Low Noise "SAN ACE 120L"

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1. Introduction

Fan motors are widely used as a cooling device in different equipment, and various fans have been developed to meet respective requirements. Sanyo Denki has long been marketing the popular "San Ace 120L" that measures 120 mm sq.×38 mm thick and lasts 200,000 hours to meet the needs of users who require long life and high reliability. However, recent trends in electrical equipment are toward higher density mounting of electrical and mechanical parts in compact packages, and higher performance. As a result, more heat is generated yet ventilation is impeded, thus worsening the operating conditions of fan motors and increasing equipment noise. Moreover, electrical equipment is being installed in systems in populated areas such as offices and towns where noise pollution is a concern, so quieter fan motors are demanded.

Sanyo Denki has developed the low noise "San Ace 120L" that offers greatly improved noise performance and yet offers the same cooling capacity and lifespan to meet users' requirements.

This report introduces the features and techniques used to reduce the noise of the fan.

2. Features of the low noise "SAN ACE 120L"

Fig. 1 shows the outside view of the low noise "SAN ACE 120L".

When developing the low noise "San Ace 120L" fan, the targets were to leave the structure unchanged but reduce the noise by developing a new blade and frame.

The main features of this product are as follows.

(1) The cooling performance, life and electric performance are the same as the conventional fan.

(2) Low noise design is considered even after installation in users' equipment.

2.1 Dimensions and Specifications

Fig. 2 shows the dimensions and specifications of the low noise "SAN ACE 120L".

2.2 General Characteristics

Table 1 shows the general characteristics of the low noise "SAN ACE 120L".

2.3 Air Flow Versus Static Pressure Characteristics

Fig. 3 shows an example of air flow versus static pressure characteristics of the low noise "SAN ACE 120L"

2.4 Operating Noise

The noise values shown in the catalogs are the no-load values measured by suspending a motor in air, and are therefore different from the actual noise generated when a motor is mounted in the user's system. Fig. 4 compares the air

flow versus static pressure and noise of the conventional "San Ace 120 L" fan and those of the new low noise "San Ace 120 L". Fig. 5 shows the method of measuring load noise.

The noise of the axial flow fan is stable and low when the load is low (A and a in Fig. 4) as shown. However, when the load exceeds a certain threshold, the noise increases drastically (B and b in Fig. 4). This drastic change is caused by separation that are created in the air flow. An effective method to reduce noise when a fan is mounted is to minimize the pressure loss and to use the fan at a low load range.

We have succeeded in reducing the noise by about 4 dB with A-weight sound pressure level during low load operation, and in widening the low noise range by reducing the noise after mounting of the fan.

3. Methods for Reducing Noise

We have used our know-how accumulated while developing various low noise fans and innovative techniques to minimize noise. The major methods are as follows.

3.1 Blade Shape

The cross-sectional shape and the projected shape of the blades are basically the same as the R-type fan that is the newest 120 mm sq.×38 mm thick model.

3.2 Outside Diameter of Blades

The frame of Long Life Fans is cast aluminum in order to prolong service life, and also the aluminum frame can be made thinner than the resin frame. Therefore, air flow was increased by making the frame thin and increasing the outside diameter of the blades.

3.3 Mounting Angle of Blades

We reduced noise by reducing the mounting angle of blades when the pivot is at the tip of the intake side blade as the air flow is increased due to the enlarged outside diameter of blades. When the mounting angle of blades is made small, air flow is decreased because the distance between the blade ends and frame spokes is greater. As a result, the interfere noise between them is decreased. Fig. 6 shows the relation between the cross-section of blade and spoke.

3.4 Frame Shape

The frame shape is based on that of the R-type, the newest model, of 120 mm sq.× 38 mm thick fan in the same way as the blade design.

3.5 Silencing Fin

The air flow that is exhausted from the back of the blades forms a swirling air flow that creates a vortex of air between the blades and surrounding structures. This vortex generates interfere noise. However, the noise can be reduced by installing the fin at the outer edges of the exhaust side of the frame.

Fig. 7 compares the air flow versus the static pressure characteristics and the air flow versus noise characteristics, with and without the fin. As Fig. 7 shows, the noise at low load is decreased by approx. 1 dB, but the air flow versus static pressure characteristic is almost unaffected.

Fig. 8 shows the noise analysis data of 1/3 octave band of the noise values shown in Fig. 7 when the static pressure is 20 Pa. When the fin is attached, the values of the 250 Hz and 315 Hz components are lower. These frequency components are the fundamental frequencies when air passes through the blades of the fan. Fig. 8 shows that the fluid noise caused by blades can be reduced by attaching the fin to the outer edges of the exhaust side of the frame.

The fundamental frequency "f" of the passing sound of blades of a fan is given by

the following equation:
f = N/60n (Hz)
N : fan rotation speed (min^{-1})
n : number of blades
In case of the 9LB1212H101, the following equation applies.
N = 2600 (min^{-1})
n = 7
f = 2600/60 * 7
= 303.3 (Hz)

4. Construction

We have briefly described the structure and performance of the low noise "SAN ACE 120L".

Electronic equipment will continue to offer higher performance and have higher packing density, resulting in higher heating density, so there will be great demand for cooling fans. The low noise "SAN ACE 120L", which is a low noise, long life and highly-reliable fan, will help improve the environment and conserve resources.

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Table 1 General characteristics of the low noise "SAN ACE 120L"

Model No.	9LB1212H101	9LB1212M101	9LB1224H101	9LB1224M101	9LB1248H101	9LB1248M101
Rated voltage (V)	12	12	24	24	48	48
Operating voltage range (V)	10.2 to 13.8	10.2 to 13.8	20.4 to 27.6	20.4 to 27.6	40.8 to 55.2	40.8 to 55.2
Rated current (A)	0.39	0.22	0.19	0.11	0.11	0.06
Rated rotating speed (min^{-1})	2600	2000	2600	2000	2600	2000
Air flow (m^3/min)	2.9	2.2	2.9	2.2	2.9	2.2
Static pressure (Pa) (mmH_2O)	67.62 6.9	42.14 4.3	67.62 6.9	42.14 4.3	67.62 6.9	42.14 4.3
Noise (dB[A])*1	39	32	39	32	39	32

*1 At 1 m from the intake surface of the fan

Fig. 1 Outside view of the low noise "SAN ACE 120L"

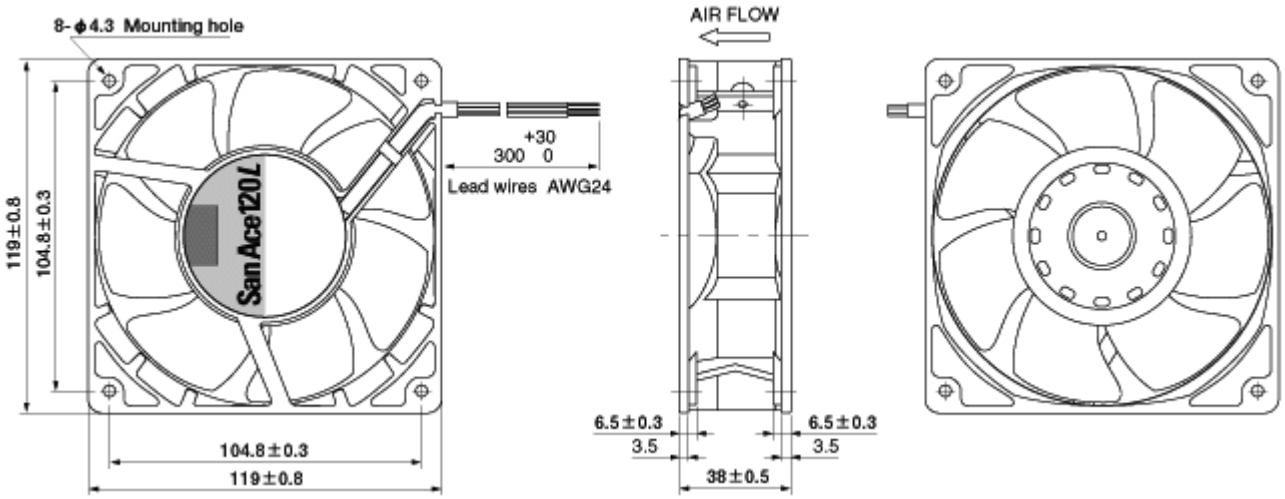

Fig. 2 Dimensions and specifications of the low noise "SAN ACE 120L"

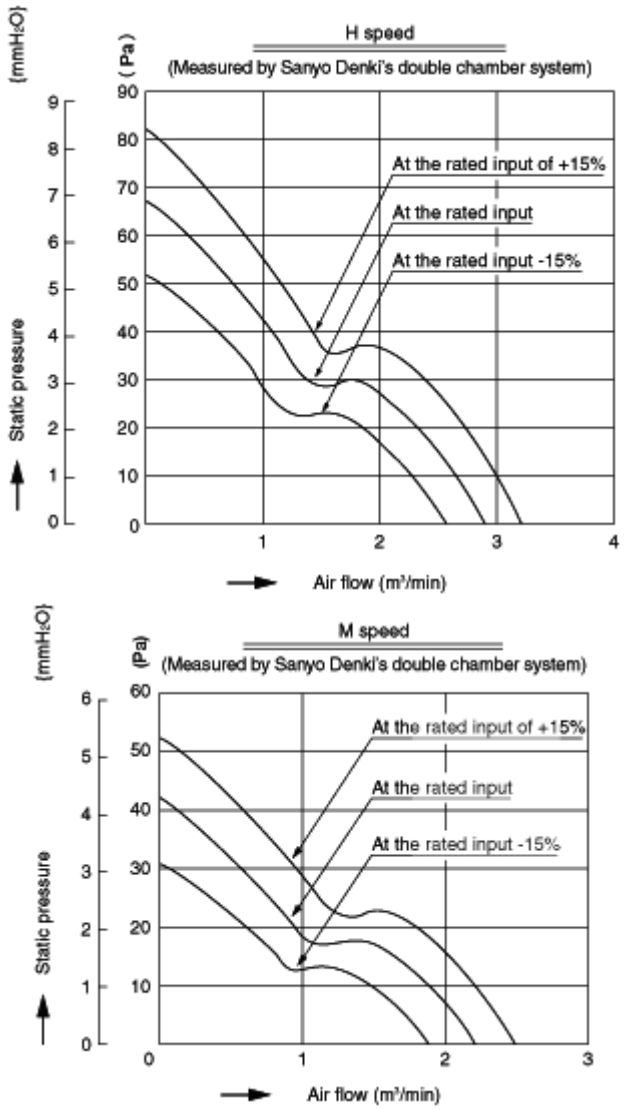

Fig. 3 Example of air flow versus static pressure characteristics of the low noise "SAN ACE 120L"

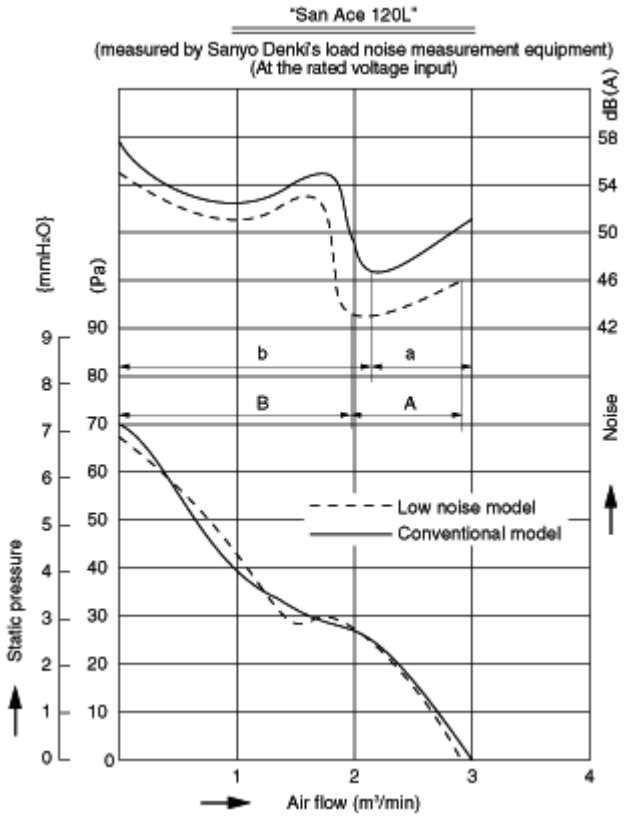

Fig. 4 Example of air flow versus static pressure and noise characteristics

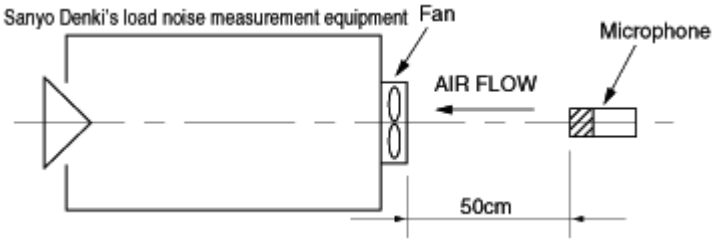

Fig. 5 Method of load noise measurement

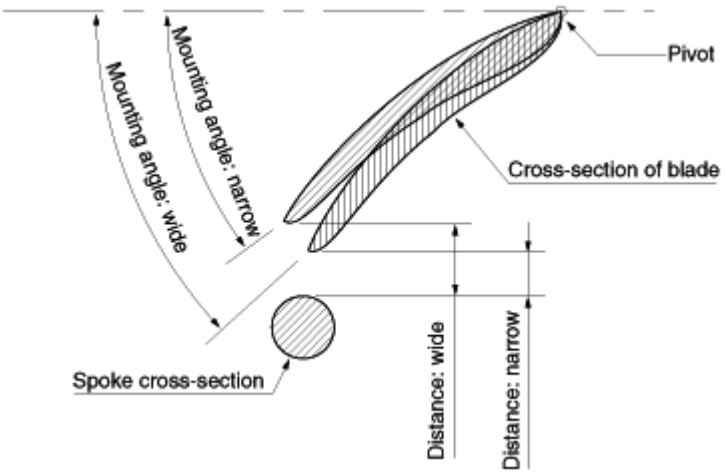

Fig. 6 Positional relation between cross-section of blade and spoke

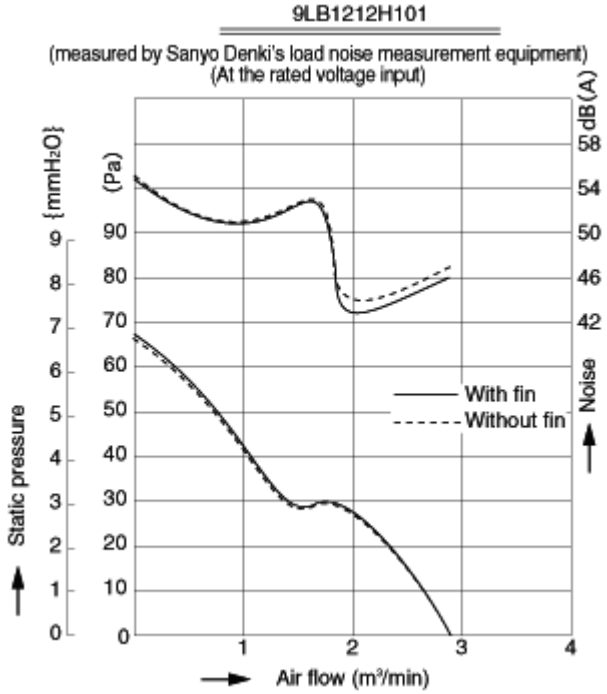

Fig. 7 Air flow versus static pressure and noise characteristics

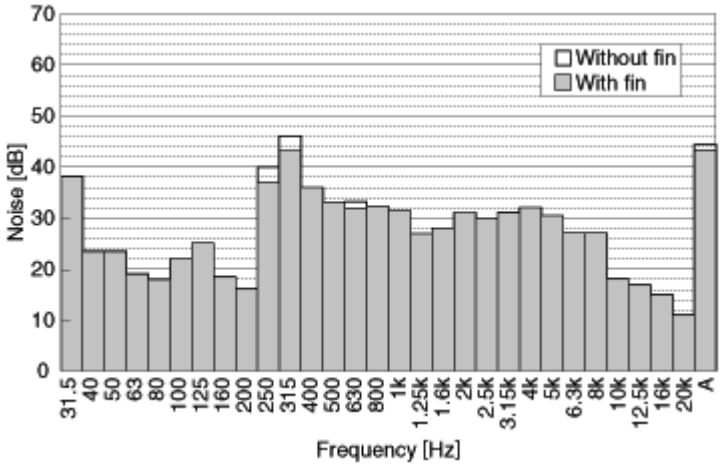

Fig. 8 Noise analysis data of 1/3 octave band
Static pressure = 20 (Pa)