CLIMAREM - SPRING 2021

Newsletter of CLIMAREM Sp. z o.o. June 2021

New challenges

The year 2021 brought a number of new challenges to our company. We can boast of worldwide projects of large-size tanks for cooling systems, production of cryogenic tanks with vacuum insulation, new technologies of titanium welding and production of titanium heat exchangers, as well as progress in R&D project of refrigeration systems working on ecological refrigerants for marine applications.

New abilities, you can find attractive

We present recently manufactured tanks for the TES-type system, demonstrate the approval process of titanium welding technology, introduce our new offer for insulation systems. In addition, you will find the review of marine projects, briefly describe projects for industrial technological systems, and announce new events.
We wish you a pleasant reading.

Emilia Węglewska,

Head of the Trade and Marketing Department

In this issue

Thermal Energy Storage Tank

Flow in Stratified Thermal Energy Storage Tank

Thermal Energy Storage tanks (so called TES units), produced in CLIMAREM, are used to off-set and reduce peak energy demand for air-conditioning systems without affection the comfort levels. TES units contains normal water or glycol water (a mixture of water and ethylene). Thermal energy is stored or charged using refrigeration equipment during low-energy demand off-peak periods and then discharged for use during high energy demand, peak periods.

How it works

There are several pipe diffusers present within a cylindrical storage tank. Warm and cooled water enters and exits the tank through diffusers located at the top and bottom of the tank. These diffusers provide a stable, clearly defined transition layer or "thermocline" that keeps the water warm at the top of the tank and chilled water at the bottom.

During charging, the tank is completely filled with water at a temperature of 13 ° C. At regular intervals, the hot water is slowly replaced by 6 ° C chilled water supplied by the external chiller.
This process takes place slowly over a period of several hours until the tank is completely filled with water at a lower temperature. Chilled water is supplied through the bottom diffusers, displacing warmer water through similar diffusers at the top of the storage tank. This process occurs slowly over a period of a few hours until the tank is filled completely with the lower-temperature water. The chilled water is supplied through the bottom diffusers displacing the warmer water through similar diffusers at the top of storage tank.

In discharge mode, the chillers and associated condensing units are turned off and the chilled water from the TES tank is used to cool the facility. At the end of the distribution phase, the tank will mainly contain hot water. To "charge" or cool the water, hot water exits through the top diffuser, from where it is sent to the cooling system. It is then returned to the tank as chilled water through the bottom diffuser, where it is ready for use by the cooling system.
Thermal energy storage tanks are specially insulated.

Application

Almost any chilled water cooling system can benefit from a thermal energy storage tank. Some common applications are:
• Commercial buildings and industrial facilities
• Data centers
• Military bases and airports
• Power plants

During production of large-size tank

Benefits of using TES tanks

- Reduced electricity demand costs.
- Lower consumption cost by taking advantage of changing power rates.
- Reduced energy consumption - thanks to the operation of the cooling unit shifted to the evening hours.
- A TES tank is an easy and economical way to increase the cooling capacity of installed chilled water system, allowing to postpone or eliminate the need for new cooling equipment.

Technical characteristics of the TES tank

Overall dimensions: ø3600x12000
Hazard Category — SEP
Highest / lowest allowable pressure: 8.0 / -0.3bar
Hydraulic test pressure: 12.9 bar
Permissible temperatures: +50 / -15 oC
Volume: 130 000 l
Empty tank weight: 23 750 kg

The tank was subject to specialist seismic calculations in accordance with PN-EN 13445 and Eurocode 8 with the parameters of the Italian NTC standard and for wind and snow loads.

Assembly of technical ladders (top), spiral coil (right)

Outfiting tanks

As part of the order, we offer design and manufacture of barriers, ladders, valves, coils or other elements required by standards and customer needs.

Steel platforms

Service and communication platforms for tanks can be divided into: horizontal platforms on, around or between large tanks, structurally connected to them. Installed as a communication route and for the purpose of servicing the tank.
Steel platforms are used on tanks, skids and modules in almost every industry. Depending on their purpose, their design is dictated by specific legal requirements. We produce platforms in accordance with European regulations or appropriate for the country of destination.
Properly performed assembly determines the correct functioning and safe use of the platforms. Being both a manufacturer and a contractor, we are able to properly plan the assembly sequence, which is performed by experienced and well-prepared assembly teams.
The additional equipment depends on the operating conditions. These are: steel barriers and balustrades, steel stairs, technical ladders.

Technical ladders

The offered technical ladders are welded or bolted structures, designed to overcome level differences on the offered large-size standing tanks, technical structures. Hot dip galvanized, powder coated, also in warning colours. They can also be made of stainless steel.
The developed system of fasteners and design solutions guarantees proper use of the product in all conditions.

Heaters, spiral coils

The spiral coil is characterized by high heating power, several times greater than the standard U-shaped coil. The use of such a coil causes rapid heating of the utility medium. These heaters can operate in systems with gravity or forced circulation. Coils, thanks to their dual use both for heating and cooling, are widely used in all branches of industry.

Application example:

- Solar tanks
- Central heating boilers
- Hot water heaters
- Mining
- Brewing
- Power engineering
- Chemical
- Other

Natural gas separators

Natural gas separators

Parameters:

Allowable pressure –290 bar
Test pressure –415 bar

Heat treatment

In the production process of the separators, stress relief annealing was used - heat treatment consisting in heating the material to a temperature of about 500 -600 ^{o}C, heating it up and slowly cooling it down.
The purpose of annealing is to remove casting, welding, thermal and cold working stresses. The structure of the steel is not changed during stress relief

Shell and tube heat exchangers with titanium tube bundle

TITANIUM HEAT EXCHANGERS

Application

Titanium has a high resistance to corrosion, the influence of sea water, it is very light, shockproof and durable.

Valued for its combination of lightness and high strength, titanium is used in heat transfer, chemical transfer and transport, in the marine industry, offshore installations and in aviation. More and more often it is chosen to reduce the weight of the structure or improve the process technology.

The chemical tanker trucks use titanium because it is lightweight, corrosion-resistant and extremely strong. Due to the advantages of its long-term durability, titanium is increasingly used in construction materials and equipment for industrial plants. Titanium is increasingly used in off-shore installations, in generators of alternative energy sources, for the production of pipes and process equipment. Titanium is a safe and economical material that is perfect for heat exchangers that are used in extremely high temperatures and high pressures, and also for the harmful substances.

Gas cooler

Gas cooler is an element of two-stage refrigeration systems and cascade systems operating on the natural refrigerant, which is R744 carbon dioxide.

Parameters

REFRIGERANT:

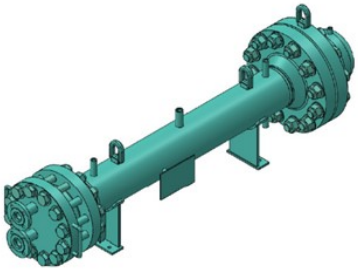
R744 (CO_2)

COOLING CAPACITIES:

16 - 1270 kW

COOLING MEDIUM:

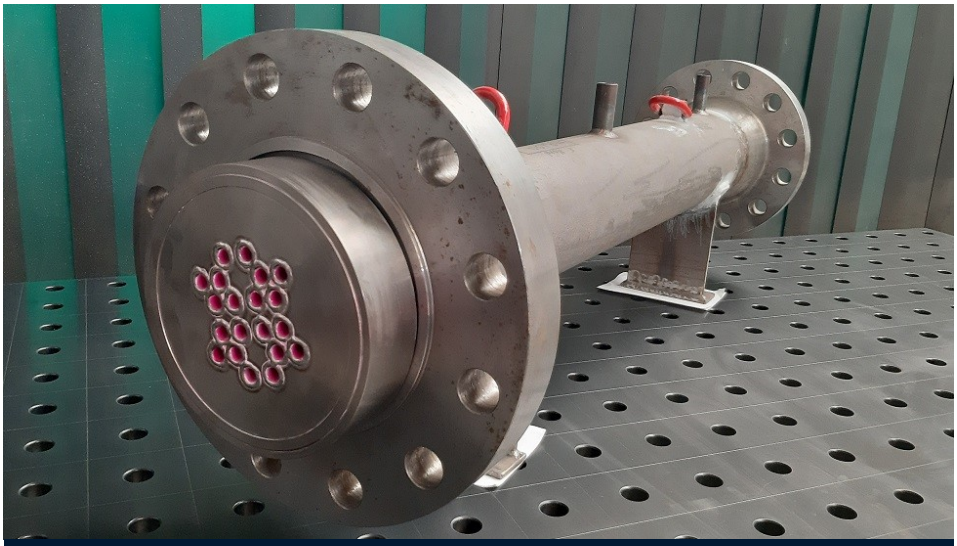
Sea water, saline



Used tubes

To reduce the dimensions of the exchanger, we decided to use externally finned tubes with a developed area of approx. 0.14 m^2/m.

The arrangement of the pipes is in a triangular arrangement of 60°, thanks to which it is possible to obtain greater heat transfer coefficients on the outside and a larger heat transfer surface with the same diameter than in the arrangement of pipes in the 45° or 90° system.



Parameter	Units	Tube side	Shell side
PED group		Sea water	R744 (CO_2)
		II	II
Designed pressure	Bar(g)	0 / 5,5	-1 / 130
Work pressure	Bar(g)	5	110
Test pressure	Bar(g)	8,6	186
Design temperature	°C	-10 / 90	- 10 / 160
Work temperature In / out	°C	27 / resulting temperature	127 / 44

Construction of the heat exchanger

Due to the corrosive nature of the medium - sea water, it was decided that sea water would flow in the space inside the tubes, and carbon dioxide (R744) in the shell. The construction of the heat-exchanger is of the BET type according to TEMA - floating head without limitation, thanks to which it is possible to easily remove, replace the tube bundle and compensation of thermal expansion caused by a large temperature difference of the media. Both tube sheets, process tubes and the floating head welded to it are made of titanium. Process tubes are welded to the tube sheets. To ensure greater tightness, it was decided that the ends of the process tubes were additionally expanded (with double-grooved holes) in the tube sheets.
The water cover is made of carbon steel. In order to prevent corrosion processes caused by the action of sea water, its inner part has been covered with a layer of sea water-resistant plastic. The exchanger's shell (not in contact with sea water) is made of low-carbon fine-grained steel intended for operation at high temperatures. Due to the high pressure of R744, it was decided to use steel P355NH with improved properties. In order to ensure sufficiently high speeds (and relatively high values of heat transfer coefficients), the exchanger is 4-flow on the water side and equipped with vertical segment baffles and sealing plates inside the shell (on the carbon dioxide side).

Research laboratory for refrigerants

INNOSHIP R&D Research project

As part of the work on the research project: "Development of an innovative, ecological cooling device for ship and ship applications", a research laboratory was constructed under the "INNOSHIP" Sectoral Operational Program.

An analysis of threats to the test stands was carried out, they were equipped with special ventilation and fire protection, and an expert opinion of the Office of Technical Inspection was carried out.

The scope of technical expertise of UDT

1. Assessment of the presented documentation of the refrigeration system in terms of meeting the requirements of the standard: PN-EN 378 2.2017
2. Assessment of the design of the cooling installation against the fulfillment of the requirements of Directive 2014/68 / EU
3. Carrying out a pressure strength test of the assessed refrigeration system.

Working laboratories

Two stands were built in the laboratory, working on the natural refrigerant R744 (carbon dioxide) and HFO refrigerants.
We are currently at the testing, research and optimization stage.

Salt chamber test

Test joint of Ti gr 2 pipes welded in a titanium tube sheet has been checked in a salt chamber, type ascott CC1000iP for 876h, which according to the

ISO 9227 NSS standard corresponds to the influence of sea water on the welded joint for 10 years, in a corrosive environment of category C5- M as defined in ISO 12944-2.
The tests passed positively, which is confirmed by the report.

NUMBER OF TRIAL: 057/2021	REPORT FROM SALT CHAMBER SPRAY
Type of salt chamber:	ascott CC1000iP
Kind of trial:	According to ISO 9227 NSS
Customer:	CLIMAREM SP. Z O.O.

Fundusze Europejskie Inteligentny Rozwój
Rzeczpospolita Polska
Narodowe Centrum Badań i Rozwoju
Unia Europejska Europejski Fundusz Rozwoju Regionalnego

BUREAU VERITAS
MARINE BRANCH

Certificate N°: 5561GDA2021

CERTIFICATE OF APPROVAL
OF WELDING PROCEDURE

Manufacturer:	CLIMAREM Sp. z o.o., ul. Hutnicza 4, 81-061 Gdynia
WPQR N°:	5561GDA2021
WPS N°:	89
Test date:	27.04.2021
RANGE OF APPROVAL	
Welding process:	142 (GTAW-P)
Parent metal acc. ISO/TR 15608:	51 (Ti Gr1 ÷ Ti Gr2 – Group 51.1 – Pure titanium with $O_2 \leq 0.20$ %)
Thickness range [mm]:	Tube-wall: 1 ÷ 4 Tube-plate: ≥ 20
Tube-outside diameter[mm]:	≥ 16
Welding position:	PA (1F), PB (2F), PF (3F), PD (4F) and PH (5F)
Type of joint:	FW, sl
Filler:	-
Heat input [kJ/mm]:	0,37 ÷ 0,50
Preheat temp. [°C]	5°C
Interpass temp. MAX [°C]	-

We would like to state hereby that the test pieces were welded and checked according to the requirements of EN ISO 15614-8 and the positive results have been achieved.

Date and place of issue: 21.05.2021 GDAŃSK

Surveyor's name, signature and stamp: Jan Dąbkowski

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Titanium welding technology

The technology was qualified by the notified body TÜV Rheinland and the Bureau Veritas classification society. For this purpose, the following non-destructive and destructive tests were carried out in accordance with PN-EN ISO 15614-8:

- Visual examination
- Penetration Testing
- Radiographic examination
- Macrographic examination
- Hardness test
- Squeezing test

TÜV Rheinland Polska Sp. z o.o.
Notified Body for Pressure Equipment 2627

TÜVRheinland®
Precisely Right.

Welding Procedure Qualification Record (WPQR)
Protokół Kwalifikowania Technologii Spawania (WPQR)
Certificate No. / Certyfikat nr: 01 2627 PL/V-210074.00

Manufacturer	CLIMAREM Sp.z o.o.	pWPS No	89
Address	ul. Hutnicza 4 81-963 Gdynia	Specimen No.	89
		Date of Welding	27.04.2021

CODE / TESTING STANDARDS	DIN EN ISO 15614-8:2016; 2014/68/EU
TEST PIECE / Złącze próbne	
Parent material (sub-group ISO / TR 15608) – Designation / Materiał podstawowy	Tube / Rura: 8338 Gr. 1 (51) with/z Plate / Blacha 8265 Gr. 2 (51)
Product form and dimensions [mm] / Forma wyrobu i jego wymiary [mm]	Tube / Rura ø16,0 x 2,0 with/z Tube - Plate / Płyta Sitowa 20,0
RANGE OF APPROVAL / ZAKRES KWALIFIKACJI	
Type of joint / Typ złącza	Corner Joint / Narożne
Parent material group(s) and sub-group(s) / Grupa(y) materiału (bez podstawowych) i podgrupa(y)	51 – 51
Parent material thickness [mm] / Grubość materiału podstawowego [mm]	Tube / Rura: 1,0 ÷ 4,0 Tube - Plate / Płyta sitowa ≥ 20,0
Outside pipe diameter [mm] / Średnica zewnętrzna rury [mm]	≥ 16,0
Smallest distance between two tubes [mm] / Min. odległość między osiami rur [mm]	4,7
Welding Process [acc. to ISO 4063] / Proces spawania [wg ISO 4063]	142
Pitch / Podziałka	Triangular and square / Trójkątna i prostokątna
Filler material - Designation / Materiał dodatkowy - Oznaczenie	–
Filler material brand / Nazwa handlowa materiału dodatkowego	–
Filler material size / wymiar materiału dodatkowego	–
Designation of shielding gas / flux / Oznaczenie gazu ochronnego / topnika	EN ISO 14175 - I1 / - -
Deposited weld metal thickness [mm] / Grubość spoiny [mm]	–
Throat thickness [mm] / Grubość spoiny pachwinowej [mm]	–
Single layer (sl) / multi layer (ml) / wielowarstwowe (ml) / wielościegowe (ml)	sl
Type of welding current and polarity / Rodzaj prądu spawania / biegunowość	DC –
Heat input [min. – max.] [kJ/cm] / Ilość wprowadzonego ciepła [min. – max.] [kJ/cm]	0,4 – 0,5
Welding Position [acc. to ISO 6947] / Pozycja spawania [wg ISO 6947]	PH
Min. Preheat Temperature [°C] / Min. temperatura podgrzewania [°C]	5
Max. Interpass Temperature [°C] / Max. temperatura międzyściegowa [°C]	–
Post Weld Heat Treatment / Obróbka cieplna po spawaniu	–
Post-heating for hydrogen release / Podgrzewanie po spawaniu dla usunięcia wodoru	–
Type of Welding source / Rodzaj źródła zasilania	–
OTHER INFORMATIONS / Inne informacje	

RESULT / wynik
We confirm that the statements in this record are correct and that the test pieces were prepared, welded, tested and have fulfilled the requirements in accordance with above mentioned specifications. / Potwierdzamy, że informacje zawarte w tym protokole są poprawne oraz że złącze zostało przygotowane, spawane i badane zgodnie z wymaganiami wyżej wymienionej normy/specyfikacji.

Location: Żabrze
Date: 26.05.2021
TÜV Rheinland Polska Sp. z o.o. Notified Body for Pressure Equipment 2627

Attachments: 1. Welding Report / Raport z procesu spawania; 2. Test Report / Raport z badań

Mgr. Eng. Leszek Zadroga
Certifier, sign, personal stamp

AC 141

Work on the titanium welding station

Titanium welding technologies

Part of the research project: **"Development of an innovative, ecological cooling unit for ship applications"** is the production of a series of shell-and-tube heat exchangers with a titanium tube bundle.
For this purpose, technologies for welding joints of tubes and tube sheets made of titanium were developed and implemented.

The most common and most widely used method of welding titanium is arc welding, which is carried out with the use of special shielding chambers. These chambers can be divided into 3 types:

- Sockets attached directly to the welding gun in order to locally shield the connector from oxygen
- Compartments for the overall cover of the elements
- Workshop chamber covering a given element in which the welder is inside

To effectively carry out the welding process of titanium exchangers, the availability of various solutions on the market was checked. The TIG method was used for the welding process. Welding in the chamber was chosen as the best solution for the overall protection of the elements. For this purpose, a special chamber was made with dimensions that allow heat exchangers to be welded. The welding technology has been qualified on the basis of the PN-EN ISO 15614-8 standard.

Work is currently underway to improve the welding process, improve the ergonomics of the welder's work and improve the propagation of argon inside the station in order to optimize welding costs in the case of industrial production. Another consideration is the possibility of replacing manual welding with an automatic orbital welding machine and changing the shielding gas from argon to helium to optimize the process.

NH_3 separator

Ammonia liquid separators

We offer design, approval, production, commissioning and certification of NH_3 liquid separators for refrigeration systems. Vessels are made in accordance with the following regulations:
Pressure equipment directive: 97/23 / EC, regulations of marine Classification Societies
Regulations: PN - EN 13445: 2009

Other components of ammonia refrigeration systems

We also manufacture oil separators, liquid ammonia storage tanks, shell and tube condensers as well as shell and tube evaporators.

New welding technologies

Number	Notified Body	Scope
83	TUV	Plate, material group 1.2 (thickness 3 - 16 mm), met. 135/121, impact strength –50
84	TUV	Tube, diameter > 50 mm, gr. mat. 1.2 (thickness 3 - 24 mm), met. 135/136, impact strength –50
85	TUV	Tube, diameter > 20 mm, gr. mat. 1.2 (thickness 3 - 20 mm), met. 141, impact strength –50
86	DNV	Forging + PWHT, gr. Mat. 1.2 (thickness 20 - 80 mm), met. 121
87	DNV	Forging/ Plate + PWHT, gr. Mat. 1.2 (thickness 20 - 80 mm), met. 121
88	TUV	Plate + PWHT, gr. mat. 1.2 (thickness 15 - 60 mm), met. 135/121, one-sided welding

Tank with insulation made of polyurethane foam

Cryogenic thermal insulation

Tanks, evaporators and heaters that we produce for heat exchange systems, cold accumulation or water preparation units are thermally insulated. The effectiveness of thermal insulation often determines the operation of the unit and its operating costs.
We use the following types of thermal insulation:
- Mineral wool
- Rubber insulation
- Foamed polyurethane
- Vacuum insulations

Insulating foams are characterized by a closed cell structure resulting from the expansion of a large amount of gas inside the pores of polystyrene, polyurethane, rubber or silica. The fraction of the solid phase in the foam volume is small and amounts to about 2%. The remaining volume is formed by closed cells from 0.01 to 0.1 mm.

The essence of vacuum insulation is the use of a double-walled vessel with a vacuum created between them. By achieving a sufficiently low pressure and avoiding thermal bridges, it is possible to achieve a state where heat is transferred only by radiation and conduction is neglected low. To reduce the amount of heat transferred by radiation, the inner surfaces of the vacuum vessel must be covered with low-emissivity materials such as silver, gold, copper, and aluminum.

Multilayer vacuum insulation uses several to several dozen radiation screens located in the vacuum space. Currently, radiation screens are made mainly of polyethylene foils covered on one or both sides with a layer of aluminum. Due to very good insulating properties, multilayer vacuum insulation is also called superinsulation.
Multilayer vacuum insulation was made in our company as part of the work on a prototype of a freezing device, which is carried out together with the Institute of Fluid-Flow Machinery of the Polish Academy of Sciences.

WCH-r7chiller

Technical parameters:

Cooling capacity: 76 kW

Fresh water cooled

Shell and tube evaporator and condenser

Semi-hermetic reciprocating compressor

Chiller unit

Chillers for the off-shore diving base

Deep Arctic is a unit for underwater works, which is a saturation diving base and equipped with an offshore crane.

The main purpose of the reconstruction carried out at Remontowa Shipyard was the installation of an advanced hybrid battery power system. Once installed, the system will improve the efficiency and flexibility of the ship's operation, including by increasing the efficiency of the drive system and its reliability by extending the trouble-free operation of engines, and will have a positive impact on the environment, with the expected, significant reduction in fuel consumption, because together with it, emissions of SOx, NOx and CO_2 will be reduced.

As part of CLIMAREM's deliveries, 4 chillers with a total capacity of 304kW and fan coils for cooling the battery room were delivered and installed.

2021 on board repairs and overhauls

As part of repair work on ships, we have performed the following works:

M/V ORION

- Installation works in freezers and cold rooms, repairs of refrigerators and freezers

M/V Willem Van Rubroeck

- Replacement of compressors in refrigeration installations
- Renovation of heat exchangers

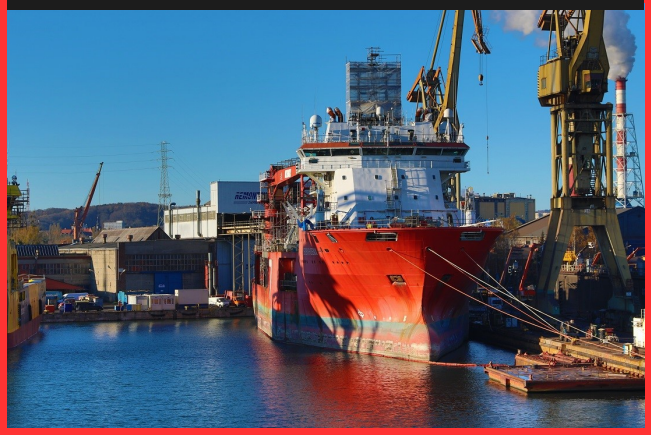
M/V SILVER WIND

- Disposal and retrofit of refrigerants

M/V SEVEN PHOENIX

- Chiller service
- Installation works and air-conditioning installation tightness tests
- Repairs of chilled water coolers
- Renovation of heat exchangers and heaters in air-conditioning units
- Modernization of the cooling installation of condensing units
- Work in the area of food stores
- Overhoul of refrigeration compressors
- Air conditioning system repair works

M/V Seven Phoenix



S/Y OCEANIA

- Review of the cold store
- Renovation of air-conditioning units

M/V STENA SPIRIT

- Air conditioning system renovation

M/V WILLEM VAN RUBROECK

- Modernization of ventilation of the engine room and superstructure
- Renovation of the refrigeration system of refrigerators
- Installation of a cold store provision

Ventilation ducts

Ducts and ventilation boxes

We produce and prefabricate ventilation ducts of the following thickness:
0.5-8 mm

We provide equipment for ventilation systems in the scope:

- carbon, galvanized and stainless steel ducts
- ship boxes
- louvers
- regulation flaps
- and other elements of ventilation accessories

Ship box

Corrosion protection

Ducts are shot blasted and painted according to the customer's guidelines or our quality standard.

Standards

Components of ventilation systems are made in accordance with the following standards:
PN-EN-12237 "Ventilation for buildings - Duct network - Strength and tightness of sheet metal pipes with a circular cross-section"
PN-EN-1507 "Ventilation for buildings - Ventilation ducts made of sheet metal with a rectangular cross-section - Requirements for strength and tightness"

Shell and tube heat exchangers for mining cooling systems

Shell and tube heat exchangers for industrial mining machinery

Our shell-and-tube condensers are used in cooling installations where the condenser is cooled using:
- Sea water
- Brines
- Polluted water

Mining Cooling Units

Our heat exchangers work well in chillers in methane and non-methane mines. Mining cooling devices are used for local air conditioning, primarily in the mining of hard coal, metal ores, salt, and in tunneling. The device is used to cool the ventilation air as well as dehumidify it. Devices of this type, in an intermediate version, i.e. with a water cooler, can also be used to cool engines used in mining processes.

Nor—Shipping 2022

We invite you to visit us at the Nor-Shipping Fair, which will be held near Oslo in Lillestrøm on January 10-13, 2022.

OUR STAND NUMBER: C01-37

Nor-Shipping

CLIMAREM - Twój dostawca urządzeń ciśnieniowych i HVAC

OUR OFFER:

I HFC / HFO / R744 refrigeration equipment:

- condensing units
- chillers
- shell and tube evaporators
- shell and tube condensers
- gas coolers
- refrigerant receivers
- autonomous air conditioners
- coolers

II Components for refrigeration systems on R717 (NH3)

- separators
- shell and tube evaporators
- shell and tube condensers
- intermediate coolers
- receivers
- filters

III Process equipment

- shell and tube heat exchangers
- pressure vessels
- high pressure vessels
- titanium pressure equipment
- heaters
- boiler heat exchangers

IV Pressure equipment for glycol

- glycol coolers
- distillate coolers
- deaerators
- regenerators
- tanks
- filters
- absorption columns

V Equipment for gas installations

- three-phase separators
- two-phase separators
- linear heaters
- shell and tube heat exchangers
- tube-in-tube exchangers
- distillation columns
- boilers
- absorption columns

VI Hyperbaric chambers

VII HVAC equipment

- ducts
- fans
- heaters
- dampers, fire dampers, louvers
- ventilation cabinets, diffusers
- ventilation grilles
- air handling units
- fan coil units

Contact us

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