



Industry

■ Industrial Systems

■ Production Plants

■ Automotive Systems

■ Biotechnology and Scientific Instruments

■ Semiconductor Manufacturing
and Inspection Equipment

High Quality and Efficient Operation Supported by Hot Rolling Mill Control System

The construction of new steel plants continues around the world against a background of economic growth particularly in emerging nations. Hitachi supplies steelmakers with electrical control systems that contribute to high quality and stable operation in all areas of steel production. As part of our aim of strengthening our hot rolling control capabilities in particular, Hitachi has in recent years been responding to new demand by developing control systems for hot rolling mills that contribute to high quality and highly efficient steel production in collaboration with mechanical equipment manufacturer Mitsubishi-Hitachi Metals Machinery, Inc.



Masahiro Kayama (left), Chief Engineer; Ken Kuribayashi (middle), Senior Engineer; Toshiaki Takahashi (right), Engineer, Electrical Control Systems Engineering Department, Power Electronics & Drive Systems Division, Information & Control Systems Company, Hitachi, Ltd.

Strengthening Hot Rolling as well as Cold Rolling

Most modern steel products are produced using a rolling process. The two types of process in which a piece of steel that has been cast and cut to a particular size is elongated by being passed between rolls and then wound into a coil are hot rolling in which the steel is rolled at high temperature and cold rolling in which the steel is rolled again after being allowed to cool back to room temperature. The division of Hitachi that makes machinery for the steel industry has a large share of the market for cold rolling equipment in particular. In 2000, it merged with the steel industry equipment division of Mitsubishi Heavy Industries, Ltd. which was strong in hot rolling to form Mitsubishi-Hitachi Metals Machinery, Inc. Since then, the control systems departments in Hitachi have also been focusing their attention on the development of control technology for hot rolling. In 2007, the latest equipment from Mitsubishi-Hitachi Metals Machinery and our control system were selected for a hot rolling mill at Dongbu Steel Co., Ltd. of South Korea and have been operating reliably since commencing commercial operation in 2009.

Precise Control Made Possible by Simulator and Support Tools

Hot rolling requires delicate and precise control of roll speed, rolling force, strip tension, and other parameters while continuously monitoring the strip thickness and width, material temperature, and similar measurements. Whereas control can use data collected from an extensive range of different sensors in cold rolling, the high temperature of the steel being hot rolled restricts where sensors can be located.

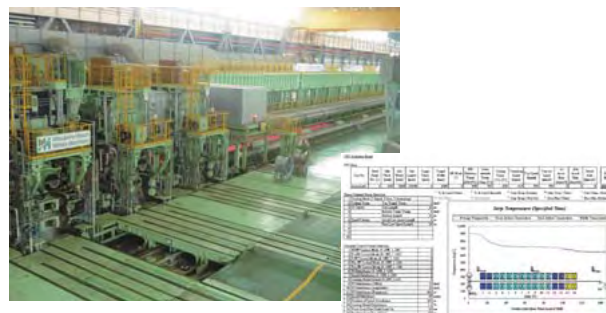
Simulation technology and model-based prediction techniques are important for estimating the condition of the steel strip accurately from this limited information. We worked with Mitsubishi-Hitachi Metals Machinery to develop a simulator that integrates knowledge about factors such as physical phenomena and the characteristics

of the hot rolling equipment with control simulation technology. Our aim is to achieve highly precise control by making full use of pre-engineering methods including using this simulator to conduct preliminary studies of control techniques.

However, because a wide range of actual conditions in the plant can cause the results to vary from the simulation, it is also necessary to tune the system while the mill line is operating to improve rolling accuracy. This work is facilitated by support tools such as MICA (modular integrated concept architecture) and PDA (process data analysis) which were developed specifically for rolling mill control. MICA has an interface that corresponds directly to the behavior of the machinery being controlled and provides an environment that simplifies the process of writing and modifying programs. Similarly, PDA is used to modify control parameters using large volumes of actual rolling data which is collected at 1-ms intervals. Adaptive control techniques are also used to adjust the models used in the control calculations automatically so that they match the results of rolling, including the models of the rolling mill equipment and steel strip.

Intelligent Control System with High Added Value

Another important factor in producing high-quality steel strip is ensuring that the tensile strength and other mechanical properties of the steel match the required values and this means that the control must take account of the microstructure of the steel. Because microstructure is influenced by the temperature of the steel strip it is currently controlled indirectly by improving the accuracy of temperature control during hot rolling, but our aim for the future is to achieve even more reliable control by analyzing the evolution of the microstructure during rolling. In the future, we intend to develop more intelligent control systems that include functions such as calculating the control parameters from the product quality requirements. We are working hard to supply control systems with better accuracy and greater added value to respond to the forecast growth in steel demand that comes with economic growth, particularly in emerging nations.



Dongbu Steel Co., Ltd. hot rolling mill in South Korea and simulator screen

Awarding of “Minister of Economy, Trade and Industry’s Commendation for Intellectual Property” for Excellence in Patent Strategy in Recognition of Use of Intellectual Property to Realize Group Synergies

Hitachi High-Technologies Corporation was awarded the “Minister of Economy, Trade and Industry’s Commendation” at the Japan Patent Office’s 2009 “Intellectual Property Awards.” The award was in recognition of company’s achievements that include working in collaboration with Hitachi, Ltd. to promote the strategic use of intellectual property in a way that has the entire company working together and maintaining the top share of the market for its leading-edge products which are distributed internationally. Hitachi intends to use the impetus provided by this award to strengthen further our activities in the field of intellectual property.



Toshiiro Ishizuka (left), General Manager; Takashi Nagamatsu (right), Engineer, Intellectual Property Department, Hitachi High-Technologies Corporation

Recognition of Intellectual Property Activities that Produce Products with a High Level of International Competitiveness

The “Intellectual Property Awards” are awarded by the Japan Patent Office each year on “Invention Day” (April 18) to individuals and companies who have contributed to the effective utilization, development, or other aspects of the industrial property rights system. In this year’s awards, Hitachi High-Technologies Corporation was awarded the “Minister of Economy, Trade and Industry’s Commendation” in recognition of our very original use of patents. This is the first such award to be won by a Hitachi Group company.

Three reasons were given for awarding the prize. (1) A high ratio of successful patent applications achieved by strengthening measures such as creating comprehensive patent maps through close study of market developments and performing patent searches prior to applying, (2) the effort we put into applying for patents in other countries to support our global operations with the consequence that our proportion of patents applied for in foreign countries was one of the highest among Japanese corporations, and (3) as a result of these ongoing efforts, the fact that we maintained the top share of the international markets for our key products, which include CD-SEMs (critical-dimension scanning electron microscopes) for which our market share is approximately 82% and automatic blood analyzers for which our market share is approximately 20%.

Strategic Use of Intellectual Property Based on Three Key Activities

The key pillars of our intellectual property activities are three core activities that aim to combine a business strategy, research and development strategy, and patent strategy coordinated by a management strategy that is underpinned by a customer-first philosophy. To this end, we have established a cycle whereby we identify the issues, create the patents, and manage patents once they are in force under an organizational arrangement that coordinates the Intellectual Property Group and laboratories of Hitachi, Ltd. with our business strategy department, sales department, design department, and Intellectual Property Department. The three key points are as follows.

The first is making strategic use of patents based on a patent map. First we analyze the latest customer needs and issues that have been collected by our business strategy and sales departments and prepare a research and development roadmap based on how we anticipate the market developing. At the same time, we also identify the patents associated with each product and create a patent map that gives a clear indication of the strength of our position regarding patents. Based on these, we formulate our intellectual property strategy and implement measures that proactively strengthen our technology in areas where we are in competition with other companies as a way of consolidating the superior technology of each product.

The second is the process of patent management whereby we work on preparing the most important patents that represent our strengths in advance of our competitors and build a patent network with these patents at its core. The task of preparing these patents is called FS (flagship) patenting and is an activity that is characteristic of how we working together as a single unit with the Intellectual Property Group and laboratories of Hitachi, Ltd. Patent management is called PPM (patent portfolio management) and involves building a powerful patent network in a business sense by using techniques that include patent correction and splitting.

The third key point is cross-disciplinary patent management. We have created the organizational infrastructure to incorporate technologies that can be used by more than one product into our patent strategy and to encourage patents that can be effective against our competitors. We undertake measures that can increase patent utilization and make a major contribution to our business by managing patents in a way that transcends departmental boundaries.

Cultivating Greater Brand Value

However, our work on intellectual property has not always gone smoothly from the start. To raise awareness within the company, the Intellectual Property Department has created an environment that encourages people to take the time to create, perfect, and utilize new inventions by continually reminding people that “business strategy = patent strategy” and that “continuing to win at business means winning with patents.” The department has also worked consistently with the design department to improve the quality of patents. Naturally this work is made possible by the cooperation of the Intellectual Property Group and laboratories of Hitachi, Ltd. and by the leadership and deep understanding of intellectual property of our own management. In this respect, this award is the fruit of initiatives taken across our entire company and is based on the foundation of the intellectual property work of the Hitachi Group with all its traditions and past success.

For the future, we intend to increase the value of Hitachi further by extending the scope of our intellectual property activities including actively pursuing opportunities to obtain not only patents but also designs and trademarks. We will also work hard to improve the performance of our intellectual property activities so that we can contribute to business growth across the entire Hitachi Group.

Next-generation Switchgear System



22-kV C-VIS (cubicle-type vacuum-insulated switchgear) (left) and 6.6-kV solid-insulated busbar switchgear (right)

The key requirements for switchgear in recent years have been environmental friendliness, safety, and low maintenance. In response to these needs, Hitachi has developed and commercialized switchgear that are free of SF₆ (sulfur hexafluoride) gas which has a high global warming potential, use solid insulation for high-voltage components, and use grease-free operating mecha-


nisms. Attention is also currently being focused on the construction of "smart grid" electric power systems that use IT (information technology) to perform optimum control of a wide range of different power sources extending from large-scale power generation to low-power renewable energy. For these electric power systems, Hitachi is working to enhance the intelligence of systems such as Hitachi's ICU (intelligent control unit) digital protection and monitoring systems and the HISMACH (Hitachi substation human-machine console) comprehensive monitoring and control system in order to supply smart switchgear systems that incorporate the switchgear described above. In the future, Hitachi plans to build the organizational capacity to deal with electrical distribution systems outside Japan in order to strengthen its foreign activities including the products described here.

HF-W6500 Model 35/30 Industrial Computer

The HF-W Series of industrial computers are used extensively as computers with a long operating life in monitoring and control systems, semiconductor and LCD (liquid crystal display) production and inspection equipment, and in IT (information technology) applications such as communication and broadcasting equipment and call centers. Hitachi has now added the high-performance HF-W6500 Model 35/30 to its standard HF-W6500 Series of models.

The new models achieve high performance thanks to a processor with twice the performance of the previous model and a PCI (peripheral component interconnect) - Express bus. Also, the use of standard dimensions and PCI support ensures compatibility with previous models. Features of the HF-W Series include the ability to operate continuously (24 hours a day) for 10 years, ECC (error check and correct) memory for improved data reliability, and status LEDs (light-emitting diodes) that simplify maintenance.

Industrial computers need to deliver high performance year after year and they make it possible to implement advanced systems in various application fields.



100 mm

400 wide x 450 deep x 150 high (mm)

High-performance CPU

Model 35: Intel® Core™ 2 Duo (2.13 GHz) processor
 Model 30: Intel Pentium® dual-core (1.8 GHz) processor

Backward compatibility with previous model

Same external dimensions as previous model, easy to upgrade to new model
 The computer's PCI Extended bus with 6 slots (2 x PCI-Express slots and 4 x PCI slots) allows existing PCI boards to be reused.

Long-life design

Designed for continuous (24 hours a day) operation for 10 years
 Operating life is six times that of a standard office PC
 (8 hours a day x 5 years)

ECC memory

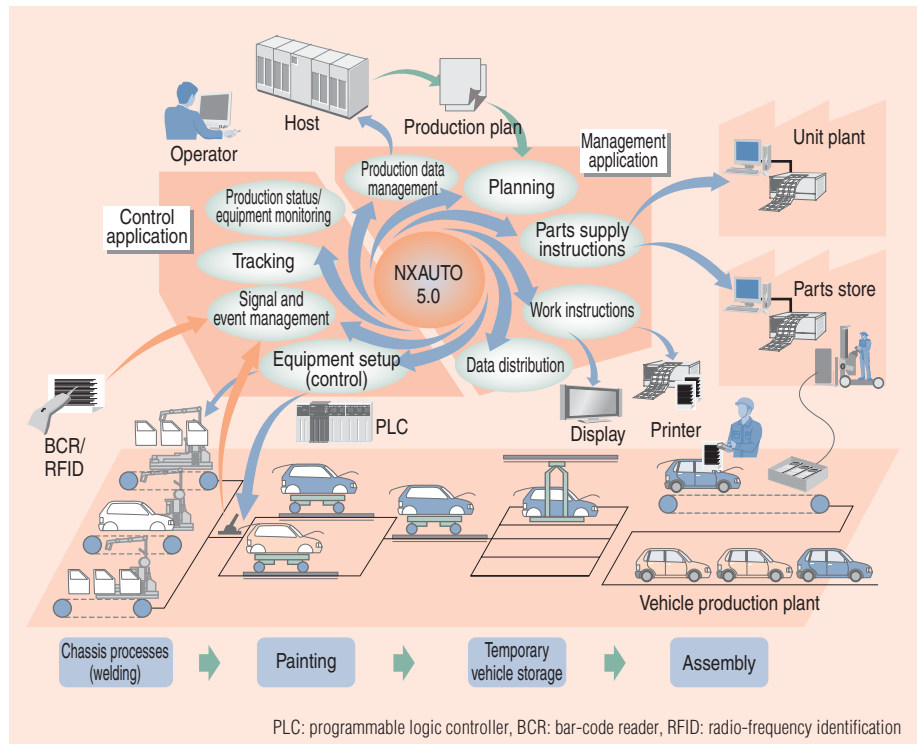
ECC memory is provided for industrial applications to strengthen data reliability.

* See "Trademarks" on page 87.
 CPU: central processing unit, PC: personal computer

Overview of HF-W6500 Model 35/30 industrial computer

NXAUTO 5.0 Process Management System for Automotive Industry

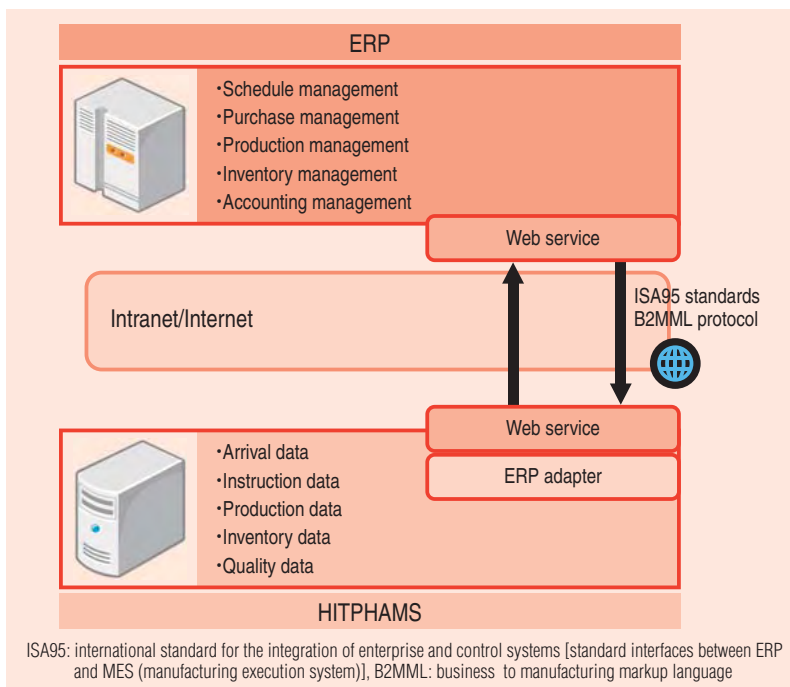
Advanced production execution and management systems that can provide precise manufacturing instructions for each vehicle, collect production data, and control conveyor lines have become an essential part of the current environment where the use of mixed-model production lines with single-vehicle lot sizes has become common practice. To meet these needs, Hitachi has released NXAUTO* 5.0, the latest version of its NXAUTO Series of process management systems for the vehicle manufacturing industry. A feature of NXAUTO 5.0 is that it is split into separate management and control applications. This allows the system to be configured quickly using parameter settings, and the system has a high degree of scalability being able to support applications ranging from simple production lines that only require basic management functions through to complex high-volume production lines.



Overview of NXAUTO 5.0 functions

* "NXAUTO" is a registered trademark of Hitachi, Ltd. in Japan, USA, and Canada.

Enhanced Support for ERP Integration*¹ in HITPHAMS Using HITPHAMS ERP Adapter



ISA95: international standard for the integration of enterprise and control systems [standard interfaces between ERP and MES (manufacturing execution system)], B2MML: business to manufacturing markup language

Enhanced support for ERP integration in HITPHAMS using HITPHAMS ERP adapter

ERP (enterprise resource planning) adaptor is an optional feature of Hitachi's HITPHAMS*² pharmaceutical plant management system. It handles the transfer of data between HITPHAMS and the ERP system (inward goods data, production instructions, production data, inventory data, quality data, and so on) in accordance with ISA (International Society of Automation) 95 standards. The software has also been enhanced to improve data integration compared with previous versions. The support for realtime data integration also facilitates prompt decision making by management. Hitachi intends to market the software globally in the future.

¹ ERP integration is only supported for SAP AG. (February 2009 release).

*² "HITPHAMS" is a registered trademark of Hitachi, Ltd. in Japan, USA, and China.

* See "Trademarks" on page 87.

WJ200 Series Compact High-performance Inverter

The WJ200 series inverter is designed for excellent performance and user friendliness.

[Key features]

(1) High starting torque of 200% or greater achieved by sensorless vector control (heavy-duty model)

(2) Same inverter can control an induction motor or permanent magnetic motor* (planned*).

(3) Trip avoidance functions (minimum-time deceleration function and over-current prevention function)

(4) Hitachi's easy sequence programming software can be used to define sequential operation programs that can be downloaded to the inverter.

(5) Conforms to applicable safety standards and complies with the European Machinery Directive. Safety standard compliance can be achieved at low cost (Cat.3, PLd to EN/ISO 13849-1 and SIL CL2 to EN 62061/IEC 61508/EN 61800-5-2 compliance is planned).

(6) Network compatibility and external ports [standard features include USB (universal serial bus), RS-485 and RS-422 ports]



WJ200 series inverters

(7) Long lifetime components (design lifetime: 10 years or more*)

The design lifetime is calculated and not guaranteed.

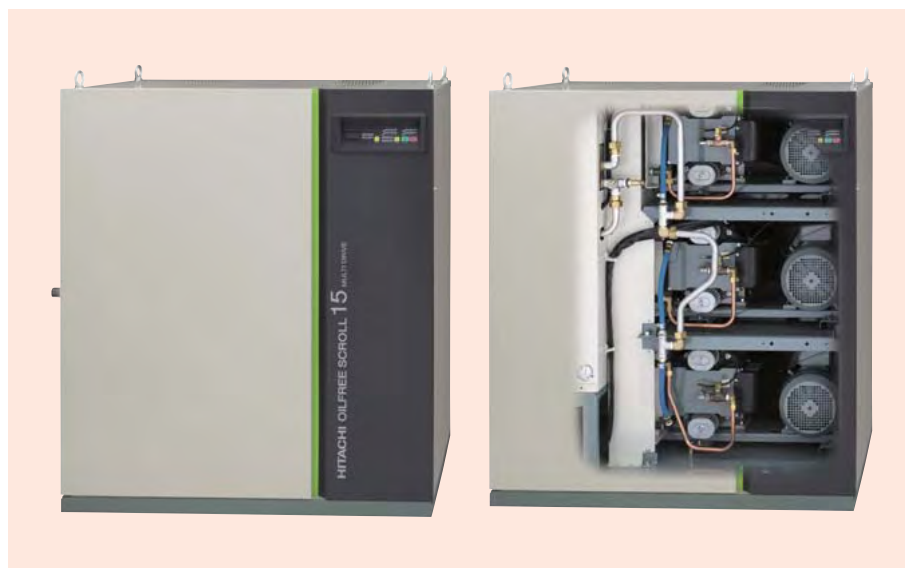
(8) The cooling fan can be replaced without special tools.

(9) Notifies when DC (direct current) bus capacitors and cooling fan(s) are due for replacement.

(Hitachi Industrial Equipment Systems Co., Ltd.)

* Ambient temperature: Average 40°C (no corrosive gases, oil mist, or dust)

Oil-free Scroll Compressor (7.5–15 kW)



Exterior (left) and internal layout (right) of 15-kW oil-free scroll compressor

Oil-free scroll compressors are environmentally conscious air compressors that use continuous compression to achieve low vibration and low noise and can supply clean compressed air that

is not contaminated by oil. Hitachi has now extended its product range by developing new models in the 7.5-kW, 11-kW, and 15-kW classes.

[Key features]

(1) The new models are fitted with multiple compressor units (two in the 7.5-kW and 11-kW models and three in the 15-kW model) and save energy and minimize sudden pressure changes or waste associated with generating too high a pressure by automatically turning on units as required based on the volume of air being used.

(2) Installation is simplified by locating the inlet, outlet, and power supply cable inlet on the left side of the compressor with the right and rear sides being made flat.

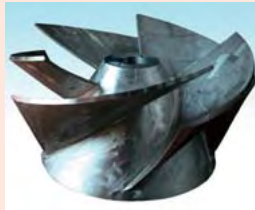
(3) An external input/output terminal for remote operation is provided as a standard feature to improve ease of use.

(Hitachi Industrial Equipment Systems Co., Ltd.)

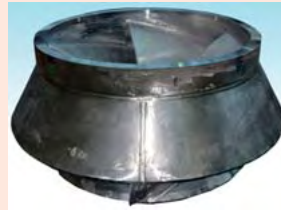
Large Seawater Intake Fully Fabricated Pump Series for Chemical Plants



(a)



(b)



(c)

Vertical mixed-flow pump fully made from duplex stainless steel sheets (a), open impeller with high specific speed produced using new impeller vane design technique (diameter: approximately 1,470 mm) (b), and high-head closed impeller produced using new impeller vane design technique (diameter: approximately 1,420 mm) (c)

This vertical mixed-flow pump is utilized as a seawater intake pump for supplying cooling water at electricity generation and chemical plants in the Middle East in particular. Because the pump is fabricated from steel sheets, the volume of CO₂ (carbon dioxide) emitted in its production is cut down by more than 40% compared to pumps made by casting.

The key features of the fully fabricated seawater pump are as follows:

(1) Materials with high corrosion resistance are used because the

unit is utilized to pump seawater from the Gulf which has a higher salt concentration than normal seawater. To improve reliability, the pump is made from duplex stainless steel and/or super duplex stainless steel which have superior corrosion resistance to standard stainless steel. This significantly reduces maintenance costs associated with corrosion prevention and minimizes the product's LCC (life cycle cost).

(2) The use of rolled steel removes the risk of material defects and provides high reliability (corrosion resistance and rigidity), because rolled steel has homogenous properties.

(3) The superior availability compared to casting means production times can be shortened. Also, the high strength of the material allows the pump to be made lighter, more compact and with lower cost.

One of the features of this pump relates to the problem whereby the impeller and guide vanes (diffuser casing) could, in the past, only be produced by casting because of their complex flow path shape. On the new pump, however, the use of multi-variable flow and strength analysis combined with Hitachi's unique manufacturing processes makes it possible to produce all components including the impeller and guide vanes fabricated from steel sheets.

(Hitachi Plant Technologies, Ltd.)

SDS-U Series Oil-free Screw Compressor

In the current environment where measures to reduce CO₂ (carbon dioxide) emissions are a high priority, improving the energy-efficiency of air compressors which account for approximately 25% of power consumption in general industrial plants is of particular importance.

It is in response to this need that Hitachi has developed and released the SDS-U Series of oil-free screw compressors incorporating industry-leading energy-efficient technology.

[Key features]

(1) Improved efficiency achieved by using a profile rotor that compensates for thermal distortion and through reduced airflow losses obtained from flow analysis using the latest techniques in computational fluid dynamics*.

(2) An energy-saving operation control function runs the compressor efficiently based on the actual operating conditions.

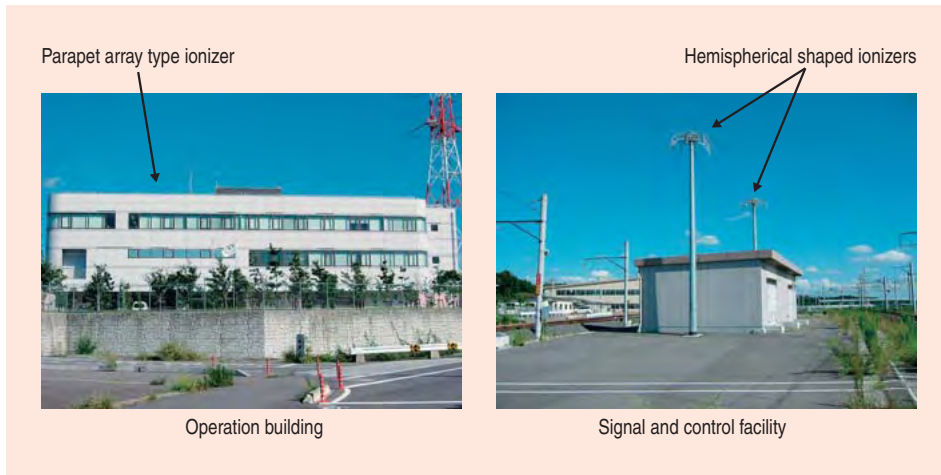
(Hitachi Plant Technologies, Ltd.)

* Efficiency of 280-kW class compressor is improved by approximately 2.5% compared to the previous model. This can reduce annual CO₂ emissions by up to about 31 t (Hitachi estimate).



SDS-U Series oil-free screw compressor (top) and internal structure of air block (bottom)

Reducing Lightning Risk Using Dissipation Array System



DAS installed on TX buildings in Tsukuba, Japan

The DAS* (Dissipation Array* System) significantly reduces the risk of lightning to a protected facility. By preventing direct lightning strikes, the DAS also reduces the secondary effects of lightning which are the cause of most lightning-related problems in industries such as telecommunications, military operations, oil & gas, train control, manufacturing, and IT (information technology). The DAS is a passive system and does not require any external

source of power. The system is energized by the electric fields generated by the storm cell. This makes it a low-maintenance system.

More than 180 DASs have been sold and, as of March 2009, there have been no reports of damage due to direct lightning strikes at any of these sites.

The TX (Tsukuba Express) is a MRT (mass rapid transit) railway line operated by the Metropolitan Intercity Railway Company in Japan. It commenced operation on August 24, 2005 and provides fast, convenient, and safe transportation in the Tokyo metropolitan area.

No lightning related incidents have occurred at the TX buildings in Tsukuba where DAS was installed in 2007.

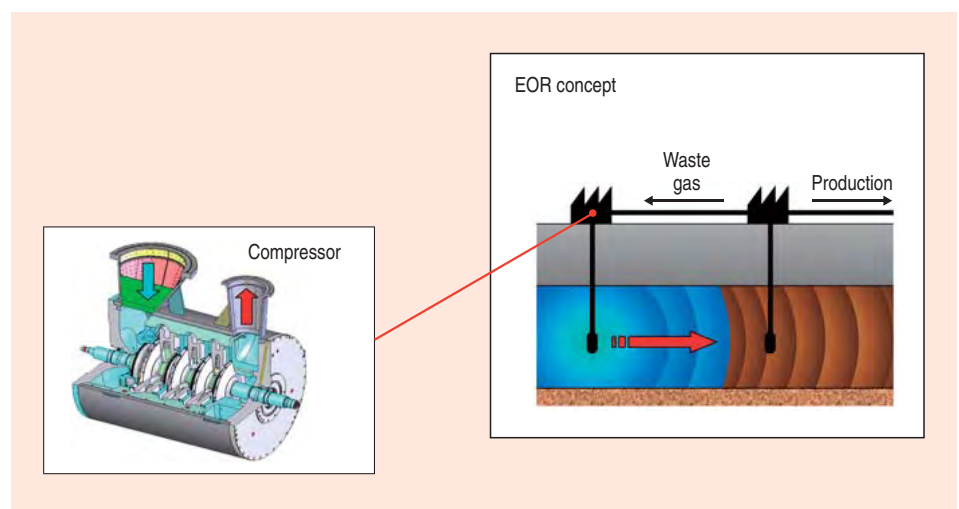
(Hitachi Plant Technologies, Ltd.)

* See "Trademarks" on page 87.

Gas Re-injection Compressor

Gas re-injection is one of a number of methods known as EOR (enhanced oil recovery) that are used in oil production to increase the amount of crude oil recovered. Compressors used in gas re-injection plants have a key role in the EOR process and therefore need to exhibit high reliability and efficiency under severe environmental conditions. High-pressure centrifugal compressors built by Hitachi are commonly used for this application in recent years and are in use on the Arabian Peninsula. The following special design considerations were taken into account to ensure these compressors could fulfill the requirements.

- (1) The casings were designed to withstand 30 MPa internal pressure and are hydrotested at 45 MPa.
- (2) Internal compressor parts exposed to process gases are made of or coated with stainless steel. This is necessary because of the presence of highly corrosive gases including H₂S (hydrogen sulfide), CO₂ (carbon dioxide), and H₂O (water vapor).



Gas re-injection system

- (3) Robust rotor design with whirl-free labyrinth
- Use of gas re-injection technology has grown rapidly, not only because it can recover more crude oil, but also as a technique for reducing emissions of greenhouse gases. Hitachi intends for its compressor technologies to play an important role in this field. (Hitachi Plant Technologies, Ltd.)

Energy-efficient Technology for Heating and Cooling Systems for Air Conditioning

The Takasago Works of Hitachi Cable, Ltd. has a large clean room for the production of composite semiconductors. The air conditioning system for the clean room has achieved a significant reduction in power consumption by using a "guaranteed-temperature automatic cut-in control" system that the company has developed.

Used in a cooling water circulation and supply system that incorporates a number of large turbo-coolers and heat-storage water tanks, the technology controls the power of the cooling water pump so as to keep the temperature at which the cooling water returns to the heat-storage water tank precisely equal to the rated design value (a patent was awarded in 2009). In contrast to the standard method used previously which resulted in the flow rate being too high throughout the year except in mid-summer, the new method minimizes and optimizes the cooling water flow rate. The temperature influences product quality and to ensure an adequate margin for keeping it in the required range, the system is operated so as to determine how far the flow can be reduced without risking it being too low.

Control of the system is fully automatic to ensure that the turbo-coolers and their associated auxiliary equipment can operate as a system with maximum efficiency using the minimum number of cooler units (the number of coolers in Takasago Works system was reduced from eight to five) while providing this "minimized but safe" flow rate.



Turbo-cooler at Takasago Works of Hitachi Cable, Ltd.

Since being installed and commencing operation in 2007, the technology has achieved an 810-t reduction in annual CO₂ (carbon dioxide) emissions compared to before the upgrade and annual savings of 25 million yen in electricity which represents approximately 30% of usage by this equipment. (Hitachi Cable, Ltd.)

Pneumatic Tired Roller and Macadam Roller

With the aim of improving safety, Hitachi has developed a tired roller and a macadam roller that comply with EU Stage IIIA emission standards and have a reduced environmental impact including less noise and improved fuel consumption. The rollers are better able to respond to social needs.

[Key features]

- (1) Improved safety provided by the newly developed ROPS (roll-over protective structure) cab and canopy which protect the operator in the event of a roll-over (tired roller).
- (2) Better ability to detect hazards using an infra-red rear obstacle sensor which is included as a standard feature
- (3) Proprietary step design makes it easy to access to the opera-

tor's station and provides excellent downward visibility on the left side (reduces operator workload).

(4) Compliance with exhaust gas regulations (2008 Ministry of the Environment regulations in Japan, EU Stage IIIA, US Tier 3)

(5) Noise is minimized by making the engine and fan quieter (sound power levels are 98 dB in the tired roller and 95 dB in the macadam roller, which complies with the EU standard).

(6) Lead-free radiator and wiring harness (environmental feature)
In addition to satisfying the European visibility standard (1 × 1 m), the standard features of the rollers include an HST (hydrostatic transmission) made by Hitachi Construction Machinery Co., Ltd. for improved reliability (on the tired roller),

safe-start interlock, and seatbelts. Hitachi intends to continue developing easy-to-use products that take account of safety and the environment.

(Hitachi Construction Machinery Camino Co., Ltd.)



From the left, the ROPS cab tired roller, standard canopy tired roller, and standard canopy macadam roller

High-voltage, Large-capacity IGBT Drive System for Hot Rolling Mills

Hitachi has released a high-voltage large-capacity IGBT (insulated-gate bipolar transistor) drive system suitable for use in the roughing mill of a hot rolling mill where the requirement is for high torque at low speed. The system achieves its high output voltage through an NPC (neutral point clamped) three-level inverter configuration that uses two standard 3.3-kV/1.2-kA (2.4-kAp) IGBTs connected in series, and the inverter's high capacity is achieved by using a unit structure for the main drive circuit with cell units connected in parallel. The system has been used in roughing mills, finishing mills, and other hot rolling mill drive applications in Japan and elsewhere in the world where it is operating successfully.

[Key features]

(1) Standard 3.3-kV/1.2-kA (2.4-kAp) IGBTs are used to ensure



Item	Specification				
Circuit	NPC three-level inverter				
Compatible motors	Single-winding		Double-winding		
Number of converter panels	1	3	3 × 2 banks		
Number of parallel cell units	Single × 1	Dual × 1	Triple × 1	Dual × 2 units	Triple × 2 units
Rated output (MVA)	5.4	10.2	15	20.4	30
Rated output voltage (Vrms)	4,090				
Cooling system	Water cooled (deionized water)				
Overload specification	150% per 1 minute				
Efficiency	98% or better (converter + inverter)				

High-voltage, large-capacity IGBT drive system (rated output: 15 MVA) (left) and its specifications (right)

long-term product availability.

(2) The inverter capacity is increased by using a high output voltage which is achieved by connecting two IGBTs in series [the maximum converter capacity is 15 MVA (or 30 MVA with a two-bank configuration)].

(3) Connecting the main drive circuit in parallel allows a series of models to be produced with different capacities and this means the optimal drive system can be chosen to match user requirements.

Electrical System for Cold Rolling Mill at POSCO-Vietnam Co., Ltd. in Vietnam



V1C continuous pickling line and cold rolling mill (left) and control room (right)

The POSCO-Vietnam No. 1 Cold Mill (V1C) continuous pickling line and cold rolling mill supplied to POSCO-Vietnam Co., Ltd. in Vietnam has commenced production and is operating smoothly. The plant is the first continuous pickling line and cold rolling mill to be constructed in Vietnam by the South Korean company POSCO and the plant will become a production base for Southeast Asia where demand for cold-rolled sheet steel, including high-quality automotive grades, is anticipated to grow. While it is common for a single company to handle the entire contract

for the electrical system of a continuous pickling line and cold rolling mill, in this case the customer supplied the electrics for the pickling line themselves and Hitachi was responsible for the electrical systems in the cold rolling mill only.

V1C produces thin steel strip with a thickness range of 0.15 to 1.6 mm. The combination of high-capacity IGBT (insulated-gate bipolar transistor)

drives with high performance and sophisticated functions, strip thickness control that uses optimum control logic, and other systems achieves a high level of strip thickness quality along the entire length of the steel strip and ensures reliable operation even when producing product as thin as 0.15 mm. Also, continuous stable operation from the pickling line to the cold rolling mill is made possible by the use of an open network for communications with the pickling line PLCs (programmable logic controllers) which achieves smooth transfer of data.

Electrical System for Wide Continuous Pickling Line and Cold Rolling Mill at Jiuquan Iron & Steel (Group) Co., Ltd. in China



Control room (left) and tension reel (right) at wide continuous pickling line and cold rolling mill of Jiuquan Iron & Steel (Group) Co., Ltd.

Large cold rolling mills for steel strip provide improved product quality, reliable equipment operation, and maintenance efficiency improvements through the use of the latest control systems, data analysis, and maintenance support tools. The continuous pickling line and cold rolling mill supplied to Jiuquan Iron & Steel (Group) Co., Ltd. (JISCO) at Jiayuguan in the Gansu province of northwest China operates continuously to produce sheet steel for use in home appliances or as building materials or interior panels for motor vehicles. The plant is running smoothly

and achieving high levels of quality and yield.

The control system achieves consistent product quality along the entire length of the steel strip and reliable equipment operation, using sophisticated IGBT (insulated-gate bipolar transistor) drives with a fast response throughout the line, R700 PLCs (programmable logic controller) with features that include high-speed processing and communications, and the latest strip thickness control and shape control systems. The supplied analysis and maintenance support tools, which include a plant data trace function that collects 16 times as much data as previous systems and an RMD (remote maintenance for drive) system that can perform maintenance changes on the IGBT drives remotely, help improve the efficiency of tasks such as plant commissioning and user maintenance work.

Electrical System for Continuous Pickling Line and Cold Rolling Mill for Thin Strip at Baosteel Group Shanghai Meishan Co., Ltd. in China

The electrical systems supplied for a continuous pickling line and cold rolling mill for thin strip at Baosteel Group Shanghai Meishan Co., Ltd. in China have now commenced commercial operation.

Steel industry equipment in China has increasingly been manufactured domestically in recent years and the rolling mill mechanical systems for this project were supplied by a Chinese manufacturer and the electrical systems by Shanghai Baosight Software Co., Ltd. The equipment supplied to the project by Hitachi included main motors, drive systems, PLC (programmable logic controller) hardware, and level-two computer hardware while Shanghai Baoli Automation & Engineering Co., Ltd. handled the control system design, software design, operation panels and other hardware, and on-site commissioning.

The plant is capable of efficient non-stop high-speed rolling of strip with a minimum thickness of 0.18 mm and is intended primarily for the production of thin sheet for use as feedstock for the tinplate used in packaging including food, beverage, and other cans. To achieve this, the high-voltage IGBT (insulated-gate bipolar transistor) drives with sophisticated functions and fast response, R700 PLCs with high-speed processing capabilities, and RS90 Series level-two computer system are augmented by a PDA (plant data analysis) system for high-speed data collection that



Electrical system for continuous pickling line and cold rolling mill for thin strip at Baosteel Group Shanghai Meishan Co., Ltd.

simplifies the process of identifying the cause of operational problems and makes tuning work proceed more efficiently.

Commencement of Commercial Operation of Continuous Hot-dip Galvanizing Line at Union Steel Holdings Limited in South Korea



5CGL at Union Steel (entry side)

The 5CGL (No. 5 continuous hot-dip galvanizing line) at Union Steel in South Korea has commenced commercial operation.

The plant is the first coating line at Union Steel to have dual-purpose operation capable of producing both hot-dip galvanized and Galvalume* steel strip, while the plant also aims to improve its competitiveness through superior products and product quality with enhancements to the finishing equipment that have made the plant the first in the industry to produce thermoset polymer steel strip.

Quality demands have been getting progressively more severe in recent years. The plant features hardware that combines a plant controller capable of high-speed arithmetic processing (R700 Series) with a 1-Gbit/s high-speed optical network and PROFIBUS (process field bus), and makes full use of Hitachi's proprietary IGBT (insulated-gate bipolar transistor) drive control functions to implement a tension control system that ensures stable operation and high product quality inside the furnace and elsewhere.

Working in collaboration with South Korean mechanical equipment manufacturer POSCO Engineering and Construction Co., Ltd., the 5CGL plant was put into operation with a very short lead time between commencing design and plant commissioning.

(Date of commencement of commercial operation: May 2009)

* See "Trademarks" on page 87.

Completion of Large PTA Plant Using Hitachi Production Process

Yisheng Dahua Petrochemical Co., Ltd. has constructed a large PTA (purified terephthalic acid) plant that uses the Hitachi PTA production process at Dalian in China. Hitachi Plant Technologies, Ltd. licensed the Hitachi PTA production process, carried out basic engineering, and supplied the main reactor for the plant. The plant has the world's largest production capacity and has been operating successfully since it commenced commercial operation in March 2009.

The Hitachi PTA production process was first developed in 1995 and has been subject to ongoing improvements since then. A new highly efficient agitating system in the oxidation reactor has successfully increased production capacity. Consumption of raw material, chemicals, and utilities has also been improved by adopting new technologies including an optimal oxidation reaction control system, the latest catalyst compound ratio, and powder recovery from waste effluent. Extensive design work during the basic engineering stage which focused on improving energy efficiency has also helped reduce energy consumption.

In this way, economies of scale and improved process technologies have reduced the operating costs for the Hitachi PTA production process.

(Hitachi Plant Technologies, Ltd.)



PTA production plant for Yisheng Dahua Petrochemical Co., Ltd. in China

Completion of Flavoring Manufacturing Plant in Suzhou China

T. Hasegawa Flavours (Suzhou) Co., Ltd. has established a plant for producing food flavorings at Suzhou Industrial Park in Suzhou, China, which will act as its key manufacturing base in the Chinese food market. Hitachi Plant Technologies, Ltd. and Hitachi Plant Engineering & Construction (Suzhou) Co., Ltd. received the order for the plant and were involved in every stage from planning to construction, including engineering, procurement, construction, and commissioning. The Suzhou plant celebrated its inauguration and started production in November, 2009.

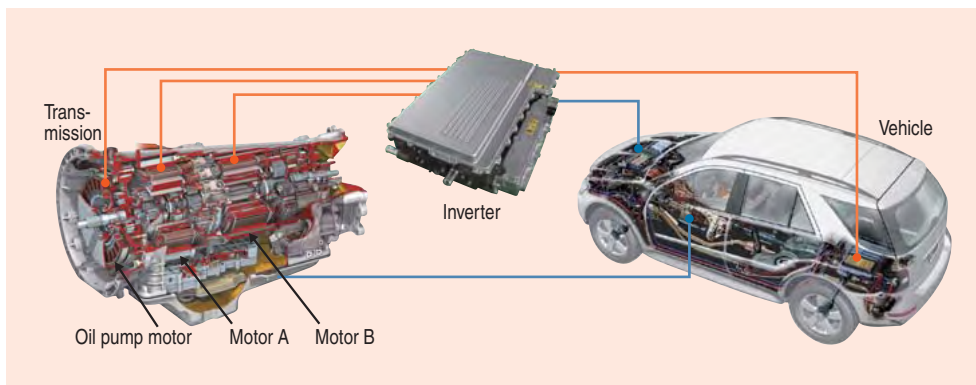
Hitachi Plant Technologies, Ltd. and Hitachi Plant Engineering & Construction (Suzhou) Co., Ltd. can offer customers factory planning and construction know-how that takes advantage of their worldwide construction experience,



Food flavoring production plant of T. Hasegawa Flavours (Suzhou) Co., Ltd. at Suzhou Industrial Park in Suzhou, China

knowledge, and leading-edge technology to support the customer's global business development. (Hitachi Plant Technologies, Ltd.)

Inverter for Dual-mode Hybrid Systems for Daimler AG and BMW AG



PEB inverter for dual-mode hybrid system

Supply of the PEB (power electronics box) inverter for dual-mode hybrid systems to Daimler AG and BMW AG of Germany has commenced.

The dual-mode hybrid system jointly developed by General Motors Company of the USA together with Daimler and BMW contributes to improvement in fuel consumption of up to approximately 40% (based on research by Daimler) through the use of motor-assist control which operates the gasoline engine in its optimum combustion range.

The PEB incorporates inverters that control three separate electric motors, these being the two motors used by the dual-mode hybrid system and the motor that drives the EMP (electronic

motor pump) transmission oil pump. As the PEB is mounted on the engine room and therefore must be able to maintain its reliability under extreme heat, it incorporates its own water cooling system. It also has an ultra-slim design (135 mm) that allows it to fit in the narrow gap between the engine and hood.

[Key features]

(1) To support the Daimler and BMW dual-mode system, the PEB incorporates two inverters able to control two 60-kW motors

located in the transmission simultaneously but independently.

(2) An additional inverter controls the EMP in the transmission that generates the oil pressure.

(3) Controls charging and discharging of the 300-V battery.

(4) An HVIL (high-voltage interlock loop) high-voltage discharge function that ensures safety in the event of a collision or other accident

(5) An ultra-slim design (135 mm) that allows the unit to fit between the engine and hood

(Delivery start date: October 2009)

(Hitachi Automotive Systems, Ltd.)

Fuel Sub-system for Gasoline Direct Injection Engines

Hitachi has developed a fuel sub-system for gasoline direct injection engines that helps reduce CO₂ (carbon dioxide) emissions and has started production for General Motors Company.

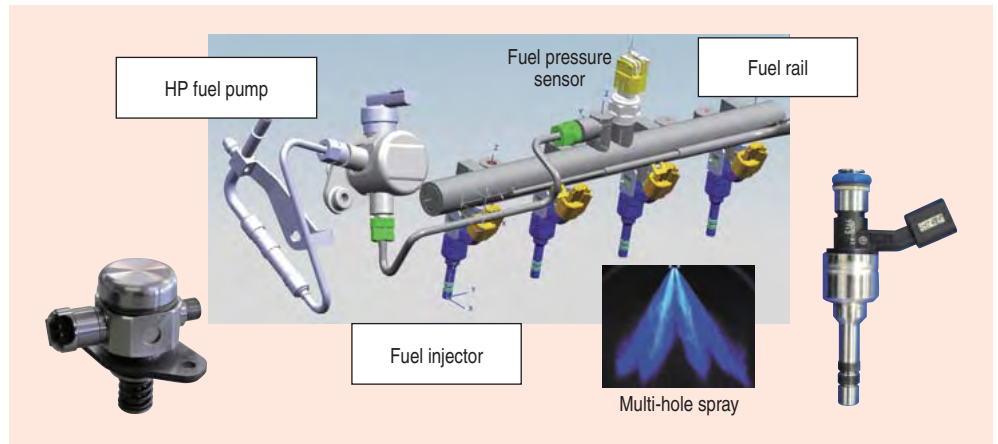
[Key features]

- (1) Fuel injector, multi-hole spray
- (2) HP (high-pressure) fuel pump supports alcohol-based fuels [up to E85 (fuel blend of 85% ethanol and 15% gasoline)]
- (3) Proprietary fuel rail design helps reduce noise when idling.

These fuel sub-system components were developed in conjunction with Hitachi's original spray simulation technology and sophisticated production technology to meet the requirements of the North American market which has the most severe exhaust emission regulations in the world.

To improve fuel economy and performance, the fuel sub-system will be augmented with the following hardware and software fuel control systems.

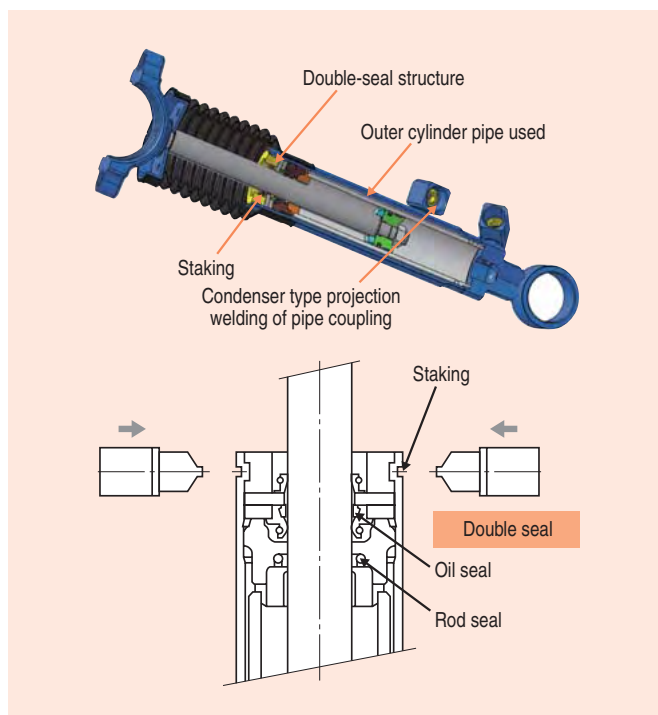
- (1) Integrated controller with ASICs (application-specific integrat-



Fuel sub-system for gasoline direct injection engines

- ed circuits) for fuel injectors and HP fuel pump
 - (2) Higher dynamic range with optimized drive control and fuel pressure control for higher performance
 - (3) Fast feedback fuel control with layout of pipes and pressure sensor designed to reduce fluctuations in pump pressure
- (Production start date: July 2009)
(Hitachi Automotive Systems, Ltd.)

Hydraulic Cylinder for Stabilizer Control



Hydraulic cylinder for stabilizer control (top) and staking and double-seal structure (bottom)

Hitachi has commenced mass production of a hydraulic cylinder for stabilizer control following a development process that simultaneously enhanced the product's design, production techniques, and production equipment.

[Key features]

- (1) Product design

A proprietary seal structure achieves low friction at high pressures (standard operating force: 3 to 14 MPa).

- (2) Production techniques

The cylinder uses new production techniques including condenser type projection welding of an outer cylinder pipe and piping joint and staking to attach the end cap instead of machining a single casting (reducing the weight by approximately 100 g compared to the previous model).

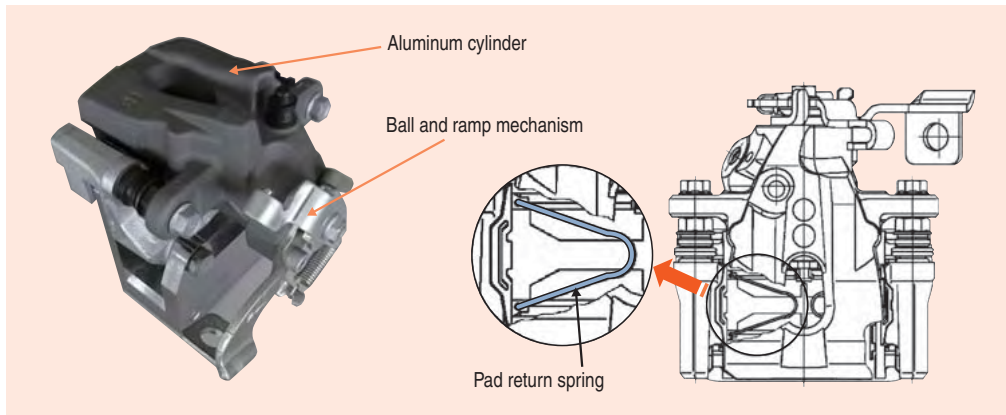
- (3) Production equipment

A dedicated production line was installed to produce the cylinder using the new design and production techniques.

The hydraulic cylinder for stabilizer control is fitted on the Toyota Land Cruiser Prado and it is anticipated that it will be adopted in a wider range of vehicles in the future.

(Production start date: September 2009)
(Hitachi Automotive Systems, Ltd.)

Aluminum Rear Caliper with Built-in Parking Brake and Reduced Drag



Aluminum rear caliper with built-in parking brake and reduced drag

Hitachi Automotive Systems, Ltd. has developed an aluminum rear caliper with built-in parking brake and reduced drag that is small and light and has reduced drag torque.

[Key features]

(1) Lighter weight

This disk brake caliper is fitted on the Toyota Prius hybrid and it is anticipated that it will be adopted in a wider range of vehicles in the future.

(Production start date: May 2009)

(Hitachi Automotive Systems, Ltd.)

The aluminum cylinder body is 18% lighter than Hitachi's cast model.

(2) Ease-of-operation and ease-of-installation

Adoption of a ball and ramp mechanism makes the parking brake easier to use and easier to install in the vehicle.

(3) Improved fuel consumption

Adoption of a pad return spring reduces the drag torque and achieves zero drag torque by the time the vehicle has traveled 100 m.

Analysis Tool for Operation Logs of Vehicle Equipped with the Car Navigation System for Commercial Vehicle

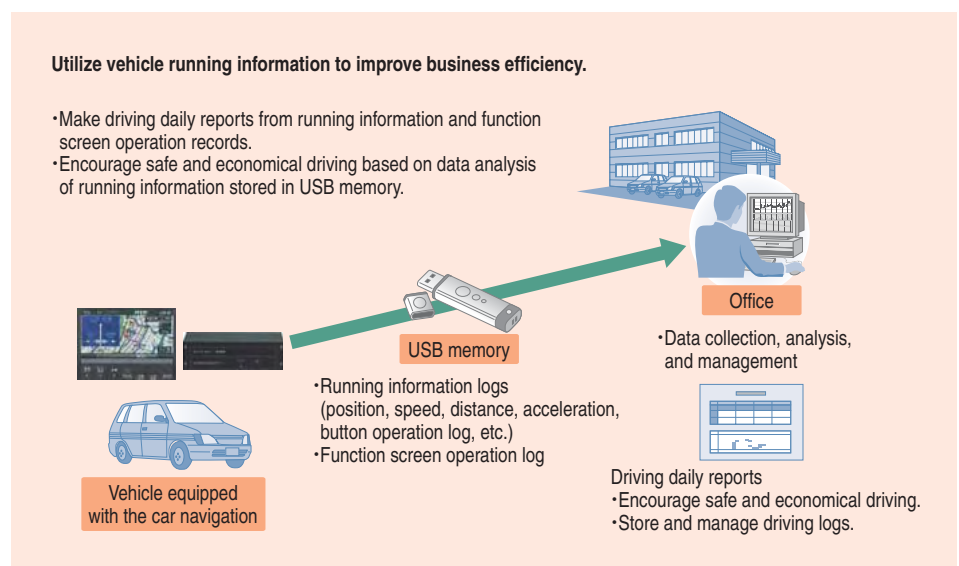
Hitachi has developed an operation log analysis tool for analyzing vehicle running information collected and stored by the car navigation system for commercial vehicles (the car navigation).

The software tool runs on a PC (personal computer) and analyzes vehicle running information (speed, acceleration, idling time, etc.) stored on USB (universal serial bus) memory by the car navigation. Its functions include making and automatically printing out driving daily reports, evaluating safety and economics, and collecting, analyzing, and managing operational data. It also has the system cooperate with the user customization screen (function screen) function in the car navigation so that information about vehicle operational status can be added into the driving daily reports.

In this way, the system will contribute to improving efficiency and encouraging safe and economical driving for a wide range of different commercial vehicles (including sales vehicles, security and maintenance vehicles, and so on).

[Key features]

(1) Automatically print out driving daily report for record-keeping.



Functions and typical uses of operation log analysis tool

(2) Create daily or monthly operation table (by driver or by vehicle).
 (3) Evaluate or rank driving on safety and economy based on frequency of exceeding the speed limit, rapid acceleration and deceleration, idling, and so on.

(4) Plot distribution of speed changes, unsafe driving, and other parameters on a graph.

(Hitachi Automotive Systems, Ltd.)

Car Navigation System with Integrated AV and On-line Traffic Information Search Function



AV car navigation unit with internal hard disk

Hitachi has developed a new car navigation system for the Japanese market that features an integrated AV (audio-visual) player and an on-line traffic information search function that works with the traffic information service provided by Hitachi. On-line traffic information searching can achieve more accurate navigation route search performance by augmenting existing data

such as VICS* (Vehicle Information and Communication System) data and the statistical traffic data contained in the navigation unit with realtime traffic information distributed by the Hitachi Traffic Information Center, selecting whichever is most appropriate in each situation. On roads where VICS information is not available, the system can make use of traffic information generated from probe data collected from taxis and Clarion brand car navigation units. The Hitachi Traffic Information Center is accessed via a Bluetooth*-enabled mobile phone to obtain traffic information whenever required (Bluetooth is a short-range radio communications standard for digital devices).

The function is provided on the top end models from two different series of 2009 car navigation units: an HDD (hard disk drive) series and a solid state memory series that uses an SDD (silicon disk drive). These units are available both from the general market and as dealer options, and Hitachi aims to have them installed in a wider range of vehicles in the future. (Clarion Co., Ltd.)

* See "Trademarks" on page 87.

Ultra-wide-angle Vehicle-mounted Camera

Hitachi has developed a new ultra-wide-angle front camera for cars to help drivers see vehicles approaching from the side at intersections and similar locations.

When entering an intersection, crossroad, or other locations with poor visibility, the camera detects any approaching vehicles, bicycles, pedestrians, or other hazards. The key feature of the camera is that, because of its ultra-wide 190° horizontal field of view and anamorphic lens that enlarges the left and right ends of the image, it does not shrink the size (height) of the object being viewed excessively.

Because the ultra-wide-angle anamorphic lens developed for this product allows the camera alone to achieve what previously required the combination of a fish-eye lens and image processing, it also contributes to making the system simpler.

The camera was released in Japan in November 2009 with vehicle manufacturers as the target market. (Clarion Co., Ltd.)



Ultra-wide-angle vehicle-mounted camera (top) and example screen (bottom)

TM3000 Next-generation Tabletop Microscope Offering Smaller Size and Ease of Use with Improved Functions

Hitachi High-Technologies Corporation has announced the development of the TM3000 tabletop microscope. Shipments of the compact, affordably priced, and exceptionally user-friendly TM3000 started on April 1, 2010.

Developed by Hitachi specifically as a cutting-edge yet highly accessible microscope, the TM3000 represents a new type of tabletop microscope. Hitachi has long been involved in the manufacture and sale of electron microscopes used across a full spectrum of industries, most notably in the fields of nano and biotechnology. The predecessor to the TM3000, the TM-1000, has been shipped over 1,000 units since its launch in April 2005. Today the TM-1000 is in use at research institutes, companies, schools, and science museums worldwide, demonstrating its utility in educational spheres as well as industrial applications.

As the successor to the TM-1000, the TM3000 offers a dramatic improvement in all the features of the earlier device, including its compact size, ease of operation, and magnification. Through more attention to compact design, the desktop footprint of the microscope has been reduced by roughly 20%. The operation of the TM3000 has also been simplified thanks to auto start, auto focus, and other automated onboard functions. The most groundbreaking achievement of the new device, however, is that magnification has been expanded to 30,000X, enabling observation with even higher magnification. Moreover, the TM3000 is easy to control and samples can be viewed through a connected PC (personal computer), making it simple for even first-time electron microscope users to operate. Hitachi is aiming for initial annual shipments of 500 units of the TM3000 tabletop microscope, and will seek to further expand product sales worldwide. Going forward, the TM3000 is expected to play an active role in areas ranging from research and development to quality assurance in a host of fields, including materials, semiconductors, food products, and biotechnology by simplifying and facilitating observation of the microstructures of material surfaces. Together with greater utilization of the device at elementary schools, science museums, and other science education sites, hopes are high that the TM3000 will help counter the recent trend of students away from science programs.

[Key features]

- (1) Energy-saving design turns off power when not required. Startup time around 3 minutes
- (2) No coating required due to observation under variable-pressure vacuum
- (3) Vary magnification from 15X to 30,000X quickly and easily.
- (4) Three observation condition settings: 5 kV, 15 kV, and analysis
- (5) Fully automatic functions such as auto start, auto focus, and auto brightness/contrast
- (6) Extremely easy to use thanks to image shift function, navigation buttons, and other features
- (7) Stereoscopic image observation with high depth of focus

[Dimensions and weight]

Main unit	330 wide × 606 deep × 565 high (mm), 63.0 kg
Diaphragm pump	145 wide × 256 deep × 217 high (mm), 4.5 kg



Tabletop Microscope TM3000

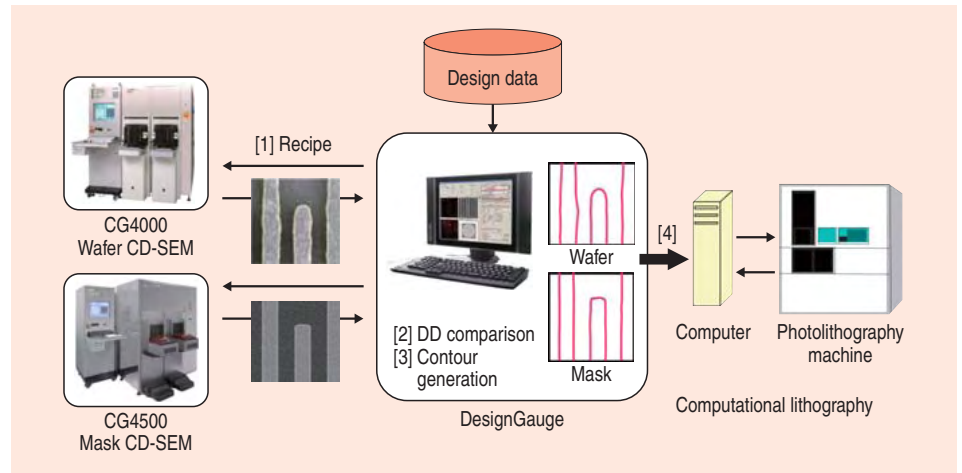
[Specifications]

Magnification	15 to 30,000x (digital zoom: 2x, 4x)
Observation condition	5 kV/15 kV/analysis
Observation mode	Standard mode/charge-up reduction mode
Sample stage traverse	X: ±17.5 mm, Y: ±17.5 mm
Maximum sample size	70-mm diameter, 50-mm height
Signal detection system	High-sensitivity semiconductor BSE (backscattered electrons) detector
Auto image adjustment function	Auto start, auto focus, auto brightness/contrast
Evacuation system (vacuum pump)	Turbo molecular pump: 30 L/s × 1 unit, Diaphragm pump: 1 m ³ /h × 1 unit
Operation help function	Image shift

(Hitachi High-Technologies Corporation)

Semiconductor Lithography Measurement Solution Combining CG4000, CG4500, and DesignGauge

The ongoing miniaturization of semiconductor devices is achieved through numerous different improvements in the field of lithography. In recent years in particular, the desire to produce patterns that are close to the limits of resolution possible using optical methods is driving greater complexity in techniques such as OPC (optical proximity correction) which is used to correct pattern distortion. This in turn is causing the optical conditions, masks, and other tools used in pattern projection to also become more complex. Hitachi High-Technologies Corporation has responded to this situation by supplying a semiconductor lithography measurement solution. This integrated measurement system utilizes the high-performance CG4000 and CG4500 CD-SEMs (critical dimension—scanning electron microscopes) and DesignGauge for handling DD (design data). The function for automatically generating recipes from the DD significantly improves the efficiency with which very large measurement recipes can be prepared. Meanwhile, the function for comparing measurements against the DD and the function for generating



Semiconductor lithography measurement solution

pattern contours support the conversion of data to two dimensions which is an effective means for improving the precision of more complex OPC models. The system makes possible integration with computational lithography, a field that will progress further in the future, and Hitachi believes it capable of making a major contribution as a platform that can deliver new value in the field of semiconductor lithography measurement. (Hitachi High-Technologies Corporation)

Σ-G4 and Σ-G5 Compact, Premium, Modular Mounters



Σ-G4 compact, premium, modular mounter (front-side component feed type)

Hitachi High-Technologies Corporation has developed the Σ Series of next-generation, compact, premium, modular mounters

(Σ-G4 front-side component feed type and Σ-G5 front-and-rear component feed type) which achieve a productivity improvement in practice of approximately 150% compared to previous models [based on the IPC (Institute for Interconnecting and Packaging Electronics Circuits) 9850 standard].

In addition to seeking to duplicate the high speed, high precision, and high productivity of the previous GXH-3 model, the new units have a best-size modular design to provide a precise fit with the wide range of different production requirements that exist these days.

[Key features]

(1) Compatible with a wide range of components

High-speed head: 0.4×0.2 mm to 44 mm square

Multi-function head: 1.0×0.5 mm to 55 mm square, 100×26 mm connectors

(2) Quick changeover

Flexibility is improved by the ease with which heads, trays, and other main units can be replaced.

(3) Line control system

Operational performance is improved by allowing coordinated operation of multiple linked modules.

(Hitachi High-Tech Instruments Co., Ltd.)