² /AISI 316L	***
Cement production and processing	Cu AISI 304	Cu AISI 304	AISI 304 AISI 304	AISI 304 AISI 304	***

Condensers (NH₃)

Application case	Tube	Fin	Front plate	Casing	
Industrial atmosphere	AISI 304	Epoxy	StZn ² /AISI 304	StZn ²	
Waste disposal Sewage plant	AISI 304	AISI 316L	StZn ² /AISI 304	StZn ² /AlMg3	***
Installation in coastal regions (up to 20 km distance)	Zista* AISI 304	Epoxy Epoxy	StZn ² /AISI 304 StZn ² /AISI 304	StZn ² StZn ²	***
Sea air, high concentration Ships, offshore drilling platforms	AISI 316L	Cu/AISI 316L	AISI 316L	AISI 316L	
Cement production and processing	Zista* AISI 304	Cu AISI 304	AISI 304 AISI 304	AISI 304 AISI 304	***

*More detailed descriptions on page 6.

Specific projects require individual advice

Make use of Gntner's long-term experience. With precisely targeted application know-how and innovative products, we develop together with you the optimal solution for your project.

According to your specifications, we design the corresponding heat exchangers with reliable data and assist you for selecting the optimal heat exchanger type and number of units.

Our sales staff supports you for determining the concept optimally suited for your specific project and provides you with the required technical data.

Define specific project situation

Individual consultation by Gntner

Optimal product selection



We speak your language

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We are striving to continually improve this brochure.

You have experience in using material combinations for specific application cases? And your experience goes beyond the content of this brochure? Then we would appreciate it very much if you would share this experience with us. Please send an e-mail with the topic "material combination" to: info@guentner.de

Exclusion of liability:

These recommendations for material selection of heat exchangers reflect our experiences. They can neither replace the assessment of the installation situation and location by experts nor the assessment of possible corrosion attack. The recommendations are merely intended for technical information purposes. We assume no liability for the completeness and correctness of the indications. The information is intended to support the technical assessment of the installation situation and location.



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Recommendations for Condensers and Drycoolers with finoox[®] and microox[®] technology

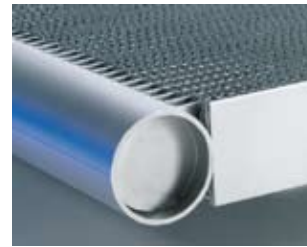


Güntner condensers and drycoolers are used worldwide for heat dissipation. For various applications, the heat exchangers components are selected with standard materials without corrosion protection. For other applications with increased risk of corrosion due to aggressive ambient conditions, Güntner offers as option different possibilities for corrosion protection. Here you can choose between different material combinations and coatings. Güntner heat exchangers exist with two technologies:



The finoox[®] technology

Finned heat exchangers consist of round tubes and fins. By expanding the tubes, the tube and fin material have direct contact. Common finned heat exchangers are made of aluminium fins and copper tubes.



The microox[®] technology

The microox[®] technology for stationary refrigeration installations was developed on the basis of microchannel heat exchangers. These new microox[®] heat exchanger coils consist entirely of aluminium, with fins placed between profiles. These resistant heat exchangers are brazed in an automatic production process.

This table compares the corrosion resistance of both technologies for frequently occurring application locations and categorises their corrosion resistance.

Application	Aggressive substances	Special characteristics	Recommended material combinations								
			finoox [®] Cu/Al	finoox [®] Cu/Ep	finoox [®] Cu/Cu	finoox [®] VA/Al	finoox [®] VA/Ep	finoox [®] VA/VA	finoox [®] Steel galv.	microox [®] Al	microox [®] Al coated
Urban areas	COx		+	0	0	0	0	0	0	+	+
Country			+	0	0	0	0	0	0	+	+
Agricultural	SOx, NOx	Fertilizers, organic components	0	0	0	0	+	0	0	-	+
Coastal areas	Chloride	Low chloride concentration, humidity	0	+	+	-	0	0	0	-	+
Sea air, ships, offshore drilling platforms		High chloride concentration, spume	-	-	+	-	-	0	+	-	0
Heavy industry	Sulphur, SOx, NOx	Soot	0	+	0	0	+	0	-	-	0
Steel industry											
Food industry		Grease, humidity	0	+	0	0	0	0		0	+
Waste disposal	Ammonia	Particles, organic components	0	+	0	0	0	0	-	0	+
Sewage plant	Sulfur, ammonia	Organic components	-	-	-	-	0	0	-	-	0
Desert		Low humidity	+	0	+	0	0	0	0	+	+

□ standard + recommended 0 possible - not recommended

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