

# Engine-driven Refrigeration Unit TU series using Low GWP Refrigerant



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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.

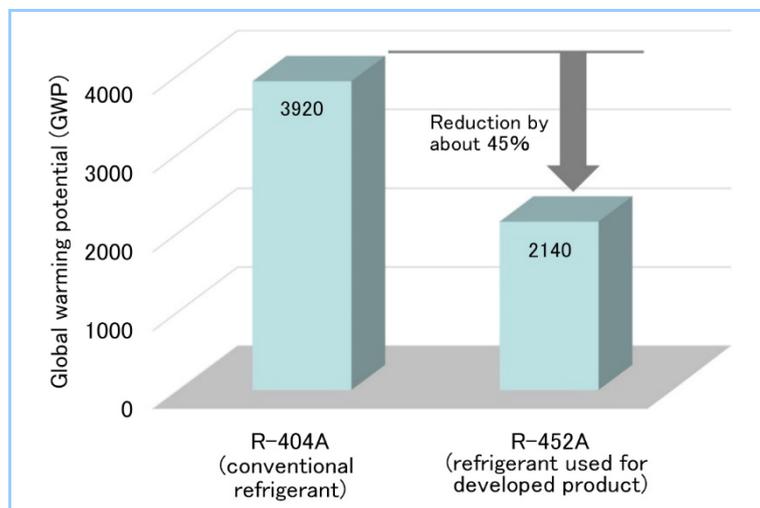
Mitsubishi Heavy Industries Thermal Systems, Ltd. promptly developed the TU series, engine-driven transport refrigeration units (hereinafter referred to as the "developed product") that use a refrigerant with a low global warming potential (GWP) in order to lead the contribution to the suppression of global warming in the transport refrigeration unit industry. This report presents the developed product.

## 1. Product features

### 1.1 Consideration for global environment

#### (1) Adoption of low GWP refrigerant

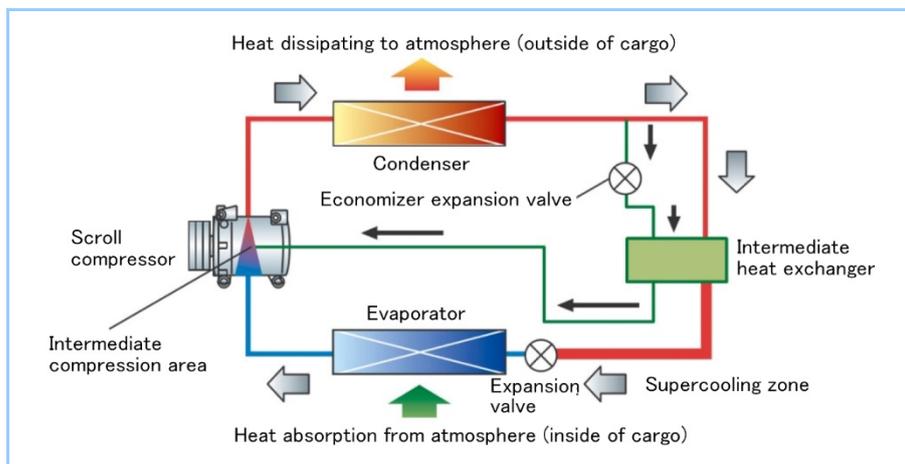
R-404A, a refrigerant that has been used in transport refrigeration units, replaced HCFC refrigerants in order to eliminate the ozone layer depletion effect and has seen widespread use as a refrigerant for low-temperature applications. However, the GWP of R-404A is as high as 3920 and further alternatives are needed from the perspective of suppressing global warming. Therefore, the developed product uses R-452A with a lower GWP, which has similar refrigerant characteristics to R-404A and is easy to use for low temperature applications. The GWP of R-452A is 2140, which results in a reduction by about 45% in comparison to the conventional refrigerant as shown in **Figure 1**.



**Figure 1** Comparison of global warming potential (GWP)

## (2) Compatibility with fuel efficient and exhaust gas purifier truck

Improvement in the fuel consumption of trucks with transport refrigeration units has also been promoted in order to suppress global warming. In recent years, trucks are equipped with various engine auxiliaries in the engine room and under the loading platform to improve the reduction fuel consumption and purify the exhaust gas, which limits the space for mounting a transport refrigeration unit. TU series is equipped with a dedicated engine (engine-driven refrigeration units), but its condensing unit (outside unit) width (in the longitudinal direction of the truck) is 1589 mm and it can be mounted in about half the space between the front and rear wheels of typical trucks, allowing it to address the increase of engine auxiliaries. In addition, the TU100SC and TU100SCM adopt an economizer cycle as shown in **Figure 2**, in which a part of the refrigerant liquefied by the condenser is branched and decompressed, the mainstream refrigerant is cooled by the intermediate heat exchanger, and then returned to the intermediate compression area of the compressor, to realize both smaller dimensions and a higher cooling capacity suitable for large size trucks.



**Figure 2 Economizer cycle**

## (3) Multi-evaporator lineup that improves transportation efficiency

There are several temperature zones for cargo requiring controlled temperature transportation, such as frozen, chilled and dry(room) temperature, but trucks are not always full of cargo of a single temperature zone. Dividing the cargo space of a truck into several rooms and setting each room to a different temperature zone enables improvement in the loading rate and a reduction in the number of services due to the improved transportation efficiency. The TU series has several types of multi-evaporators, which can handle cargo of different temperature zones by connecting up to three evaporator units and one condensing unit to realize different temperatures for each of the divided rooms.

## 1.2 Consideration for users

## (1) Driver-friendly controller

The cabin controller shown in **Figure 3**, which the driver checks and operates during every service, is equipped with a large display that can display the temperature of up to 3 rooms at the same time with Japanese text and has preset buttons to improve visibility and operability. This controller provides a better environment in driving with less attention to the status check and condition of the refrigeration unit, helping to prevent erroneous operation.



**Figure 3 External view of cabin controller**

## (2) Timer function that enables reduction of driver's working time

The controller has a built-in ON/OFF timer calendar that enables operation start reservations for the next day or after holidays, as well as operation stop reservations after cargo room drying operation. In addition, when the inside of the cargo rooms is kept at an appropriate temperature in advance of loading or service, it is not necessary for the driver to go to work early in the morning and operate the switch, which contributes to workstyle reform such as the reduction of working hours.

## (3) Measures against use in harsh environments

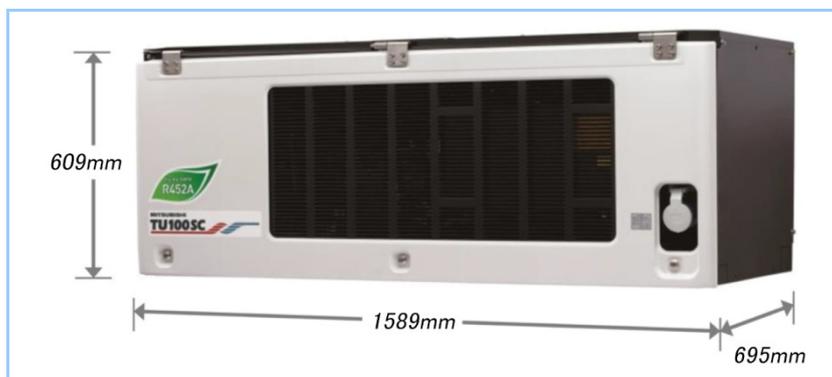
A corrosion-resistant hot-dip galvanized frame and stainless steel shroud are optionally available, which ensures reliability even when driving in areas where the influence of mud splashes and snow melting agents tends to occur.

## 2. Specifications and external view

**Table 1** lists specifications of the developed product. The TU100SC and TU85SC are single-evaporator models and the TU100SCM is a multi-evaporator model, which is a combination of a front-side evaporator and a rear-side evaporator. **Figure 4** depicts the external view and outer dimensions of the product.

**Table 1 Product specifications**

Model			TU100SC	TU85SC	TU100SCM		
					Front-side evaporator	Rear-side (ML) evaporator	Rear-side (MA) evaporator
Cooling capacity (at outside temperature of 35°C)	Cargo room temperature 0°C	(W)	10,200	8,500	9,500	9,000	6,600
	Cargo room temperature -18°C	(W)	6,400	5,700	6,200	5,700	4,300
	Cargo room temperature -29°C	(W)	4,500	3,800	4,300	3,800	3,100
Refrigerant/Volume		(kg)	R452A/4.6	R452A/3.6	R452A / 4.6 to 6.0		
Engine	Fuel type/ Displacement	(cc)	Diesel fuel / 1,116				
	Rated output / Engine speed	(kW/min <sup>-1</sup> )	12.5/2,100				
Standby motor	Power supply		3-phase 200 VAC 50/60 Hz or 3-phase 220 VAC 60 Hz				
	Efficiency class / Output	(kW)	IE3/5.5				
Compressor	Model		CSA130E	CSA130	CSA130E		
	Displacement	(cc)	125.6				
Dimensions	Condensing unit	(mm)	W1589×H609×D695				
	Evaporator unit	(mm)	W1535×H348×D602	W1532×H348×D612	W2000×H200×D753	W1520×H151×D623	
Weight	Condensing unit	(kg)	435	430	445		
	Evaporator unit	(kg)	49		48	49	30
	Other	(kg)	31		39		
	Total	(kg)	515	510	Depending on combination of evaporators		



**Figure 4 External view and outer dimensions of condensing unit**

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### **3. Future development**

We will continue to develop and provide transport refrigeration units that are friendly to the global environment and humans and can be used safely and reliably.