

Introduction of Product

Introduction of PC138US and PC128US-8 Hydraulic Excavators

Youjirou Ohbatake

Masami Naruse

New hydraulic excavators, models PC138US and PC128US-8, have been developed and introduced into the market based on the Komatsu concepts of “environment,” “safety” and “IT.”

The background to the development and its technology are described, and the new products are also described.

Key Words: hydraulic excavator, tail swing minimal radius vehicle, PC138US, TIER3, domestic super low noise, EOPS

1. Introduction

Since the market entry of its model 2 in 1999, the PC138US and PC128US (hereinafter “PC138US”) have responded to a variety of market demands as the core models of Komatsu’s tail swing minimal radius hydraulic excavators. Recently, demands for a reduction in the environmental load are becoming increasingly more rigorous. Against this backdrop, since 2006, new-tier exhausted gas regulations have been enforced successively in Japan, the United States and Europe. The EU has already implemented Tier-2 noise regulation beginning 2006. The PC138US-8 complying with the regulations and featuring various selling points based on Komatsu’s concepts of “environment,” “safety” and “IT” has introduced into the market. The PC138US-8 is described in the following. (Fig. 1 and Photo 1)



Photo 1 PC138US-8

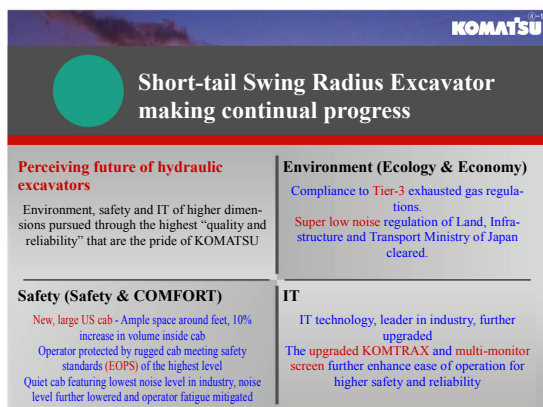


Fig. 1 Development concepts

2. Objective of Development

To develop a hydraulic excavator that complies with the environmental regulations, reduces the environmental load, pursues comfort, enhances utilization of IT and maintainability and upgrades its product power based on the concepts of “environment,” “safety” and “IT” and meeting user needs.

- Compliance with environmental regulations
 - Compliance with next-tier exhausted gas regulations of Japan, the United States and Europe
 - Display of guidance messages prompting energy saving drive on the monitor panel
 - Eco gauge
 - Idling stop caution

- Reduction of ambient noise
Compliance with super low noise regulation of Land, Infrastructure and Transport Ministry of Japan
Compliance with EU Tier-2 noise regulation
- 2) Safety and comfort
To develop hydraulic excavators as global machines clearing stricter safety standards of the world and pursuing safety and comfort. The following features should be incorporated to accomplish this:
 - Large comfortable cab of new design with a structure to protect the operator during tipping.
 - New anti-slip floor plates
 - Large side and forward mirrors
(Compliance with new ISO standard)
 - Rearview monitoring system installed as a standard provision
 - Low noise inside the cab
- 3) IT
To provide a “better view,” “easier usage” and “more information” by further advancing the IT technology.
 - New large color liquid crystal multi monitor screen
 - Function switches
 - Air conditioner switches and displays included in the monitor panel
 - Upgrading of KOMTRAX functions
- 4) Enhanced work performance
The work efficiency and work capacity have been enhanced further through the adoption of a new hydraulic system and integrated control of the engine and hydraulic power
 - Travel performance greatly enhanced through a single pump system of a new double flow type
 - Turning power during combined operation enhanced through an increase in the capacity of the turning motor.
- 5) Enhanced maintainability
 - Fuel pre-filter with a water separator
 - Easy cleaning of air cleaner suction inlet

3. Selling Points

Based on the foregoing, the selling points of the PC138US-8 and the technologies required to accomplish them are described.

3.1 Environment

3.1.1 Compliance with Next-tier Emission Gas Regulations of Japan, the United States and Europe

Compliance with next-tier exhausted gas regulations of Japan, the United States and Europe. The exhausted gas

Table 1 Next-tier exhausted gas regulations
Regulatory values: NOx/HC/PM * (NOx + NMHC)/PM (g/Kw*h)

	Next-tier regulation		Current regulation	
	Enforcement period	Regulatory value	Enforcement period	Regulatory value
Japan	08/10~	4.0/0.7/0.25	03/10~	7.0/1.3/0.4
U.S.A.	08/1~	*4.7/0.40	04/1~	*7.5/0.40
Europe	08/1~	*4.7/0.40	04/1~	7.0/1.3/0.4

regulations for the PC138US class in regions and years of enforcement are as follows. (Table 1)

To meet the aforementioned exhausted gas regulations, a new electronically controlled high pressure fuel injection system (high pressure common rail [HPCR]) is adopted with the SAA4D95LE engine (Model 2), achieves high pressure injection and assures optimum control of multi-stage injection and injection time. The injection nozzle is placed in the center of the cylinder to increase air intake by a change in the turbo and to ensure uniform fuel injection. The shape of the combustion chambers is optimized to achieve low emissions of NOx and PM.

In addition to the low emission technology, the technology incorporated in the engine, as well as the technologies for low fuel consumption and for noise reduction described below, are shown below. (Fig. 2)

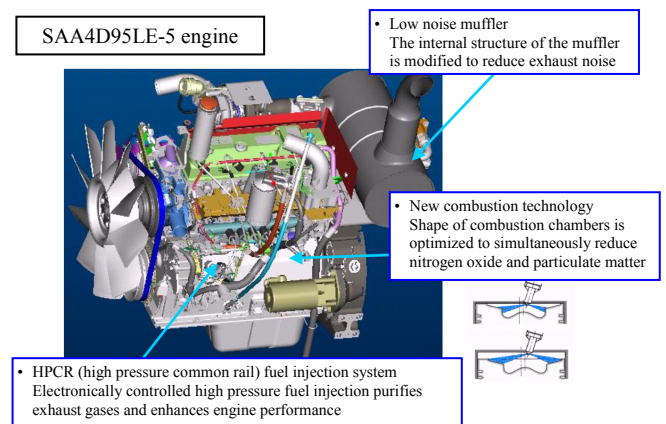


Fig. 2 Technologies incorporated in engine

3.1.2 Low Fuel Consumption

The fuel consumption efficiency (production volume per fuel consumption) is reduced by about 5% to 10% in comparison with Mode A of Model 2 in loading onto excavating dump trucks in Mode P. In Mode F, a work rate equal to that in Mode A of Model 2 could be accomplished at a low fuel consumption level. Newly incorporating an E-mode adjusting function, the demand for fuel economy operation is met. (Table 2)

Table 2 Comparison of fuel consumption and fuel consumption efficiency

Loading onto dump truck	Mode	PC138US-8		PC138US-2	
		P	E0	A	E
	Work rate	1.04	1.02	1.00	0.95
Fuel consumption	0.97	0.89	1.00	0.90	
Fuel consumption efficiency	1.07	1.15	1.00	1.06	

(Indicated basing Mode A of Model 2 as 100. Mode P of Model 8)

E mode adjusting function

Loading onto dump truck	Mode	PC138US-8			
		E0	E1	E2	E3
	Work rate	1.02	0.98	0.96	0.93
Fuel consumption	0.89	0.86	0.83	0.77	
Fuel consumption efficiency	1.15	1.14	1.16	1.21	

(Indicated basing Mode A of Model 2 as 100. Mode P of Model 8)

Exhausted gas regulations are met by the engine alone, while fuel consumption is improved. Pressure losses of the hydraulic system are reduced. Matching control of the engine and hydraulic pump was optimized by electronic control. The efficiency of hydraulic equipment has been improved also.

3.1.3 Eco Gauge and Idling Stop Caution

A gauge indicating the fuel consumption status of the machine is installed on the right of the multi-monitor screen. The operator is notified of the high load operation status as the gauge changes from a green zone to an orange zone. (Fig. 3)

If idling continues longer than a preset time, a message will be displayed on the monitor screen to notify the operator to try to stop idling. (Fig. 4)

Fuel consumption is indicated on an indicator "Eco Gauge"



Green zone indicates operation is within the energy saving operation zone

Fig. 3 Eco Gauge

Displayed when idling is continued



Fig. 4 Idling stop message screen

3.1.4 Reduction of Ambient Noise

The excavators comply with the super low noise level of the Land, Infrastructure and Transport Ministry of Japan, as well as the EU Tier-2 noise regulation. The regulatory values for the PC138US class excavators are less than 98dB (A) with the Land, Infrastructure and Transport Ministry regulation and less than 100dB (A) with EU Tier 2.

The noise of the engine itself is reduced. The high pressure common rail [HPCR] enables multi-stage fuel injection, thereby reducing combustion noise. The muffler has a low noise structure and reduces the sound emitted by the exhaust. (Fig. 2)

To simultaneously achieve a heat balance and low noise, a side-by-side cooling system with an increase in the cooling capacity is employed. At the same time, the flow of cooling air inside the engine hood is improved through computerized flow dynamics (CFD) simulation, achieving a tightly sealed hood and supply of a necessary air volume to the cooling core at the same time. A noise absorption braid and resonator are newly installed, reducing fan noise and engine air intake noise. By optimally placing sound-absorbing materials on the machine body, the ambient noise of the machine is reduced. (Fig. 5)

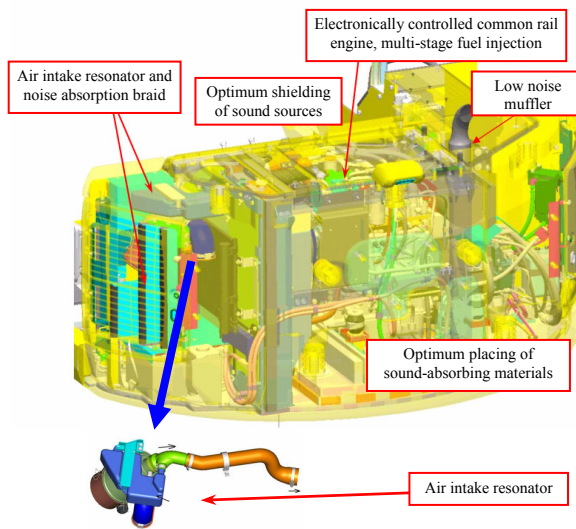


Fig. 5 Technologies for noise reduction

3.2 Safety and Comfort

The following features have been incorporated into the existing safety and comfort design to accomplish operator safety and comfort.

3.2.1 Cab with a Structure to Protect the Operator during Tipping

Accidents caused by tipping often account for a large portion of accidents involving hydraulic excavator operators. Protection of the operator during tipping is very important from the standpoint of safety. The strength of the PC138US-8 cab has been greatly enhanced to protect the operator during tipping. A new cab with a frame that is made of pipes is installed. Cab deformation during tipping is kept to a certain range to protect the operator inside. This ensures operator safety even if the vehicle overturns one turn. (Fig. 6)

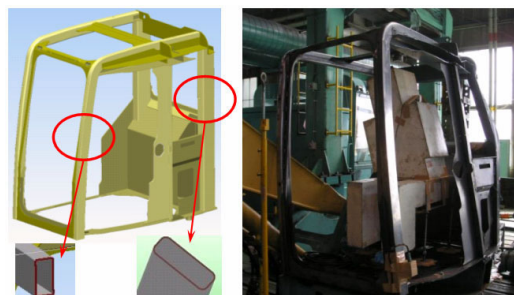


Fig. 6 Cab with operator protective structure

3.2.2 Anti-slip Floor Plates

Replacing the anti-slip floor plates of an emery paper type that have been used in the past, more durable and safe anti-slip floor plates with protrusions are placed on all floors of the machine cab. (Fig. 7)

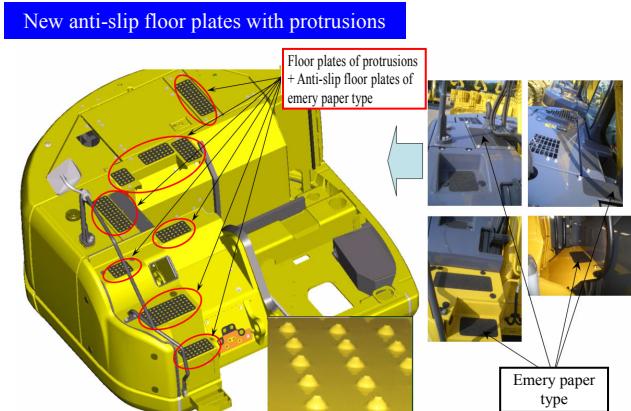


Fig. 7 Anti-slip floor plates

3.2.3 Right Handrail Mirror and Cab Handrail Mirror

Replacing the rearview mirror mounted in the past on the counterweight, a rearview monitoring system (see 3.2.4) is installed as a standard provision. Additionally, a large mirror has been added to the right handrail. Furthermore, a mirror has been added to the left handrail of the operator cab, allowing sufficient safety checking of the right front, left, right and rear. The visibility provided by these mirrors and by the rearview monitoring system meets the new ISO standard. (Fig. 8)

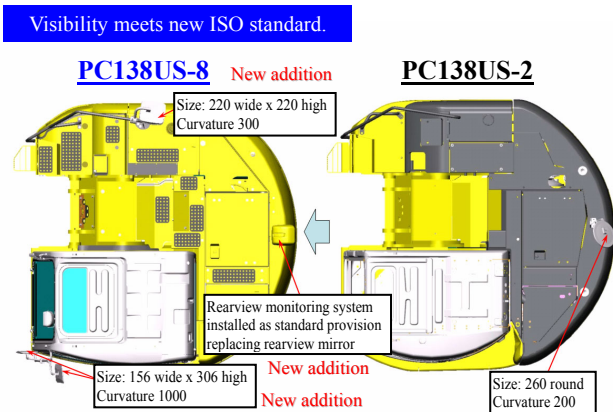


Fig. 8 Mirrors

3.2.4 Rearview Monitoring System Installed as a Standard Provision

Replacing the rearview mirror that was installed before, a rearview monitoring system is installed as a standard provision. An expanded rear visibility greatly assists safe operation by the operator. (Photo 2)

Rearview monitoring system

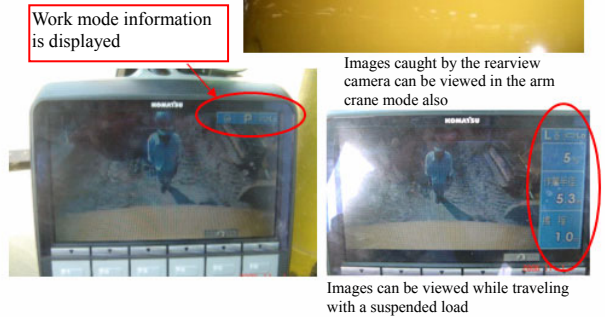


Photo 2 Rearview monitoring system

3.2.5 Reduction of Noise Inside Cab

A total of 2dB could be reduced compared with existing machines (dynamic noise value at the operator's station) through control on sound sources such as a reduction of engine noise and low-noise air conditioner blower motor, through the new cab that excels in rigidity and acoustic effects and through optimization of sound shielding and sound absorption of the machine body.

3.2.6 Large, Comfortable Cab

The cab width has been increased compared with the cab of Model 2, increasing the floor area by 11%. All these features assure a wide forward visibility and ample spaces around the feet. Coupled with a lower noise level and large multi-monitor screen, a pleasant operator environment is now provided.

The door opening and closing force is now reduced 15% to 20% by improving the shape of the sliding rails. (Figs. 9 and 10)

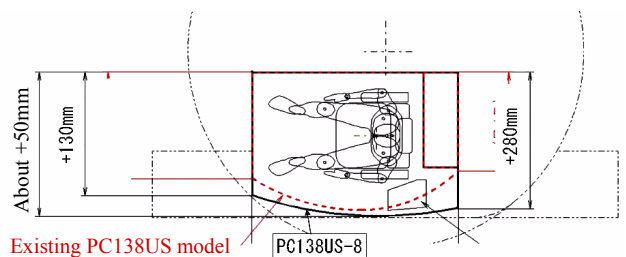


Fig. 9 Large, comfortable cab of new design

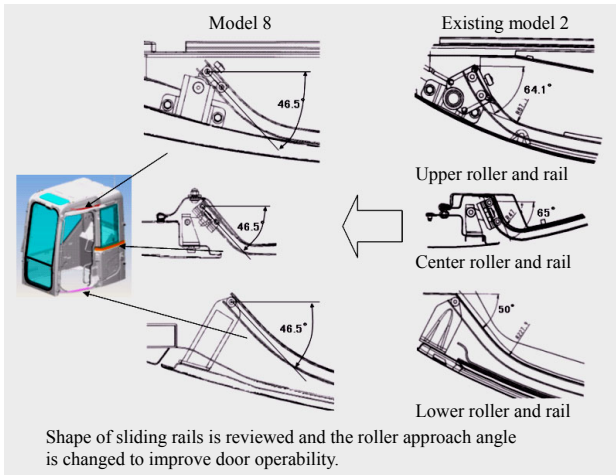


Fig. 10 Improvement in shape of door sliding rails

3.3 IT

3.3.1 New Large Color Multi-monitor Screen and Switches

A high-resolution 7" TFT (thin film transistor) liquid crystal panel is installed, greatly enhancing the visibility.

The function switches are suitable for multi-function operations. The air conditioner switch functions are included in the monitor switch module to further enhance the operability. (Fig. 11) The switches are multi-lingual and a desired language can be selected from 12 languages. (Fig. 12)

Two flow rates can be set in the breaker mode. An attachment mode has been added to interface various attachments. The flow rate can be set in three types. (Fig. 13)



Fig. 11 Color multi-monitor screen and function switches

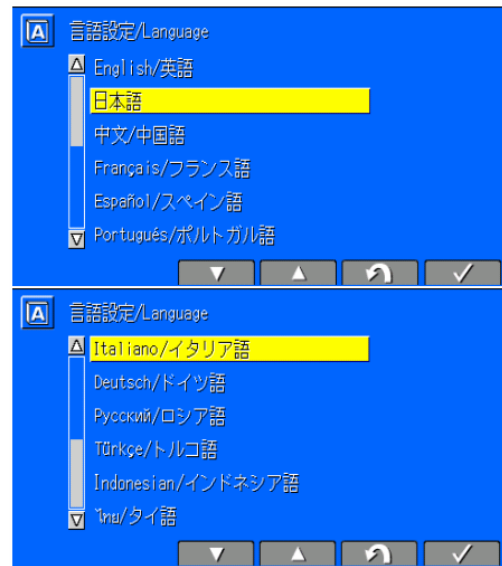


Fig. 12 Multi-lingual monitor screen

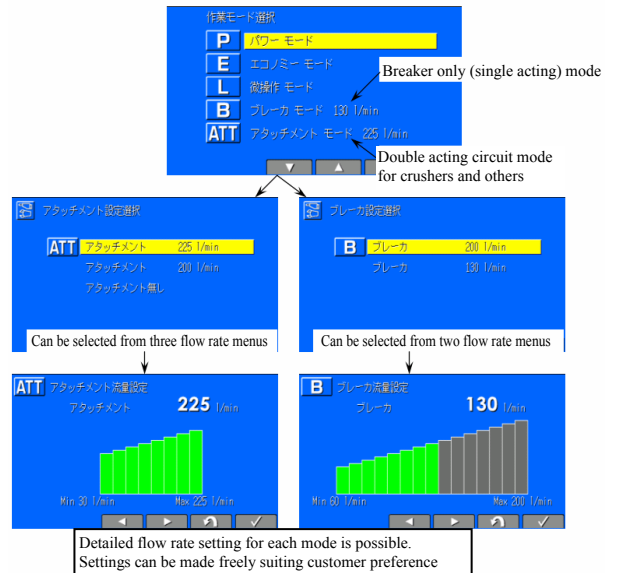


Fig. 13 Attachment mode

3.3.2 Upgrading of KOMTRAX Functions

The KOMTRAX functions that have been incorporated beginning Model 2 are enhanced further to provide "safety" and "reliability" to the user.

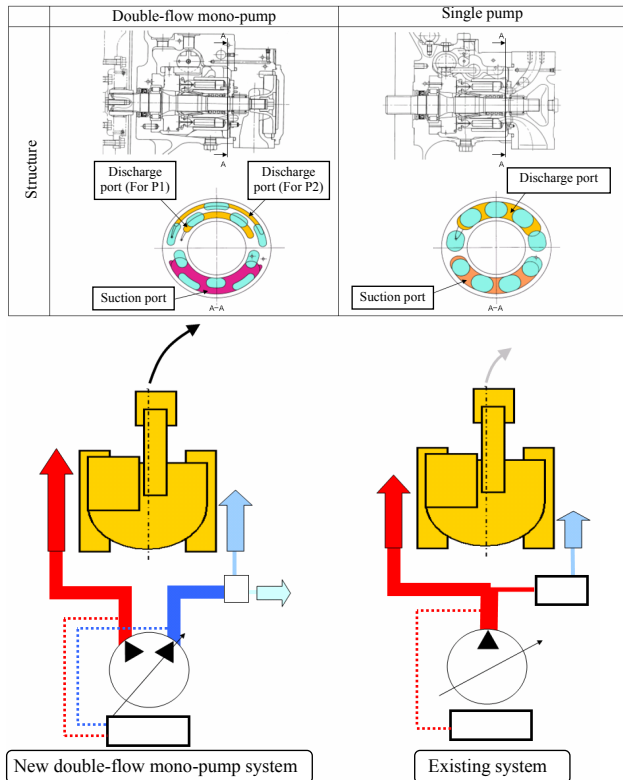
KOMTRAX stores and manages vehicle operation positions by GPS and information such as vehicle operation status and conditions in a Web server through communication equipment and supplies the data to DBs, GRs and users through the Internet. KOMTRAX has been useful in determining the vehicle operation status in remote locations, in timely parts services, in vehicle dispatch, in locating vehicle failures in remote places, in speeding up failure diagnosis and repairs and in other aspects. The burglarproof function has now been reinforced and functions to download data, to deliver data through a cell phone and other functions have now been added to beef up the function lineup.

The burglarproof function inhibits a third person from arbitrarily starting the engine and incorporates password setting, time reservation lock, calendar reservation lock and other functions, enabling setting of an engine start lock (immobilizer).

3.4 Enhanced Work Performance

3.4.1 New Double-flow Mono-Pump System

A newly developed double-flow mono-pump system adopted in the models features smoother traveling with fewer speed reductions during steering while negotiating an upward slope or in ungraded land. (Fig. 14)



The pump is a compact pump, but divides the discharge flow rate into two directions, achieving an increase in the travel flow rate by reducing pressure compensating losses.

Fig. 14 Double-flow mono-pump system

3.4.2 Enhanced Swing Acceleration during Compound Operation

A newly developed swing motor with a boosted capacity increases the swing acceleration during loading onto a truck by about 10%. (Table 3)

Table 3 Enhanced swing acceleration

Item	Unit	PC138US-8	PC138US-2
Motor capacity	Rate	1.12	1.00
Swing acceleration time during loading onto truck *	Rate	0.90	1.00
Work machine increase amount *	Rate	1.00	1.00

*: Results with prototype vehicle

3.5 Enhanced Maintainability

3.5.1 Fuel Pre-filter

Parallel with the use of HPCR, a prefilter with a water separator has been installed in addition to the main fuel filter, to increase fuel cleanliness and to prevent mixing of water in fuel. The fuel pre-filter is installed in the hydraulic pump room inside the cover on the right of the machine body. (Fig. 15)

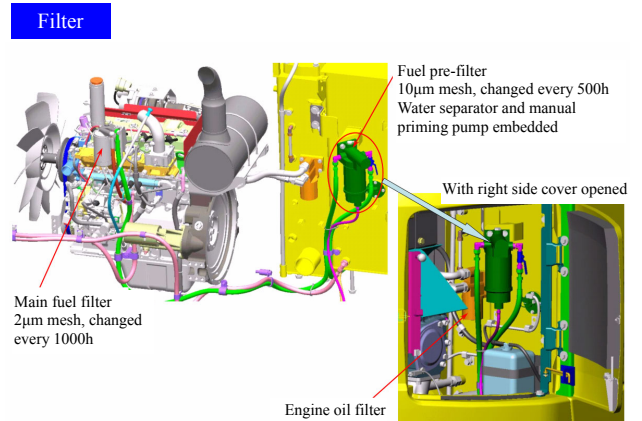


Fig. 15 Fuel pre-filter

3.5.2 Easy Cleaning of Air Cleaner Intake Port

The structure around the intake port net of the air cleaner is simplified to make cleaning work easy. (Fig. 16)

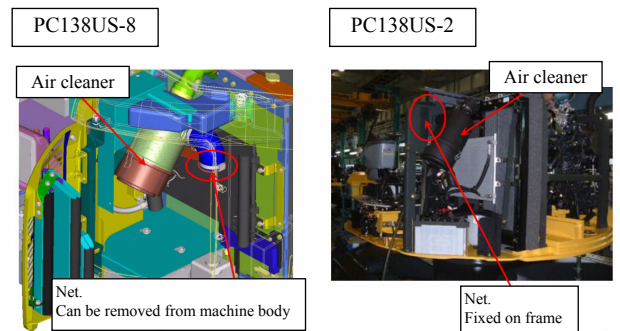
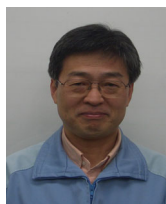


Fig. 16 Simple structure of air cleaner intake port

4. Conclusion

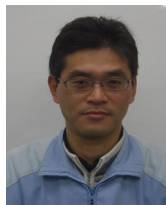
An effort was made during the development of PC128US and PC138US-8 to achieve functions and performances exceeding regulatory levels and those of existing machines meeting the market requirements of Japan, the United States and Europe as the core of US machines of Komatsu and as representative models of 10-ton class hydraulic excavators. Future plans include cooperation with the related divisions and departments to ensure smooth market entry and sales expansions inside and outside of Japan making the best use of the average and strength of producing only in one plant at Komatsu's Awazu Plant.

Introduction of the writers



Youjirou Ohbatake

Entered Komatsu in 1981.
Currently assigned to the Construction Equipment Technical Center 1, Corporate Development Division.



Masami Naruse

Entered Komatsu in 1989.
Currently assigned to the Construction Equipment Technical Center 1, Corporate Development Division.

[A few words from the writers]

Since the market debut of Model 2 in 1999, this is the first full changing of models in eight years. It is hoped that the new models that meet the exhausted gas and noise regulations and that fully utilize the component development capability of Komatsu, featuring a new product appearance, design, electric and hydraulic systems and functions will win a high evaluation in the market.