Introduction of Products

Introduction of Hydraulic Excavator PC138US/PC128US-10

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Komatsu Ltd. launched the hydraulic excavator PC138US/PC128US-10 which conforms to Tier4 interim exhaust gas regulations to realize higher level of "ecology", "safety" and "information communication technologies (ICT)" based on our reputed "quality and reliability".

This item describes the background of development and the featured technologies of this new model.

Key Words: *Environment, Safety, ICT, Low Fuel Consumption, Hydraulic Excavator, Ultra-short Tail Swing Machine, PC138US, Tier4 Interim, Ultra Low Noise for Japanese Market, ID Key*

1. Introduction

PC138US/PC128US (hereafter PC138US) are playing an active part at various worksites ranging from a narrow worksite such as piping work to general civil engineering works as core models of our ultra-short tail swing hydraulic excavators, and have gained high reputation for their quality and reliability. In recent years, importance on the reduction in environmentally hazardous substances including CO_2 has been increasing and in line with this, Tier4 interim exhaust emission regulations have been introduced since 2011 in Japan, North America and Europe in succession. Under such environments, PC138US-10 has been developed with the aim of complying with the above regulations and ensuring customers' benefits as well as being environmentally friendly and has been introduced to the markets. Its outline is introduced below. (**Figs. 1, 2**)

Fig. 1 PC138USLC-10 (North American specifications)

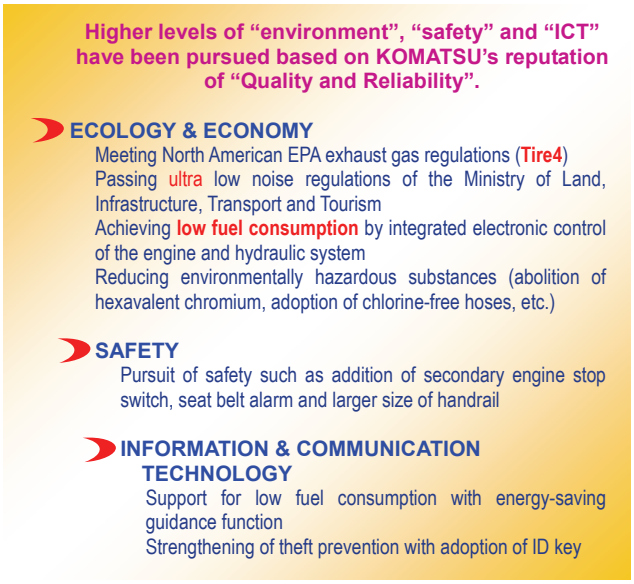


Fig. 2 Development concept

2. Development Objectives

The basic concept is pursuit of higher levels of "Ecology", "Safety" and "Information & Communication Technology (ICT)" based on KOMATSU's "Quality and Reliability". This is the same as that of PC200, PC300 and PC400-10 which have already been introduced to the market. Based on this concept, the product competitiveness has been enhanced by complying with environmental regulations, reducing fuel consumption, pursuing safety and fully utilizing ICT technology. Its outline and features are introduced below.

(1) Environmental friendliness

- Conformity with the Japanese, North American and European exhaust gas regulations (Tier4 Interim)
- Reduction in fuel consumption by 7% compared to the current model (comparison of average work pattern by analysis of KOMTRAX)
- Support for reduction in fuel consumption with energy-saving guidance function
- Reduction in environmentally hazardous substances
- Conformity with ultra low noise regulations of the Ministry of Land, Infrastructure, Transport and Tourism and EU Stage II noise regulations

(2) Safety and comfortability

The following items have been additionally adopted with respect to the current model with the aim of developing this model as a global machine pursuing safety design that passes world's severe safety standards and comfortability.

- Larger handrail for access to engine compartment
- Secondary engine stop switch
- Seat belt alarm
- Battery disconnect switch
- Right side monitor system (option)
- AUX jack

(3) ICT

The following items have been added by further advancing the ICT technology.

- Strengthening of antitheft function by adoption of ID key
- Improvements of KOMTRAX report content
- High-resolution large color liquid crystal multi-monitor

(4) Improvement of maintainability

- Use of fan belt to auto tensioner
- Centralized arrangement of fuel filters

3. Selling Points

Based on the above, selling points of PC138US-10 and technologies to achieve them are explained.

3.1 Environment

3.1.1 Conformity with exhaust gas regulations

The new model complies with the Japanese, North American and European Tier4 interim exhaust emission regulations. The exhaust gas regulations and the year when the regulations are implemented in the PC138US class machines by region are as follows. (**Table 1**)

Table 1 Comparison of exhaust gas regulation standards

Regulation standards: NOx/HC/PM *(NOx+NMHC)/PM (g/kW·h)

	Tier3		Tier4 interim	
	Schedule for regulations	Regulation standards	Schedule for regulations	Regulation standards
Japan	Oct. 2007	4.0/0.7/0.25	Oct. 2012	3.3/0.19/0.02
U.S.	Jan. 2007	*4.7/0.40	Jan. 2012	3.4/0.19/0.02
Europe	Jan. 2007	*4.7/0.40	Jan. 2012	3.3/019/0.025

Various new technologies have been incorporated into the engine while the above exhaust gas regulations are satisfied and economy required of small models and maintenance free are achieved. The items are listed below. (**Fig. 3**)

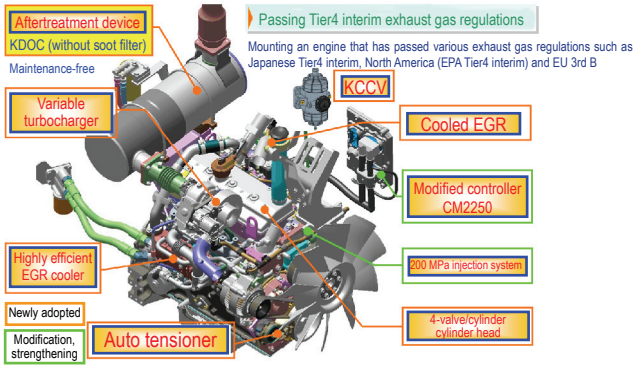


Fig. 3 Technologies incorporated into the engine

- Exhaust gas after-treatment device

A highly efficient oxidation catalyst, KDOC (Komatsu Diesel Oxidation Catalyst) has been newly developed.

This is of simple structure without a soot filter or a sensor and regeneration control for removing soot or periodic maintenance is not necessary.

Besides, KDOC is integrated with a high performance silencer to reduce exhaust noise. (**Fig. 4**)

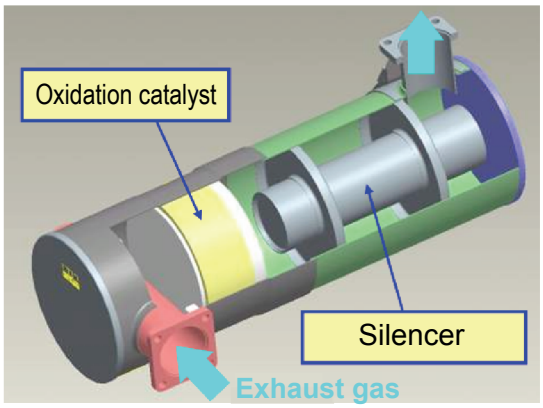


Fig. 4 Structure of KDOC

- Variable turbocharger

VFT (Variable Flow Turbo) having an electric flow control valve of simple structure has been newly developed.

This turbocharger supplies air optimally according to the load condition and enhances combustion efficiency, realizing compatibility between purification of exhaust gas and economy. (**Fig. 5**)

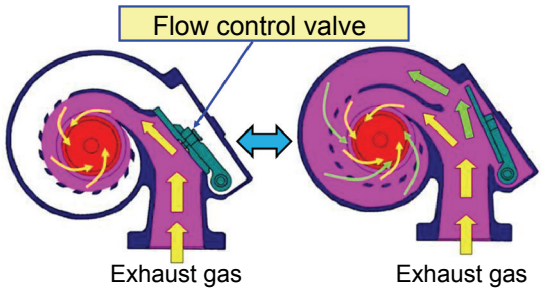


Fig. 5 Structure of VFT

- Cooled EGR system and highly efficient EGR cooler

An electric EGR (Exhaust Gas Recirculation) valve of simple structure has been newly developed. In combination with a highly efficient EGR cooler, the combustion temperature has been effectively decreased, reducing Nox and furthermore contributing to the reduction in fuel consumption.

- KCCV ventilator

Zero emission of blowby gas has been achieved by returning it to the intake system through the newly developed small KCCV (Komatsu Closed Crankcase Ventilation) ventilator.

- DF air cleaner

A large DF (Direct Flow) air cleaner which can straighten the airflow in the intake passage has been newly developed. The measurement accuracy of the MAF (Mass Air Flow) sensor has been increased and PM emitted from the engine has been successfully reduced to an absolute minimum. (**Fig. 6**)

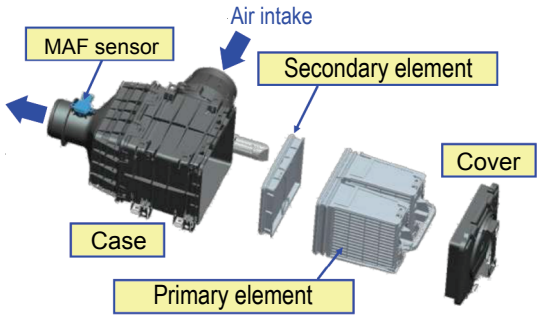


Fig. 6 Structure of DF air cleaner

- Others

Reduction in Nox, PM and fuel consumption has been achieved by increasing the injection pressure (200 MPa) of the electronically controlled high-pressure fuel injection system which has been adopted since the current model, adopting 4-valve system for the intake and exhaust valves and optimizing the combustion chamber shape. Furthermore, the accurate control of the EGR rate and fuel injection has

become possible through coordination between the modified engine controller (CM2250) and various additional latest sensors and actuators, and PC138US has passed the newly adopted NRTC (Non Road Transient Cycle) test.

3.1.2 Reduced fuel consumption

Reduction in fuel consumption by 7% compared to the current model has been achieved by analyzing how PC138US is used by KOMTRAX, focusing on points where a fuel consumption reducing effect is high and incorporating technologies to be described later.

a. Improvement in engine fuel efficiency and low-speed matching control

Exhaust gas emission regulations have been satisfied by incorporating the above engine new technologies and at the same time fuel efficiency of the engine (fuel efficiency map) have been improved. Engine speed is controlled to be matched at low speed utilizing a characteristic that fuel efficiency is better as engine speed is lower when compared on the same horsepower. At the same time, the pump maximum flow rate equivalent to that of the current model is secured by increasing the pump maximum capacity and reduction in fuel consumption has been achieved without decreasing a work amount. (**Fig. 7**)

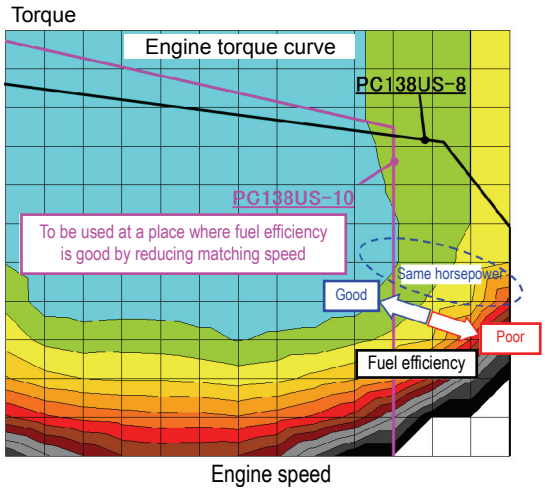


Fig. 7 Schematic diagram of low-speed matching

b. Reduction in fan speed by improvement of cooling capacity

Ventilation resistance has been substantially reduced by increasing the engine compartment height and widening the inlet and outlet opening. In addition, cooling capacity has remarkably increased by adopting highly efficient and large-capacity cooling system and fan speed can be reduced without worsening the heat balance. Thus, reduction in fuel consumption equivalent to the horsepower consumed by the fan has been achieved. (**Fig. 8**)

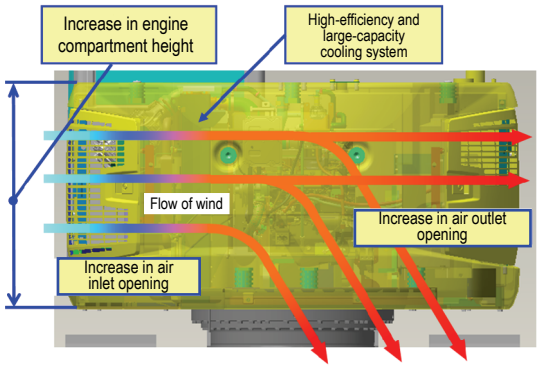


Fig. 8 Technologies to increase cooling capacity

c. Increase in size of work unit piping and travel unit piping

The increase in size of work unit piping and travel unit piping has reduced hydraulic pressure loss during work and travel, resulting in improvement in fuel economy. (**Fig. 9**)

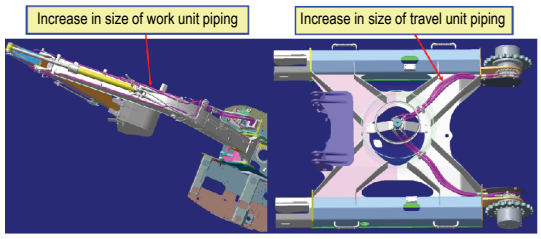


Fig. 9 Increase in piping size

d. Lower auto deceleration speed

Reduction in fuel consumption has been achieved by further decreasing auto deceleration speed when the lever is in the neutral position. (**Fig. 10**)

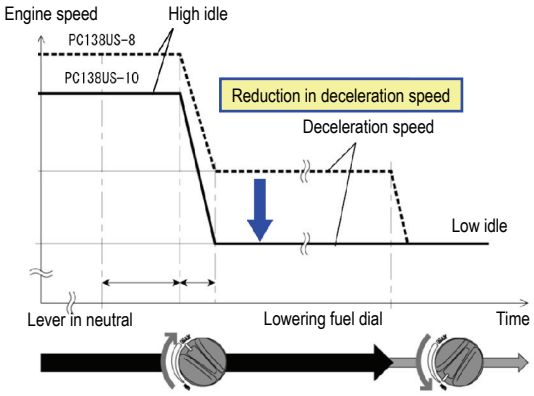


Fig. 10 Lower auto deceleration speed

3.1.3 ECO guidance function

A function to display operating advice on the multi-monitor has been newly incorporated with the aim of operating the vehicle efficiently and suppressing unnecessary fuel consumption. When an operating condition applies to a certain condition, each advice is displayed on the upper part of the multi-monitor screen. (**Fig. 11**) Items related to reduction in fuel consumption, conditions on which advice is displayed and outline of the purpose are listed below.

(1) Suppression of hydraulic relief

This is displayed when there is an unnecessary hydraulic relief operation. The purpose is to suppress unnecessary hydraulic relief.

(2) E mode recommended

This is displayed when light load work continues in the P and ATT/P mode. The E mode is used in light load work to suppress fuel consumption.

(3) Travel in partial speed recommended

This is displayed when the machine travels for a long time with travel speed adjustment set to Hi. Lowering the engine throttle dial suppresses the fuel consumption.

(4) Idling stop recommended

This is displayed when a condition in which there is no lever operation continues for a long time. The purpose is to suppress fuel consumption during unnecessary idling.

A function to display the average fuel consumption has been added on top of the Eco gauge installed in the current model.

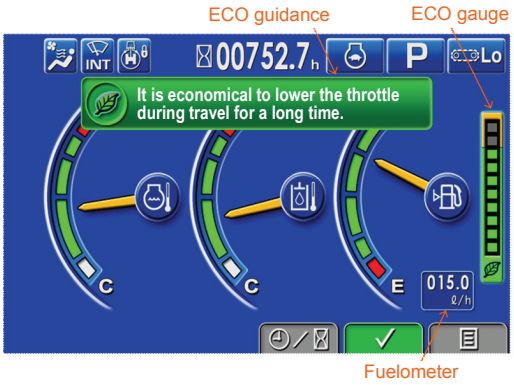


Fig. 11 Example of ECO guidance display

The display function of the following items has also been added.

- Operation record screen which displays operation time, idling time, etc. (**Fig. 12**)
- ECO guidance record screen which displays the number of times when each ECO guidance is displayed (One point advice is similarly displayed)
- History screen of average fuel consumption per hour and per day

The display of these screens to an operator in real time enables operation with fuel consumption kept in mind, which, in combination with the existing maintenance management function, allows for efficient vehicle operation and maintenance management.

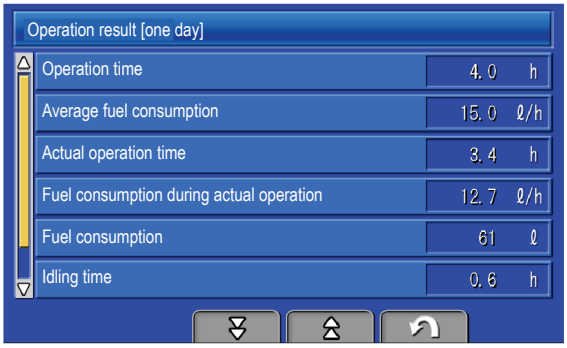


Fig. 12 Operation result screen

3.1.4 Reduction in environmentally hazardous substances

Fuel consumption has been reduced using aforementioned technologies to reduce fuel consumption, realizing substantial reduction in CO_2. In addition, environmentally hazardous substances have been reduced such as disuse of hexavalent chromium and adoption of chlorine-free hoses.

3.1.5 Conformity with noise regulations

As with the current models, the new models have passed the ultra low noise regulations of the Ministry of Land, Infrastructure, Transport and Tourism and EU Stage 2 noise regulations. Reduction in engine speed by aforementioned low-speed matching control, and reduction in fan speed and optimal arrangement of sound absorbing material have greatly contributed to the passing of the above regulations.

3.2 Safety and comfortability

In addition to the low-noise, large-sized ROPS round cab, rearview monitor and antislip treatment to the steps which are conventional safety and comfortability design, the following has been adopted to further enhance safety and comfortability.

3.2.1 Larger handrail for access to engine compartment

To prevent a fall from the machine cab, the handrail for access to the engine compartment has been enlarged and furthermore, a handrail has been added to the rear of the operation cab. (**Fig. 13**) This satisfies the new regulation of ISO (2867). The structure is designed to eliminate the need to go round to the counterweight side during maintenance of the engine and its surrounding parts.

Fig. 13 Handrail for preventing a fall from the machine cab

3.2.2 Secondary engine stop switch

For a case in which the engine does not stop due to breakage of the key switch etc., the secondary engine stop switch is installed under the operator's seat. (**Fig. 14**)

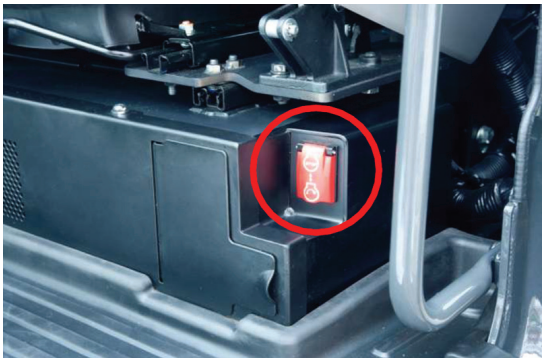


Fig. 14 Secondary engine stop switch

3.2.3 Seat belt alarm

An alarm sign will light up on the upper left part of the monitor when the seat belt is not fastened to urge the operator to wear the seat belt.

3.2.4 Battery disconnect switch

A battery disconnect switch has been made standard equipment to improve safety during maintenance of electric circuits. (**Fig. 15**)

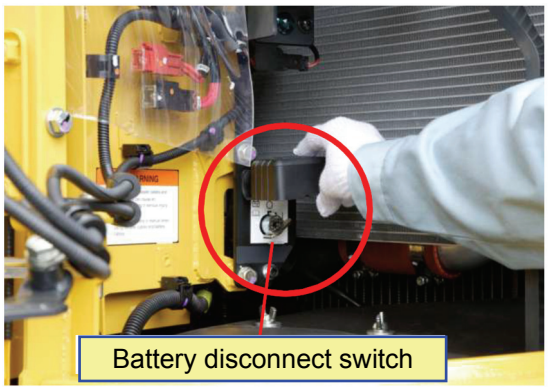


Fig. 15 Battery disconnect switch

3.2.5 Right side monitor system (option)

A right side monitor system has been newly made available as option for the customers who put importance on the right side visibility. (**Fig. 16**)

Fig. 16 Right side monitor system

3.2.6 AUX jack

An AUX jack is newly installed so that speakers in the operation cab can be used by an electronic equipment of the customer. (**Fig. 17**)

Fig. 17 AUX jack

3.3 ICT

3.3.1 ID key

The ID key is a system which controls engine start by reading the key ID with the ID key antenna placed near the key cylinder and comparing electronically the read ID with the ID key controller to judge whether the key has valid ID. (**Fig. 18**) This has further strengthened the antitheft function.

Fig. 18 Monitor display when unregistered key is used

3.3.2 Improvement in KOMTRAX function

In addition to the KOMTRAX report content up to now, advices on reduction in fuel consumption is described to enrich KOMTRAX content.

3.3.3 New large-sized color multi-monitor

The visibility and screen resolution of the conventional 7 inch large TFT (Thin Film Transistor) liquid crystal have been further enhanced by the adoption of high resolution liquid crystal. In addition, the multilingual support for this monitor is enhanced and a language can be selected from among 25 languages.

3.4 Improvement in maintainability

3.4.1 Fan belt auto tensioner

The fan belt auto tensioner has been newly adopted, eliminating the need for belt tension adjustment.

3.4.2 Relocation of fuel main filter

The fuel filter has been relocated from the engine compartment to the pump room and is now maintainable from the ground together with the fuel prefilter, engine oil filter and coolant reservoir tank. (**Fig. 19**)

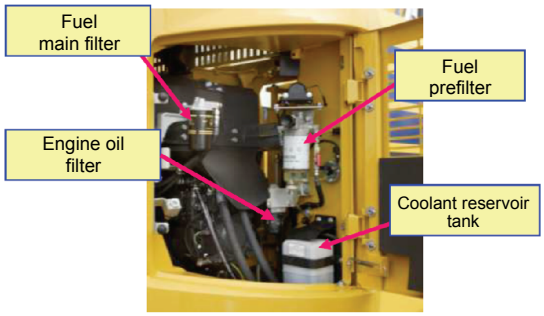
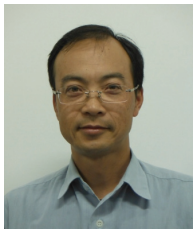


Fig. 19 Maintenance items in pump room

4. Conclusion

Various ideas and contrivances have been incorporated into PC128US/PC138US-10 here and there in addition to technologies and selling points introduced in this journal, and these models have been completed as a machine at a higher level than that of the current models. From now on, they will be released to various markets starting with North America, and then Europe and Japan in succession and we are confident that these new models will certainly satisfy customers.

Introduction of the writers



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[A few words from writers]

Exhaust emission and fuel consumption regulations which become severer year by year continue to stimulate engineers like us. Back-breaking effort and originality and ingenuity are required there and they will eventually bear fruit as innovation. Bearing a heavy load on my shoulder, I move forward step by step. I suddenly notice that I am at a far elevated place and when I look back, I see small flowers blooming. I'd like to continue such development in the future.