

## PRESS RELEASE – Technical analysis of Mirai COLD

### Future is here – MIRAI reveals its eco-friendly solution for ultra-low temperatures

European company MIRAI Intex has invited renowned prof. Dr. Michael Kauffeld to make an independent technical assessment on the unique air cycle refrigeration machines produced by Mirai Intex. These units underwent several tests in June of 2019 at MIRAI's test chamber and we are happy to summarize some of the results from this report.



**MIRAI Cold 10**

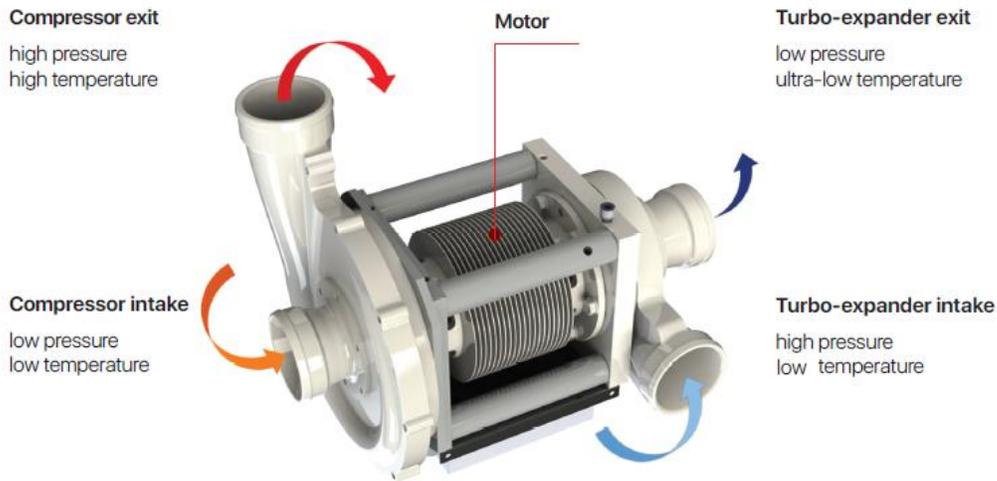


**MIRAI Cold 15**

The measurements were performed on two machines, namely MIRAI Cold 10 and MIRAI Cold 15. The machines consist of an **oil free turbo compressor and turbo expander mounted on the same shaft and driven by a speed-controlled electric motor. The shaft is supported by air foil bearings.** Heat produced by the Turbo-module is rejected to the ambient air or to cooling water via a heat exchanger on the high-pressure side. Essential for the efficiency of the machine is an internal regenerative heat exchanger. Machines are equipped by intuitive PLC interface to observe and control machines together with set of PT100 temperature sensors.

The Ultra-low temperature refrigeration machines from MIRAI Intex, i.e. the single-stage, single-sided open over-pressure process, were compared with a 3-stage cascade refrigeration system. For the cold

air cycle, the influence of the isentropic efficiency of the compressor and expander as well as the temperature differences at the internal heat exchanger were investigated.



Report confirms that the stated COP's of both machines are achieved. The Turbo module reaches an excellent isentropic efficiency of the compressor as well the expander in the temperature range from  $-40^{\circ}\text{C}$  down to  $-160^{\circ}\text{C}$ . Measurements showed even higher efficiency than 0.7 what was considered for comparison between common 3-stage cascade. It means that results are more favourable for Mirai refrigeration machines.

Comparison of the coefficient of performance between a 3-stage cascade system and an air cycle at chamber temperature of  $-100^{\circ}\text{C}$  can be seen on figure 1.

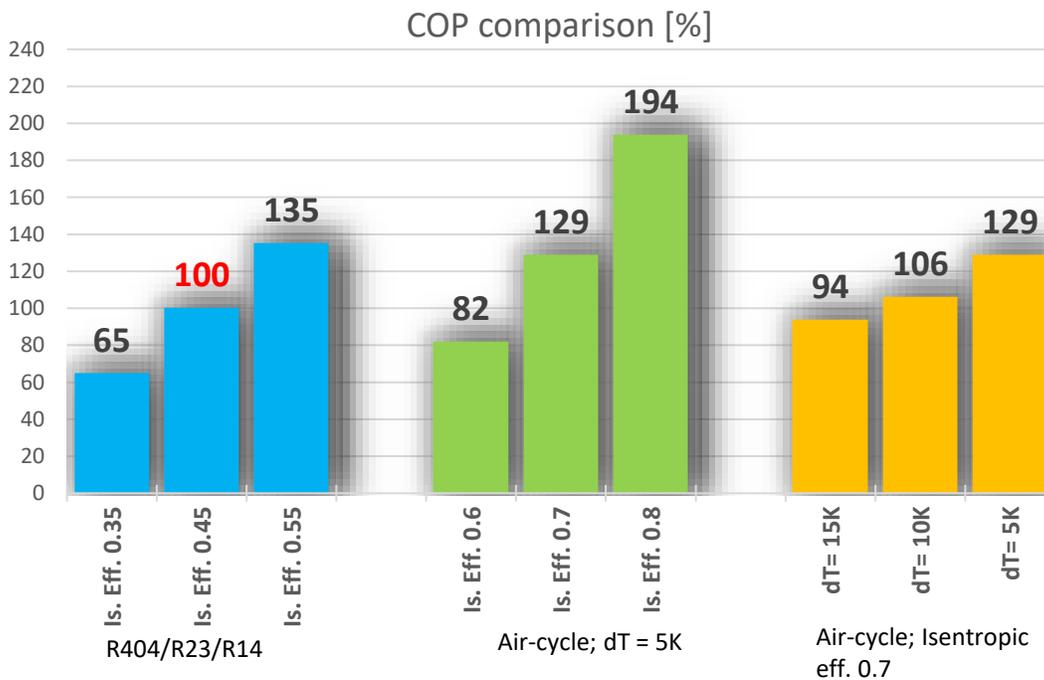


Figure 1 COP comparison between 3-stage cascade with different air cycle efficiencies with dT 5 and air-cycle with efficiency 0.7 on various dT

Prof. Dr. Kauffeld stated in his report: „Hence, the development by MIRAI Intex makes sense from an energetic point of view as well as from a refrigerant point of view. Air as perfect refrigerant is completely non-toxic and non-flammable “. If used in an oil free machine, such as the MIRAI Intex air cycle machine, no threats whatsoever originate from the working fluid.

For Ultra-low temperatures below  $-50\text{ }^{\circ}\text{C}$ , MIRAI’s machines with efficient oil-free turbo compressors / expanders **are on a par or even superior at lower temperatures with current cascade refrigeration systems in terms of energy efficiency and with almost 30% better COP comparatively**. In terms of **service costs even unbeatable**. The refrigerant is free of charge, no regularly recurring leakage checks are necessary, and maintenance is also much easier due to the absence of oil. „The efficiencies and temperature values given by MIRAI could be confirmed. Both machines run smoothly, without vibrations and with low noise emission. “concludes report prof. Dr. Kauffeld. The service costs of a cold air refrigeration system are significantly lower than those of a cascade vapour compression system under the conditions of the EU F-Gas Regulation EC 517/2014. Leakage checks are therefore required at least twice a year or even four times a year, where each leakage check costs approx. 1,000 €. This results in cost advantages of up to € 4,000 per year. Prof. Dr. Kauffeld also adds: „The annual maintenance required for cascade refrigeration systems is almost unnecessary for a cold air machine. In any case, it could be reduced from approx. one week for a cascade refrigeration system (8,000 to 10,000 €) to one day for e.g. filter replacement and short functional checks“. **Service cost is estimated approx. min. 10 times lower** compared to common cascade vapour compression system. At last but not least, with zero GWP, Mirai machines can be considered as a **best refrigeration option for many applications** together with fight for better environment in upcoming years.



## MIRAI Intex – Save the planet with us

MIRAI INTEX is an engineering company dedicated to the protection of the environment through the implementation of innovative technologies that don't leave an ecological footprint. The company was founded in 2015 in Switzerland with an ambitious goal to revolutionize the refrigeration industry in favour of climate protection. MIRAI specializes in the design and manufacturing of turbo compression equipment, based on which they have managed to make the most ecologically sound refrigeration machines for ultra-low temperature applications that are cheaper to operate than any other ultra-low temperature solution on the market. The applications range from Biomedical and Food Storage to Climate Testing, liquefaction of gases and cooling down of chemical processes.

Managing office is in Vienna, Austria and the production facility in Brno, Czech Republic.

For more details on MIRAI Intex, please consult at [sales@mirai-intex.com](mailto:sales@mirai-intex.com) or visit the website [www.mirai-intex.com](http://www.mirai-intex.com).

*In case of publication, please submit one copy to us of each of the published items for our archives.*