



CLOSED CYCLE SYSTEM

MIRAI INTEX | SAVE THE PLANET WITH US



About us

Welcome to Mirai

Mirai Intex is an engineering and manufacturing company founded in Switzerland in 2015, with the main mission to reshape the Ultra-Low Temperature (ULT) refrigeration industry, for the benefit of the environment, human health and safety.

Refrigeration machines developed and produced by MIRAI Intex are made of high-grade components and materials, to ensure long-term, efficient and reliable operation. Our commitment to climate protection is visible through our manufacturing practices and our environmentally friendly product design.

The implementation of air-cycle cooling technology helps to eliminate the use of harmful fluorinated gases, as well as prevent ozone layer depletion and global warming. With our innovative refrigeration technology, we contribute to reducing greenhouse gas emissions as well as increasing the safety of refrigeration equipment operating at ultra-low temperatures.

Our portfolio covers a wide range of applications starting from Biomedical and Food Storage to Freeze-drying and liquefaction of gases.

Save the planet with us. Just being mindful of the area you work in can have a huge impact on the whole environment.

Our technical support team provides installation, commissioning and service assistance. Troubleshooting support for our machines is available 24/7. Any support request can be also submitted online on our website. Urgent service requests are processed within 24h.

Montreal Protocol on Substances That Deplete the Ozone Layer, 1989

Framework Convention on Climate Change, 1992

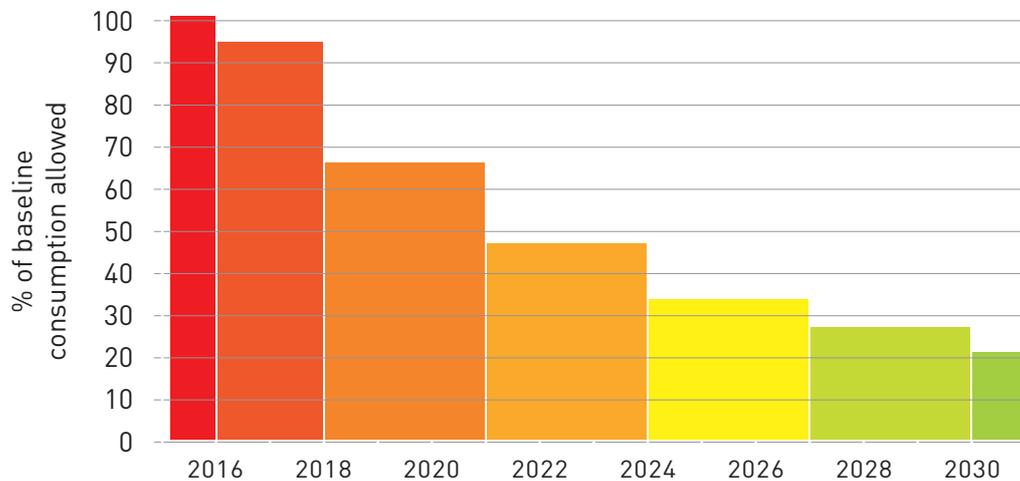
Kyoto Protocol, 1997

Paris Agreement, 2015

European Commission F-gas regulation, 2015

Kigali Amendment, 2019

EUROPEAN UNION F-GAS PHASE DOWN



Baseline = the average HFC consumption between 2009 and 2012

The aim of the phased reduction of F-gas emissions is to reduce the usage of HFCs by 79 % between 2015 and 2030. And not without reason: F-gases amplify the greenhouse effect and contribute to climate change, with some common gases being thousands times more devastating than carbon dioxide.

Reducing usage levels is thus an important building block for achieving the European Union's climate goals.

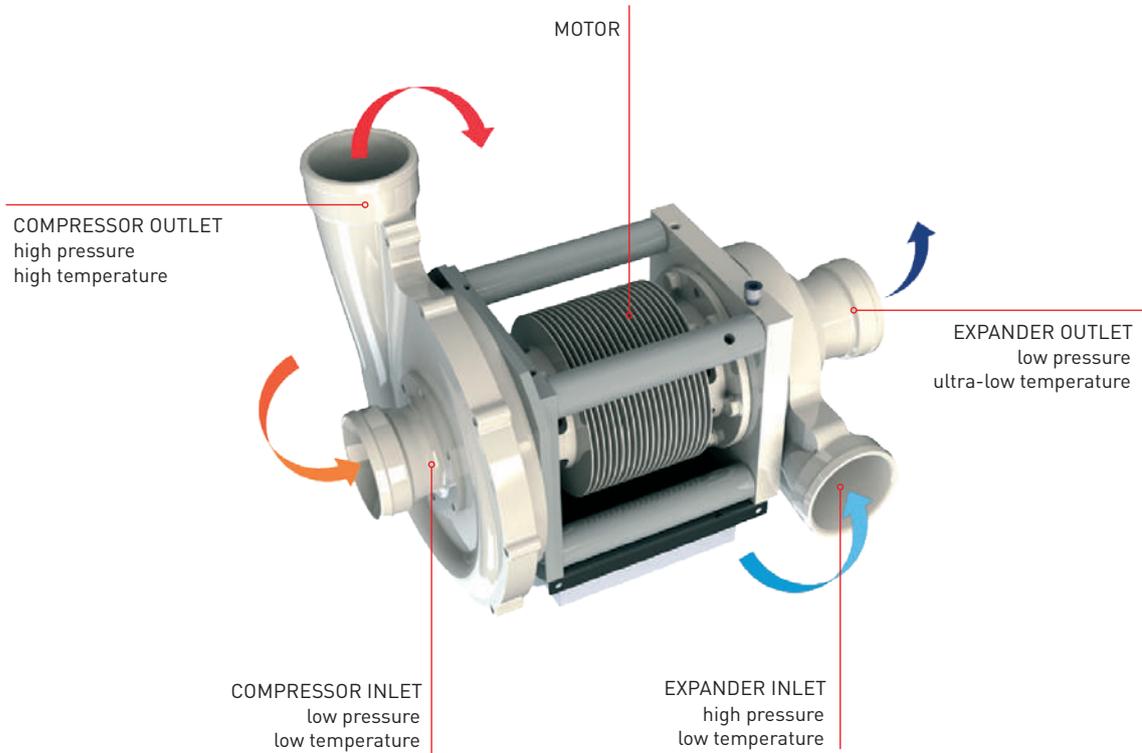
We at Mirai support our customers with alternative refrigeration solutions, with a GWP ZERO.

Air is not a subject of F-gas regulation and is the best substitute to existing refrigerants and offers full refrigeration, capacity and safety.





Technology

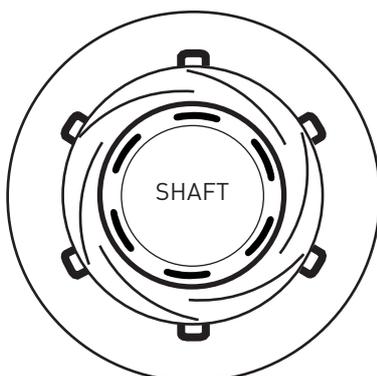


Air Cycle Technology

The air cycle, is widely used in air separation plants as a cooling stage to obtain cryogenic cold, to liquify natural gas, as well as in an aircraft air conditioning systems.

The heart of the system is turbo-module unit developed and manufactured in-house for the most efficient and reliable work. The technology is based on the heating capability of air during compression and cooling down during expansion. Repetition of compression and expansion cycles allows to reach and maintain ultra-low temperatures down to $-160\text{ }^{\circ}\text{C}$.

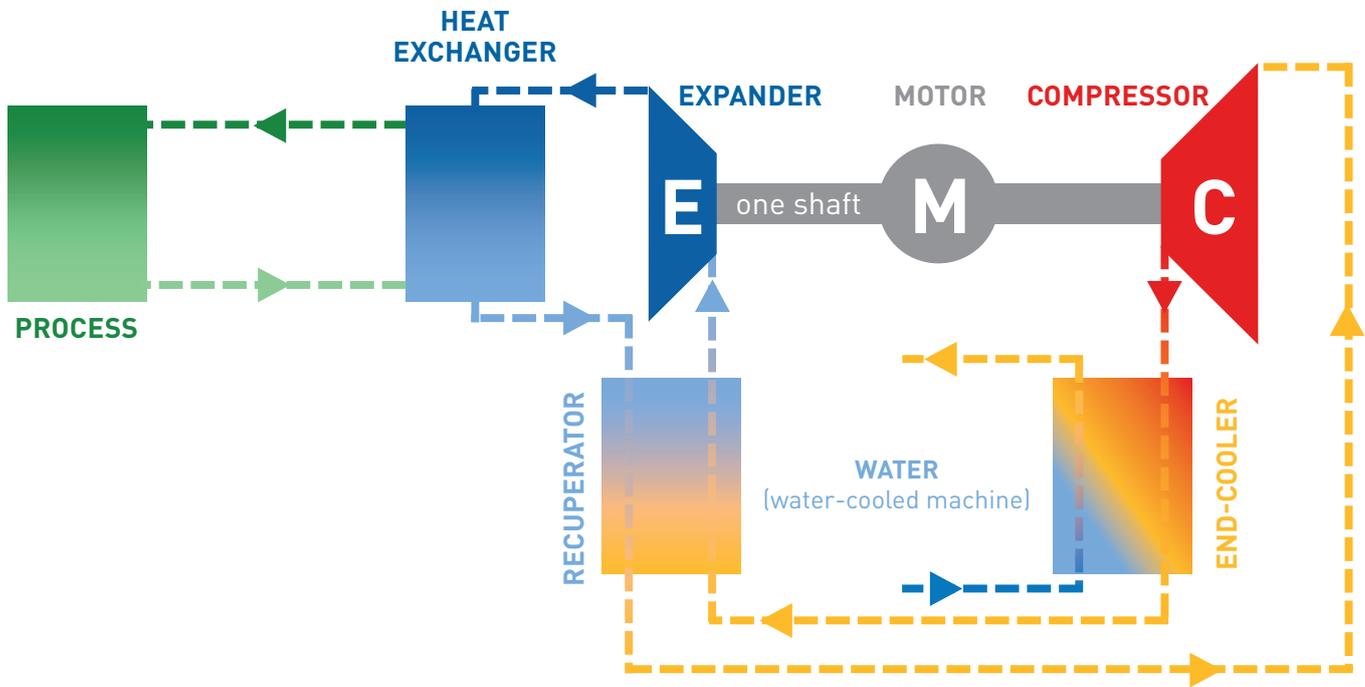
A key technological feature is that the turbo expander and compressor are located on the same shaft. The energy produced during the expansion process is transferred through the shaft to the compressor, which allows to reduce energy consumption up to 30 % compared to vapor compression systems.



Air Bearings

Our air bearing system eliminates the need for complex oil management systems and makes our machines more reliable and maintenance-free.

When the shaft is spinning fast enough it starts to float on the air cushion created by the increased air pressure from its spinning.



How does the Air Cycle Technology work?

Air is heated during compression and cooled through a series of heat exchangers and then expanded to reach ultra-low temperatures. While repeating the cycle of compression, cooling and expansion we can achieve temperatures down to $-160\text{ }^{\circ}\text{C}$.



Video of Air Cycle Technology

Minimal service requirements

Maintenance costs are cut to the minimum. No refrigerant leakage tests or refrigerant purchase and replenishment costs are required. Air is free of charge. Long-lasting, wear-resistant parts and components ensure a long machine life, due to the oil-free operation.



Advantages of the system

Air cycle system has a lot of advantages, and the main one is that it uses air as a refrigerant, therefore it is environmentally neutral. In addition, air cycle equipment is extremely reliable and durable, which helps to reduce maintenance costs and ensures life-long cycle without the decline in performance, unlike vapor compression cycle equipment.

A unique feature of the technology is that it can produce useful heat and can be integrated into the heat management system of the building and produce additional heating.

All MIRAI Cold machines are factory equipped with a frequency inverter, which allows consuming only the energy required to maintain set conditions; all done automatically.

Mirai Intex developed air bearings that absolutely eliminate the need for lubricants in the system. This ensures additional cost savings but mainly safe and worryless experience for our clients.



THE MOST ECO-FRIENDLY REFRIGERATION MACHINE



MINIMAL SERVICE REQUIREMENTS



SAFEST SOLUTION ON THE MARKET



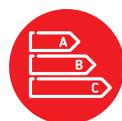
REMOTE MONITORING AND SOFTWARE UPDATES



ANY TEMPERATURE IN THE RANGE FROM -40 °C TO -130 °C



TECHNOLOGICALLY ADVANCED



HIGH ENERGY EFFICIENCY



ECONOMICAL IN USE



LOW NOISE AND NO VIBRATION



EASE OF INSTALLATION AND PROJECT PLANNING



MAXIMAL TEMPERATURE ACCURACY & UNIFORMITY



LEGAL COMPLIANCE

Closed cycle systems

In the case of a closed cycle machine, the ultra-cold air is circulating only inside of the refrigeration machine in a closed loop. For that reason, closed cycle machines are equipped with an additional heat exchanger for the secondary working fluid.

The best example of a secondary medium would be silicone oil for which MIRAI Cold machines are optimized. The secondary loop can cool down numerous applications requiring ultra-low temperatures. MIRAI Cold machines could be easily retrofitted to applications, that have been using conventional or outdated methods of cooling or used as a refrigeration unit for brand new installations.

MIRAI Cold closed cycle machines are the true plug & play refrigeration solution for ultra-low temperatures with environment and sustainability in mind. Multiple machines can be used in a modular configuration for redundancy and convenience.

MIRAI Cold 10 T



MIRAI Cold 15 T



MIRAI Cold 23 T



MIRAI Cold 80 T



Applications

FREEZE DRYING / PROCESS COOLING / SOLVENT RECOVERY / BLAST FREEZING



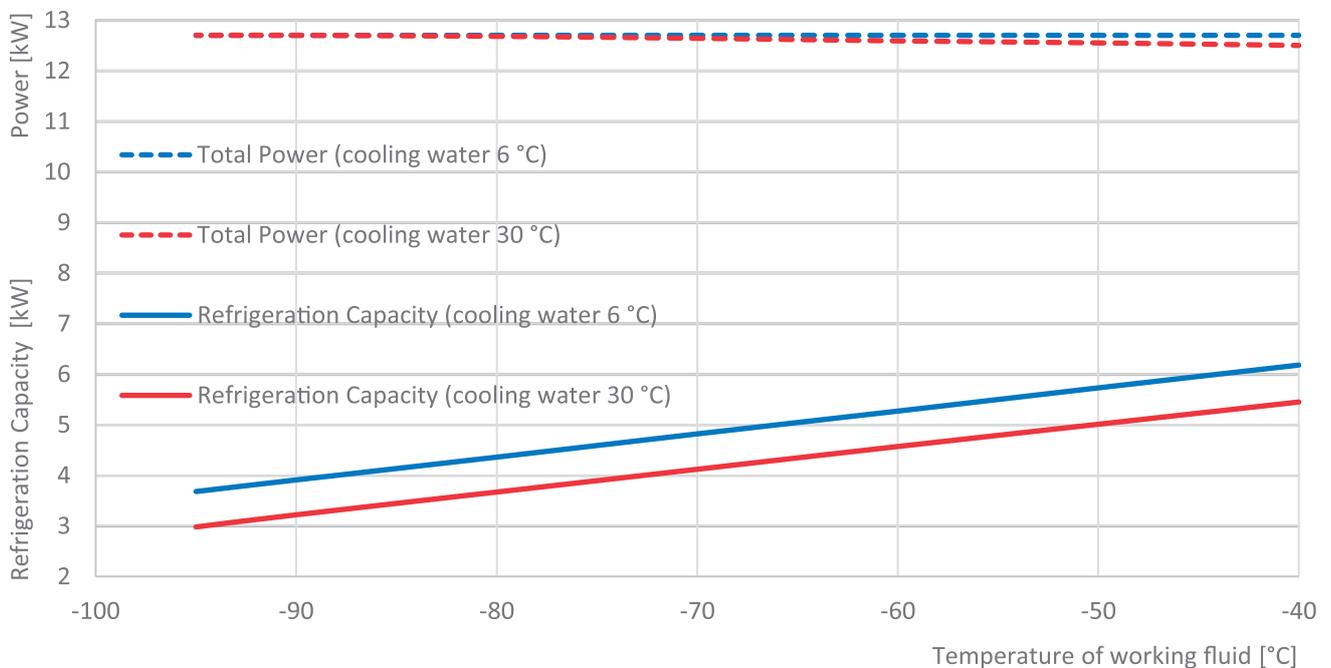
MIRAI Cold 10 T

The most compact closed cycle MIRAI Cold machine cooled by water is the ideal solution for small process cooling applications or freeze dryers.

Model name	MC 10 C/W/T
REFRIGERANT	Natural Air (R729)
TEMPERATURE RANGE	from -40 °C to -110 °C
TEMPERATURE RANGE HTF*	from -40°C to -95°C
SYSTEM COOLING	Water-cooled
REFRIGERATION CAPACITY	Up to 6.2 kW
RATED MOTOR POWER	10 kW
DIMENSIONS (L x W x H)	109 x 145 x 179 cm
WEIGHT	790 kg



MIRAI Cold 10 T (MC 10 C/W/T) - Refrigeration Capacity & Power



*Heat Transfer Fluid temperature range may depend on used fluid



Product page

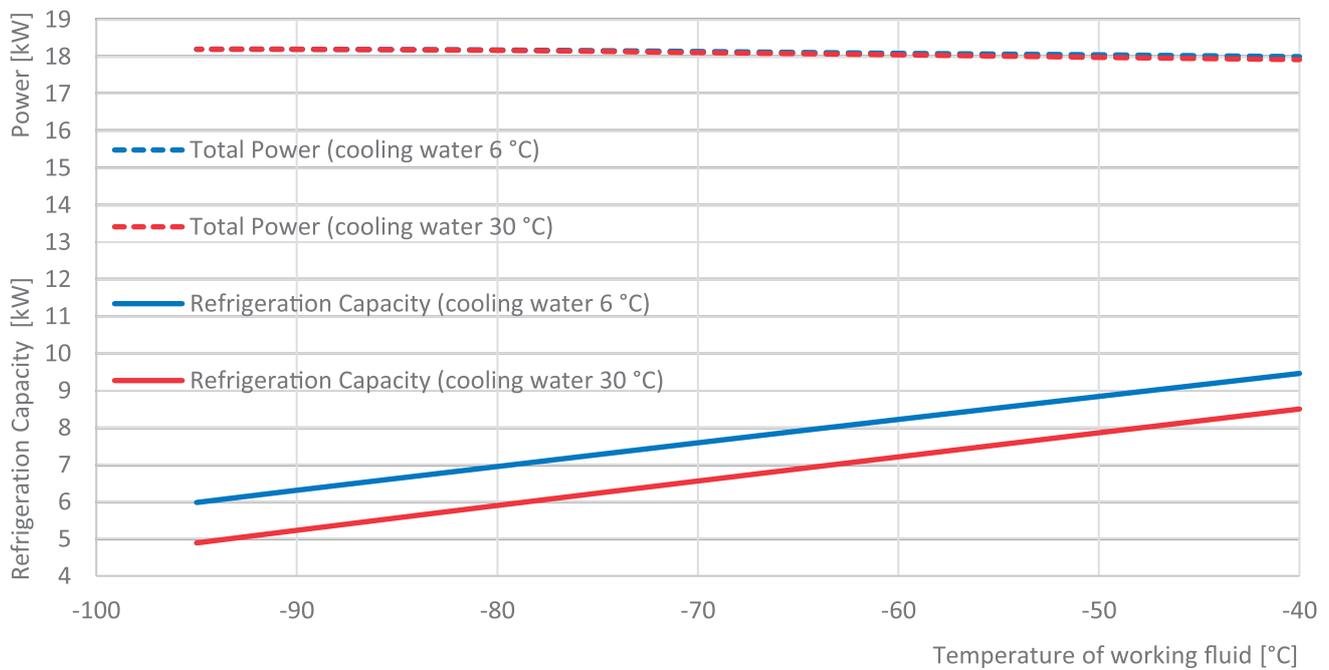
MIRAI Cold 15 T

The same size as MC 10 T but more power, that is MC 15 T. Cooled by water ideal for applications where cooling power of MC 10 T is not enough.



Model name	MC 15 C/W/T
REFRIGERANT	Natural Air (R729)
TEMPERATURE RANGE	from -40 °C to -110 °C
TEMPERATURE RANGE HTF*	from -40°C to -95°C
SYSTEM COOLING	Water-cooled
REFRIGERATION CAPACITY	Up to 9.5 kW
RATED MOTOR POWER	15 kW
DIMENSIONS (L x W x H)	109 x 145 x 179 cm
WEIGHT	830 kg

MIRAI Cold 15 T (MC 15 C/W/T) - Refrigeration Capacity & Power



*Heat Transfer Fluid temperature range may depend on used fluid





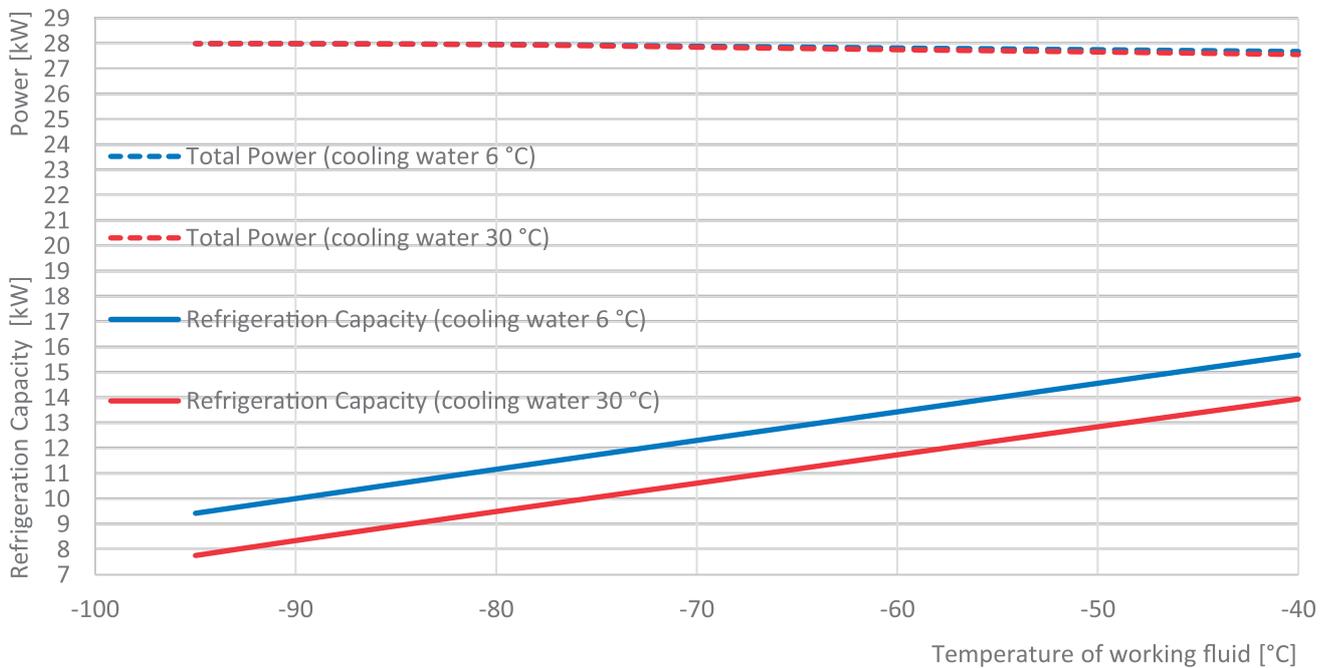
MIRAI Cold 23 T

Solution for industry-sized applications cooled by water.
Medium sized process cooling requiring ultra-low temperatures
found its environmentally friendly refrigeration solution.

Model name	MC 23 C/W/T
REFRIGERANT	Natural Air (R729)
TEMPERATURE RANGE	from -40 °C to -110 °C
TEMPERATURE RANGE HTF*	from -40°C to -95°C
SYSTEM COOLING	Water-cooled
REFRIGERATION CAPACITY	Up to 15.7 kW
RATED MOTOR POWER	23 kW
DIMENSIONS (L x W x H)	199 x 206 x 242 cm
WEIGHT	2 800 kg



MIRAI Cold 23 T (MC 23 C/W/T) - Refrigeration Capacity & Power



*Heat Transfer Fluid temperature range may depend on used fluid



Product page

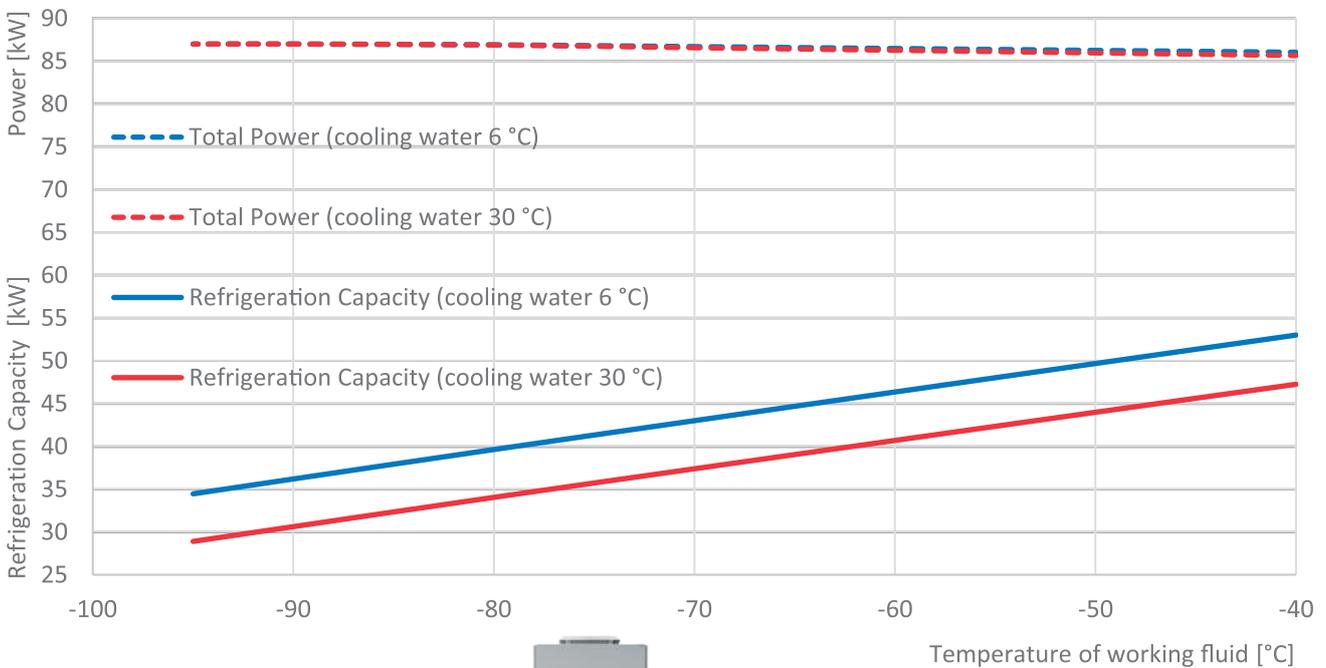
MIRAI Cold 80 T

The most powerful MIRAI Cold yet. The most compact machine when power vs machine size is considered. The electrical cabinet is separate to offer more integration options to the application's layout.



Model name	MC 80 C/W/T
REFRIGERANT	Natural Air (R729)
TEMPERATURE RANGE	from -40 °C to -110 °C
TEMPERATURE RANGE HTF*	from -40°C to -95°C
SYSTEM COOLING	Water-cooled
REFRIGERATION CAPACITY	Up to 53.0 kW
RATED MOTOR POWER	80 kW
DIMENSIONS (L x W x H)	228 x 288 x 192 cm
WEIGHT	4 300 kg

MIRAI Cold 80 T (MC 80 C/W/T) - Refrigeration Capacity & Power



*Heat Transfer Fluid temperature range may depend on used fluid



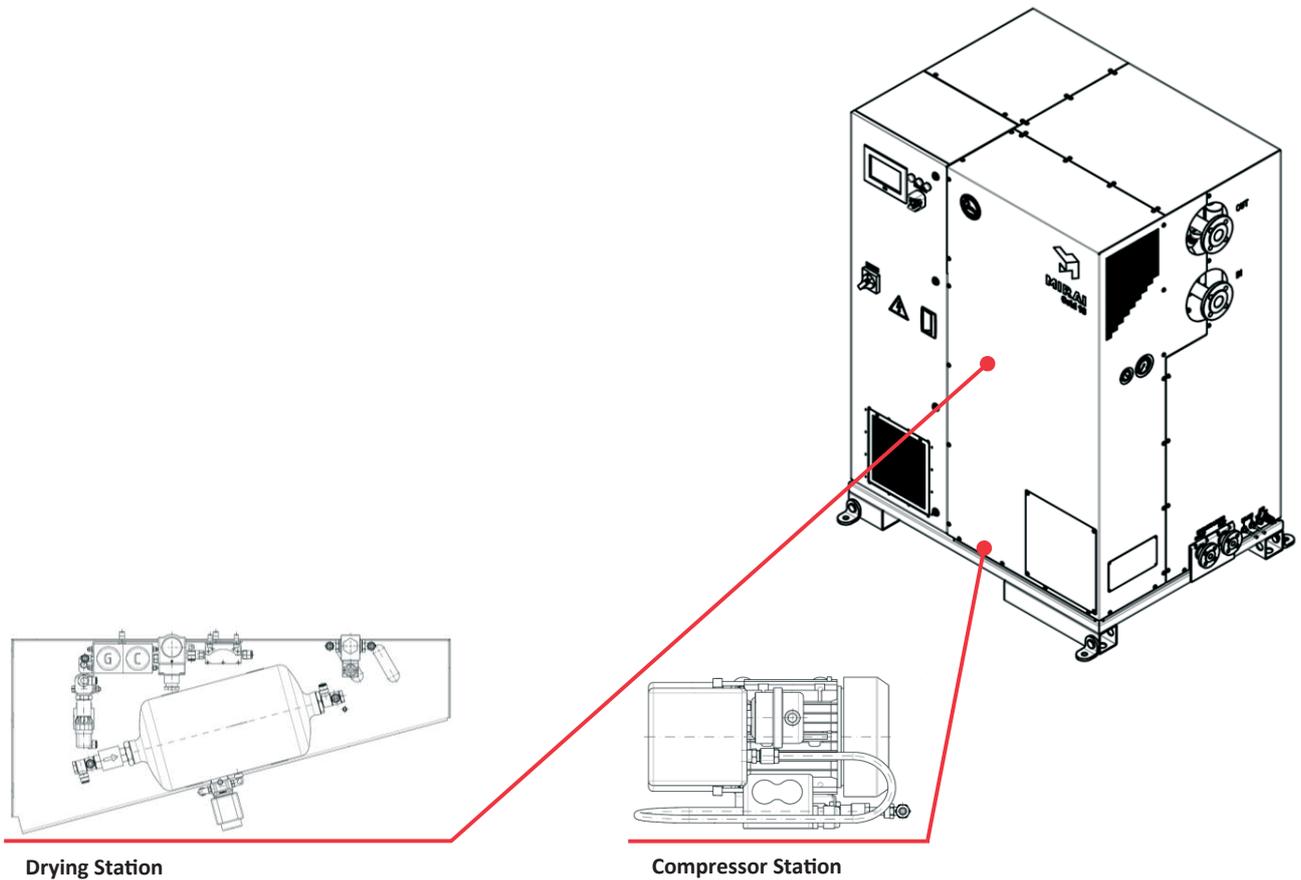
SYSTEM	Electrical cabinet
SYSTEM COOLING	Water-cooled
DIMENSIONS (L x W x H)	78 x 85 x 230 cm
WEIGHT	350 kg



Product page



System Pressurization Unit



Drying Station

Compressor Station

MIRAI Cold refrigeration machines are running only with gaseous air as refrigerant which cannot change its state to liquid. With the optional System Pressurization Unit, MIRAI Cold machines are capable of matching required operating conditions and can charge or drain the appropriate amount of air from the refrigeration cycle. Required air purity for MIRAI Cold is 1.2.1 (according to ISO 8753).

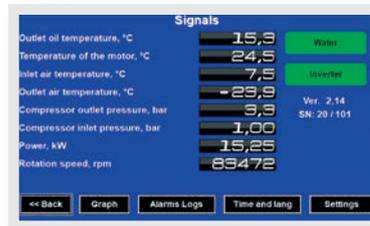
Mirai Intex has developed high-quality automated charging system available as an optional accessory for MIRAI Cold T models. This option is fully integrated inside the machine housing and therefore does not require any additional space. And since it is installed at the factory it goes through all testing procedures with the machine. The design of MIRAI System Pressurization Unit guarantees air purity level better than the minimal 1.2.1 class requirements. Therefore, this option is a perfect match for our closed cycle machines. In addition, the System Pressurization Unit is oil-free same as MIRAI Cold machines.

Control System

MIRAI Cold machines have an integrated control system with easy-to-use touchscreen interface. Integration of digital communication protocols such as ProfiNET, EtherCAT, EtherNET/IP and Powerlink comes as standard. The system offers real time monitoring, data archiving and remote monitoring as an option. Remote monitoring allows to check or set the performance of the machine as well as to update the machines software online.

Remote Monitoring

- Support from Mirai Intex during machine's operation and during troubleshooting
- Detection and prevention of problems
- Regular check-ups of machine condition and performance
- Software updates downloaded remotely to provide the latest version of improvements and optimizations





CASE STUDY

Freeze-drying

Lyophilization / freeze-drying is a process whereby a product is dried by removing the water under low temperature and pressure. Lyophilization involves the removal of water or other solvents from a given product by a process called sublimation. This occurs when the ice of a frozen product converts directly to the gaseous state without passing through the liquid phase. This enables the preparation of a stable product that is easy to use, store and transport at ambient temperatures.

With the demands on equipment and refrigerants getting stricter, customers are constantly on the lookout for new green solutions.

Mirai air cycle refrigeration technology is based on the safest natural refrigerant - air. A pleasant bonus is the economic efficiency of the system and its long service life, without deterioration of performance over time.

Together, the air cycle refrigeration solution meets the requirements of the ultra-low temperature refrigeration industry and finds its flawless embodiment in the HOF Sonderanlagenbau lyophilization system.

Results:

- Retrofit of old systems is possible with new MIRAI Cold refrigeration machines
- Launch of the new freeze-drying system product line, HOF CryoBlizzard
- Up to 15% more energy efficient
- Complete system has GWP ZERO
- Two MIRAI Cold 10 T machines provide all temperatures required by the process



Photo provided by HOF Sonderanlagen GmbH



Reference page

CASE STUDY

Solvent Recovery

Recovery of solvents from process streams is necessary, from both ecological and economical points of view. The goal is to recover, purify and re-use expensive process components, capture a specific chemical or fraction from a mixed stream, and/or remove a byproduct from wastewater to meet effluent regulations.

Solvent Recovery is based on the principle that the vapor of a boiling mixture will be richer in low boil point components such as alcohols, acetones, aliphatic hydrocarbons and, ketones.

When the vapor is cooled and condensed, the liquid condensate becomes a valuable product that can be sold back into the industrial marketplace.

Three well-known names, Mirai Intex, Refolution and HOF Sonderanlagenbau have come together to offer a state-of-the-art solution for handling, cleaning, purifying, and recycling a wide range of solvents.

Only natural refrigerant (AIR) is used in multiple stages of the cooling process. The ultra-low temperature process is realized with a Mirai Intex air cycle refrigeration solution MIRAI Cold 10 T. The process can also handle wet gases from scrubbers with special heat exchangers that are designed to endure ice formation and are separated into two lines with a recovery cycle.

Results:

- Exhaust air purification with simultaneous recovery of the solvent
- Solvent recycling of up to 99% – virtually no need to buy new solvents
- Efficient exhaust gas cleaning in accordance with TA-Luft and other regulations
- Infinitely variable output with effective partial load performance
- Maximum pressure of 10 bar
- Redundant and failsafe system design
- Fast commissioning



Photo provided by HOF Sonderanlagen GmbH





MIRAI

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