

Cooling Fans that Contribute to Energy Conservation Products

Katsumichi Ishihara

1. Introduction

In recent years, protection of the global environment has become an important global issue, therefore making energy conservation in products an important component for Sanyo Denki's customers. Cooling fans, which are used in devices for various fields, are no exception. In particular, cooling fans in IT equipment or communications equipment consume considerable amounts of power as they become higher performance, and reducing power consumption for all components has been tried so hard. In this situation, reduction of power consumption becomes necessary condition for fans that are used as cooling solutions.

In order to solve these types of issues, we firstly assume operating area where many fans would actually be used, and thus we narrowed down the target for performance of the developed fan. Next, we redesigned all parts like motor with magnetic circuit and structure with electrical circuit, impeller and frame so that fan has the best performance at assumed operating area and we have proceeded development of new low power consumption fan.

This document explains the differences in the development approaches for low power consumption fans compared to conventional products and introduces the features and overview of the low power consumption fan series.

2. Approaches for Low Power Consumption

When axial fan is actually used, the operating area required for fan is often similar to the area as shown in Fig. 1. Conventionally, the approach used to satisfy the operating range involved improving the overall air flow versus static pressure characteristics through methods such as raising speed or redesigning the impeller.

Theoretically, increasing speed of the fan should increase the air flow by the same ratio, but the power consumption

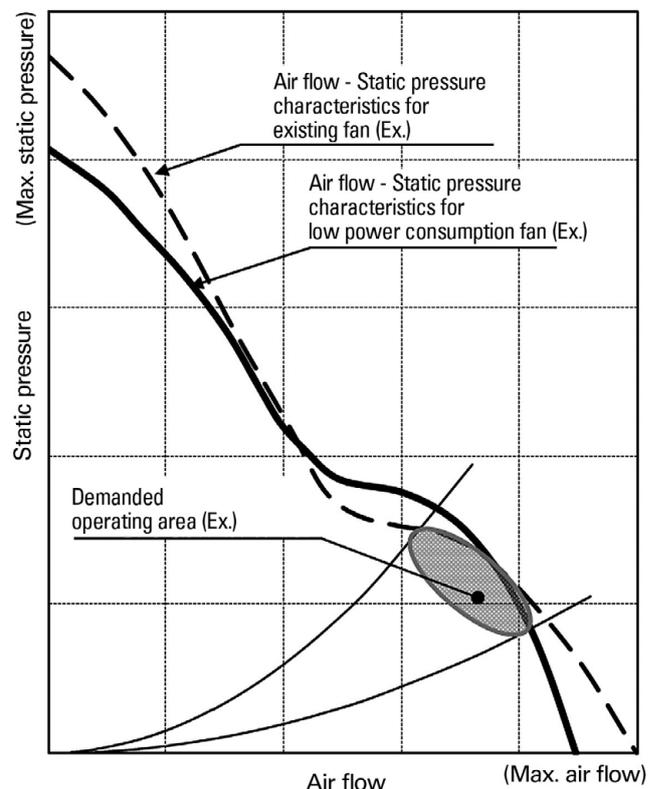


Fig. 1: Comparison of characteristics for existing and low power consumption fans

increase is proportional to the cube of speed increase. As a result, the method to increase the air flow by raising speed of the existing products could not satisfy the demanded operating area while simultaneously reducing the power consumption.

With this in mind, we used an approach with the goal of reducing power consumption while maintaining same characteristics in the operating area actually used by fans as shown in Fig. 1.

Low power consumption fans have lower maximum air flow compared to existing fans, so at a glance, we might assume that they have inferior cooling performance. The maximum air flow is the air flow of a single fan running

in no-load state. Fans are used mounted on devices, and therefore, they would never be used in the no-load state. The air flow versus static pressure characteristics for low power consumption fan are equal to one for existing fans near the demanded operating area. In other words, when the fan is mounted on the device, the low power consumption fans can generate operating air flow equal to that of existing fans, and therefore they can maintain equal cooling performance.

3. Features of Low Power Consumption Fans

As noted previously, low power consumption fans were completely redesigned about structure and drive system in order to satisfy the air flow versus static pressure characteristics in operating area required when mounted on the device and reduce power consumption. The best mounting angle and shape for the blade were discovered in order to increase static pressure efficiency reducing impeller load for the motor. Furthermore, by repeating simulations and trials, the best conditions for the motor and electrical circuits were discovered to achieve the best possible efficiency while driving the impeller. In particular, optimizing the following three issues had a large effect on reducing the power consumption.

- (1) Shape of the stator core for the motor
- (2) Magnetic attraction of the magnets
- (3) Coil winding specifications for the motor

As a result, the low power consumption fans have succeeded in dramatically reducing power consumption compared to previous Sanyo Denki models and they have achieved the lowest power consumption in the industry.



Fig. 2: Appearance of the low power consumption fan series

The lineup of low power consumption fan series currently has ten models: 40 mm sq., 20 mm thick; 40 mm sq., 28 mm thick; 52 mm sq., 15 mm thick; 60 mm sq., 15 mm thick; 60 mm sq., 20 mm thick; 60 mm sq., 38 mm thick; 80 mm sq., 32 mm thick; 80 mm sq., 38 mm thick; 92 mm sq., 25 mm thick; and 92 mm sq., 38 mm thick.

The rate of reduction in power consumption from each conventional Sanyo Denki model is summarized in the graph (Fig. 3).

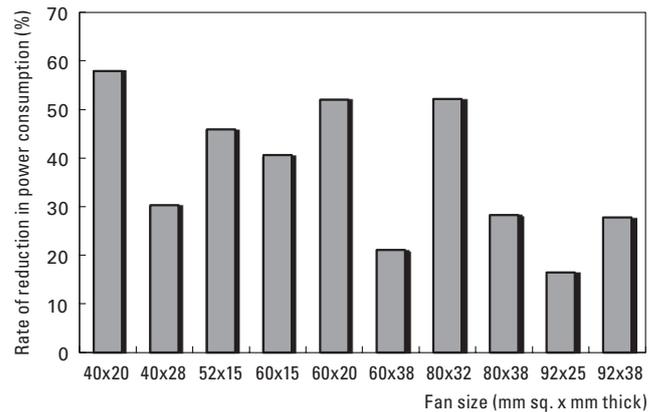


Fig. 3: Rate of reduction in power consumption from conventional models

This rate of reduction is calculated by comparing the power consumption near operating area. Compared to the conventional models, there is a maximum rate of reduction of 58%, meaning that the low power consumption model is approximately half the power as conventional models while achieving equal cooling performance.

Due to improvement of impeller and frame, the SPL (Sound Pressure Level) has also been reduced in addition to the power consumption. Fig. 4 shows the amount of reduction in SPL during equal cooling performance.

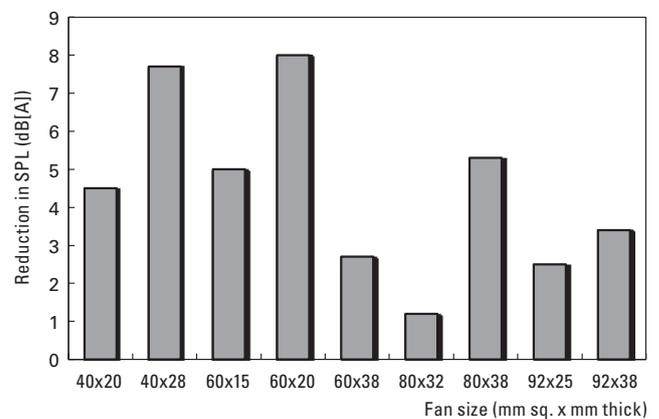


Fig. 4: Reduction in SPL from conventional models

Compared to the conventional models, there is a maximum reduction in SPL of 8 dB(A). In theory, this means that if approximately 6 fans with the same SPL were running at the same time, the SPL would be reduced to equal to the SPL of only one fan.

As other features, all of low power consumption fans have a PWM control function that can finely control speed. When the cooling target requires a high air flow, the fan is run at full speed, and when a low air flow is sufficient for the cooling target, the drive is controlled to low speed. Since speed can be finely controlled depending on the situation, the power consumption can be reduced even further.

Furthermore, the squared dimension, thickness dimension, and dimension are made compatible with conventional models, so the low power consumption models can be mounted with same mounting condition as the conventional models without any design change about customer's equipment.

4. Conclusion

This document explained customer demands and the methods used to meet those demands in the conventional models as well as the solutions used with the low power consumption fans as “Technologies that Contribute to Customer Success.” This document also introduced the current low power consumption fan series lineup. Low power consumption fans are products that were developed by concentrating first on the idea that the fans would be used for customers' equipment. These low power consumption fans can contribute to energy conservation for customers' equipment, and make a large contribution to global environmental protection.

We will continue to research and develop the best products for customers' demands. As a result, we believe that we will be able to contribute to customer success.



Katsumichi Ishihara

Joined Sanyo Denki in 2001.
Cooling Systems Division, Design Dept.
Worked on the development and design of cooling fans.