

Introduction of Product

Introduction of GALEO Series Small-Sized Wheel Loaders

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Small-sized models of Type WA-3 Wheel Loader, which has been marketed since 1993, were fully changed after 10 years to incorporate advanced technologies and thus meet the user needs of new age. They are marketed as WA100-5, WA150-5, WA200-5, WA270-5 and WA320-5 GALEO series. This report introduces these new models.

Key Words: *Wheel Loader, GALEO Series, Tier2 emissions Regulation, Safety, IT, Electronically Controlled Hydrostatic Transmission, Shift Control, Traction Control, Variable Shift Control*

1. Introduction

Wheel loader is used for the excavation, transportation and loading of construction materials. Especially medium-to small-size classes are used in a wide range of application, including piling operation, grading operation and snow removal, and therefore required high versatility.

Type WA-3 has been highly reputed by a wide range of users since it was put on the market in 1993 but is gradually losing its competitiveness due to recent active model change of competitors and new participation of other manufacturers in the market. In such circumstances, it is strongly required to develop a new product that matches the needs of the new age, causes a great sensation in the world, and excels the reputed rival machines not only in Japan but also in North America and Europe.

On the other hand, there is a tendency of recent society that gives more importance to global environmental conservation and the respect for humanity, as is evidenced in the desire for strict regulation of exhaust gas and noise emission that comes to be stronger in North America, Europe and Japan.

In such circumstances, we developed WA-5 GALEO by making full model change after 10 years and incorporating advanced technologies and various measures for environmental conservation and safety, and put it on the market. This report provides the overview of the new model (**Photo 1**).



Photo 1 Appearance of WA200-5 GALEO

2. Targets of Development

Before starting the development of new series, we determined the targets of development as shown in Fig. 1, considering that the new product will acquire and keep sufficient competitiveness as a next-generation wheel loader and that Komatsu's new brand concept for the new century, i.e. "IT,

Environment, Safety and Fundamental Performance", will be materialized as the selling points of advanced technologies incorporated in the new products to meet the needs of worldwide users.

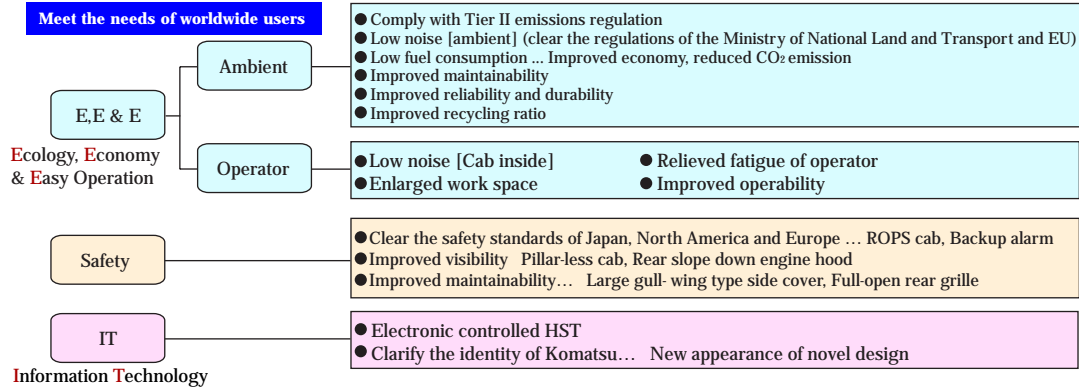


Fig. 1 Targets of Development

3. Product Line

To compete with rival machines in Japan as well as overseas, product line of small-sized wheel loader was rearranged as shown in Fig. 2, where the number of models was reduced from 9 to 7, and model names were determined according to their "shakaku" (size of machine).

| area | Conventional model WA-3 | | | GALEO WA-5 | | |
|-----------------------|-------------------------|---------|-------|------------|-------|----|
| | JP | US | EU | JP | US | EU |
| Bucket m ³ | | | | | | |
| 1.3 | WA100 | | WA120 | WA100 | | |
| 1.4 | | WA120 | | | | |
| 1.5 | WA150 | | | WA150 | | |
| 1.6 | | | | | | |
| 1.7 | | | WA180 | | | |
| 1.8 | | | | | | |
| 1.9 | WA200 | WA180 | | | | |
| 2.0 | | | | WA200 | | |
| 2.1 | WA250 | | | | | |
| 2.2 | | | WA270 | | | |
| 2.3 | | WA250 | | | WA250 | |
| 2.4 | | | | | | |
| 2.5 | | WA300ex | | WA270 | | |
| 2.6 | | | | | | |
| 2.7 | WA300ex WA300 | | WA320 | | | |
| 2.8 | | | | | WA320 | |
| 2.9 | | | | | | |
| 3.0 | | | | WA320 | | |

Fig. 2 Product Line of Komatsu Small-Sized Wheel Loader

4. Selling Points

For the following 6 concepts of GALEO series small-sized wheel loader that were developed based on our brand concept, the selling points and supporting technologies are described below, taking WA200-5 for example.

- (1) Fundamental performance
Compatibility of low fuel consumption and high production
- (2) Operator comfort
High operator comfort with low vibration and noise
- (3) Environment
Environment friendly clean engine and low noise
- (4) Safety
Conforming to international safety standards
- (5) IT
Installation of KOMTRAX and EMMS
- (6) Maintenance
Easy maintenance and extended interval of periodic maintenance

4.1 Fundamental performance

- (1) Low fuel consumption and high production
To achieve high power and low fuel consumption, Komatsu SAA6D102 engine and hydrostatic transmission are installed. Engine matching at low speeds contributes to improve fuel consumption to a large extent (maximum 24% compared with conventional models).

Figs. 3 and 4 show an example of comparing the fuel consumption and production when loading materials onto a 10-ton dump truck (V shape loading).

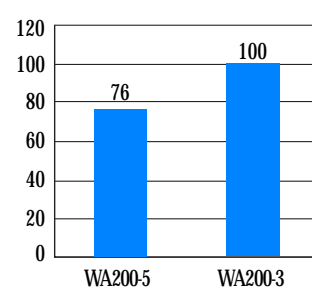


Fig. 3 Fuel Consumption per Hour L/H (%)

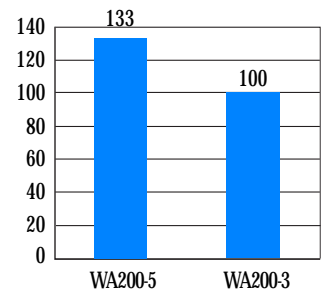


Fig. 4 Production per Unit of Fuel m³/L (%)

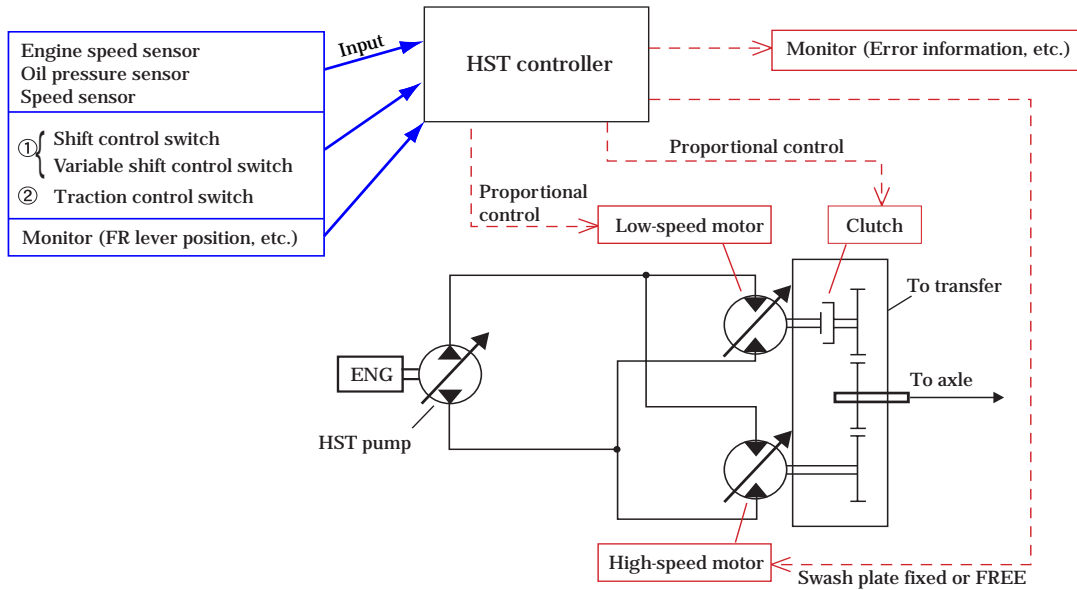


Fig. 5 Electronically Controlled HST System Diagram

In addition, full range infinite speed control by the electronically controlled hydrostatic transmission, and new functions (traction control and variable shift control) achieved excellent travel performance and operability that far surpass conventional models (torque converter + transmission) (Fig. 5 and Photo 2).

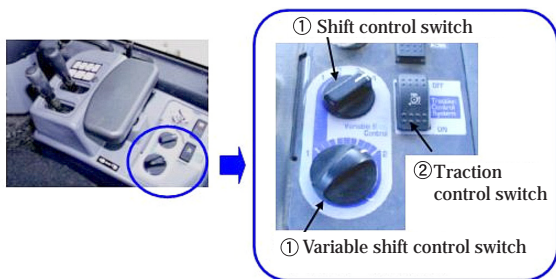


Photo 2 HTS Control Switches

①-2 Variable shift control system

When the shift control switch is set to 1st speed, max. travel speed can be changed in the range from 4 km/h to 13 km/h with the variable shift control switch (Fig. 7).

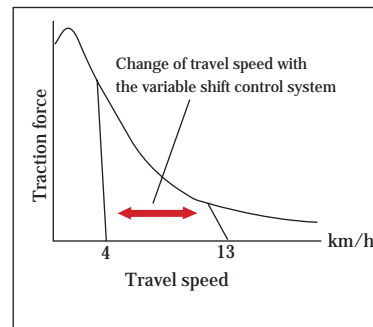


Fig. 7 Variable Shift Control System

①-1 Shift control system

With the shift control switch, maximum speed can be changed over among 1st to 4th speed (Fig. 6).

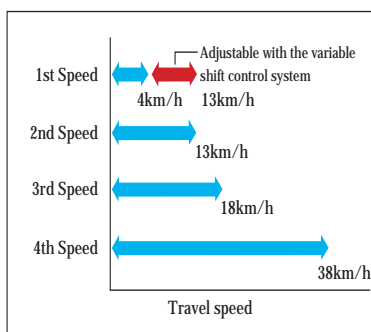


Fig. 6 Shift Control System

② Traction control system

Maximum traction force can be changed over in two steps (equivalent to F2 of conventional models). This function is very effective for the work on soft ground where tires easily slip (Fig. 8).

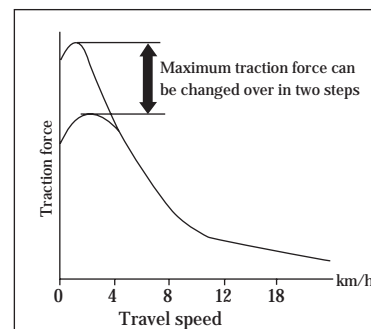


Fig. 8 Traction Control System

By combining these systems, it is possible to select speed and traction force so as to best match the working conditions or operator's taste and thus efficiently perform the work.

4.2 Operator comfort

(1) Reduction of noise at operator's ear

In addition to the employment of viscous mounts of cab and rubber mount for hydraulic piping, which are the same as conventional models, the number of sealed portion is reduced by employing the monocoque cab where cab and floor are integrated into one and the rigidity of floor frame is increased to improve sound insulating properties and airtightness. As a result, approximately 5 dB of noise reduction is achieved (Table 1).

Table 1 Noise Level at Operator's Ear

| Item | | WA200-5 | Conventional model |
|-------------------------------|-------|---------|--------------------|
| Noise level at operator's ear | dB(A) | 70 | 75 |
| Cab pressurization | Pa | 59 | 44 |

(2) Installation of large capacity air conditioner

To provide a comfortable environment throughout the year, a large capacity air conditioner, the capacity of which is increased by approximately 8%, compared with conventional models, is installed. In addition, in order to prevent fine dust from coming in the cab, integrated monocoque cab is employed to increase airtightness. As a result, the ambient pressure in the cab when the air conditioner is used in fresh air introduction mode is increased to a large extent, compared with conventional models (Table 1).

(3) LCAS (Lumber Care Air Suspension) seat (option)

Due to the feature of wheel loader that work is performed while making the whole machine travel at high speed, the degree of fatigue of operator is generally high. Especially the operators who work for a long time strongly require improvement. To meet such user needs, LCAS seat is prepared as an option. The air suspension reduces shock and, by adjusting the swell of the three air bags (lumber supports and side support) that are so set as to wrap the waist of operator, soft riding comfort can be obtained. Thus, you can take the optimum operation posture to match your figure during work (Photo 3).

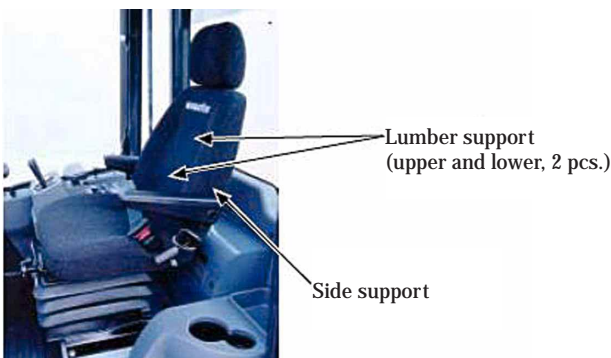


Photo 3 LCAS Seat

4.3 Environment

(1) Installation of the engine conform to the Tier II emissions regulation

The newly developed engine is installed that conforms to the Tier II emissions regulation of EPA (Environmental Protection Agency, USA), EU and the Ministry of National Land and Transport of Japan.

(2) Low noise

By employing a low-noise engine and lowering the rated speed by approximately 20%, compared with conventional models, noise level was reduced. In addition, the engine room shielding structure was employed to cut engine noise. Further, side by side radiator and hydraulic driven fan (Photo 4) were employed and the shroud and fan tip clearance were decreased to increase air flow efficiency and reduce the maximum fan speed. As a result, we succeeded in reducing ambient noise to a large extent and clearing the low-noise regulations of the Ministry of National Land and Transport and EU even with standard machine (Table 2).

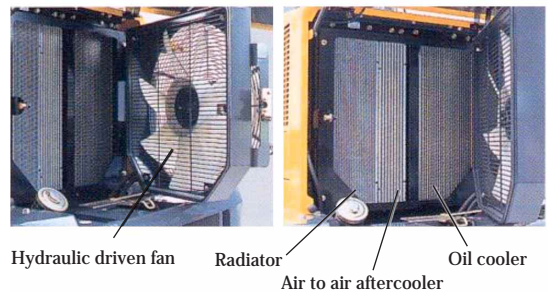


Photo 4 Hydraulic Driven Fan System

Table 2 Ambient Dynamic Noise

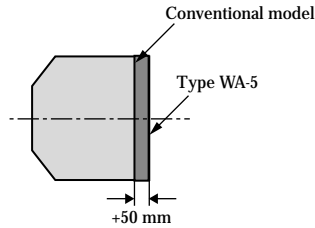
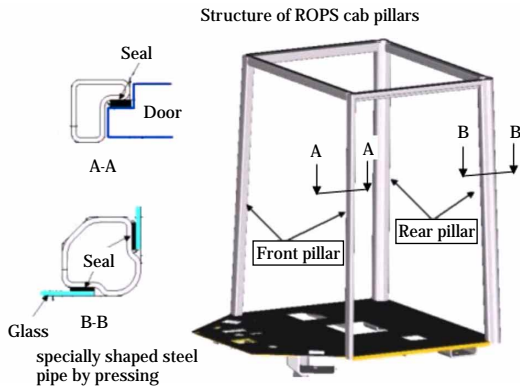
| Item | dB(A) | WA200-5 | | Conventional model |
|------|-------|--|------------------|------------------------|
| | | Low-noise specification of the Ministry of National Land and Transport | EU specification | Standard specification |
| | | Ambient dynamic noise | 104 (104) | 106 (106) |

(:) Restriction

4.4 Safety

(1) Employment of large ROPS cab

The operator's cab is of integrated monocoque structure, and the main frame is made by pressing specially shaped steel pipe to improve the shock absorbing effect and achieve excellent durability. As a result, we succeeded in conforming to the FOPS standard for protecting operators from falling object and the ROPS standard for protecting operators in case of overturn. In addition, in order to secure a large work space so that the operators of large build can easily work, the cab was extended rearward by 50 mm, compared with conventional models, and flat glass and pillar-less structure are employed for the front windshield to improve front visibility (Fig. 9).



| | | WA200-5 | Conventional model |
|--|----------------|---------|--------------------|
| Cross-sectional area of cab (at the height of waist) | m ² | 1.64 | 1.62 |

Fig. 9 ROPS Cab

(2) Employment of rear-hinged open door for easy entrance and exit

Door hinges are mounted on the rear side of machine to increase the door opening angle and thus secure a large opening for entrance and exit. In addition, the tilt angle of step is increased so that operator can enter the cab directly from the step. Thus, easy entrance and exit are assured (Photo 5).



Photo 5 Rear Hinged Open Door

(3) Emergency steering (option for Japanese and overseas general specification)

We developed the HTS driven emergency steering system that clears the ISO 5010 Emergency Steering Performance Test, so that even if hydraulic pressure supply from the steering pump is stopped due to engine stop, HST motor driving (driven by wheels) hydraulic pressure is supplied to enable steering while the machine is traveling (Fig. 10).

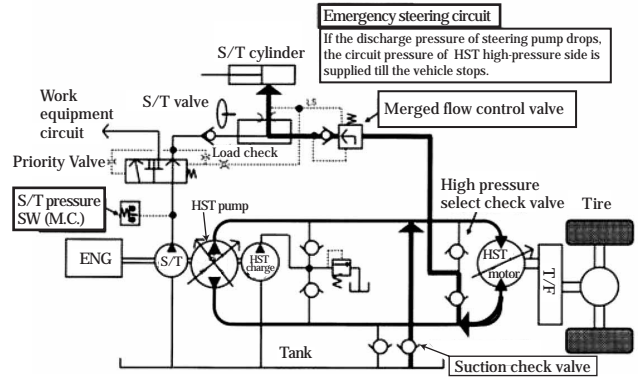
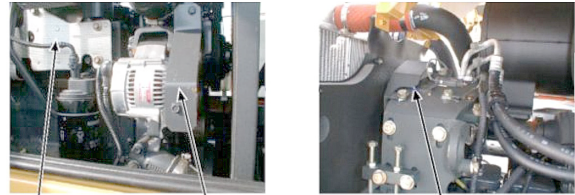


Fig. 10 Emergency Steering System

(4) Installation of safety guard

To prevent unexpected contact with dangerous object during inspection or maintenance, rotary equipment guard (alternator, air compressor) and thermal guard (exhaust manifold) are installed to improve safety (Photo 6).



Thermal guard (exhaust manifold) Rotary equipment guard (alternator) Rotary equipment guard (air compressor)

Photo 6 Safety Guard

4.5 IT

(1) Employment of EMMS (Equipment Management Monitoring System)

The new monitor panel is equipped with the troubleshooting function as well as the maintenance control function so that in case of trouble occurrence, the corresponding error code and the state of maintenance of equipment can be displayed as needed on the character display that is installed at lower center, beneath the main monitor (Photo 7).

(2) Employment of load meter built in the main monitor (option)

LCD screen is provided at the center portion of the main monitor to indicate the reading of the load meter. It does not obstruct the front visibility from the cab because of compact arrangement and has high accuracy. This feature is incorporated in WA320-5 of Japanese specification as standard because this type is frequently used for loading products (Photo 8).

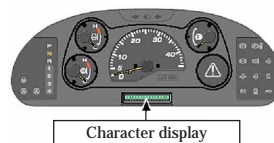


Photo 7 Main Monitor (Standard)

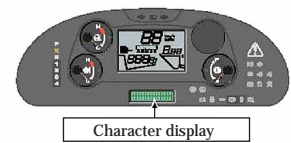


Photo 8 Main Monitor For Load Meter (Option)

(3) Installation of KOMTRAX2 (WA1000-5/WA150-5 option)

The application of KOMTRAX2, which is installed in medium-sized GALEO series as standard, is expanded up to small-sized machine WA200-5 to enable grasping the operating or trouble condition of equipment and promptly and appropriately maintaining it (Fig. 11).

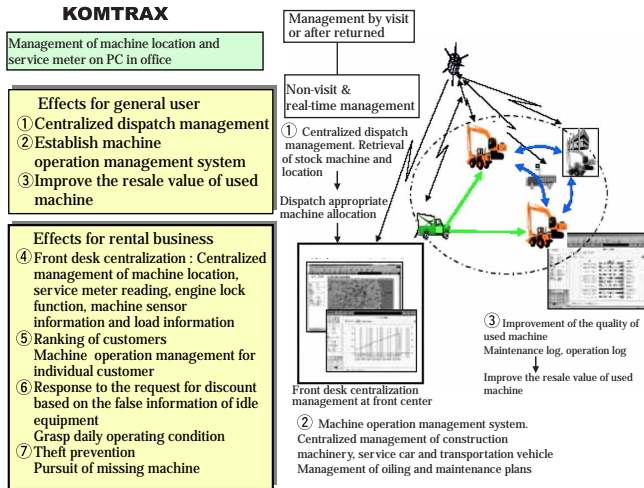


Fig. 11 KOMTRAX System

4.6 Maintenance

(1) Improved maintainability of engine and its periphery

Large gull-wing type engine side cover is employed and the daily inspection items are arranged on the right side of machine so that inspection can easily be done only by opening the right side cover. (Photo 9)

(2) Easy cleaning of radiator

The side by side installation system that arranges radiator, air to air aftercooler and oil cooler side by side in a line as well as swing-out hydraulic driven fan are employed to ease cleaning. In addition, it is devised that cores can individually be dismantled or remounted without removing the engine hood, thus improving maintainability (Photo 9).

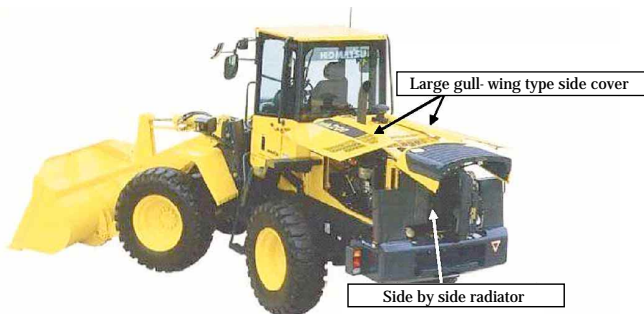


Photo 9 Engine Periphery Access Doors

(3) Easy inspection of the wear of service brake disc

The wear check port for service brake disc is provided on the axle brake housing to ease inspection so that the wear condition of disc can easily be checked (Fig. 12).

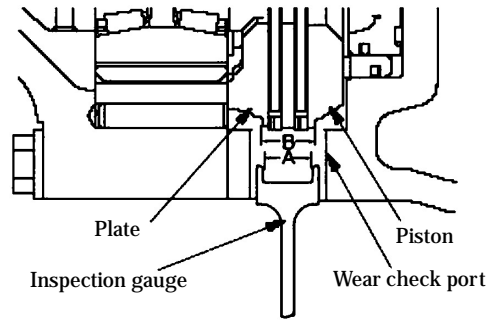


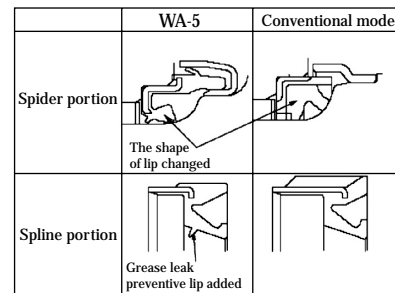
Fig. 12 Sectional View of Brake Disk

(4) Extended interval for replacing engine oil and filter

The consumption of engine oil is reduced by improving the cylinder liner. As a result, the interval for replacing engine oil and filter is extended to 500 hours, or twice the value of conventional models (250 hours).

(5) Extended interval for greasing the drive shaft

The sealing property of the greased portions of spider and spline is improved to extend the greasing interval (Fig. 13).



| Item | Model | WA-5 | Conventional model |
|-------------------------------------|-------|-------------------|--------------------|
| Greasing interval of spider portion | h | 4000 or two years | 1,000 |
| Greasing interval of spline portion | h | 4000 or two years | 500 |

Fig. 13 Structure of Grease Seals

5. Conclusion

WA270-5/320-5 was put on the market in July 2003, and the marketing of GALEO series small-sized wheel loader was completed when WA100-5/150-5/200-5 was put on the market in October of the same year. Due to excellent operability and high performance, this series is highly reputed by the users not only in Japan but also worldwide.

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[A few words from the writers]

The product planning of this development was started in 2001, where we encountered the difficult problems of completing the development in quite a short time and starting up the overseas production earlier than in Japan because the overseas affiliated companies (KA and KOHAG) had to start production at latest 2003 in order to meet the Tier II emissions regulation.

In spite of such difficulties, the production could smoothly be started up in KA, KOHAG and then Japan without delaying behind the schedule. This success seems attributable to that development department, production department and the overseas affiliated companies in union aimed at the optimization of the whole.