

Direct-Driven Transport Refrigeration Unit TDJS/TDS Series Contributing to Suppressing Global Warming in the Cold Chain



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Suppression of global warming is a global issue and countermeasures are being taken for products in various fields. Transport refrigeration units installed in many trucks and trailers that support the controlled temperature transportation infrastructure for perishable foodstuffs, pharmaceuticals and industrial raw materials are also required to play their own roles, while reducing the impact of global warming at the same time.

Mitsubishi Heavy Industries Thermal Systems, Ltd. (MTH) developed the TDJS/TDS series, direct-driven transport refrigeration units (hereafter "developed product") that use a refrigerant with a low global warming potential (GWP) and realize the reduction of CO₂ emissions during operation, in order to contribute to the suppression of global warming in the controlled temperature transportation field. This report presents the developed product.

1. Product features

1.1 Consideration for global environment

(1) Adoption of low GWP refrigerant

R-404A, a refrigerant that has been used in transport refrigeration units, replaced HCFC (Hydrochlorofluorocarbon) refrigerants in order to eliminate the ozone layer depletion effect and has been used as a refrigerant for low-temperature applications. However, the GWP of HCFC is as high as 3920 and further alternatives are needed from the perspective of suppressing global warming.

The developed product uses R-452A, which reduces the GWP by about 45% in comparison to the conventional refrigerant as shown in **Figure 1**. R-452A is suitable for transport refrigeration units in view of its combustion risk, toxicological risk and low-temperature characteristics, and has the advantage that customers can use it in the same way as it is used conventionally.

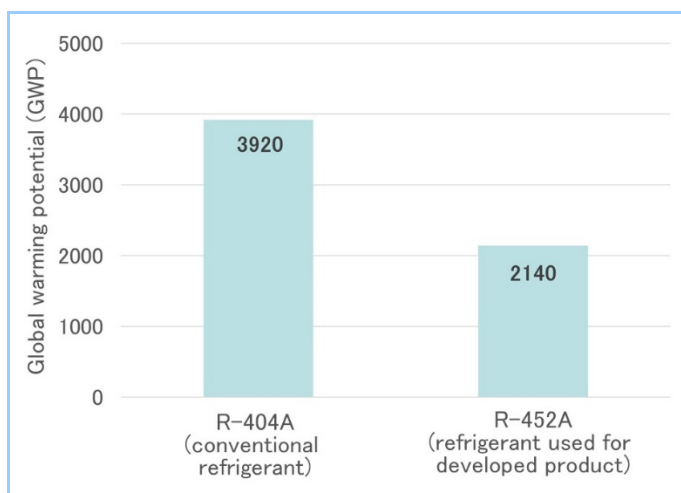


Figure 1 Comparison of GWPs of refrigerants

(2) Reduction of CO₂ emissions by using multi-evaporator system

Multi-temperature transportation by dividing the cargo space of a truck into several rooms and controlling the temperature of each room to a different temperature zone enables improvement in the vehicle operation efficiency and a reduction of CO₂ emissions. To realize it, we offer a lineup of multi-evaporator systems as shown in **Figure 2** so that the customer can choose an optimum system according to the usage.

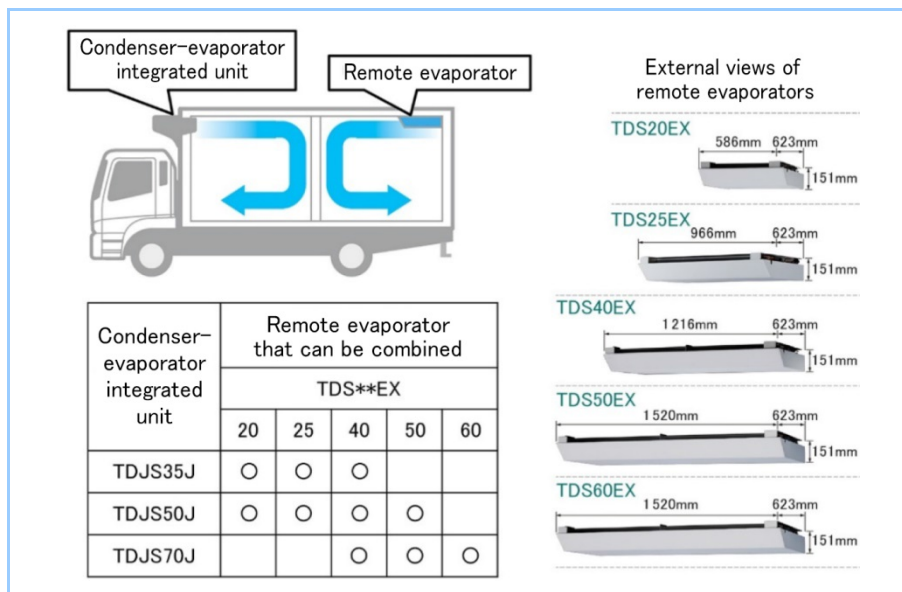


Figure 2 Lineup of multi-evaporator systems

(3) Reduction of CO₂ emissions by standby system

One of the means to reduce CO₂ emissions is a standby system. The standby system operates a refrigerator running on commercial power while the truck is stopped, thereby eliminating the need of engine idling during precooling or waiting for delivery of loaded goods and reducing the engine operating time.

In the conventional standby system, a compressor was driven at a constant speed (50/60 Hz) by a three-phase induction motor and the capacity of the motor/compressor was changed according to the required refrigeration capacity. In the developed product, a small electric compressor with a built-in inverter is newly adopted and the rotating speed is changed according to the required refrigeration capacity, resulting in the achievement of a significant weight reduction as shown in **Table 1**. The maximum load capacity is thereby increased, and we will be able to offer the standby system that can be adopted by many customers.

Table 1 External views and weights of motor compressors for standby system

Applicable vehicle		Small-sized truck	Medium-sized truck	Large-sized truck
Conventional products	External view			
	Model	TPK11T	TPK15T	TPK20T
	Outer dimensions (mm)	W255×H330×D371	W540×H454×D414	W540×H454×D414
	Weight (kg)	57	92	108
Developed product	External view			
	Model	TPK36A		
	Outer dimensions (mm)	W250×H328×D391		
	Weight (kg)	21		

1.2 Improvement of working environment

The developed product has a lineup of models for large-sized trucks which are easy to fit in high roof trucks or wing body trucks for improvement of the working environment.

(1) Improvement of vehicle inside space

A high roof truck has a high-ceilinged cabin which makes an increased inside space. In order to improve the work environment for long-distance drivers who often take a rest in the cabin, high roof trucks are being increasingly introduced. On the other hand, given no space for a refrigerator to be installed at the top of the cabin, the conventional direct-driven transport refrigeration unit for large-sized trucks is difficult to install in a high roof truck. The developed product adopts an air trunk structure in which two condensers are mounted in staggered arrangement to prevent the exhaust heat from the condensers from interfering with each other as shown in **Figure 3**. The purpose was to have the outer dimensions which allow a refrigeration unit to be installed under the chassis while securing the heat exchange area required for a large-sized truck. The developed product opens up the option for customers to choose high roof trucks, thereby contributing to the improvement of driver's work environment.

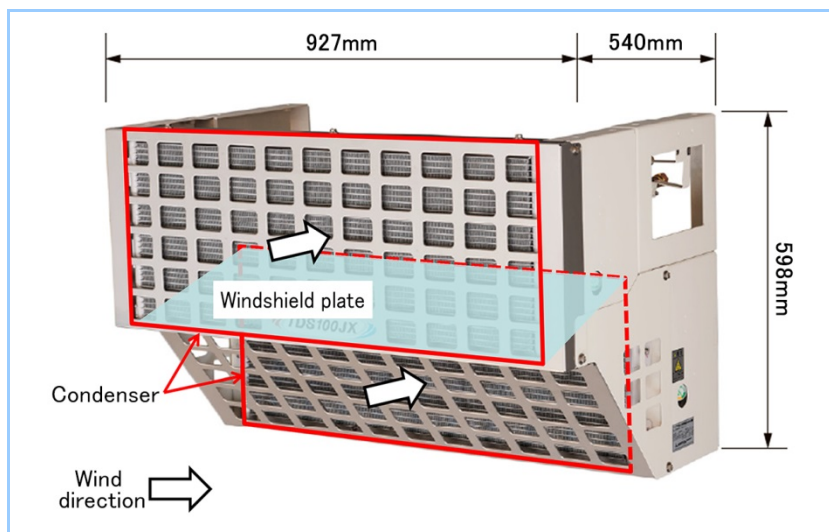


Figure 3 Structure of condenser units of transport refrigeration unit for large-sized truck with high roof

(2) Reduction of working hours

A wing body truck is a vehicle of which the sides of the body can be fully opened and enables the cargo to be loaded and unloaded in a short time and with high efficiency by forklifts. Therefore, it is becoming mainstream in freight vehicles because of the convenience. On the other hand, compared to general van body trucks, it has many moving parts and restrictions may be imposed on the installation of a refrigerator.

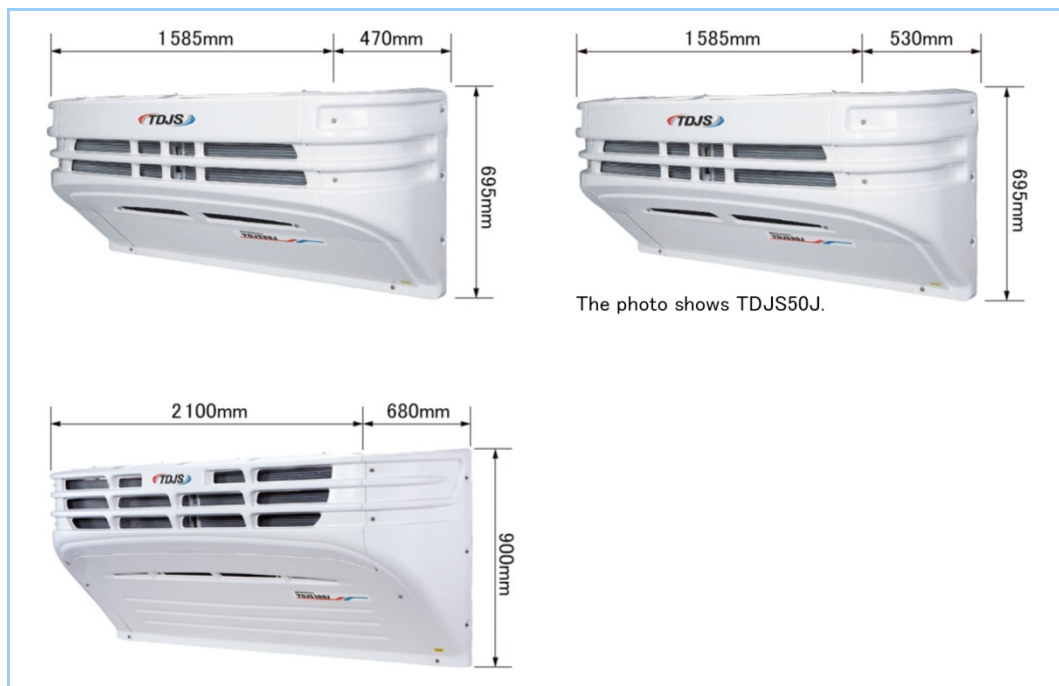
Against the restrictions, the weight, external shape and installation position of the developed product were considered so that it could be adapted to a wing body truck. This contributes to the reduction of the working hours with the increased efficiency of cargo loading and unloading.

2. Specifications and external views of main models

Table 2 lists the specifications of the main models for small-, medium- and large-sized trucks of the developed product. **Figure 4** shows the external views and outer dimensions of the models of the developed product.

Table 2 Specifications of main models for small-, medium- and large-sized trucks

Applicable vehicle			Small-sized truck	Medium-sized truck	Large-sized truck
Model			TDJS35J	TDJS50J	TDJS100J
Cooling capacity (at outside temperature of 35°C)	Cargo room temperature: 0°C	W	3,400	4,450	8,900
	Cargo room temperature: -18°C	W	2,000	2,550	5,200
Refrigerant/GWP			-	R452A / 2,140	R452A / 2,140
Refrigerant volume			kg	1.7	2.1
Compressor	Model	-	CSA90	CSA90	CSA90 x 2 sets
	Displacement volume	cc	92	92	92 x 2 sets
Integrated unit dimensions			mm	Figure 4	Figure 4
Integrated unit weight			kg	71	82

**Figure 4 External views and outer dimensions of main models for small-, medium- and large-sized trucks**

3. Future prospect

We will continue to develop and provide transport refrigeration units that are friendly to the global environment and humans.