

K7V-Series – Swash Plate Type Axial Piston Pump



Out of consideration for the global environment, interest in saving energy and enhancing performance is increasing in the excavator market, and that is why we developed the K7V series of next-generation pumps to meet those demands. Hydraulic systems are required to have higher total efficiency and higher operation speed. To offer products with these features, we applied the latest efficiency enhancement technology and assumed a high input torque in designing the K7V series, thereby achieving the highest level of efficiency and output density in this class as well as high reliability.

Introduction

China, India, and other countries have developed rapidly, causing the globalization of the construction machinery market to expand rapidly as well. At the same time, there is growing awareness about the global environment in the construction machinery as in other markets. Recently, efforts for energy saving are as essential in the construction machinery market as they are in the automobile market.

1 Background

Recently, the market environment and trends in the construction machinery field are changing drastically. For example, environmental regulations are becoming tighter and tighter, energy saving is becoming more and more important, and hybrid systems and electronic controls are becoming more prevalent. Construction machinery manufacturers are developing models that can respond to these changes, and hydraulic equipment such as pumps is required to have higher performance and reliability.

Over 30 years have passed since the K3V series and K5V series, which are bestselling pumps for excavators, were developed and put on the market. These series have high reliability and versatility, and have been used in various kinds of construction machinery, including excavators. In recent years, with an increasing interest in environmental preservation and energy saving, hydraulic pumps are required to have functions and performance

that match the increasingly diverse market trends and customer orientation, such as being more efficient and compact. To respond to these requests, we developed the K7V series, which replaces the K3V series and K5V series.

2 Specifications

The K7V series was developed with the goal of overwhelming the performance of the previous series and competitors' products in every way. The rotary parts, which are the core parts of pumps, were totally redesigned to achieve higher efficiency and reliability than the previous series. **Figure 1** shows a sectional view of the K7V series pump with the major rotary parts, and **Table 1** shows the lineup and specifications of the K7V series.

(1) Pressure specifications

The K7V series has the same rated pressure as the previous series at 35 MPa, which is common for excavators, and the K7V series' rotary parts were designed so that K7V pumps could be used for construction machinery other than excavators and handle future increases in pressure. The K8V series, which is a pump for closed circuits that uses the same rotary parts, has a rated pressure of 42 MPa.

(2) Displacement

As an energy saving effort for diesel engines, which are the main source of power for excavators, construction

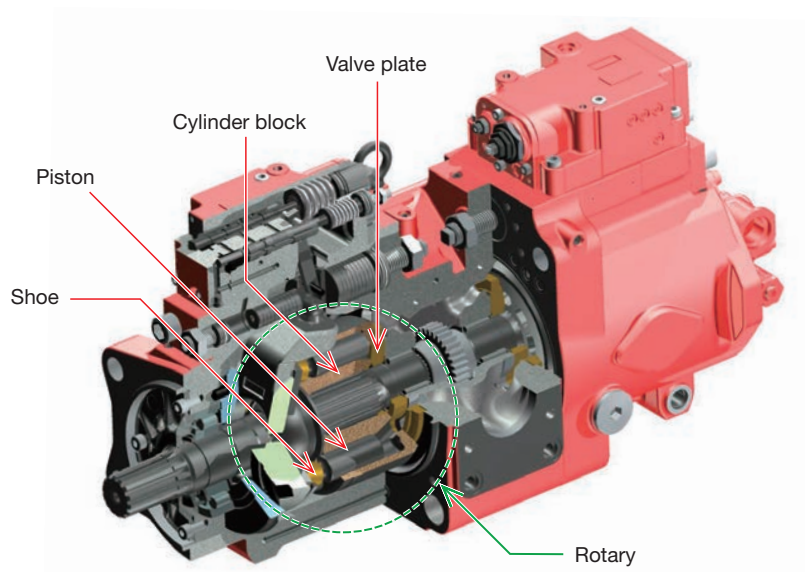


Fig. 1 Cross sectional view and major rotary parts of K7V series

Table 1 Specifications of K7V series

Size	125	140	160	180	280
Maximum displacement [cm ³]	130	140	160	180	280
Rated pressure [MPa]	35	35	35	35	37
Peak pressure [MPa]	40	40	40	40	42
Maximum self-priming speed [min ⁻¹]	2,360	2,200	2,100	2,000	1,800
Maximum speed [min ⁻¹]	2,700	2,500	2,350	2,300	2,100
Maximum input torque [N·m]	931	931	1,500	1,500	2,500

machinery manufacturers tend to decrease the engine speed. To maintain the excavator operation speed with a reduced engine speed, higher pump displacement is required. To meet the trend and needs in the market, the displacement was set so that a sufficient discharge flow rate could be achieved.

3 Features

(1) High efficiency

The fuel economy of construction machinery is directly affected by the pump efficiency, so customer requirements for pump efficiency are extremely high. The

K7V series' overall shape and major dimensions that determine the pump performance were optimized to achieve the world's highest level of efficiency. In order to optimize the major dimensions, we developed a program that enables accurate pump efficiency estimation by quantifying the loss generated in each section between rotary parts based on accurate efficiency measurement results to accurately grasp the influence of each design factor. With this program, major dimensions were determined as shown in **Fig. 2** by setting constraints such as interference and strength, and combining major dimensions so that the highest efficiency could be achieved with minimum loss under these constraints.

Figure 3 shows the efficiency measurement results of the existing K3V112 and the new K7V125. With the maximized effect of optimization, the K7V series has achieved higher efficiency than existing pumps by 3 point

percent or more in the normal operation range.

(2) High power density

To increase the pump displacement for reduced engine speeds, a higher permissible input torque than that of existing pumps was achieved by increasing the strength of internal parts.

Also, to reduce cavitation, the shapes of the flow paths in the sections with high pressure loss were optimized by visualizing the pressure loss in the paths by means of CFD analysis. As a result, the K7V series has achieved a higher maximum self-priming speed than existing pumps.

(3) High reliability

Because of the increasingly globalized market, excavators are being used in severe conditions more often, requiring pumps to have higher reliability. At the same

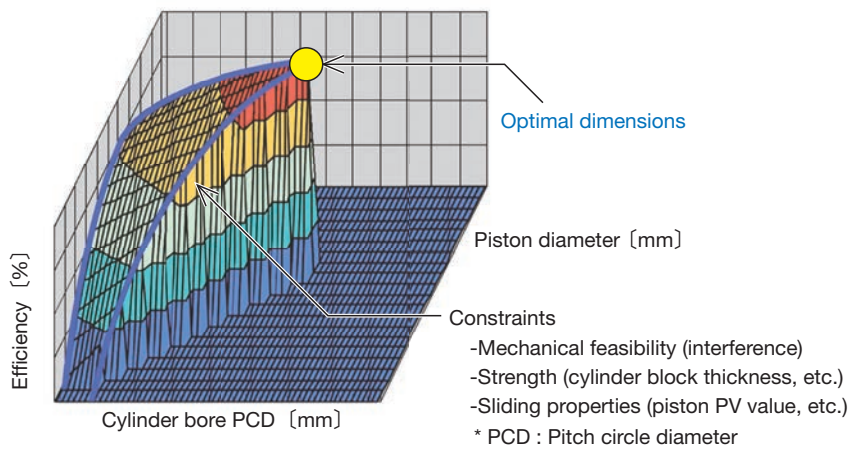


Fig. 2 Optimization of cylinder bore PCD and piston diameter

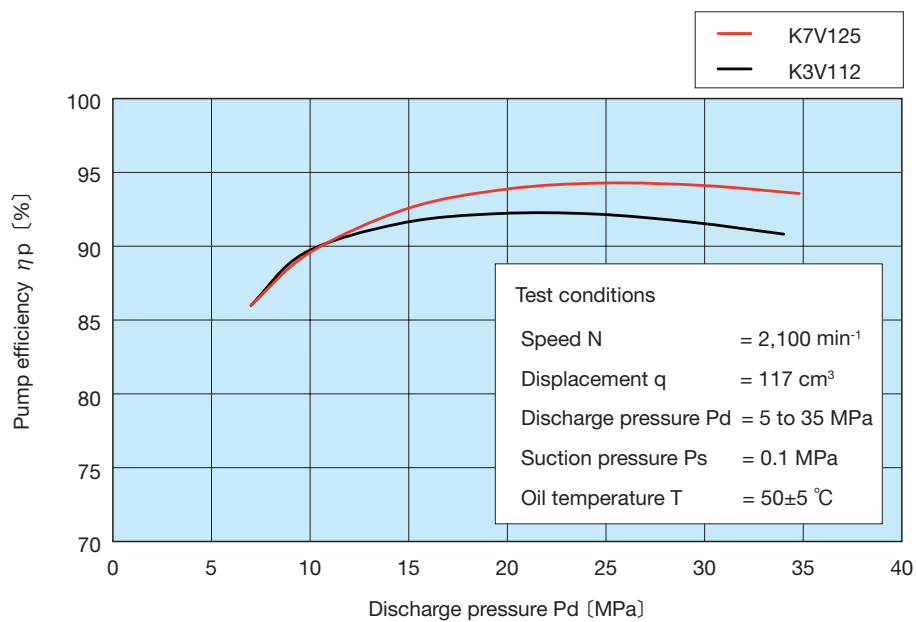


Fig. 3 Pump efficiency measurement results of K7V125 and K3V112

time, because of increased pressure and torque, the rotary parts are forced to slide under harsher conditions than before, requiring lower contact pressure on the sliding surface. For the K7V series, the local contact pressure was reduced by optimizing the shape of the sliding surface by means of elastic fluid lubrication analysis, thereby preventing seizure and enhancing reliability.

Conclusion

Currently, the K7V series comes in five sizes, every of which enjoys a good reputation from customers. We will be continuously expanding the lineup to respond to market needs.

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