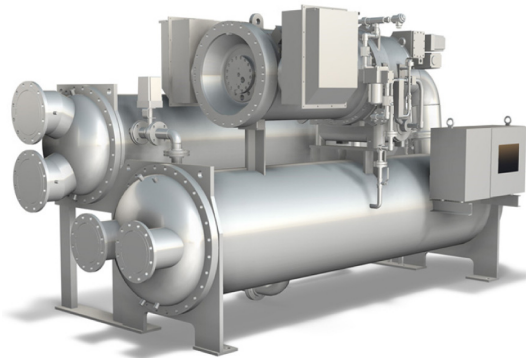


## Energy-efficient Centrifugal Chillers of MHI Bingshan Refrigeration (Dalian) Co., Ltd.



Sales Department, Air-Conditioning &  
Refrigeration Division  
Machinery, Equipment & Infrastructure

In November 2013, Mitsubishi Heavy Industries, Ltd. (MHI) established a joint company with Dalian Refrigeration Co., Ltd. (DRC) of China. The joint company, MHI Bingshan Refrigeration (Dalian) Co., Ltd. (MBRD), manufactures centrifugal chillers. MHI is responsible for provision of highly efficient compressors and centrifugal chiller design technology, which is the foundation of the high efficiency and solid reliability of our products. DRC, on the other hand, supplies high-quality heat exchangers at low cost. Through MBRD, MHI and DRC started sales of centrifugal chillers specifically designed for the Chinese market in December 2014. While using MBRD's production of centrifugal chillers as the base for sales expansion in China, MHI will also contribute to energy conservation in various countries by further releasing highly efficient centrifugal chillers to global markets.

### 1. Overview of the newly established joint company

MHI has the highest market share of manufacturers of centrifugal chillers in Japan. Accentuated by their high efficiency and fine functionality, our products have been widely used for heat source systems of plant/factory air conditioning or manufacturing processes, district heating/cooling heat supply, office air conditioning, etc. Thus, MHI has significantly contributed to the improvement of heat source systems in terms of energy conservation and cost reduction. Having initiated the introduction of variable speed control and magnetic bearings to compressors ahead of its competitors, MHI promotes waste-heat utilization through the application of turbocompressor heat pump systems and is also engaged in further improving the overall heat source system efficiency by means of optimized management of the number of operating chillers or auxiliary equipment control.

DRC is the core company of Dalian Bingshan Group Co., Ltd., which specializes in air-conditioning/cooling/refrigerating systems and petrochemical facilities, and is the largest manufacturer of screw compressor chillers in China. DRC especially excels at low-temperature chillers and its product portfolio is centered on the Bingshan ("iceberg") brand of industrial refrigeration systems. The Dalian Bingshan Group has invested in a total of 35 enterprises, including foreign-capital firms as well as joint ventures with companies from Japan, the U.S., Germany and the U.K., and is China's largest group of companies dealing in cooling products and facilities such as food freezing, air conditioning and cooling for both industrial and household use.

As a joint venture between these two companies, MBRD was founded in Dalian City, Liaoning Province in November 2013 to manufacture centrifugal chillers (Figure 1). Its factory was constructed on DRC's plant site in Dalian City and has a floor area of approximately 12,000 square meters (Figure 2). It is equipped with separate specialized assembly lines for compressors and chillers, as well as commissioning equipment for centrifugal chiller. With these manufacturing facilities, the factory will serve as a large production base with an annual production capacity of 500 units. MBRD has been licensed to manufacture MHI's medium- and large-size centrifugal chillers and is also provided with MHI's highly efficient compressors. DRC, on the other hand,

supplies MBRD with high-quality heat exchangers at low cost and offers the expertise to realize conformity with Chinese standards.

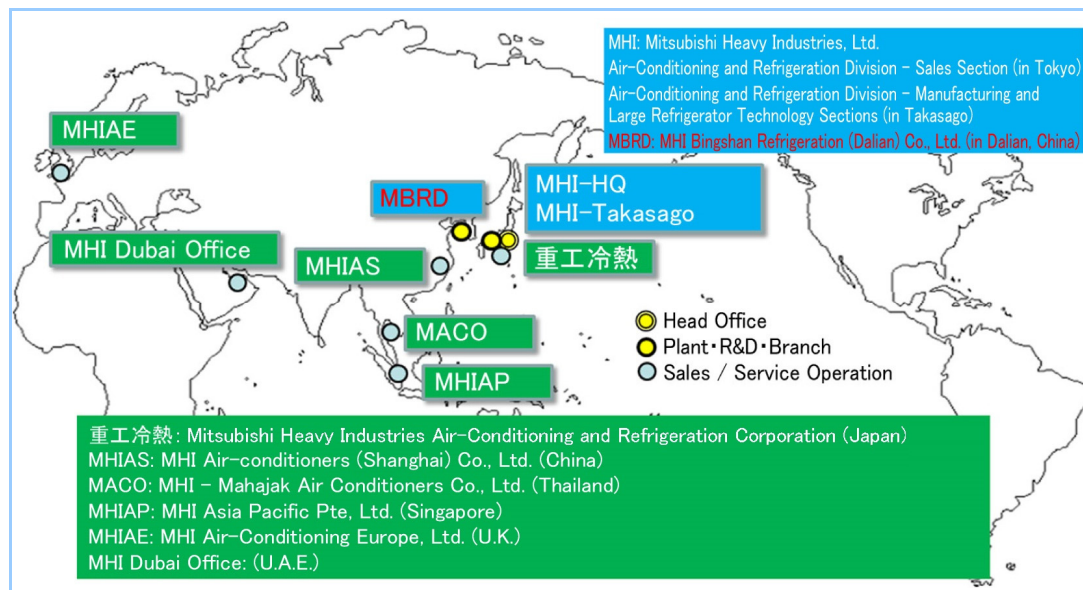


Figure 1 MHI's manufacturing and sales bases for centrifugal chillers



Figure 2 Exterior view of the new factory

## 2. Features of products for the Chinese market

China is the world's largest market for centrifugal chillers and in addition to U.S.-based makers, which undertake business activities globally, Japanese manufacturers and Chinese local companies also compete in the Chinese market. As the market is still growing, sales competition is extremely high. Based on our state-of-the-art centrifugal chillers, MBRD can offer products with dual advantages: the world's highest efficiency and functionality, and being designed especially to comply with Chinese market demand. There are two series of product lineups available: the High Efficiency Series, placing importance on performance, and the Standard Series, focusing on the balance between performance and initial costs, thus enabling us to deal with diverse market needs for chillers.

The following are the features of products for the Chinese market and their specifications are given in **Table 1**.

### (1) High efficiency

MBRD's High Efficiency Series retain the high efficiency of our centrifugal chillers. While securing better performance than the products of rival companies in the Chinese market, the High Efficiency Series can be labeled as Grade 1 under the Chinese energy efficiency standards (equivalent to a COP of 6.1 or higher according to GB standards) throughout the

cataloged range (i.e., 600 to 1800 USRt). On the other hand, MBRD's Standard Series attain Grade 2 under the Chinese energy efficiency standards (equivalent to a COP of 5.6 or higher according to GB standards), securing generally required performance levels.

(2) High-level functionality

Equipped with the same large liquid-crystal control panels as in the Japanese specifications, MBRD's products retain good usability for operational control and high visibility of operation status. The board design has been simplified by rationalizing the processing of special data output/communications, while maintaining extended start-up functions such as re-starting after instantaneous power failure, adoption of variable speed control and high-precision controllability owing to use of high-efficiency CPU boards.

(3) Installability and transportability

To reduce the required space for installation, MBRD's products retain the equipment arrangement structure of MHI's latest models in the GART Series, for which a nearly 20% reduction in installation area has been achieved compared with conventional models. Even the largest-capacity units can be transported under the Chinese transportation size limitations without disassembling the main component, thus making it easy to be transported.

**Table 1 Specifications of products for the Chinese market<sup>\*1</sup>**

Item	Unit	High Efficiency Series			Standard Series		
		80P	100P	150P	70R	100R	150R
Chiller model type	GART	80P	100P	150P	70R	100R	150R
Cooling capacity	USRt	800	1,000	1,500	700	1,000	1,500
Temperature condition	°C	Chilled water: 12.0 / 7.0°C, cooling water: 30.0 / 34.7°C					
Main power supply voltage	V	380V/10kV		10kV	380V/10kV		10kV
COP <sup>*2</sup>	—	6.42	6.62	6.48	5.96	6.1	6.02

\*1: The conditions other than chilled water and cooling water temperatures are in accordance with GB/T18430.1-2007.

\*2: COP stands for coefficient of performance and is an indicator of performance. Higher COPs suggest better energy conservation. In refrigeration systems, COP shows cooling capacity (kW) per 1 kW of power consumption.

### 3. Future plans

By securing a manufacturing base in China, which is the world's largest market for centrifugal chillers, we will enhance our cost competitiveness and further expand our sales in China, together with a view to further advancing and actively participating in global markets.