140 × 140 × 38 mm *San Ace 140* 9RA Type Low Noise Fan

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1. Introduction

Equipment such as commercial air conditioners and medical equipment used near people requires particularly quiet fans. Also, energy conservation has become an important issue in recent years due to the worldwide trend toward CO_2 emissions reduction. We have offered a 140 × 140 × 38 mm 9P type fan (hereinafter, "current product") since 1999. However, this has become obsolete and is unable to meet recent customer needs, especially in noise and power consumption performance.

To meet such market demands, we have developed and launched a low-noise *San Ace 140* 9RA type fan (hereinafter, "new product").

This article introduces the features and performance of the new product.

2. Product Features

Figure 1 shows the new product. The new product has lower noise and lower power consumption than the current product while maintaining the same size and cooling performance.

Fig. 1 Appearance of 140 × 140 × 38 mm *San Ace 140* 9RA type

3. Product Overview

3.1 Dimensions

Figure 2 shows the dimensions of the new product.

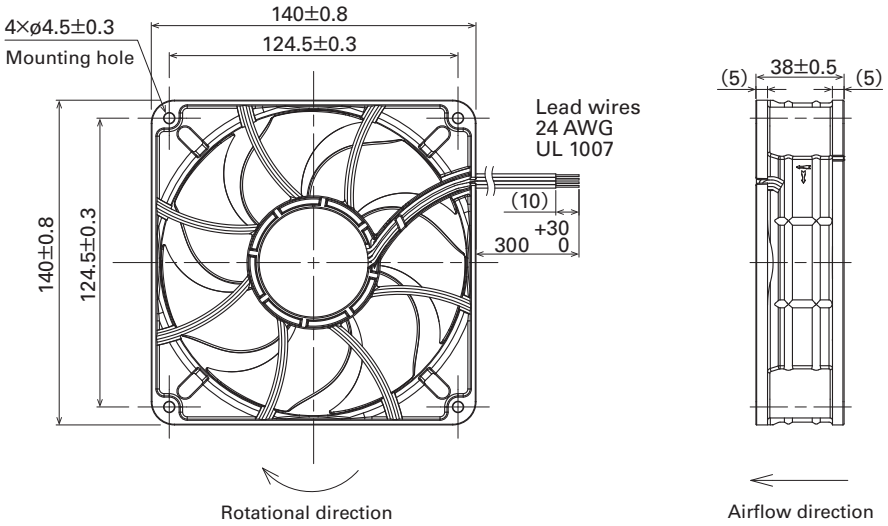

Fig. 2 Dimensions of 140 × 140 × 38 mm *San Ace 140* 9RA type (Unit: mm)

3.2 Specifications

Tables 1 and 2 show the general specifications of the new product, and Figure 3 shows the airflow vs. static pressure characteristics.

While the current product lineup offers only two different fan speeds (medium-speed and low-speed models), the new product lineup offers four fan speeds (fastest, high-speed, medium-speed, and low-speed models) for use in a wide range of markets.

Compared to the current medium-speed models, the new high-speed and fastest models have achieved an 18% and 33% increase in maximum airflow, respectively.

In addition, the fastest model comes with PWM control. The PWM control enables the external control of fan speed according to the amount of heat generated by equipment, contributing to reducing noise and power consumption of equipment.

Table 1 General specifications of 140 × 140 × 38 mm *San Ace 140* 9RA type fastest models

Model no.	Rated voltage [V]	Operating voltage range [V]	PWM duty cycle* [%]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}]	Max. airflow [m^3/min]	Max. airflow [CFM]	Max. static pressure [Pa]	Max. static pressure [inchH_2O]	Sound pressure level [dB(A)]	Operating temperature range [°C]	Expected life [h]
9RA1412P1G001	12	10.8 to 13.2	100	1.10	13.2	4250	6.0	212	160	0.64	52	-20 to +70	40000 at 60°C (70000 at 40°C)
			20	0.09	1.1	1250	1.81	64.0	16.3	0.065	19		
9RA1424P1G001	24	21.6 to 26.4	100	0.53	12.7	4250	6.0	212	160	0.64	52		
			20	0.05	1.2	1400	2.17	76.7	21.5	0.086	22		
9RA1448P1G001	48	43.2 to 52.8	100	0.28	13.4	4250	6.0	212	160	0.64	52		
			30	0.04	1.9	1600	2.32	82.0	29.5	0.118	25		

* Input PWM frequency: 25 kHz. Speed is 0 min^{-1} at 0% PWM duty cycle.

Table 2 General specifications of 140 × 140 × 38 mm *San Ace 140* 9RA type high-speed, medium-speed, and low-speed models

Model no.	Rated voltage [V]	Operating voltage range [V]	Rated current [A]	Rated input [W]	Rated speed [min^{-1}]	Max. airflow [m^3/min]	Max. airflow [CFM]	Max. static pressure [Pa]	Max. static pressure [inchH_2O]	Sound pressure level [dB(A)]	Operating temperature range [°C]	Expected life [h]
9RA1412S1001	12	7 to 13.8	0.75	9.0	3750	5.3	187	130	0.52	49	-20 to +70	40000 at 60°C (70000 at 40°C)
9RA1412H1001			0.43	5.2	3050	4.3	152	92	0.37	43		
9RA1412M1001			0.19	2.3	2250	3.2	113	54	0.22	35		
9RA1424S1001	24	14 to 27.6	0.37	8.9	3750	5.3	187	130	0.52	49		
9RA1424H1001			0.22	5.3	3050	4.3	152	92	0.37	43		
9RA1424M1001			0.10	2.4	2250	3.2	113	54	0.22	35		
9RA1448S1001	48	40.8 to 55.2	0.21	10.1	3750	5.3	187	130	0.52	49		
9RA1448H1001			0.13	6.2	3050	4.3	152	92	0.37	43		
9RA1448M1001			0.06	2.9	2250	3.2	113	54	0.22	35		

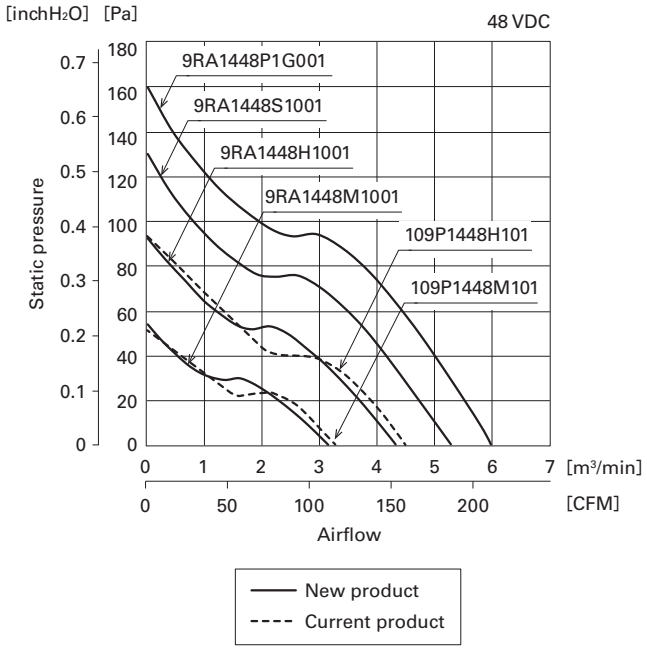

Fig. 3 Airflow vs. static pressure characteristics of 140 × 140 × 38 mm *San Ace 140* 9RA type fans

4. Key Points of Development

In order to reduce noise and power consumption, the new product has an optimally selected motor and new impeller and frame shapes designed with an innovative concept without being constrained by the current product shape.

The key points of development are described below.

4.1 Motor design

For the new product to achieve the target airflow vs. static pressure characteristics, we selected a motor with the optimal output out of the ones used in our existing fans. This enabled the downsizing of the motor, increasing the design freedom of the impeller and frame.

In contrast to the unipolar motor drive (two-phase half-wave) of the current product, the new product uses a highly efficient bipolar drive (single-phase full-wave).

4.2 Impeller and frame design

To achieve low noise and low power consumption, simulations were performed to find the optimal combination of various parameters such as impeller hub diameter, blade shape, number of blades, blade mounting angle, frame shape, and stator blade shape and number. Through evaluations on actual equipment with the selected combinations, the optimal shape was determined.

Figures 4 and 5 compare the impeller shape and frame shape, respectively, between the new and current products.

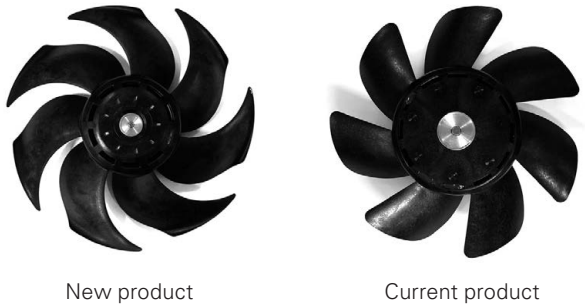

Fig. 4 Comparison of the impeller shape of the new and current products

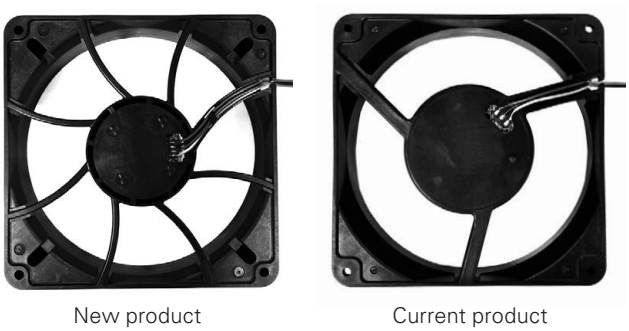

Fig. 5 Frame shape comparison of the new and current products

5. Comparison of New and Current Products

5.1 Noise level and power consumption comparison

Figure 6 compares the power consumption and noise level of the current and new products at equivalent cooling performance. At the estimated system impedance (equipment ventilation resistance) shown in the figure, the new product has 9.5 dB(A) lower noise and 24% lower power consumption compared to the current product.

5.2 Environmental impact comparison

Figure 7 compares the CO_2 emissions of the new and current products over their life cycles.

The new product produces 41% less CO_2 emissions over its product life cycle compared to the current product thanks to its greatly reduced power consumption. In addition, its motor has been downsized and its product weight has been reduced from 450 g to 360 g, contributing to waste reduction.

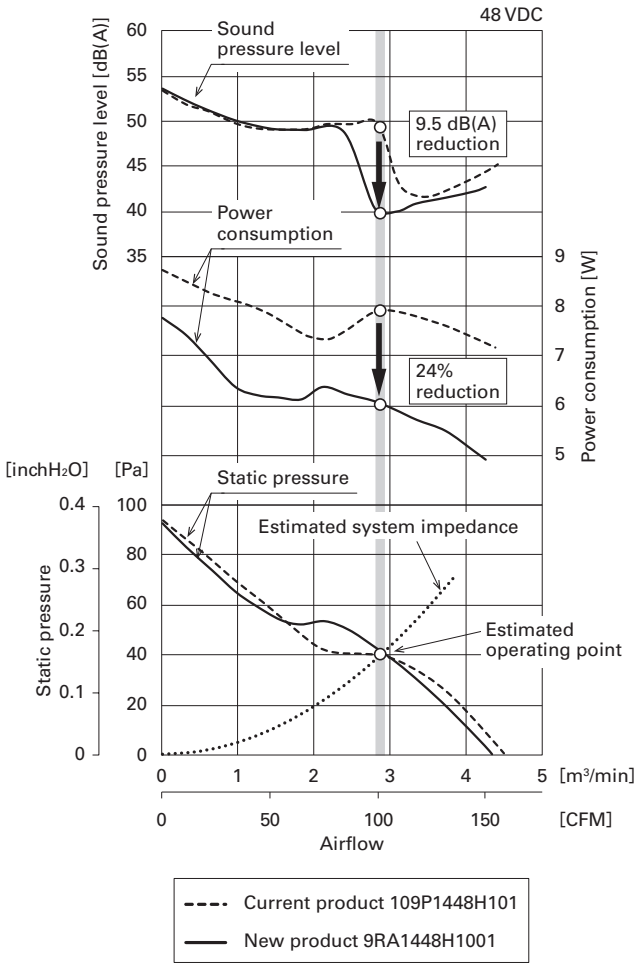

Fig. 6 Noise level and power consumption comparison

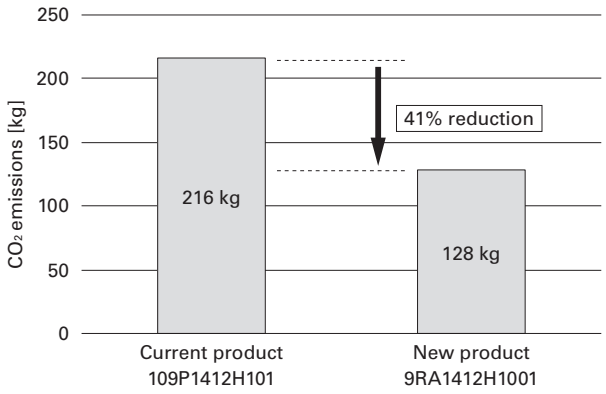

Fig. 7 CO_2 emissions comparison based on our life cycle assessment calculation software (40,000-hour continuous operation in free air)

6. Conclusion

This article introduced the features and performance of the low-noise *San Ace 140* 9RA type fan.

The new product has lower noise and lower power consumption than the current product while maintaining the same cooling performance. In addition, the lineup includes models with higher airflow and higher static pressure than the current product.

This contributes to reducing noise, saving energy, and improving the performance of equipment used near people such as commercial air conditioners and medical equipment. It also reduces total CO_2 emissions over the equipment life cycle, contributing to a reduction in environmental impact.

We will continue developing products that promptly meet market demands to contribute to creating new value for our customers.

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