

## Introduction of Products

# Mining Hydraulic Excavator PC3400-11M0

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*The PC3400-11M0, with a bucket capacity of 18 m<sup>3</sup> has been marketed as a new model in the 200-ton plus hydraulic mining excavator series. In addition to the technology cultivated by Komatsu Germany (KG), which develops and manufactures mining excavators in Germany, this machine has been developed by introducing the technology of the Komatsu hydraulic excavators of the 200-ton or smaller class to implement further evolution. This paper outlines the machine. (Fig. 1)*



**Fig. 1** PC3400-11M0

**Key Words:** PC3400, Mining Hydraulic Excavator, Komatsu Germany, KG, Super-large control valve

## 1. Introduction

In recent years, the hauling capacity of dump trucks in mines around the world tends to increase. The bucket capacity of mining excavators of loading machines has also been increasing accordingly, and so the demand has shifted from a bucket capacity of 15 m<sup>3</sup> to 18 m<sup>3</sup> for hydraulic mining excavators of the 300-ton operating weight class. Our product lineup includes the current model with a bucket capacity of 15

m<sup>3</sup> (PC3000) and the next classification is the PC4000, which has a bucket capacity of 22 m<sup>3</sup>; thus, we have developed a model of a new series, PC3400 (18 m<sup>3</sup>), as a larger model of PC3000 vehicle classification. This paper introduces the new model.

## 2. Aims of Development

- (1) Improved productivity, ecology and economy
  - 1) 31% increase in production volume (tons/h) (vs. current model)
  - 2) 22% improvement in fuel efficiency (vs. current model)
- (2) Improved reliability
  - 1) Significantly increased life of main welded structures
  - 2) Improved reliability of electric and hydraulic systems
- (3) Reduced TCO and production costs
- (4) Improved safety and comfort
  - 1) Equipped with KomVision for mining
  - 2) Improved access system to the machine body
  - 3) Improved cab comfortability
  - 4) Improved maintainability
  - 5) Easier management of machine condition

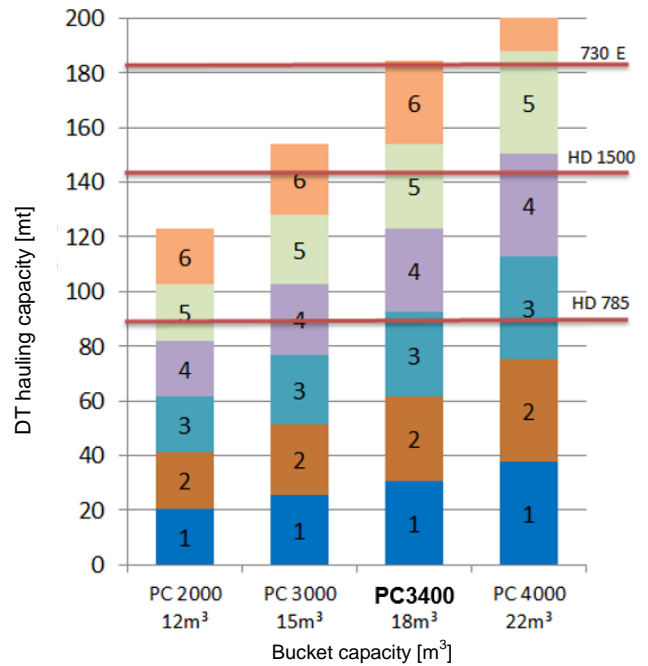


Fig. 2 Matching to DT

## 3. Selling Points

### 3.1 Improved productivity, ecology and economy

#### 3.1.1 31% increase in production volume (tons/h) (vs. current model)

One of the biggest priorities in mining operations is to fill each dump truck (DT) as quickly as possible, and load it onto as many dumps as possible. The PC3400 machine achieves this goal by improving the two points below.

- (1) Improving DT matching by increasing the bucket capacity

The current model, PC3000-6, has a bucket capacity of 15 m<sup>3</sup>, and the corresponding DTs, HD785 and HD1500, can be loaded with four and six paths respectively. Increasing the bucket capacity to 18 m<sup>3</sup> has enabled the number of loadings to be reduced by one, thereby reducing the loading time per one DT by 25%. (Fig. 2)

- (2) Increasing engine output

To secure a cycle time equivalent to that of the current model while increasing the bucket capacity, the engine was changed from QSK38 (940 kW) to QSK50 (1,193 kW) manufactured by Cummins Inc. and the output was increased, thereby achieving a cycle time shorter than that of the current model.

The emission level is equivalent to US EPA Tier2, meeting the regulations outside the regions that have introduced US EPA Tier4 and equivalent.

#### 3.1.2 22% improvement in fuel efficiency (vs. current model)

- (1) Adoption of variable speed hydraulic drive fan control

As for the fan rotation of the current model, the radiator fan rotation is proportional to the engine speed by belt drive, and the rotation of the oil cooler fan changes between only two steps of High and Low. By hydraulically driving the radiator fan and installing variable displacement pumps, stepless fan speed control according to the water and oil temperature is possible for this machine. This reduces fuel consumption for fan drive and improves fuel efficiency.

- (2) Equipped with a newly developed Komatsu main valve

This machine is equipped with a super-large Komatsu control valve (Fig. 3) newly developed along with this development. Although it is the largest valve in the Komatsu series, the increase in size and weight has been suppressed by various measures. In addition, the pressure loss has decreased by increasing the diameter of the internal path, thus contributing to the improvement of fuel efficiency. In addition, full electronic control with the built-in electromagnetic proportional control (EPC) valve enables fine tuning of operator controls, thus allowing an improved feeling during compound operations. This is the selling point of this machine. For details, see the article, “Development of Super-Large Control Valve” in this journal volume.



Fig. 3 Komatsu super-large control valve

### 3.2 Improved reliability

#### 3.2.1 Significantly increased life of main welded structures

KG mining excavators have a high reputation in the mining market for the long life and high reliability of their main welded structures. Following the KG design method for the main welded structures, the PC3400 has implemented a lightweight, high-strength welded structure by (1) large cross sectional thin-walled design, (2) adoption of castings on the stress concentration area, (3) full penetration of all welded joints, and (4) removing residual stress by annealing the completed welded structure. (Fig. 4)

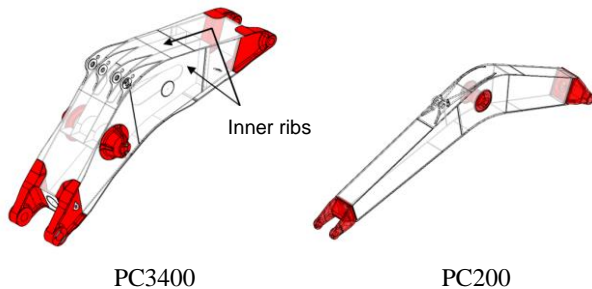


Fig. 4 Work equipment (boom) comparison

In addition, the productivity and cost were also improved by methods such as casting shape optimization by the promotion of the simultaneous engineering activity and the utilization of CAE technology.

#### 3.2.2 Improved reliability of electric and hydraulic systems

Main hydraulic components of current model are supplied by Bosch Rexroth (Germany) and ZF (Germany). To further increase the reliability of the components, this machine uses Komatsu products for more than 90% of hydraulic components and reduction gears and for all the controllers. As for the installation evaluation of electric cables and hydraulic hoses, the reliability has been improved by adopting the Komatsu standards applied to 200-ton or smaller machines, which are well-established in the market.

### 3.3 Reduced TCO and production costs

This development focused also on the total cost of ownership (TCO) and production cost (\$/ton). By improving the fuel efficiency as mentioned above and using the REMAN programs of components, the increase in TCO was suppressed to +7% and the productivity was improved by +31% (vs. current model), resulting in success in decreasing the production cost (\$/ton) by 18%.

### 3.4 Improved safety and comfort

#### 3.4.1 Equipped with KomVision for mining

The machine comes standard with KomVision for mining, which has been proven in PC2000.

The visibility to the surrounding of the machine has been improved by stitching the images from seven cameras and displaying an overhead view image on a 10.4-inch high-definition monitor. (Fig. 5)



Fig. 5 KomVision overhead view image

#### 3.4.2 Improved access system to the machine

##### (1) Main ladder tilted 45 degrees

In response to requirements from EMESRT, the main access ladder of the machine is inclined at 45 degrees to ensure high safety. In addition, the ladder has been widened relative to the current model, making the access easier.

##### (2) Equipped with a retractable steel emergency escape ladder on the left and right of the machine

The machine also has a steel emergency escape ladder on the opposite side of the operator cab. It is for service personnel to escape when an emergency event such as a fire occurs during maintenance. A more stable footing has been secured than that of a rope-type ladder, enabling safer escape in an emergency. (Fig. 6)



Main access ladder



Emergency escape ladder

Fig. 6 Access ladder and emergency escape ladder

### 3.4.3 Improved cab comfortability

The machine uses a large-capacity DENSO air conditioner proven in the PC2000, improving the cab cooling and heating capacity by 43%. The arrangement of levers and switches has been optimized to reduce operator fatigue.

### 3.4.4 Improved maintainability

(1) Shortening the maintenance access routes

By concentrating daily inspection points around the maintenance path, we aimed to significantly shorten the distance traveled during daily inspections, to shorten the time required for daily inspections, and to improve the availability. The path width and the height inside the engine compartment also, have been expanded compared to the current model to ensure sufficient maintenance space. (Fig. 7)

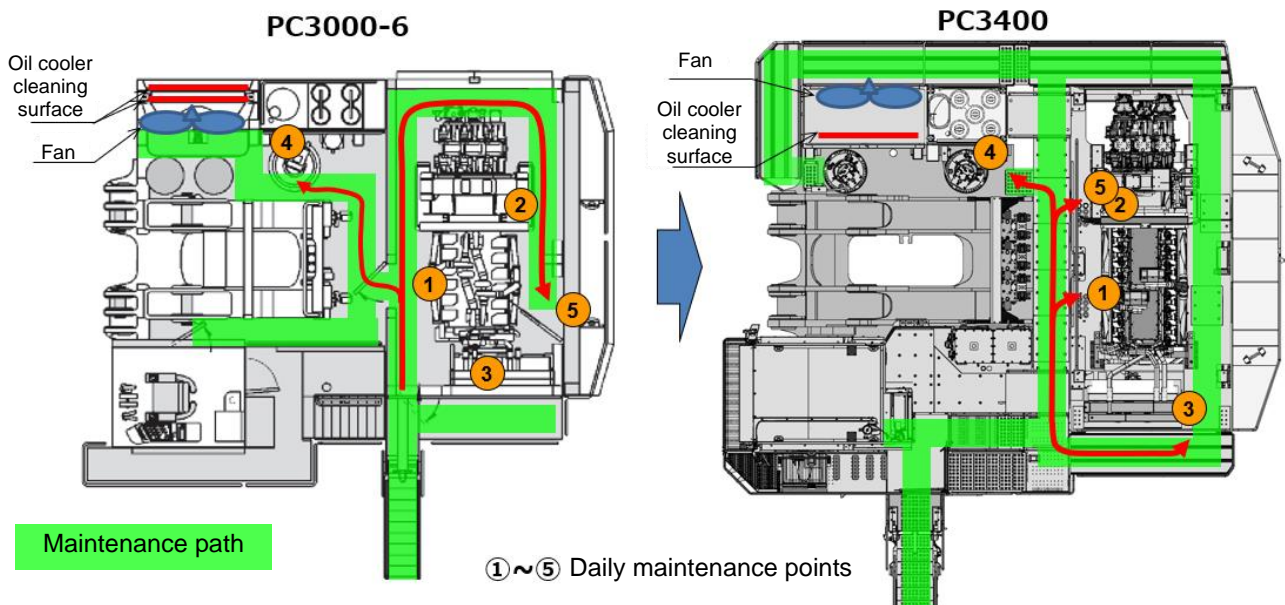


Fig. 7 Maintenance access path and oil cooler arrangement

## (2) Easier oil cooler cleaning

This machine allows the oil cooler to be easily cleaned without using an aerial work platform. This is achieved by using a single-layer core, repositioning the fan, and extending the path. (Figs. 7 and 8)



Current model

PC3400

**Fig. 8** Scene of oil cooler cleaning

### 3.4.5 Easier management of machine condition

By equipping the machine with the latest generation of KOMTRAX Plus, it is now possible to store data about the operation, such as vehicle position information, in addition to conventional KOMTRAX information about the machine condition. By being compatible with Wi-Fi, this machine allows you to acquire data without climbing the vehicle to connect the cables.

## 4. Conclusion

Although KG's current models have a reputation for long life and high reliability of main welded structures, they get many electrical and hydraulic problems; the market has been calling for improvements. We are convinced that by taking in the strengths of Komatsu, i.e. the technology for improving reliability of electrical and hydraulic components, we have developed a highly merchantable product that has the advantages of both German and Japanese designs. The first machine is currently operating in good condition at the Semirara mine in the Philippines under Komatsu group-wide support. We would like to satisfy our customers and support them to increase sales in the future.

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### [A comment from the authors]

This was Komatsu's first joint development with KG. KG, which has an over 100-year history, has independently cultivated mining excavator technology; thus, we needed to combine the technologies of both Komatsu and KG. As it is the first trial for us, we faced many difficulties and learned a lot from KG through trial and error. On the other hand, we hope that the German engineers at KG who participated in this joint development will also learn the strong points of Komatsu's development through this development and utilize it in the development of KG models. Finally, we would like to thank all of the people who helped us for this development.