

## PV Values of Vane Pumps

Refer to “Development of Vane Pump for Medium Passenger Vehicle CVT” (page 26)

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### What is the PV Value?

The PV value (or PV factor) is one of the wear factors in a sliding scene and can be calculated from the pressure (P) applied to the contact surfaces of the sliding parts and the sliding velocity (V).

The surface pressure P can be determined by dividing the pressing force N by the contact area A.

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### PV Value of Vane Pumps

#### 2.1 Operating Principle of Vane Pumps

First of all, the following describes the pumping mechanism of vane pumps to suck or discharge the hydraulic oil:

- ① The engine outputs a driving force to rotate the rotor of the pump via the shaft.
- ② As the rotor rotates, vanes inserted in the slots pop up radially with the centrifugal force and the pump’s internal pressure increase on the back of the vanes.
- ③ The pop-up vanes slide along the curved internal surface (oval shape) of the cam ring.
- ④ The pump sucks or discharges the oil as the oil chamber formed by the cam ring, rotor and vanes increases or decreases in volume.

These parts and their operation are shown in Fig. 1.

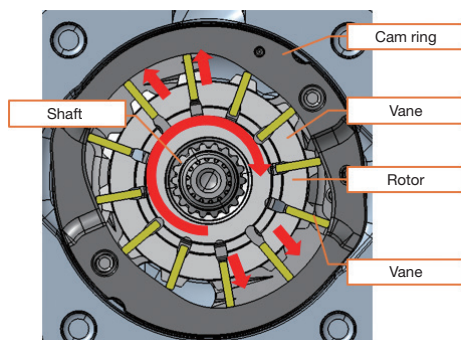


Fig. 1 Cross section of vane pump

#### 2.2 PV Value of Vane Pumps

As the rotor rotates, the pop-up vanes are pressed against the cam ring by the centrifugal force and the pump’s internal pressure increase on the back of the vanes. This applies the surface pressure P to the contact surfaces. The vanes slide along the cam ring surface at a sliding velocity V as the rotor rotates.

A lower PV value implies higher wear resistance and a higher PV value brings about lower wear resistance. The PV value at which the cam ring wears out is called the PV limit. Photo 1 shows a cam ring that was subjected to a durability test with a PV value exceeding the PV limit and eventually worn out. Photo 2 shows a cam ring that was subjected to a durability test with a PV value lower than the PV limit.

To improve the wear resistance of a vane pump, the PV value should be kept at a low level. To do so, the surface pressure P must be reduced by increasing the contact area A, decreasing the pressing force N, or lowering the sliding velocity V.

Wear resistance is affected not only by the PV value but also by material, surface roughness, and hardness of the parts coming into contact with each other, lubrication of the hydraulic oil, and other factors. It is necessary to design a vane pump with considerations given to the balance among these factors.

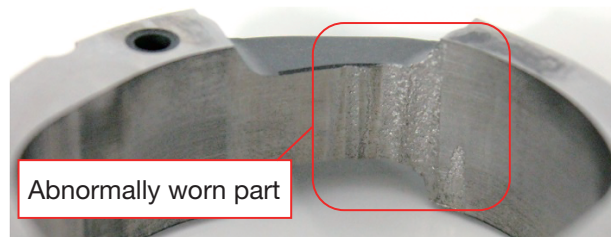


Photo 1 Abnormally worn cam ring with PV value exceeding the limit



Photo 2 Cam ring with PV value lower than the limit after durability test