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## **Mitsubishi Electric's Aluminum Vertical Flat Tube Design Improves Heat Exchanger Performance by an Unprecedented 40%**

*Lower energy consumption and less refrigerant will realize more efficient air conditioners*

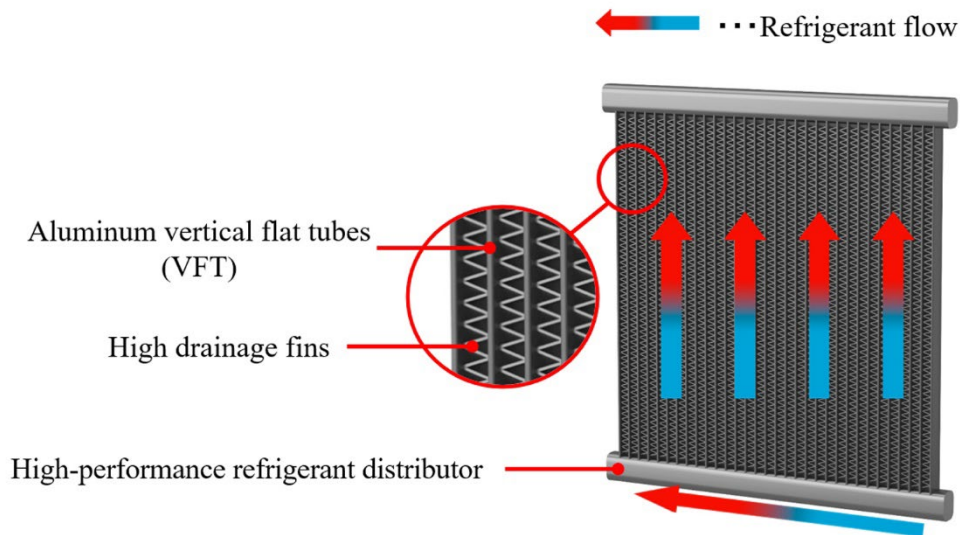


Fig. 1 Aluminum vertical flat tube heat exchanger

**TOKYO, November 1, 2023** - [Mitsubishi Electric Corporation](https://www.mitsubishielectric.com) (TOKYO: 6503) announced today that it has developed an aluminum vertical flat tube (VFT) design that improves heat exchanger performance by up to an unprecedented\* about 40% in heat-pump\*\* air conditioners used for heating and cooling (Fig. 1).

The new VFT heat exchanger combines small-diameter flat tubes, arranged vertically and very compactly, and a high-performance refrigerant distributor with a double-tube structure that evenly distributes refrigerant. Compared to conventional aluminum horizontal flat tube (HFT) heat exchangers, Mitsubishi Electric's new VFT heat exchanger also reduces refrigerant charge thanks to about up to 20% smaller internal volume compared to HFT designs. In addition, Mitsubishi Electric used proprietary analysis technology to develop a new fin design that significantly improves drainage, eliminating the problem of melted frost water freezing on

\* According to Mitsubishi Electric review of stationary air conditioners for cooling and heating, as of November 1, 2023

\*\* Heats, cools, or warms water with high efficiency by transferring heat between outdoor and indoor air

the fins and reducing air contact with the heat exchanger, which reduces performance.

While traditional heat-pump air conditioners use fluorocarbon refrigerants that contribute to global warming, reducing the refrigerant charge tends to lower heat exchanger performance. To reduce refrigerant charge and also improve heat exchanger performance, Mitsubishi Electric focused on reducing the internal volume of the heat exchanger and increasing the surface area of air in contact with the refrigerant, in part by compactly arranging a large number of small-diameter flat tubes. Conventional HFT heat exchangers also use a large number of flat tubes, but the design suffers from low heat exchanger performance because it does not evenly distribute the refrigerant, a mixture of gas and liquid under the influence of gravity.

**Key Features**

**1) New design achieves unsurpassed heat transfer with less refrigerant**

In conventional HFT heat exchangers, the refrigerant flows vertically inside the distributor and then into tubes arranged horizontally, but the large number of tubes increases the difficulty of distributing the gas and liquid refrigerant to all tubes evenly due to gravity’s influence. In the new VFT design, refrigerant flows horizontally inside the distributor and then into the tubes arranged vertically, achieving uniform distribution unaffected by gravity (Fig. 2).

Also, using simulation technology and high-speed cameras to visualize the flow of gas and liquid refrigerant inside the distributor, Mitsubishi Electric designed a new distributor with a double-tube structure that discharges gas and liquid refrigerant through multiple small holes for even mixing (Fig. 3). The design incorporates the industry’s smallest class diameter\* flat aluminum tubes arranged highly compactly (more than 100 tubes per heat exchanger), which is about four times more tubes than in a conventional HFT heat exchanger.

As a result, heat exchanger performance is up to about 40% more efficient than that of a conventional HFT heat exchanger, and less refrigerant is required because the internal volume of the VFT heat exchanger is up to about 20% smaller.

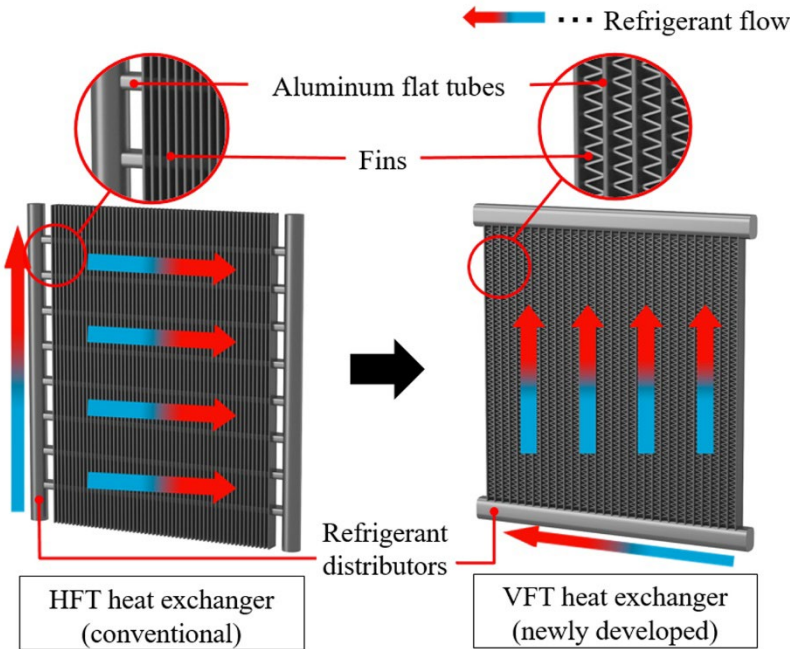


Fig. 2 HFT and VFT heat exchangers

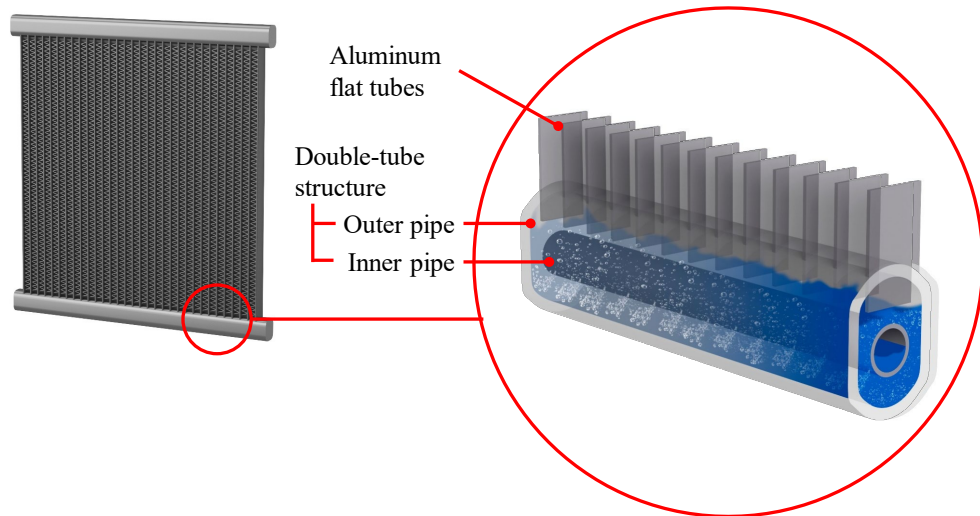


Fig. 3 High-performance refrigerant distributors

2) ***Newly designed fins efficiently drain water to maintain air conditioner efficiency***

Heat-pump air conditioners use a defrost operation to melt frost on the outdoor unit during heating. However, if melted frost water is not drained away, it can freeze on the fins and thus lower performance by reducing the amount of air coming in contact with the heat exchanger. Since the new VFT heat exchanger arranges the fins horizontally and therefore on top of each other, the fin design used in HFT units was not suitable, so Mitsubishi Electric used proprietary drainage analysis technology to develop the industry's first\* high-drainage fins, which combine drainage slits and a cut structure. (Fig. 4). Going forward, Mitsubishi Electric expects to develop heat-pump air conditioners for heating and cooling that incorporate the company's new VFT heat exchanger.

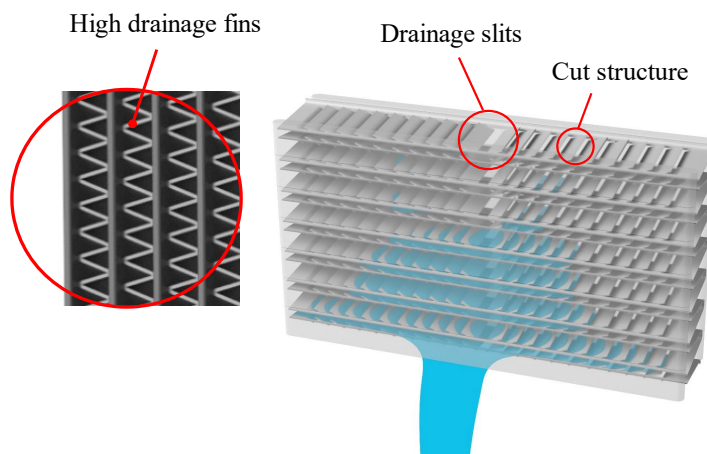


Fig. 4 High-drainage fins

**Future Plans and Prospects**

Going forward, Mitsubishi Electric will continue to refine its newly developed VFT heat exchanger, which it plans to combine with heat-pump air conditioners with the goal of contributing to a more carbon-neutral world.

*"VFT" and "HFT" are pending trademarks of Mitsubishi Electric Corporation.*

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**About Mitsubishi Electric Corporation**

With more than 100 years of experience in providing reliable, high-quality products, Mitsubishi Electric Corporation (TOKYO: 6503) is a recognized world leader in the manufacture, marketing and sales of electrical and electronic equipment used in information processing and communications, space development and satellite communications, consumer electronics, industrial technology, energy, transportation and building equipment. Mitsubishi Electric enriches society with technology in the spirit of its “Changes for the Better.” The company recorded a revenue of 5,003.6 billion yen (U.S.\$ 37.3 billion\*) in the fiscal year ended March 31, 2023. For more information, please visit [www.MitsubishiElectric.com](http://www.MitsubishiElectric.com)

\*U.S. dollar amounts are translated from yen at the rate of ¥134=U.S.\$1, the approximate rate on the Tokyo Foreign Exchange Market on March 31, 2023