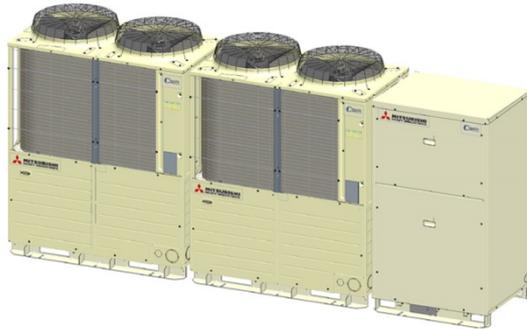


# 40-HP CO<sub>2</sub> Refrigeration Condensing Unit Realizes Short Construction Period “HCCV4001M”



Mitsubishi Heavy Industries Thermal Systems Ltd.

From the perspective of mitigating global warming, refrigerants currently in use for refrigeration and air conditioning equipment need to be replaced by those with a lower global warming potential (GWP). However, most condensing units, which are used to refrigerate cold storage warehouses or showcases in supermarkets, still use fluorocarbon refrigerants with a large GWP such as R404A (GWP: 3920) and R410A (2090). To address this issue, Mitsubishi Heavy Industries Thermal Systems, Ltd. (MTH) released 10-horsepower (HP) and 20-HP commercial condensing units of the “HCCV series” using natural refrigerant CO<sub>2</sub> (GWP: 1), and these units have earned a good reputation. However, when it comes to the application of these 10-HP and 20-HP models to large cold storage warehouses or supermarkets, some installers and customers consider that the multiple unit installation entails complicated refrigerant piping systems and increased construction costs, which are said to be obstacles to introduction. Therefore, we have newly-developed a 40-HP condensing unit as a larger capacity model of the “HCCV series”, thereby achieving simplified refrigerant piping, space saving and reduced weight. This report presents the product characteristics and specifications.

## 1. Characteristics

### 1.1 Simplified connecting piping realizes short construction period and the labor saving

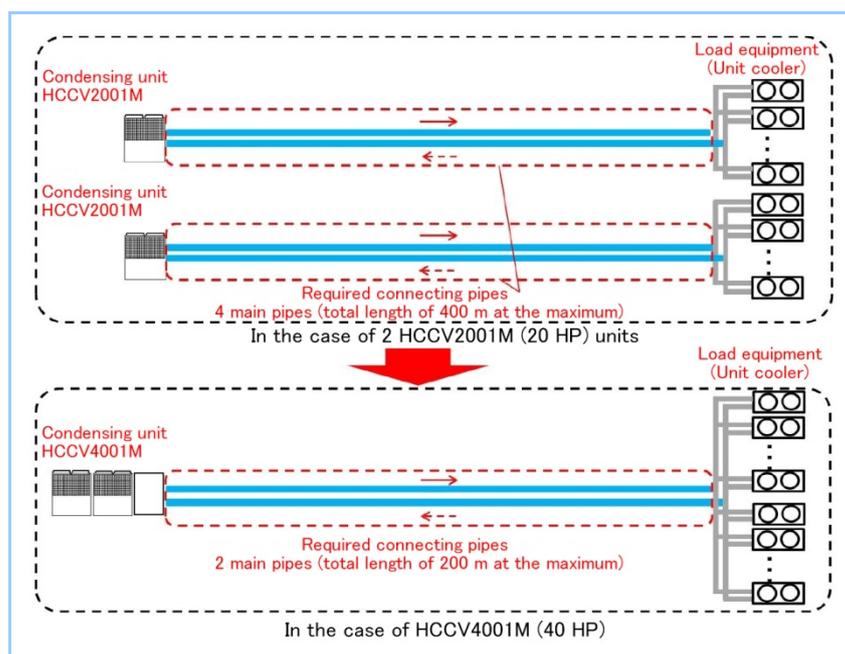


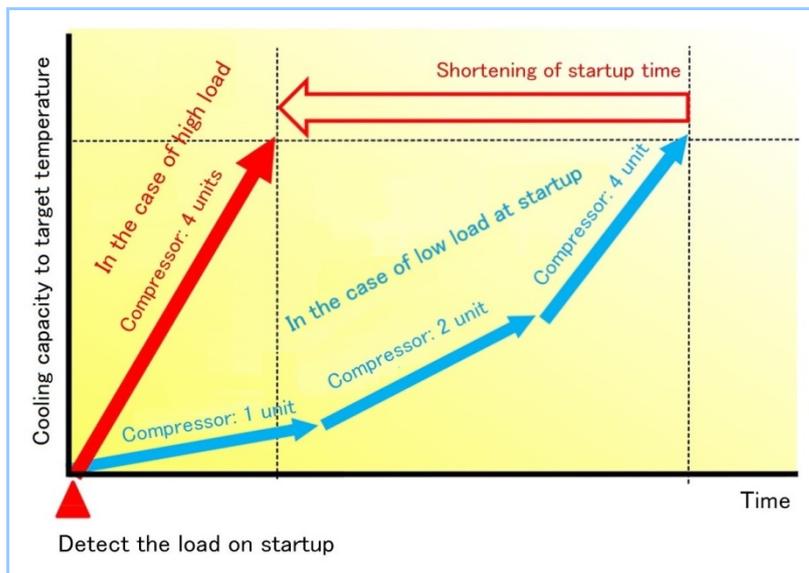
Figure 1 Simplified connecting piping system

The large capacities required by large cold storage warehouses or supermarkets are currently handled by installing multiple 20-HP units in series. However, this involves as many connecting pipes as the number of units installed. When there are many units to install or when the piping runs are long, the work period is prolonged, which is an issue. Therefore, we have developed a large capacity 40-HP unit, successfully halving the number of connecting pipes between the load-side equipment (e.g., unit coolers or showcases used to refrigerate products) and the condensing unit as shown in **Figure 1**. The resultant outcomes include not only the reduction of connecting pipe materials used, but also shortened construction periods and labor saving. Since the location of the available area for condensing unit installation is often limited in large cold storage warehouses or supermarkets, the required length of the piping runs is usually long. The resulting benefits are greater where longer piping runs are needed.

## 1.2 High reliability

### (1) Optimal operation with 4 Scroll-and-Rotary compressors installed

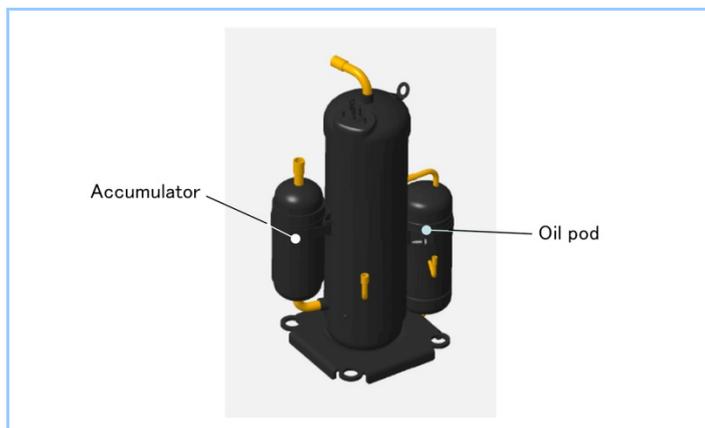
To handle a wide range of load changes as well as the need for large capacities, this product is equipped with 4 highly-efficient Scroll-and-Rotary compressors with a proven record in 10-HP and 20-HP applications. Optimal control at the highest efficiency is achieved by concurrently using the functions for changing the number of units in operation and operating each of the compressors at variable speed. To improve the cooling rate, the expansion valve which is positioned between the high-pressure region and medium-pressure region is controlled in an optimal manner, so that the four compressors can be simultaneously started at full capacity. With this optimized control, the time at which the internal temperature is cooled to the target temperature can be shortened even when the storage temperature is elevated (e.g., after defrosting). In the case of low load operation, a single compressor is started up to minimize the power consumption as shown in **Figure 2**.



**Figure 2** Number of compressor units in operation according to the refrigeration load on startup and the shortening of startup time

### (2) Ensuring the amount of oil in the compressor

To ensure compressor reliability, it is necessary to prevent the lubricating oil level from decreasing. In particular, when using multiple compressors, it is important to prevent the unbalance of oil quantity among the compressors. It is also necessary to ensure the amount of oil in the compressor, when the return oil is deficient during periods when a small number of compressors operate continuously at low rotation speed. To handle these issues, each compressor is equipped with a sensor to detect the amount of oil for refrigerator, so that it can be controlled for each compressor to maintain the same level. The amount of oil is further backed up by performing oil return control, through which oil collected in the load equipment is returned to the compressor. Compressor reliability is also enhanced by attaching an oil pod to the compressor to increase oil storage capacity as shown in **Figure 3**.



**Figure 3 Scroll-and-Rotary compressor – oil pod**

(3) Backup operation function

If the compressor breaks down, cold storage warehouses or showcases should still keep their cooling capacity. Even in such situations, because our product is equipped with multiple compressors, the refrigeration system can continue to function by allowing the remaining unbroken compressors to operate. Cooling operation is therefore possible until repairs are completed.

(4) Remote monitoring to check operating conditions

It has become possible to remotely diagnose malfunctions with improved accuracy using the service tool enabling the monitoring of the operating conditions of load equipment together with data from the condensing unit. With this function, on-site failure diagnosis work is no longer required, and the time required until recovery can be shortened.

## 2. Specifications

**Table 1** shows the specifications of the HCCV4001M, a 40-HP CO<sub>2</sub> refrigeration condensing unit, to be launched.

**Table 1 HCCV4001M specifications**

Model		HCCV4001M
Application		Refrigeration
Power supply		3-phase 200 V, 50/60 Hz
Refrigerant in use		R744 (carbon dioxide)
Ambient operating temperature		-15°C to +43°C
Operating temperature		-45°C to -5°C
Legal refrigeration capacity		11.92 tons
Design pressure		High pressure 14 MPaG/Low pressure 8 MPaG
Compressor	Type	Two-stage compression Scroll-and-Rotary
	Drive system	DC inverter
	Number of compressors	4
External dimensions		Condensing unit: width 1350 × depth 720 × height 1690 (mm) × 2 units Vessel unit: width 890 × depth 720 × height 1566 (mm)
Product weight		1,120 kg

## 3. Future prospects

The newly-developed 40-HP CO<sub>2</sub> refrigeration condensing unit realized reduced construction costs and a shortened work period.

We will continue to increase the capabilities of the series to expand its application range from cold storage warehouses and supermarkets to even larger scale operations, thereby contributing to global environmental conservation and the reduction of CO<sub>2</sub> emissions.