

akebono's Corporate Mission: Showing the Way to the Brakes of the Future



Having celebrated its 80th anniversary in 2009, akebono has consistently provided safety and security for society as an expert maker of brakes. In recent years, growing concerns about limited resources and environmental problems have placed a spotlight on new technologies. Given this situation, what kind of technological development will take akebono to the next stage of growth? To answer this question, we talked to those working at the cutting edge of development.

The Challenges of Formula 1 are the Ultimate Ecology

Formula 1 (F1), it is the pinnacle of world automobile racing. Aiming to develop brake technology for the most extreme conditions, akebono has since 2007 been the Official Supplier of brakes to the Vodafone McLaren Mercedes F1 team.

“What they need are brakes that make the car go faster,” explains Takayuki Ichige of the VCET Project where brakes are developed in collaboration with the racing team. “Along with consistently functioning precisely to the commands of the driver, it is critical that F1 brakes have the reliability to safely handle the tightest of corners. In order to realize contradictory functions—being completely lightweight yet highly rigid—while boasting outstanding cooling capability, low drag and of course high reliability, all within extremely

demanding parameters, our meticulous design mechanisms take into account materials selection, their surface treatment and all other aspects.” Ichige elaborates, “Reducing weight and raising the level of cooling—if we applied this expertise to brakes equipped on vehicles sold in the market, then it wouldn’t be just a dream to realize cars with a low environmental impact through better fuel efficiency.”

There is also the issue of fostering the capabilities of engineers. Every race has different demands, and in an environment that requires repeated quick responses to accommodate these demands, enhanced skills are a matter of course. “You have to find a solution in a limited amount of time, so somehow you have to come up with an idea. I think that’s extremely important,” adds Ichige.



“akebono produces its F1 brake calipers in-house. I’ve heard that business inquiries from European car makers increase after they watch a race, and it gives me great satisfaction to know that I have a job that attracts the attention of the world.”

F1 Brake Development
VCET Project
Takayuki Ichige
Specialist



F1 brake caliper

akebono’s Next-Generation Technology (1) Electro-Mechanical Brakes

Sharpening its technological prowess in the extreme world of racing, akebono continues to welcome the challenges it faces on the front lines of next generation technology development. One technology in particular, electro-mechanical brakes, represents a shift in operating principles away from hydraulics and to the utilization of a motor.

Akiyuki Tajima of the New Electronic Application Pioneering Department notes that akebono is presently at the stage of developing basic technologies. “We conduct tests in our pursuit of understanding what characteristics electro-mechanical brakes should possess. For example, in field trials under extreme conditions, we simulate downward motion on an incline, constantly applying pressure to the brakes, surveying exactly which parts within the brake reach what temperature.”

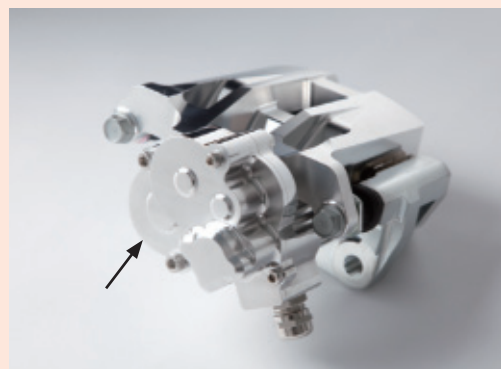
Electro-mechanical brakes have numerous advantages. The first is that because they use an electric signal, the movement of the piston can be controlled with great precision in accordance with the speed of the vehicle and other conditions, and unlike hydraulic brakes there is no need for hydraulic piping, ABS or other hydraulic devices. Electro-mechanical brakes are also capable of addressing issues that have come into importance in recent years, such as raising vehicle safety and weight reduction.

“Currently, we use motors to provide the power, but are motors really ideal?” Tajima questions. “We’re taking different ideas into consideration, including other sources of power.” This signifies that just as with F1 brake development, this is a field in which ideas are a necessity.



“Electro-mechanical brakes have great compatibility with the energy regeneration systems being used in the next wave of automobile technology, such as electric vehicles. Given that, we hope to complete their development as soon as possible.”

Electro-Mechanical Brake Development
New Electronic Application Pioneering
Department, R&D Division
Akiyuki Tajima
Staff Engineer



Electro-mechanical brakes (under development)
Arrow indicates the electro-mechanism portion

akebono's Next-Generation Technology (2) Ultra-Low-Drag Calipers

Right now, within the disc brakes of vehicles that are normally driven on streets anywhere in the world, the pad and the rotor come into contact, even if ever so slightly. This has an impact on fuel performance. The ultra-low-drag caliper that Daisuke Kobayashi is working on in the Foundation Brake Development Project is a technology intended to minimize this resistance. The issue for ultra-low-drag calipers will be raising fuel performance without altering the basic structure of the hydraulic brake, the parts for which should be kept interchangeable while keeping down costs as much as possible. "It's not as simple, however, as just trying to

reduce drag to zero," states Kobayashi. "For example, if the gap between the pad and the rotor becomes too wide, rain or snow could get inside, compromising the effectiveness of the brake. What's more, you can't say that it would be better to separate them completely as any kind of foreign object that falls inside will certainly impact safety or reliability." This is why Kobayashi is confronting the challenge of reducing resistance between the pad and the rotor to the bare minimum—all the way to the micron level—using technology that requires the utmost in precision.



"Even before electro-mechanical brakes become widespread, there is, I believe, still great opportunity for brake product creation to add value to conventional gasoline-powered cars and other vehicles."

Ultra-low-drag caliper development
Foundation Brake Development Project,
R&D Division

Daisuke Kobayashi
Staff Engineer



Ultra-low-drag caliper (under development)

akebono's Next-Generation Technology (3) Friction Materials

The manufacture of friction materials involves blending multiple raw materials, taking into consideration the demands of increasingly sophisticated customers. akebono makes controlling friction with precision possible by drawing on its core technology as an expert maker of brakes. "Braking—meaning coming to a complete halt—is the priority, and with a policy of not using materials that could have a harmful impact on the human body, we are constantly looking for new materials. To understand a material's characteristics and just how it is transformed when contained in a brake pad it is essential to have expertise based on detailed research and testing," explains Masayo Shitara of the Friction Material Application Department.

There are many factors causing change in the characteristics of friction materials—heat, pressure and variations of speed, for example—and to have a grasp of a material's characteristics with regard to these variables requires much time and hard work. In addition, there is the issue of eliciting a required characteristic in a material. "If a customer's requested figures differ greatly from actual conditions, bold ideas are needed, and in the end the material may require delicate tweaking measured in minute degrees," adds Shitara. In the global marketplace there are a wide range of demands, and it is no exaggeration to state that the development of friction materials remains an area with enormous untapped potential.



The disc brake pad equipped on Porsche's Panamera model

"A major topic in the development of friction materials is environmental protection. Abrasions cause minute pieces of the brake pad to fall outside into the environment. That's why I intend to search with an open mind for materials with a low environmental load."

Friction material development
Friction Material Application Department,
R&D Division

Masayo Shitara
Staff Engineer



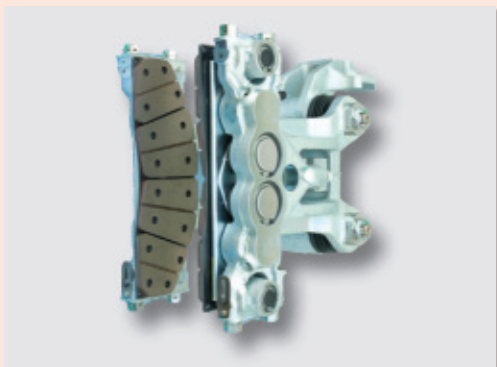
akebono's Next-Generation Technology (4) Bullet Train Disc Brakes

Approximately 50% of the brake calipers and pads used on bullet trains in Japan are manufactured by akebono. On the one hand, bullet trains need to be able to slow and come to a safe stop from speeds of 300km/h, and on the other, it is essential that rolling stock brakes also contribute to environmental protection.

“Certainly, modal shift in Japan is an example of contributing to environmental protection,” states Kazuhiro Yoshikawa of the Mechanical Component Application Department. “Shipping costs via rail are low, and it’s an effective way to reduce CO₂ emissions. However, factors that include a high friction coefficient demand high performance.”

Looking ahead, in the process of spreading Japanese railway technology overseas it will be necessary to develop products that meet environmental needs in any given country. Yoshikawa further explains his thinking, “Setting our sights on overseas locations, we cannot look to just our existing technology and think that our work is done, especially if we want to be able to respond to any kind of heavy-duty usage requirements. I hope to make things of even higher quality.”

akebono seeks to link friction materials with the development of structural components for rolling stock brakes as well and will continue to develop products with the aim of delivering performance that more than anything ensures that people travel in safety.



Bullet train disc brake

“When I go on business or other trips, I take the bullet train, and that always reminds me of the importance of brakes. It really makes me proud of how incredibly worthwhile this job is.”

Development of disc brakes for bullet trains
Mechanical Component Application Department, R&D Division
Kazuhiro Yoshikawa



Production Engineering That Gives Shape to Dreams

What enables quality with greater uniformity, realized with greater efficiency, is the new akebono production engineering. Shinichi Terashima of the Production Engineering Development Department, is constantly thinking about “the balance of safety, quality and cost.” Safety and quality are, of course, priorities, and to improve productivity, equipment must be kept simple and compact. Also, the key question is how to incorporate automation into the process. However, as Terashima explains, “When we deploy robots, we absolutely must design to automate only the efficient processes. To get around this problem, it’s essential to think about simplifying. Of course, it’s important to have a human perspective.”

At the same time, a major topic for production engineering development is the reduction of CO₂ emissions in the manufacturing process. “Forming brake pads requires an enormous amount of heat,” notes Terashima. “It should be possible to be friendly to the environment and lower the costs of energy consumption by raising the heat efficiency of this process.” The technological hurdles are definitely not low, but surmounting these problems will enable reductions in fuel consumption and CO₂ emissions as well as lower costs. To accomplish this, improving resource and energy conservation in the manufacturing of akebono products is something that we are constantly considering.



“The development of production engineering requires expertise, of course. But it’s more than just the efforts of one individual division—the work conducted across many departments will be what bears fruit.”

Production engineering development
Production Engineering Development Department, Manufacturing Division
Shinichi Terashima
Specialist

Supporting Development (1) Considering Production Equipment



Essential to the installation of production equipment, blueprints are used to determine tasks, their operability, safety and efficiency, ensuring that no problems occur.

APS, the Starting Point of All *Monozukuri*

"APS is the akebono Production System," Yoshio Takanashi of the APS Section points out as he explains this, the starting point for akebono's pursuit of *Monozukuri* (value-added product manufacturing). He notes, "Specifically, APS is the continuous elimination of waste." APS performs a valuable role in answering questions related to creating the just-in-time system—making necessary items in necessary quantities in necessary timeframes—as well as determining plant layouts and workflow—what should be where for manufacturing efficiency.

APS also stands for akebono Philosophy & Spirit, so, on the one hand, it is a way of managing and analyzing while, on the other, it is the very concept that this approach embodies. APS aims to be the common thread of the philosophy behind the pursuit of *Monozukuri* that is woven into the

functions of all the various divisions.

As Takanashi asserts, "For example, at a plant's shipping area, we obviously have to propose positioning equipment and the flow of traffic so that items can be handled with consistent timing and movement; however, it's just as vital to maintain discussions with production management, shipping managers and all other personnel involved." This illustrates how the spread of APS as the concept inspiring akebono's pursuit of *Monozukuri* will continue to be a priority. "At the APS *Jishuken* (intensive Kaizen activity), we target sections with plant facilities as sites for implementing APS," Takanashi explains, "and, through attempts to reduce inventories and loss of operational time as well as on-site implementation, we work to develop human skills."



"Those who participate in *Jishuken* are given about 20% more work than they think they can handle. Then, when they've finished their tasks, it gives them a sense of accomplishment—that's the development of human talent."

APS
APS Section, APS Corporation
Yoshio Takanashi

Supporting Development (2) the APS Dojo within the Monozukuri Dojo



The "APS Dojo" is where one can really experience APS. This is where hands-on training provides people with knowledge on how to pursue ultimate efficiency in production.

Key to the Development of Next-Generation Technology, akebono's Corporate Mission Will Open the Door to Future Brake Technology.

When thinking about the next 20 years, the question is what approach akebono should take to provide value to society. What will guide us is akebono's Corporate Mission.

"APS is, I believe, connected at a deep level to the analytical side of the Corporate Mission," Takanashi explains. "It pursues the facts behind each and every problem and is also important to making manufacturing systems where substandard products are not manufactured, indeed, cannot be manufactured. If you have certain conditions, then there is no way substandard products can result. As we build up the systems for ensuring good-quality products, I think we will accomplish what is needed to provide safety and security."

Discussing what the Corporate Mission expresses in terms of akebono's role in society Terashima states, "The latter half of the Corporate Mission statement—'every individual life'—is especially emblematic of the role our production engineering plays, namely, in protecting the lives of drivers, passengers and pedestrians as well as on-site production personnel. It also includes actually putting into place environmentally friendly production equipment."

To explain his views on the way work forms the interface between himself and society, Yoshikawa frames things this way: "My boss once told me that when people travelling in a bullet train that's moving at 300km/h can walk around freely without fastening their seatbelts, that's a clear demonstration of technology protecting people's lives." It is the very enormity of that task that gives Yoshikawa the will to tackle difficult problems.

That concept rings true for Shitara as well. "Suppose an engine doesn't work properly—you would have it repaired and then just get back in the vehicle, right? But if your trouble is a nonfunctioning brake, you'll never ride in that vehicle again. When you take the perspective that people ride in cars because they can, and do, come to a proper stop, I feel a great sense of responsibility as one supporting safety."

It is Kobayashi who turns again to the issue of "having a complete grasp, as brake specialists, of what is happening at the point where pad and rotor meet." In this connection, just how far outside the parameters of normal driving are designers capable of considering? He notes, "We are always asking the question of what research is really necessary to ensure that trouble or mistakes do not occur."

Tajima adds, "The Corporate Mission is the standard by which akebono, as a company, determines whether or not any given task should be carried out." Tajima believes that it is important to have a clear practical and theoretical understanding to the smallest detail of the designs' foundations. As with Tajima, Ichige is also aware that, "Whenever we have to determine the course of the company, or when we find ourselves at the crossroads of technology development, we should turn back and reread the Corporate Mission."

What all of these engineers have in common is the strong commitment to providing safety and security, based on the Corporate Mission, even over 10 to 20 years when next-generation vehicles may make their mainstream appearance. As Shitara states, "If vehicles change, there is no way to avoid changes to friction materials as well, which means we must change the way we think." So, while constantly searching for new technologies that enable light-weight brake components and that respond to environmental issues, as Ichige asserts, finding "brakes that fit with human sensitivities" will be akebono's task.



Global R&D that Supports Our Mission

“Friction and Vibration, their Control and Analysis,” is not merely akebono’s Corporate Mission, it refers to the basis of the Company’s core technologies. akebono constantly leverages its competencies to develop new friction materials and next-generation brakes that make possible an array of brake-related products for automobiles and other means of transportation. Stepping up its focus on basic technologies and deepening the analysis essential to product development, akebono is augmenting its R&D investment and R&D structure.

In addition, by taking advantage of distinctive characteristics of facilities throughout Japan, North America and Europe and abiding by the three tenets of higher performance, lower cost—including more compact and lightweight products—and future technologies as we carry out product development, we aim to secure critical technology as we move forward in pursuit of next-generation products that are highly competitive on a global level.

Japan

akebono is progressing in its efforts to develop high-performance, low-cost friction materials responsive to both market and customer needs. In its endeavors to develop high-quality products, akebono focuses on high-performance, cost-competitive brake pads for passenger cars using environment-friendly, safe materials that realize excellent performance with regard to noise and vibration characteristics and that minimize wheel dust. In addition, while working to enhance product performance with due consideration to environmental concerns, we are taking steps to reduce costs through the use of both new materials and improved manufacturing processes.

In the development of disc and drum brake mechanisms, we apply our efforts to improving performance and lowering cost. These efforts have been recognized by customers, who offer high praise for our opposed-type disc brakes, which employ an aluminum alloy developed for high-performance cars. Moreover we are thoroughly implementing measures to ensure the standardization of materials and processes as well as otherwise working to boost our cost-competitiveness.

In the area of combating global warming, we are striving to raise fuel efficiency through innovative weight and drag reductions. We work to meet stringent technical and cost benchmarks to reinforce our global supply system and promote technological development aimed at devising built-to-purpose products.

North America

akebono is working to develop optimum new friction materials and next-generation foundation brakes based on the domestic and global needs of U.S.-based automotive manufacturers. We support Japanese automotive manufacturers as well with completely local operations, from development to mass production.

akebono undertakes the development of friction materials for use in a wide range of vehicles, from passenger cars to SUVs to pickup trucks. These materials have exceptional NVH (noise, vibration and harshness) characteristics and are also environment-friendly.

akebono is mass-producing a new disc brake made from a lightweight aluminum alloy as well as new disc brakes with rear-wheel parking functions and others for a wide range of vehicle models. We are also promoting the development of next-generation products in tandem with R&D facilities in Japan.

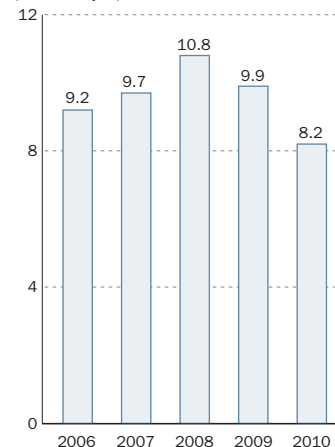
Europe

Our European operations specialize in developing friction materials, and akebono conducts R&D to respond to a wide range of customer needs, from friction materials that meet unique performance demands and conform to the rigorous environmental standards of REACH (Registration, Evaluation, Authorisation and Restriction of Chemicals) regulations to friction materials intended for auto exports to Japanese and U.S. markets from the European market. We strive to cultivate new customers by marketing “hybrid materials,” which incorporate characteristics that are suited to both the quiet-running cars preferred by the Japanese and U.S. markets and the high-performance vehicles popular in the European market. In addition to the existing development base in France, we established a local agency with a development function in Germany in pursuit of more customer-oriented development activities. Standardizing materials by procuring them from local markets and introducing a European-style manufacturing process helps reinforce our cost-competitiveness.

Total R&D-related expenditures*

Years Ended March 31

(Billions of yen)



* Above figures include R&D costs and other R&D-related expenditures incurred as part of regular improvements.

■ Formulation of akebono New Frontier 30 Rolling Plan 2010

Under its previous three-year medium-term management plan, “akebono New Frontier 30” announced in 2008, the Company addressed a number of issues, including the realignment of its facilities in Japan and North America; workforce optimization; promotion of the in-house manufacture of key components and the standardization and interchangeability of materials and processes so as to realize the cost reductions needed to ensure business sustainability; development of high-performance brakes; promotion of environmental responsiveness; development of low-cost products for lightweight and compact vehicles among other technological differentiation; and acceleration of expansion into Asia. After the financial crises of 2008, however, major changes in the business environment spurred the Company to review specific details of the plan, in what became “Rolling Plan 2010.”

To secure a foundation that will enable the accomplishment of targets, the new plan aims to further expand sales and improve profitability with competitive technologies for the future, ongoing revolutionary cost reductions and development outside Japan, and accelerating globalization, moving from a focus on Japan and North America to one covering Japan, North America, Europe and Asia.

■ Review of Japanese Market

Due to Japanese automakers’ new car sales staging a better than expected recovery, thanks to government assistance measures (environment-friendly vehicles tax incentives and new vehicle replacement subsidies), akebono received an increasing number of orders. However, for the foreseeable future it appears that there will be no full-fledged recovery in new automobile sales and thus no recovery accompanied by a surge in new vehicle production. In recognition of this situation and in addition to ongoing reductions in fixed costs, the Company is progressing with the implementation of a raft of initiatives with the aim of significantly increasing profit at a time of sluggish sales. These initiatives include: accelerating the development of interchangeability and standardization; manufacturing key components in-house to realize uniform quality and cost reductions; reducing costs by revamping logistics; reexamining energy costs; accelerating the development of next-generation production equipment; and streamlining procurement.

■ Expanding Group Operations in the North American Market

As a regionalized strategy that promotes more rapid globalization in Japan, North America, Europe and Asia, akebono is positioning North America as a crucial market where the Company is making great efforts to enhance and expand its business.

As part of these efforts, we reached a basic agreement with Robert Bosch GmbH regarding the acquisition from

North American subsidiary Robert Bosch LLC of part of the latter’s brake business, concluding an asset purchase agreement through our Kentucky-based subsidiary Akebono Brake Corporation (ABC) on September 23, 2009.

With respect to its North American business, akebono has implemented a number of restructuring measures since 2005, including completing the integration of production into two plants at the end of August 2008.

However, with the region’s operating environment lapsing into unprecedented severity due to such factors as the sharp drop in automobile sales and excess production capacity brought about by the global economic downturn as well as intensifying cost competition, akebono put into effect initiatives designed to significantly boost sales, which necessitated the further restructuring of its business. Simultaneously, Bosch was in the process of reorganizing its North American business, and akebono saw the opportunity to acquire part of Bosch’s brake business and optimize its overall brake production capacity in the region.

akebono has thus further boosted its competitiveness in the North American market, and it is anticipated that sales will soar with the commercial rights gained from the acquisition. Moreover, the Company has its sights set on an early return to profitability for its North American business and is revamping production capacity through plant reorganization and streamlining based on the promotion of the in-house manufacture of key components while pursuing synergies in procurement and other departments. akebono will also continue to promote the search for and training of human talent with leadership potential and will assume as assets the two new plants obtained through the acquisition.

■ Other Regions

● Europe

A rapid recovery cannot be expected in the European automotive market. To set in motion a return to profitability at a time of flat sales, the Company will work to streamline procurement and further improve productivity. In addition, as its sales strategy for friction materials, akebono will target luxury vehicles, taking advantage of the competencies gained through brand development activities involving the supply of brake products for F1 motor racing. As a future issue, akebono will continue to study the best approach for brake caliper production.

● Asia

In the Asian market, where major growth is expected to center on China and Indonesia, the Company intends to secure a framework that will allow increased production, promoting thorough cost reductions across the region that focus on increasing the local procurement of materials, improving productivity and securing more efficient logistics. Raising competitiveness by developing businesses that offer the usability, costs and platforms that meet local needs, akebono will take an array of initiatives to realize significant increases in sales and income.

Outline of Acquired Business

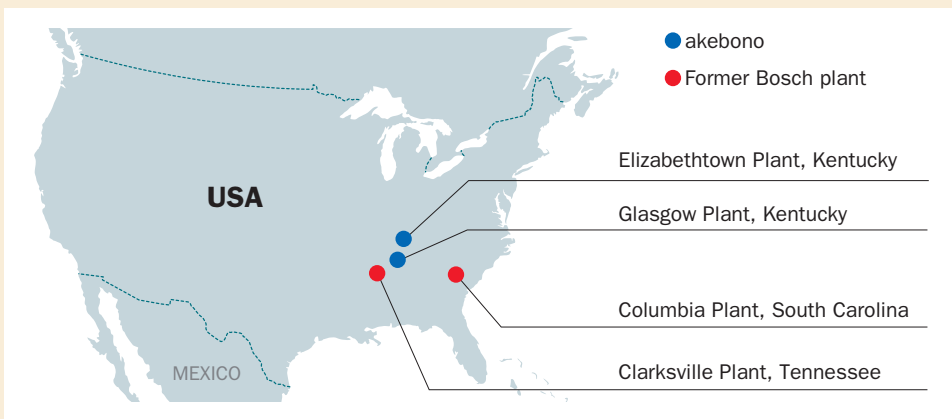
Business and commercial rights to manufacturing and sale with respect to the foundation brake, disc rotor, brake drum and corner module businesses of the Bosch Group's North American subsidiary, Robert Bosch LLC. There is no succession of account receivables and account payables.

Note: "Foundation brakes" refers to basic static components related to the control of brakes, except for operative parts, such as disc brakes, drum brakes and parking brakes. "Corner modules" are products into which chassis parts, such as foundation brakes, hub bearings, knuckles, etc., are secured during pre-assembly.

■ Date of Acquisition

December 31, 2009

■ Two Acquired Production Plants



■ Outline of Financial Information

- Acquisition price and settlement method

Acquisition value	\$19 million
Acquisition cost	\$19 million
- Acquired asset and liability and accounting method
 - Acquired assets and liabilities as of acquisition date:

Current assets	\$33 million
Fixed assets	\$74 million
Total assets	\$108 million
Current liabilities	\$3 million
Fixed liabilities*	\$83 million
Total liabilities	\$85 million
 - Accounting method

* In anticipation of incurring a post-acquisition loss, and with that loss recognized as a liability under U.S. accounting standards due to its calculation being reflected in the acquisition price, the abovementioned \$83 million in fixed liabilities is recorded under fixed liabilities on the balance sheet as "Provision incurred from transfer of business applied to foreign subsidiaries."

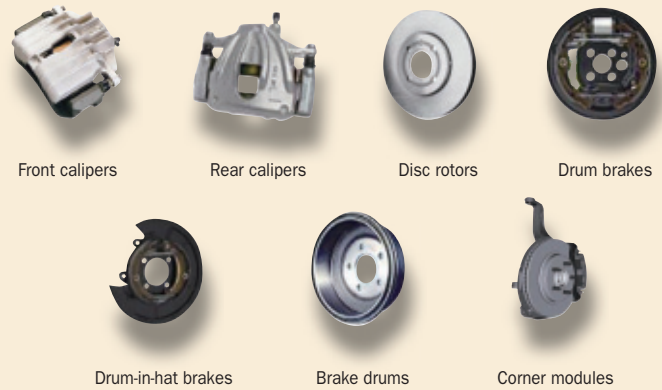
- Accounting method

Amount of goodwill from incurred loss, causal factors in loss, depreciation and amortization method and period

 - Amount of negative goodwill from incurred loss
\$4 million
 - Causal factors in loss

As the net asset amount at the time of the business acquisition exceeded the acquisition price, the difference was recorded as negative goodwill.
 - Depreciation and amortization method and period
One-time depreciation in fiscal 2009

■ Acquired Brake Components



■ Outline of Bosch Group

Head office location: Stuttgart, Baden-Württemberg, Germany
Business details: Development, manufacture, sale and service of automotive, industrial, consumer and construction-related products
Net sales: 38,174 million Euros (fiscal 2009)
Number of employees: approx. 270,000 (fiscal 2009)

History of Bosch (akebono-related)

(akebono-related events in blue)

- 1886 Bosch founded; develops engine ignition systems
- 1937 To as far as possible eliminate external influences, changes from a publicly traded to a private limited company; enters chassis field
- 1987 Bosch (then in West Germany) signs a technical support agreement with akebono covering anti-lock braking systems for commercial vehicles
- 1988 Bosch acquires shareholding in Bendix Corporation (now Allied Signal, Inc.); becomes akebono's third-largest shareholder
- 1995 akebono commences supplies to Bosch of brake pads for the F150
- 1996 Bosch acquires Allied Signal's brake division (mechanical parts only)
- 1999 Bosch becomes second-largest shareholder in akebono