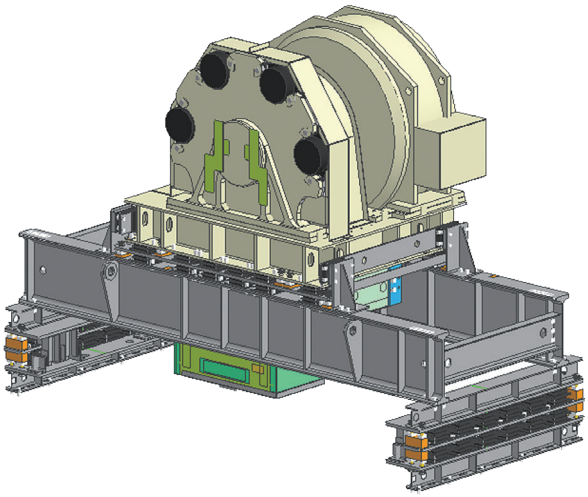
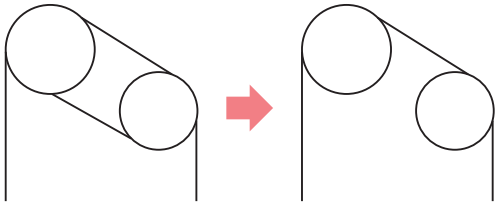
7. Building Solutions

7.1 Latest Key Technologies for High-Speed Elevators with Ultralarge Capacity



Compact traction machine



Outline of traction machine for high-speed elevators with ultralarge capacity

The prevalence of increasingly tall and large buildings is driving the need for elevator systems with greater passenger capacity. However, increasing the capacity of the drivetrain equipment causes an increase in its size, which leads to various problems concerning the layout of buildings and the installation, maintenance, and renovation of elevators.

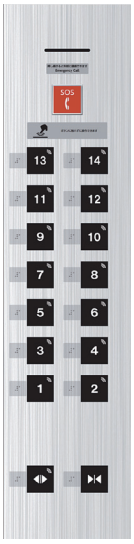
Against this background, Toshiba Elevator and Building Systems Corporation has developed a compact high-speed elevator with ultralarge capacity, applying the following approaches:

(1) In contrast to conventional double-wrap roping, the new elevator is roped with a single-wrap arrangement, halving the main shaft load and thereby doubling the output capacity in comparison with a conventional elevator having the same dimensions and weight. The traction force required for the ropes has been secured by optimizing the shape of the sheave groove.

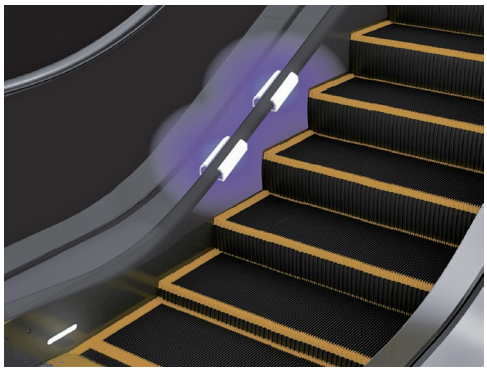
(2) The new elevator uses up to 10 wire ropes with a diameter of 22.4 mm featuring light weight and ultrahigh strength. Combined with the single-wrap traction, this has contributed to a reduction in the width of the traction machine. In addition, in order to accommodate the requirements of large buildings, the PC monitoring and operational system has been redesigned to support the monitoring of a large number of elevators and improve their reliability.

7.2 Elevator and Escalator Functions for Protection against COVID-19

Floor button with non-contact sensor



Contactless buttons on car operation panel



Handrail belt sterilizer

Contactless buttons on elevator operation panel and sterilization equipment installed on escalator handrail

Since large numbers of people use elevators and escalators every day, effective countermeasures are needed to prevent the spread of the novel coronavirus (COVID-19).

Under these circumstances, Toshiba Elevator and Building Systems Corporation has developed new products and functions to alleviate passengers' anxiety about COVID-19.

For elevators, we have developed the following functions: (1) contactless buttons for touch-free elevator operations, (2) a function to warn passengers when a car becomes crowded, (3) a scheduling function to avoid crowded runs, (4) a function to automatically ventilate cars, and (5) an SIAA(*)-certified antibacterial and antiviral coating for parts that passengers touch.

For escalators, we have developed (1) a light-emitting diode (LED) sterilizer for handrail belts and (2) an SIAA-certified antibacterial and antiviral coating for handrail belts.

These countermeasures will help to protect elevator and escalator passengers from the coronavirus.

(*) SIAA stands for the Society of International sustaining growth for Antimicrobial Articles. Products compliant with the quality and safety requirements of the antibacterial and antiviral standards of SIAA bear the SIAA mark.

7.3 Development of Socket Type LED Lamps Compliant with UNECE Regulations

LR4B

Example of vehicle-mounted lamp

Socket type LED lamp for stop/tail lamps compliant with UNECE vehicle regulations

Since commencing the mass production of socket type LED lamps for automotive stop/tail lamp applications in 2015, Toshiba Lighting & Technology Corporation has been expanding its lineup of socket type LED lamps to include normal and high-flux red, white, and amber-colored lamps for exterior use.

As Europe leads the standardization of automotive light source components via the United Nations Economic Commission for Europe (UNECE) Regulations(*), UNECE-compliant socket type LED lamps are expected to become the mainstream both in Japan and abroad. In response, we commenced the development of UNECE-compliant products and began their production in June 2021.

The main features of the newly developed socket type LED lamps for stop/tail lamp applications are as follows:

(1) Compactness

The sockets are designed to be smaller than the conventional sockets in order to satisfy the UNECE requirements for external dimensions. The maximum outside diameter was reduced from 37 mm to 33 mm while the fixture mounting diameter was reduced from 26 mm to 18 mm. Since the reduction in socket size might make it difficult to satisfy the UNECE or customer requirements for heat dissipation, we changed the materials of the socket and the shape of the socket fin to optimize heat dissipation. In addition, the area of the ceramic electronic circuit board was reduced by 49% while the outside diameter of the light-emitting component was reduced by 37%.

(2) Improved heat dissipation from the socket and the circuit board

In conventional products, an aluminum plate is inserted between the socket and the circuit board to improve heat dissipation. The newly developed LED lamps have eliminated the need for an aluminum plate, to achieve weight and cost reduction. Instead of an aluminum plate, the new LED lamps use plastic with 53% higher thermal conductivity for the socket and a 56% thicker circuit board to improve heat diffusion. As a result, the new LED lamps achieve the target thermal resistance without using an aluminum plate. In addition, the elimination of the aluminum plate and reduction in the socket size reduce the amount of materials required, resulting in decreases of 29% in weight and 11% in cost.

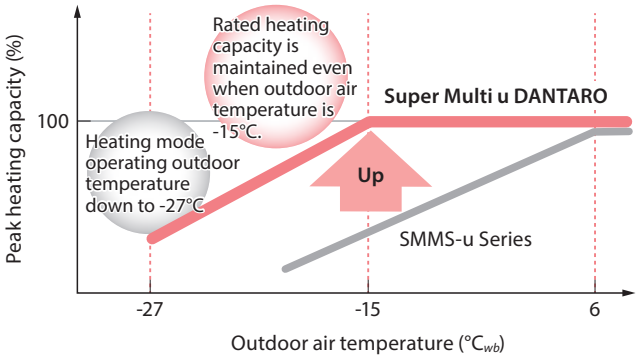
(3) Lens mounting

The sealing resin used for the conventional LEDs did not satisfy the UNECE requirements for optical characteristics. To satisfy the UNECE requirements, a new injection-formed lens is mounted after the LED component is sealed in resin.

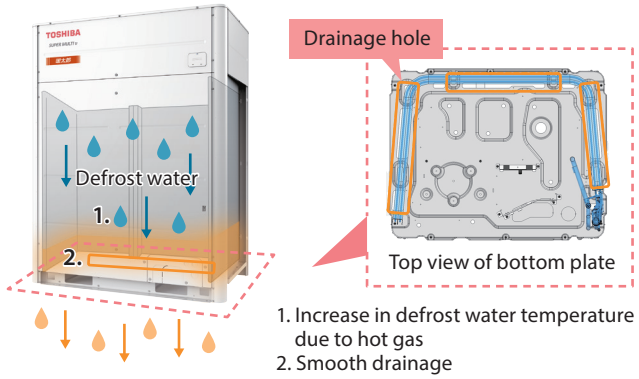
(*) UNECE Regulations: Unified regulations relating to the safety and environmental performance of vehicle structures and equipment established by the UNECE

7.4 Super Multi u DANTARO Series VRF Building Air-Conditioning Systems for Cold Regions

Super Multi u DANTARO series air-conditioning system for cold regions



Peak heating capacity vs. outdoor air temperature



Measures to prevent frosting

Toshiba Carrier Corporation has developed the Super Multi u DANTARO series variable-refrigerant-flow (VRF) building air-conditioning systems based on the Super Multi u Series, a VRF air-conditioner model that received the Energy Conservation Grand Prize from the Energy Conservation Center, Japan, in 2020. The Super Multi u DANTARO series is characterized by its enhancements for use in cold regions.

The new series features an extended heating mode operating wet-bulb (wb) temperature range down to -27°C$_{wb}$ and maintains the rated peak heating capacity even when the outdoor temperature drops to -15°C$_{wb}$. In terms of energy conservation, the 12-horsepower (hp) model provides the industry's highest annual performance factor (APF) of 5.8(*1).

To prevent frosting, the outdoor unit has a hot gas bypass circuit in the lower part of the heat exchanger and an additional drain hole on the bottom plate for smooth drainage. These prevent the defrost water generated during defrosting operation from refreezing on the bottom plate and becoming unable to be drained. A field test conducted in Hokkaido confirmed that the temperature of defrost water increased to a level sufficient for drainage without refreezing.

To ensure proper operation in a cold climate, the Super Multi u DANTARO series has the following three unique functions:

(1) Since refrigerant at a temperature of about -20°C flows through the indoor heat exchanger pipes during the reverse-cycle defrosting operation, cold air that leaks from the indoor unit causes a drop in room temperature. As a solution to this problem, the new series incorporates an individual defrosting control technology to shorten the defrosting time and raise the refrigerant temperature to the room temperature level. This technology contributes to a considerable reduction in cold air leakage and thus prevents a drop in room temperature.

(2) The combination of the individual defrosting control technology and improved heating capacity allows operation at an outdoor dry-bulb (db) temperature of down to -15°C$_{db}$, the lowest operating temperature in the industry(*2), when a fresh air intake unit is connected to the outdoor unit. This also makes it possible to take in outside air without the need for primary treatment using return air or an electric heater even in cold regions.

(3) A low-output heating operation prevents excessive chilling of buildings and the air-conditioner unit during winter nights. This helps to improve the heating startup performance and reduces peak power consumption on winter mornings.

(*1) As of June 2021 for VRF building air-conditioning systems for cold regions (as researched by Toshiba Carrier Corporation)

(*2) As of June 2021 (as researched by Toshiba Carrier Corporation)

7.5 R32 ESTIA Series 1 Heat Pump Hot-Water Supply and Heating System for European Market

Hydro unit (indoor unit) Outdoor unit: 4 kW and 6 kW class Outdoor unit: 8 kW and 11 kW class

R32 ESTIA Series 1 heat pump hot-water supply and heating system for European market

As regulations on fossil fuels and fluorinated gases (F-gases) become increasingly stringent in Europe, demand is growing for heat pump hot-water supply and heating systems using refrigerants with low global warming potential (GWP). In response, Toshiba Carrier Corporation has developed the R32 ESTIA Series 1 heat pump hot-water supply and heating system for the European market using the low-GWP R32 refrigerant.

The R32 refrigerant increases the risk of wear and deterioration of parts because of the high temperature of the gas discharged from the compressor. To prevent this problem, the new series uses wear-resistant parts coated with diamond-like carbon (DLC) and provides optimal cooling control using a liquid-injection mechanism. As a result, the new series achieves a hot-water outlet temperature of 62°C, up from 40°C for the previous model, when the outside air temperature is -25°C, realizing a high-temperature hot-water supply.

Furthermore, the 8 kW-class model has a coefficient of performance (COP) of 5.19, the industry's highest-class energy-saving performance(*). In addition, the hydro unit (water circuit) is 44% lighter and 58% smaller than that of the conventional model. This was achieved by reducing the size of functional parts, reviewing the parts arrangement, and placing electrical parts on a board.

We will continue to develop heat pump hot-water supply and heating systems that satisfy the European carbon neutrality requirements.

(*) As of April 2021 for heat pump hot-water supply and heating systems (as researched by Toshiba Carrier Corporation)