

Introduction of Product

Introduction of Hydraulic Excavator PC200-8

Masafumi Tsuji

Tomio Teranaka

The newly introduced medium sized hydraulic excavator PC200-8 was developed with the focus on “Environment,” “Safety” and “IT.” The background of the development, technology used and features of the product are described below.

Key Words: PC200-8, environmental friendliness, Tier 3, next-phase exhausted gas regulations, low noise, safety, protective structure cab for operator at roll over, IT, large liquid crystal color monitor, KOMTRAX

1. Introduction

The PC200 series including its family models comprise the leading products of Komatsu accounting for more than 10% of the total sales of Komatsu globally.

The hydraulic excavator PC200-7 was introduced to market in 2001 and has since then been enjoying a good reputation in the market. Recently, demands for a reduction in environmental load are increasing, and next-phase exhausted gas regulations will be enforced sequentially in Japan, the United States and Europe. In EU countries, Stage 2 noise regulations will start beginning 2006. With the focus on

“Environment,” “Safety” and “IT,” the Dantotsu, unique and unrivaled, product PC200-8 as outlined below has been developed and put on the market conforming to various regulations and featuring many selling points (**Fig. 1, Photo 1**).

2. Development Objectives

Selecting “Environment,” “Safety” and “IT” as development concepts, the development objectives are to conform to environmental regulations, to pursue reduction in environmental load, safety and comfortableness, to enhance IT utilization and maintainability, and to upgrade the marketability, in order to develop hydraulic excavators suiting user needs. The development objectives are summarized below.

- (1) Environmental friendliness
 - Conformance to next-tier exhausted gas regulations of Japan, the United States and Europe
 - CO₂ emission reduction (fuel consumption 10% reduction)
 - Guidance messages urging energy-saving operations displayed on the monitor panel
 - Eco gauge
 - Idling stop caution
 - Reduction in exterior noise
 - Compliant with the super low noise construction machinery specified by the Ministry of Land, Infrastructure and Transport of Japan
 - Compliant with EU Stage 2 noise regulations
- (2) Safety and comfortableness
 - To develop a global product seeking safety design and comfortableness, clearing strict safety standards of the world, incorporating:
 - Protective structure cab for operator at roll over
 - Anti-slip components toward passage
 - Large side and rearview mirrors (Compliant with new draft ISO standard)
 - Rearview monitor (Option)

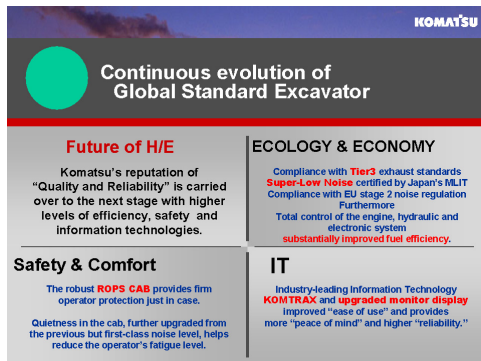


Fig. 1 Development concepts



Photo 1 PC200-8

- Noise inside cab equal to that in a passenger car
- Armrest monoblock with console

(3) IT

To further advance the IT technology of PC200-7 to provide “more information” that is “easier to see” and “easier to use.”

- A new large liquid crystal multi-screen monitor
- Function switches
- Air conditioner switches and display contained on the monitor panel
- Reinforced KOMTRAX functions

(4) Enhanced maintainability

- Vehicle easier to maintain
- A gas damper cylinder used with the hood
- Easy cleaning of coolers (Side-by-side cooling)
- Fuel prefilter (With water separator)
- Hydraulic pilot filter (Attachment specification only)
- Remote oil draining of swing machinery

3. Selling Points

The selling points of the PC200-8 and technologies to accomplish them based on the foregoing are described.

3.1 Environment

3.1.1 Compliant with next-tier exhausted gas regulations

The next-tier exhausted gas regulations and years of enforcement for Japan, the United States and Europe for the PC200 class vehicles are as follows (Table 1).

Table 1 Next generation exhaust gas regulations

Control value: NOx/HC/PM, *(NOx+NMHC)/PM (g/kW·h)

	Current regulation		Next generation regulation	
	Regulation enforcement period	Control value	Regulation enforcement period	Control value
Japan	03/10~	6.0/1.0/0.3	07/10~	3.6/0.4/0.2
USA	03/1~	*6.6/0.3	07/1~	*4.0/0.3
Europe	03/1~	6.0/1.0/0.3	07/1~	*4.0/0.3

To meet the foregoing exhausted gas regulations, the SAA6D102 engine of Type 7 was modified and was developed as the SAA6D107 engine with a larger piston displacement. High injection pressure can be obtained by using an electronically controlled high-pressure fuel injection system (High Pressure Common Rail - HPCR), allowing the random control of multi-stage injection and injection time. Tuned to the increase in the intake airflow rate, the number of intake and exhaust valves has been increased to four per cylinder. The injection nozzle is placed in the center of the cylinder to obtain uniform fuel injection. Low NOx and low PM are accomplished by optimizing the shape of the combustion chamber.

In addition to the technology that achieved low emissions, technologies incorporated in the engine are described below together with the technologies that lowered fuel consumption and noise (Fig. 2).

3.1.2 Low fuel consumption

Actual fuel consumption (l/h) was reduced by 10% in excavation and loading onto dump trucks and in ditch digging jobs in Mode P compared with Mode A conducted with Type 7.

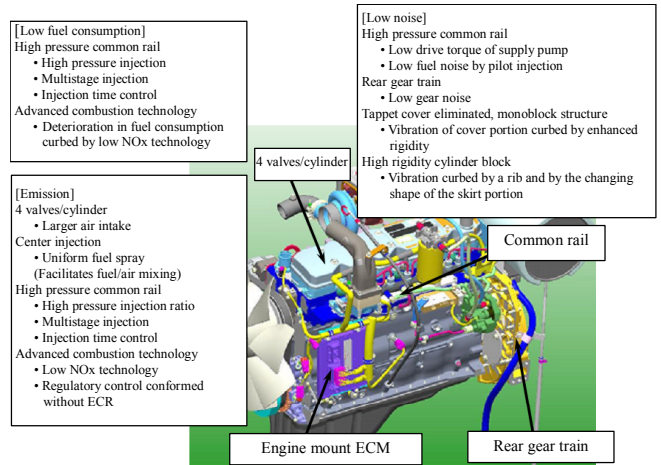


Fig. 2 Technologies incorporated in the engine

The fuel consumption efficiency (production volume per fuel consumption) increased by about 10 to 15% (Table 2).

The engine itself met the exhausted gas regulations, and fuel consumption was reduced at the same time. Losses of the hydraulic system were reduced by controlling flow merging and dividing and by using a quick return circuit. Matching control of the engine and hydraulic pump was optimized by electronic control. The efficiency of the hydraulic component was improved.

Table 2 Comparison of fuel consumption and fuel consumption efficiency

		PC200-8	PC200-7
Damp loading	Work amount	100	100
	Fuel consumption	90	100
	Fuel economy	111	100
Ditch digging	Work amount	104	100
	Fuel consumption	90	100
	Fuel economy	116	100

(Figures are shown basing Mode A of Type 7 as 100. Type 8 is for Mode P)

3.1.3 Eco gauge and idling stop caution

A gauge to show the fuel consumption status of the machine is displayed on the right-hand side of the multi-monitor screen. The gauge zone changes from green to orange to notify the operator of when the load status changes to a high load status (Fig. 3).

Fuel consumption state displayed on an indicator “Eco Gauge”



The green zone is an ideal model for energy saving operation

Fig. 3 “Eco Gauge”

If an idling state continues longer than a preset duration, a message will be displayed on the monitor urging the operator to stop idling (Fig. 4).



Fig. 4 Display screen calling for the elimination of engine idling

3.1.4 Low exterior noise

The PC200-8 conforms to the super low noise construction machinery specified by the Ministry of Land, Infrastructure and Transport of Japan and EU Stage 2 noise regulations. PC200-class vehicles need to be 100 dB (A) or less to meet the specifications of the Ministry of Land, Infrastructure and Transport of Japan, and 102 dB (A) to meet the EU Stage 2 noise regulations.

A newly developed engine itself achieved noise reduction. HPCR enabled multi-stage fuel injection and a reduction in combustion noise. A rear gear train reduced gear sound. Vibration was curbed using a high-rigidity cylinder block (Fig. 2).

To achieve both heat balance and low noise, a large side-by-side cooling unit was newly developed. The fan rotating speed is reduced by about 10% to lower the fan operation sound.

The muffler is made low noise, and a sound cover is installed to lower sound emitted by the muffler shell.

An exhaust duct is installed in the engine hood. Sound-absorbing materials are optimally placed on the vehicle body.

Through these measures, exterior noise was reduced (Fig. 5).

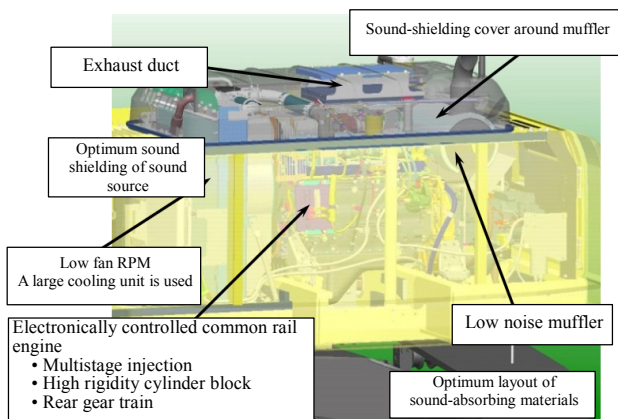


Fig. 5 Low noise technology

3.2 Safety and comfortableness

In addition to the safety and comfortableness design implemented in the past, the following new technologies are incorporated to enhance the safety and comfortableness of the operator.

3.2.1 Protective structure cab for operator at roll over

Accidents by roll over account for a large portion of accidents to operators of hydraulic excavators. Protection of the operator in roll over is very important for operator safety. The strength of the cab of the PC200-8 has been significantly increased to protect the operator in roll over. A new cab with a pipe-structure frame is used. The new cab minimizes cab deformation in roll over to a certain range, to protect the operator inside, ensuring operator safety even if the vehicle rolls over one turn (Fig. 6).

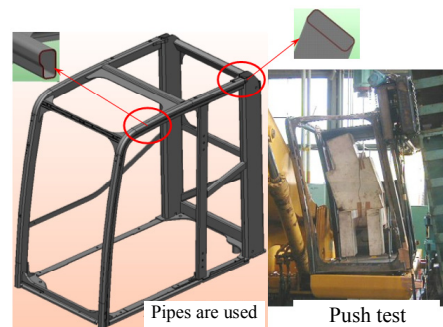


Fig. 6 Cab of protective structure for operator

3.2.2 Anti-slip floor plate

In addition to sandpaper-type floor plates that are placed in conventional models, anti-slip floor plates with small protrusions that are durable and safer are placed on passages all over the machine cab (Fig. 7).

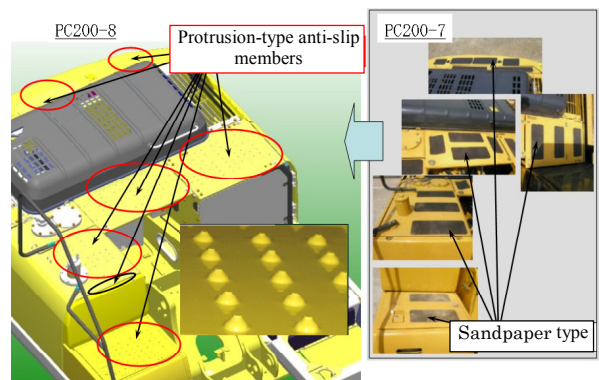


Fig. 7 Anti-slip members

3.2.3 Large side and rearview mirrors

The side mirrors installed on the cab and the right-hand handrail of the body are made larger. Large mirrors are also added on the fuel tank and counterweight, allowing safety adequate checks of the right and rear of the body. The rearview monitor is an option described in the following, and these mirrors ensure safety around the vehicle. The mirrors meet the new draft safety standard of ISO (Fig. 8).

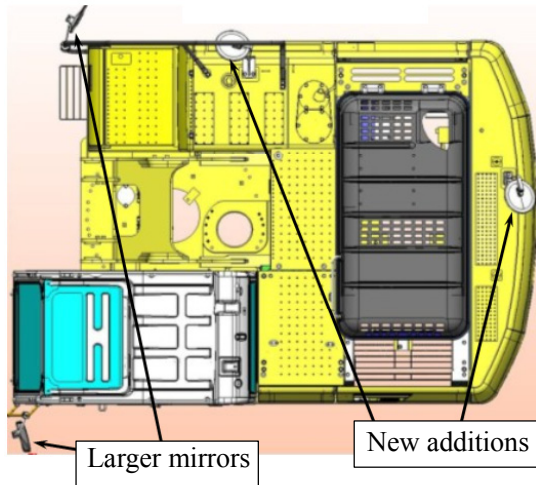


Fig. 8 Mirror

3.2.4 Rearview monitor (Option)

Camera images can be displayed on the multi-screen monitor by changing the screen when a rear camera available as an option is connected to the monitor. Images of up to three cameras can be displayed. The monitor can display one screen or two screens by selection. The monitor greatly contributes to safe operation by the operator (Photo 2).



Photo 2 Rearview monitor

3.2.5 Cab noise equal to passenger car noise level

A noise level equal to that in a passenger car is attained for the cab by minimizing the noise of the sound sources and by shielding and absorbing sounds (Fig. 9).

The noise of the engine itself has been minimized, a new air conditioner has been developed and the noise of the blower motor reduced, a new cab featuring high rigidity and a good sound-shielding effect has been installed, and the sound-shielding and absorption effects of the vehicle body have been optimized. The PC200-8 has achieved quietness highest in its class.

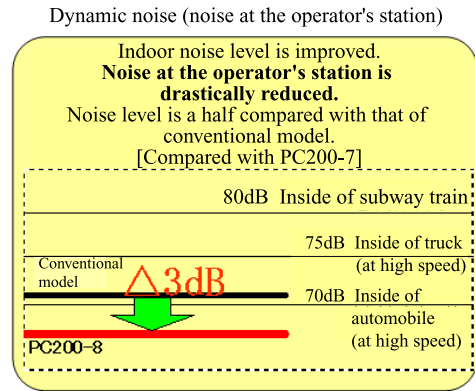


Fig. 9 Noise in cab

3.2.6 Armrest monoblock with console

The armrest has been moved from the operator seat to the console and is provided with a function to adjust its height. The new armrest assures optimum adjustment of the positions of the control lever and armrest without depending on the operator body size. The same equipment inside the cab that has enjoyed popularity with the PC200-7 because of usability is installed (Photo 3).

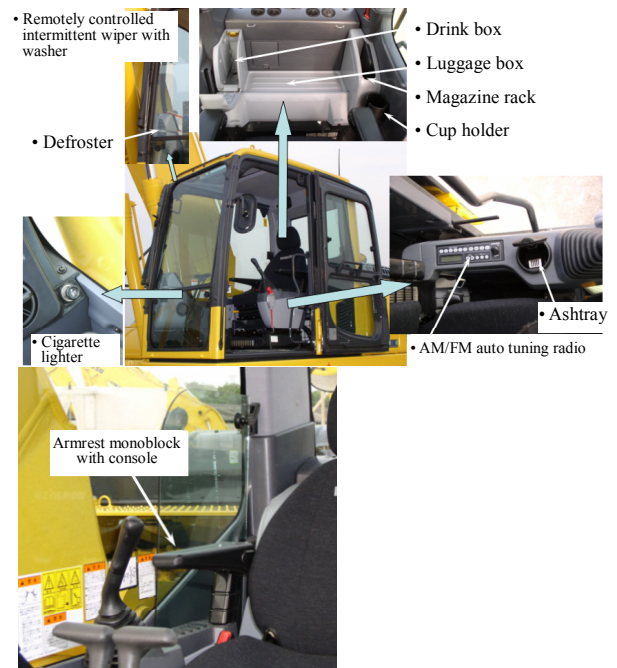


Photo 3 Equipment installed in cab and armrest

3.3 IT

3.3.1 New large color multi-screen monitor and switches

Use of a color monitor started with the -7 model, but that on PC200-8 is larger than before and also includes air-conditioning control function in its display menu for easier operation (Fig. 10).

A high-resolution 7-inch TFT (thin film transistor) liquid crystal panel offers greatly enhanced visibility.

New function switches feature the easy operation of various functions (Fig. 10).

The monitor is a multi-lingual monitor, allowing selection from ten languages (Fig. 11).

The breaker mode now allows the setting of two flow rates. An attachment mode has been newly included to suit various attachments. Three flow rates can be set (Fig. 12).



Fig. 10 Multi-display color monitor and function switches

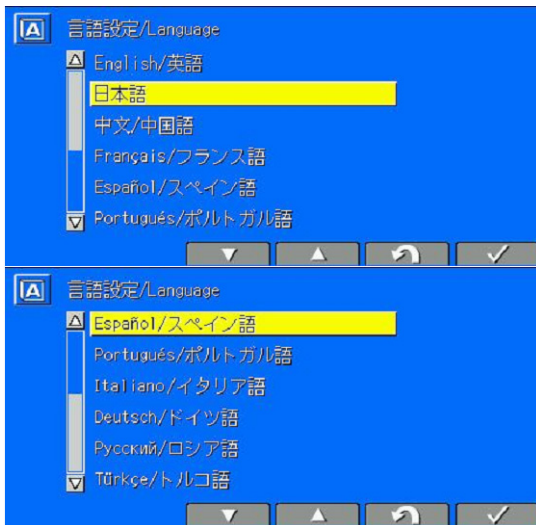


Fig. 11 Multilingual monitor

3.3.2 Reinforced KOMTRAX functions

The KOMTRAX functions first installed in the PC200-7 have been reinforced further to assure more security and confidence for the user.

KOMTRAX has been developed as a system to store and control information on vehicle working position by GPS and status and conditions in a Web server through communication equipment, and to furnish this data to the user, DB and GR through the Internet. The system has been useful in determining vehicle working status from a remote place, timely parts supply service, delivering machines, determination of a vehicle fault from a remote place, failure diagnosis and providing expeditious repair service. These functions have been reinforced by beefing up the burglarproof function and by adding

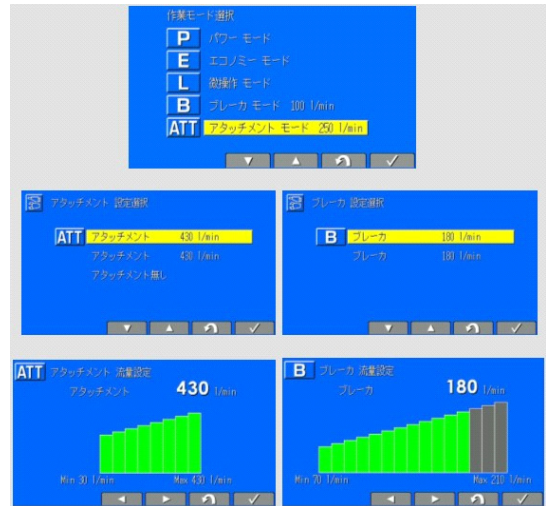


Fig. 12 Attachment mode

data downloading and data delivery through a mobile phone as well as other functions.

The new burglarproof functions include setting a password to prevent a third person from starting the engine without permission, a time reservation lock and a calendar reservation lock, allowing the setting of an engine start lock (immobilizer).

3.4 Improvement of maintainability

3.4.1 Gas damper cylinder for the hood

Gas damper cylinders are installed to allow easy opening and closing of the hood to reduce the force required to open and close the hood (Photo 4).

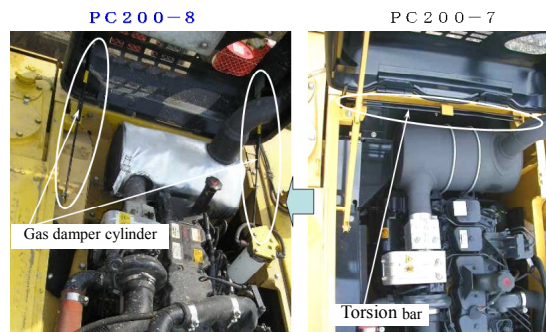


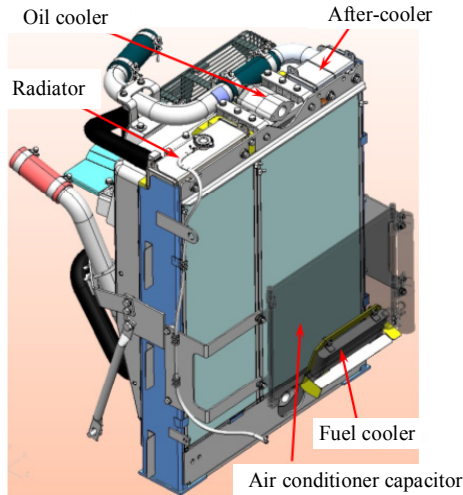
Photo 4 Gas damper cylinder

3.4.2 Easy cleaning of cooling units (Side by side)

The newly developed side-by-side cooling units allow removal of the radiator, oil cooler, after cooler and other units independently by removing them upward for easy cleaning (Fig. 13).

3.4.3 Fuel prefilter

Tuned to the installation of HPCR, a prefilter with a built-in water separator is installed in addition to the main fuel filter to enhance fuel cleanliness and to prevent mixing of water. The prefilter is installed inside the hydraulic pump room located in the right-hand cover of the vehicle body for easy operation. A sensor in the water separator detects the mixing of water, and the information is displayed on the monitor (Fig. 14).



Side-by-side type

Fig. 13 Side-by-side cooling

3.4.4 Hydraulic pilot filter

A filter is installed in the hydraulic pilot circuit to meet specifications with attachment piping to enhance the cleanliness of the pilot circuit (Fig. 14).

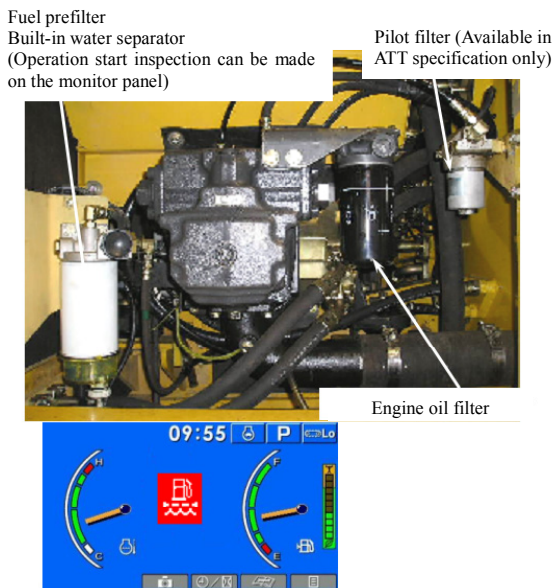
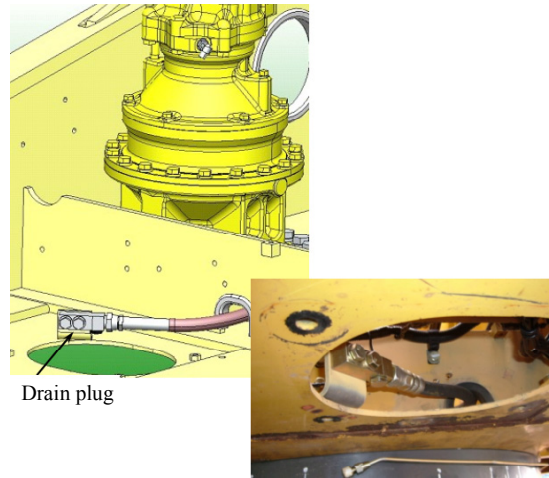


Fig. 14 Fuel prefilter and hydraulic pilot filter

3.4.5 Remote oil draining of swing machinery

Oil can be drained remotely from the swing machinery to make oil-draining work easy (Fig. 15).



Oil remote drain

Fig. 15 Swing machinery

4. Conclusion

The PC200 series are global machines and the leading construction machinery of Komatsu. The development of this series required fine-tuning the timing to match the readiness of Komatsu's production corporations of the world to start production. Mass production at Komatsu's Osaka Plant, the mother plant, was started, and production at plants in the United States, Europe and Asia was started in parallel. Transition to smooth production in large quantities is the current challenge and interest.

Introduction of the writer



Masafumi Tsuji

Entered Komatsu in 1982.
Currently belongs to Construction Equipment Technical Center 1, Development Division,



Tomio Teranaka

Entered Komatsu in 1988.
Currently belongs to Construction Equipment Technical Center 1, Development Division,

[A few words from the writer]

Komatsu has developed hardware and software of components, such as engines, hydraulic components, power lines, controllers, monitors on its own. With the cooperation with Component Development Center, the full backing of Osaka Plant, which is a production factory, and the efforts of project members, we could achieve the quality target somehow, and clear the dead line of development, and finally started the mass production.