

Industrial Products

1 Expansion of Large-scale E-commerce Distribution Warehouse that Takes Advantage of Extensibility of AGVs

In March 2017, Hitachi received an order for the system expansion of an e-commerce distribution warehouse to which it had previously delivered 154 automatic guided vehicles (AGVs) due to an increase in warehouse scale. Starting in April 2019, the warehouse began operations as a distribution base that can handle an inventory of 350,000 items while making up to 40,000 deliveries (orders) per day.

This system expansion work took advantage of the “phased equipment capability improvement” feature of AGVs, leading to improved distribution capabilities through the implementation of the following three items:

- (1) Increased number of AGVs
- (2) Expansion of storage area for AGVs and storage racks
- (3) Expanded picking stations*

Specifications	Original installation	After expansion project	Increase rate (multiple)
Delivery capacity	20,000 deliveries /day	40,000 deliveries /day	2.0
Number of AGVs	154	268	1.7
Storage racks	Approximately 4,500	Approximately 6,000	1.3
Storage area for AGVs	Approximately 18,000 m ²	Approximately 25,000 m ²	1.4



1 Scale of distribution warehouse (top) and AGVs carrying dedicated shelves in warehouse (bottom)

In addition, Hitachi adopted a picking method utilizing projection mapping technology that can visualize the positions and quantities of items to pick, to improve work productivity.

Although it is generally necessary to halt the use of previously installed equipment during on-site construction work, this expansion project was completed without interfering with operations due to the flexible extensibility of AGVs.

(Hitachi Industrial Products, Ltd.)

* Picking stations are locations where workers pick items off of storage racks carried by AGVs.

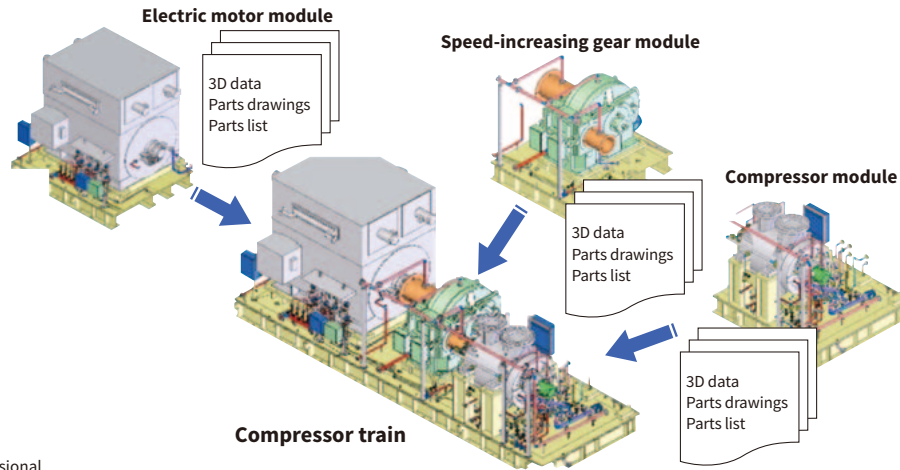
2 Downsizing and Standardization of Process Centrifugal Compressor for Refinery Service

The demand is rising for new and expanded petroleum refinery facilities due to the need to update deteriorating facilities, as well as the need to satisfy stricter regulations regarding sulfur constituent concentrations in gasoline, light oil, and heavy oil.

A process centrifugal compressor is an important machine used in the refinement process for the gasified petroleum components in a plant and there is a demand for energy saving, reducing weight and space, and quick delivery. In order to meet these compressor needs, Hitachi has developed a compact process centrifugal compressor series.

This compressor offers the following main features:

- (1) Adoption of a high-efficiency, high-reliability, and high-speed rotor made it possible to reduce the diameter of the casings comprising the flow passages by 20%, reduce the weight of the compressor itself by 40%, and reduce the train installation space by 25%.
- (2) The use of a modular design for the compressor train including the lubricant oil unit and other auxiliary machines reduce both design and manufacturing times.
- (3) Improvements to design proposal accuracy reduce



3D: three-dimensional

2 Compact standard process compressor train

the specification changes after the purchase order has been received. Along with the modular design in (2), the delivery date was shortened from 13 to 10 months. (Hitachi Industrial Products, Ltd.)

3 HF-W2000 Model 58/55/50 Industrial Computers

The HF-W series of industrial computers features stable, long-term supply, long-term maintenance service, and support for various international standards. This series is widely adopted for use in monitoring and control systems, disaster prevention systems, and other infrastructure systems, as well as in embedded devices such as semiconductor manufacturing equipment.

Recently use of this series has expanded to information field as well, including communications and broadcast systems, and medical systems. Hitachi has also began shipping HF-W2000 Model 58/55/50 computers, which are compact new high-performance models.

As products aimed at expanded application in information and communications fields, these models offer the following enhanced features compared to previous models:

- (1) More central processing unit (CPU) options
- (2) The addition of a server operating system (OS) option as the preinstalled OS
- (3) Support for multimonitor display on three screens through the simultaneous use of three display output ports

(Hitachi Industrial Products, Ltd.)

Additional CPU and OS options

- Celeron® processor option in addition to the Intel® Xeon® and Intel Core® i3 processors
- The latest Windows® 10 IoT 2019 LTSC and Windows Server® 2016 preinstalled OS options in addition to the previous Windows 10 IoT 2016 LTSB

Full range of external interfaces

- Support for multi-monitor display on three screens through the simultaneous use of three display output ports
- Six USB 3.0 ports provided to support external high-speed communication devices

Compatibility maintained with previous products

- External dimensions match those of previous products, making it easy to transition to new models
- Three expansion buses are provided (two PCI Express slots and one PCI slot) and it is possible to continue using previous PCI boards

Stable, long-term supply as well as stable maintenance service

- Stable, long-term supply for five years after release
- Maintenance service provided for up to a maximum of ten years
- Includes HDD/SSD drive bays in front that can be used to swap disks

Conforms with international safety standards and EU directives

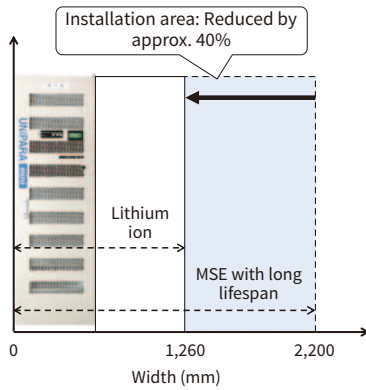
- Has UL, CSA, and CE markings, and conforms with KC, CCC, and BSMI
- Conforms with RoHS directive

IoT: Internet of Things LTSC: long-term servicing channel USB: Universal Serial Bus PCI: peripheral component interconnect
 HDD: hard disk drive SSD: solid state drive EU: European Union UL: Underwriters Laboratories Inc. CSA: Canadian Standards Association
 KC: Korea Certification CCC: China Compulsory Certification BSMI: Bureau of Standards, Metrology and Inspection RoHS: Restriction of Hazardous Substances
 * See "Trademarks" on page 151.



W93×D356×H325 mm

3 Features of HF-W2000 Model 58/55/50 computers



4 Comparison of dimensions when using lithium ion batteries

4 New Models of Small UPS with Lithium Ion Batteries

The traditional lead storage batteries used in uninterruptible power systems (UPS) were difficult and expensive to maintain, they were large, and they suffered from various other problems.

Hitachi has begun adopting lithium ion batteries for use in the small UPS models of 10 to 50 kVA UPS products in the small- and medium-capacity market segment, in order to save space and reduce the amount of maintenance labor required^{*1}. When compared to previous products utilizing lead storage batteries, these UPS models offer the following features:

- (1) Since the storage batteries offer the same long 15-year lifespan as the UPS itself^{*2}, there is no need to replace them. Also, since the voltage balance of each storage battery cell is constantly being measured and monitored, there is no need for manual measurements during periodic inspections. Not only does this reduce maintenance work requirements, it also lowers the life cycle costs.
- (2) The excellent energy density of these storage batteries makes it possible to save space. For example, when compared to MSE batteries (lead storage batteries) with a long lifespan, installation area can be reduced by approximately 40%^{*3}.



Hitachi plans to continue expanding the number of models that support lithium ion batteries.
(Hitachi Industrial Products, Ltd.)

*1 Delivery started in September 2019.

*2 During use at an environmental temperature of 25° C.

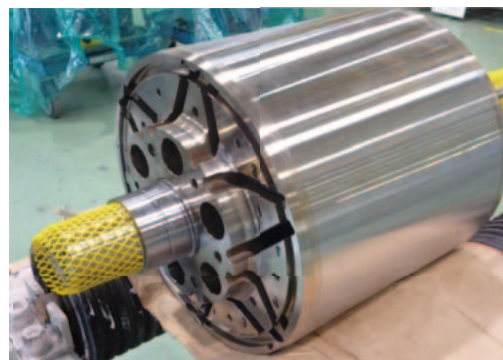
*3 In the case of a power interruption backup time of 10 minutes at 30 kVA.

5 High-efficiency Motors for Rolling Stock

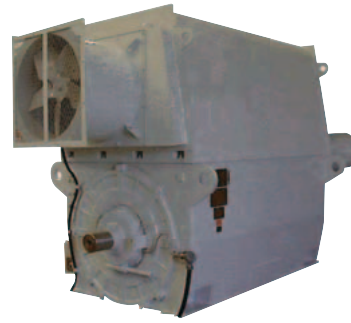
Rolling stock traction motors have seen a major shift from direct current (DC) motors to induction motors (IMs) that has been accompanied by efforts to increase performance and efficiency by up to 95% while reducing size, weight, and maintenance needs. Although the adoption of permanent magnet synchronous motors (PMSMs) is also starting to spread due to a demand for further improvements in energy efficiency, in practical terms there is also a need for further increases in the efficiency of IMs from the viewpoint of rolling stock system configuration and maintainability.

As part of its strategy for achieving high efficiency in IMs, Hitachi focused on harmonic loss, using electromagnetic field analysis to analyze the details of magnetic flux distribution inside the motor and reduce harmonic loss by around 80%. Not only did this technology achieve conventional efficiency of 97%, it also reduced loss while driving by inverter, with a reduction of loss of approximately 63% when compared to previous IMs.

Hitachi also increased the efficiency of PMSMs through multipolarization, by shortening the coil length used in the stator winding and reducing copper loss. Furthermore, Hitachi adopted an asymmetrical magnetic pole method in order to raise the power factor of the skew structure necessary to improve motor



5 High-efficiency IM (left), PMSM rotor (right)



6 5 MW class permanent magnet type generator (left), 2 MW class AC excitation method generator (right)

controllability, thereby increasing efficiency on the high-speed side. Development of these features made it possible to achieve a conventional efficiency of 98%.

Hitachi will continue deploying motors that meet each customer's needs based on these technologies. (Hitachi Industrial Products, Ltd.)

6 Highly Efficient and Highly Reliable Wind Power Generators

In order to utilize renewable energy for the sake of the global environment, Hitachi has applied the motor and generator technologies it has cultivated over many years to develop 1.5 to 2 MW class alternating current (AC) excitation method generators and 5 MW class permanent magnet type generators, while continuing to deliver many generators both domestically and internationally.

Hitachi's wind power generators are totally enclosed, include coolers, using numerical analysis for an appropriate aeration cooling design and compactness. Elements such as stator frame structures are based on a vibration-resistant design by considering changes in rotational speed due to the changing wind speed. In the case of the AC excitation method, a slip ring is used

for excitation of the rotor winding, but numerical fluid analysis and other methods are used to design a reliable structure in the brush areas that require maintenance.

Also, since harmonic voltages occur from the excited converters, Hitachi uses a reliable insulation system made up of mica materials that can stand up to long-term operation for the winding insulation. Hitachi can boast more than 15 years of results since production and delivery first began, and is storing operational data from actual machines to be fed back into design using the supervisory control and data acquisition (SCADA) IoT system.

Hitachi will continue reflecting the results of this feedback in design and manufacturing technology to meet a wide range of market needs for highly reliable wind power generators.

(Hitachi Industrial Products, Ltd.)

7 Expansion of the UX Series Industrial Inkjet Printers

Industrial inkjet printers, which are used to print quality information on industrial goods such as the date of manufacture, expiration date, and lot number, are in high demand around the world.



7 Model with head cleaner featuring automated print head cleaning function (left), high-speed dedicated one- and two-row printing model achieving high-quality printing on high-speed line (right)

As additional models in the UX series released in July 2015, Hitachi developed a model with a head cleaner as well as a high-speed dedicated one- and two-row printing model.

The main features of the model with the head cleaner are as follows (start of production in February 2019):

- (1) After the print head is set in the cleaning unit, simple panel operations are all that is required to automatically clean and dry the head internally. This eliminates the burden of manual cleaning that was required for previous models.

- (2) Since the print head is cleaned automatically in the cleaning unit, and liquid solvent is recovered inside a bottle after cleaning, reducing exposure to the solvent.

The main features of the high-speed dedicated one- and two-row printing model are as follows (start of production in March 2019):

- (1) With a maximum printing speed of 650 m/min*, this model supports one- and two-row printing on a high-speed line using a cable.

- (2) High-speed printing quality is improved thanks to the adoption of a new dedicated high-speed printing control method.

(Hitachi Industrial Equipment Systems Co., Ltd.)

* When printing 5×5 dots, 10 characters/inch.

8 Expansion of Inks for Non-OPOSP Industrial Inkjet Printers

Hitachi offers a wide range of options in its lineup of inks for industrial inkjet printers, including inks that offer high adhesiveness, quick drying time, and other features designed for different printing targets and applications. However, regulations of chemical substances have been growing stricter around the



8 4146K ink to which OPOSP does not apply (left), UX series inkjet printer (right)

world in recent years. In Japan, for instance, there is a big demand for inks for which the Ordinance on Prevention of Organic Solvent Poisoning* (OPOSP) does not apply.

Although, in 2018, Hitachi released its 4136K line of ink to which the OPOSP does not apply, and which is highly adhesive to rigid plastic, the ink's adhesion to non-rigid plastic (films) and glass was an issue. In order to respond to this issue, Hitachi then released a new 4146K line of ink in February 2019, mainly for use on cosmetics containers (glass). This ink adheres better than existing inks to which the OPOSP does not apply, and international sales are also expected.

Hitachi will continue meeting customers' needs for an expanded lineup of highly adhesive inks to which the OPOSP does not apply.

(Hitachi Industrial Equipment Systems Co., Ltd.)

* OPOSP: An ordinance of the Japanese Ministry of Health, Labour and Welfare that establishes safety standards for organic solvents.

9 K Series: High-speed Regenerative Inverter Hoist

Hoists are widely used as overhead travelling cranes and other industrial conveyance devices. In general, cranes with a large rated load also tend to have a high lift and a long travelling distance, and so an effective means of improving work efficiency is to increase the speed and reduce the load sway during travel. Also, when it comes to applications such as mold alignment work, although there are inverter hoists that allow non-step speed settings for the sake of positioning, traditional inverter hoists have emitted regenerative energy as heat with a resistor when lowering. To achieve energy efficiency, Hitachi developed the K series of high-speed



9 20 t high-speed regenerative inverter hoist

inverter hoists with regenerative converters that can recover regenerative energy as a source of power. This series of hoists offers the following key features (released model: rated load of 15 t to 60 t while hoisting, traverse mechanism).

- (1) Output is doubled by using two motors integrated with speed reducers, thereby doubling hoisting speed.
- (2) The load sway reduction function shortens work time (load sway: less than one fourth that of previous models).
- (3) It is possible to confirm factors such as the number of times started and hours of operation for each load, in order to support maintenance planning (USB output). (Hitachi Industrial Equipment Systems Co., Ltd.)

10 Expansion of Hitachi Hybrid Series (66/77 kV-Hy-GIS)

On April 1st, 2019, to construct an integrated system that combines everything from manufacturing to sales of substation equipment for industrial fields, sales and engineering departments for cubicle-type gas insulated switchgears (C-GIS) and other substation equipment aimed at extra-high voltage industrial fields were transferred from Hitachi, Ltd. to Hitachi Industrial Equipment Systems (Hitachi IES).

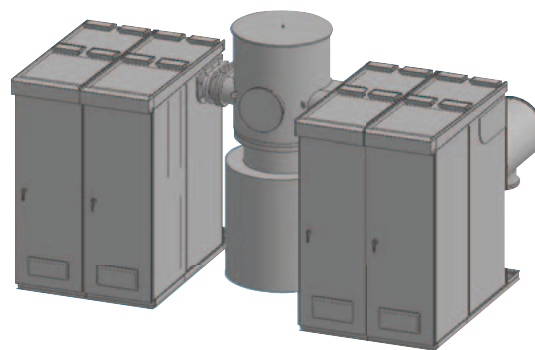
When compared with conventional package GIS (P-GIS) products, the 66/77 kV C-GIS offers the benefits of using less internal sulfur hexafluoride (SF₆) and greatly reducing installation space requirements, and Hitachi has delivered them to a large number of customers.

In addition to this transfer of business operations, Hitachi IES is also developing a hybrid GIS (Hy-GIS) that adopts hybrid solenoid operation technology that has earned a positive evaluation from customers based on its usage in high-voltage circuit breakers. This product offers the following features:

- (1) Utilizes a vacuum circuit breaker (Hy-VCB) (less maintenance, higher reliability)
- (2) Utilizes an integrated-mold-type earthing device-fitted disconnecter switch (EDS) (miniaturization)
- (3) Utilizes a three-position EDS (high reliability through reduced number of sealing points)

Hitachi IES completed development of the standard type in October 2019, and plans to continue developing options until March 2020. The company is also installing newly managed equipment in preparation for the start of mass production, which is planned for January 2020.

(Hitachi Industrial Equipment Systems Co., Ltd.)



10 Hy-GIS three-dimensional model (CHd power receiving)