

Development of Filter kits and Resin Finger guards

Hiromitsu Kuribayashi

Tomoaki Ikeda

Yoshikazu Ooya

1. Introduction

With the rising performance and increasingly small sizes of telecommunications and other equipment these days, advances are being made at an eye-catching rate in the high-density mounting of equipment. On the other hand, reports have been submitted to indicate that dust floating in a room accumulates on components of a device over many hours or foreign matter enters accidentally into a device through its opening or other access route, resulting in a failure in the device itself. The openings of cabinets and fans are therefore provided with a filter or other device to shut off the ingress of dust or other foreign matter, thus keeping the inside of the equipment clean. To meet these requirements, Sanyo Denki has developed filter kits for fans 119, 92, 80 and 60mm sq. which are easily to install and maintain.

UL and other safety standards stipulate that all fans must be equipped with a finger guard (protective net) to prevent a human finger from easily contacting a movable part of the fan (such as the impeller) and to prevent foreign matter from entering the equipment. Main finger guards now on the market are those made of steel wire and those made of resin. However, many resin finger guards entail a rise in pressure loss and noise when mounted on a fan, thus deteriorating the performance of the fan. Sanyo Denki has therefore developed resin finger guards for fans 119, 92, 80, and 60mm sq. that achieve low pressure losses and low noise and make the most of fan performance.

This paper presents an overview and features of the filter kits and finger guards. [Fig. 1](#) shows a group of Sanyo Denki's accessory products including the products that we have just developed.

2. Filter kits

2.1 Features

[Fig. 2](#) is an external view of a typical filter kit. We provided four kinds of filters made of polyester-based urethane foam is sandwiched between a resin guard and a cover and having different mesh sizes 13PPI, 20PPI, 30PPI, and 40PPI. (PPI stands for Particle Per Inch and represents the number of orifices per inch.) We developed these kits while paying special attention to the ease of installation on a cabinet.

As shown in [Fig. 3](#), commercially available products take a lot of time for assembly, because the fan and guard must first be screwed on the cabinet and then the filter and cover must be installed separately. On the other hand, the products that we have just developed are shipped with their guard, filter, and cover assembled. Screws can be put through the openings (at four positions) in the cover surface as shown in [Fig. 4](#), so that the fan and filter kit can be installed on the cabinet at the same time. When cleaning or replacing the filter, the user does not have to remove the fan from the cabinet. He or she has only to detach the cover.

2.2 Dimensional Specifications

[Fig. 5](#) shows the outer dimensions of filter kits of different dimensions. The dimensions are matched to those of the standard fan, so that the products fit most fans, including Sanyo Denki's fans. Table 1 indicates the model numbers of the filter

kits of different dimensions.

Table 1 Model numbers of Filter kits

119mm sq.		80mm sq.	
109-1000F13	Filter kit 119mm sq., 13PPI	109-1002F13	Filter kit 80mm sq., 13PPI
109-1000F20	Filter kit 119mm sq., 20PPI	109-1002F20	Filter kit 80mm sq., 20PPI
109-1000F30	Filter kit 119mm sq., 30PPI	109-1002F30	Filter kit 80mm sq., 30PPI
109-1000F40	Filter kit 119mm sq., 40PPI	109-1002F40	Filter kit 80mm sq., 40PPI
92mm sq.		60mm sq.	
109-1001F13	Filter kit 92mm sq., 13PPI	109-1003F13	Filter kit 60mm sq., 13PPI
109-1001F20	Filter kit 92mm sq., 20PPI	109-1003F20	Filter kit 60mm sq., 20PPI
109-1001F30	Filter kit 92mm sq., 30PPI	109-1003F30	Filter kit 60mm sq., 30PPI
109-1001F40	Filter kit 92mm sq., 40PPI	109-1003F40	Filter kit 60mm sq., 40PPI

2.3 General Characteristics

2.3.1 Typical Air Volume Versus Static Pressure Characteristics

When equipping a device with a fan and a filter kit, one must give sufficient consideration to the pressure loss and sound pressure level of the entire device, including its filter kit, and determine a fan and a filter kit having the performance level that meets the device requirements.

As an example, [Fig. 6](#) shows the typical air volume versus static pressure characteristics of a filter kit as mounted on the suction side of a fan 119mm sq. When the maximum air volume and maximum static pressure of the fan as handled singly are set to 100%, the maximum air volume is 76% and the maximum static pressure is 84% when equipped with a filter kit (20PPI). The sound pressure level is 4dB higher than when the fan is handled singly. Table 2 shows the performance of the fans when equipped with filter kits (20PPI) 119, 92, 80, and 60mm sq.

Table 2 Typical air volume versus static pressure characteristics of fans as equipped with a Filter kit (voltage applied 12V DC)

Dimensions	Article (model number)	Maximum air volume		Maximum static pressure		Sound pressure level	
		(m ³ /min)	Note 1	(Pa)	Note 2	(dB[A])	Increase (dB), note 3
119mm sq.	Fan only (109R1212H102)	2.90	-	64.7	-	39	-
	As equipped with a filter kit (109-1000F20)	2.20	76%	54.1	84%	43	4
92mm sq.	Fan only (109P0912H402)	1.45	-	45.1	-	33	-
	As equipped with a filter kit (109-1001F20)	1.13	78%	37.0	82%	42	9
80mm sq.	Fan only (109R0812H402)	1.03	-	35.3	-	27	-
	As equipped with a filter kit (109-1002F20)	0.79	77%	31.2	88%	37	10
60mm sq.	Fan only (109R0612H402)	0.53	-	40.2	-	28	-
	As equipped with a filter kit (109-1003F20)	0.41	77%	34.6	86%	36	8

Note 1) The percentage (%) of the maximum air volume as equipped with a filter kit on the basis that the maximum air volume of the fan when handled singly is the standard (100%).

Note 2) The percentage (%) of the maximum static pressure as equipped with a filter kit on the basis that the maximum static pressure of the fan when handled singly is the standard (100%).

Note 3) The increase (dB) in the sound pressure level as equipped with a filter kit on the basis that the sound pressure level of the fan when handled singly is the standard.

Note 4) Measured in a Sanyo Denki double chamber system with a 20PPI filter kit mounted on the fan suction side.

Note 5) The sound pressure level must be measured at a distance of 1m from the unit surface.

3. Resin Finger guards

3.1 Features

[Fig. 7](#) is an external view of typical resin finger guards (hereinafter referred to as "resin guards"). They are resin molds. We have just developed four models: those for fans 119, 92, 80, and 60mm sq. Here is a list of the features of these models:

- (1) High performance (low pressure loss and low noise)
- (2) High chemical resistance (to acids, alkalis, oils, alcohol, and other substances)
- (3) Lightweight.

3.1.1 Performance

In designing the resin guards, we paid attention to the need to minimize pressure losses and abate noises. As one measure to reduce pressure changes in the air flowing into the fan and to minimize turbulence, we installed a notch near the middle of each side of each resin guard as shown in [Fig. 8](#). When the resin guard is mounted on a cabinet, there occurs an opening B between the resin guard and the fan frame, resulting in air flowing in through the sides of the resin guard as well. This led to noise abating (for models 92, 80 and 60mm sq.). Other passages of air were also redesigned, which led to remarkable improvements. If, as shown in Table 3, a resin guard already on the market ([Fig. 9](#)) is mounted on the fan suction side in the case of a resin guard 92mm sq., there occurs a 10dB rise from the sound pressure level of the fan only. And the new product undergoes a rise by only 5dB.

Table 3 Comparison of the characteristics of the Finger guards (voltage applied: 12V DC)

Dimensions	Article (model number)	Maximum air volume		Maximum static pressure		Sound pressure level	
		(m ³ /min)	Note 1	(Pa)	Note 2	(dB[A])	Increase (dB), note 3
119mm sq.	Fan only (109R1212H102)	2.90	-	64.7	-	39	-
	As equipped with a resin finger guard (109-1000G)	2.74	94%	60.9	94%	44	5
	As equipped with a resin finger guard (already available on the market)	2.64	91%	60.6	94%	47	8
	As equipped with a steel wire finger guard (109-019E)	2.80	96%	64.2	99%	43	4
92mm sq.	Fan only (109P0912H402)	1.45	-	45.1	-	33	-
	As equipped with a resin finger guard (109-1001G)	1.39	96%	41.8	93%	38	5
	As equipped with a resin finger guard (already available on the market)	1.27	88%	39.2	87%	43	10
	As equipped with a steel wire finger guard (109-099E)	1.40	97%	43.5	96%	38	5
80mm sq.	Fan only (109R0812H402)	1.03	-	35.3	-	29	-
	As equipped with a resin finger guard (109-1002G)	1.00	97%	32.2	91%	35	6
	As equipped with a resin finger guard (already available on the market)	0.89	86%	30.8	87%	40	11
	As equipped with a steel wire finger guard (109-049E)	1.01	98%	35.3	100%	35	6
60mm sq.	Fan only (109R0612H402)	0.53	-	40.2	-	28	-
	As equipped with a resin finger guard (109-1003G)	0.50	94%	40.2	100%	35	7
	As equipped with a resin finger guard (already available on the market)	0.49	93%	38.5	96%	36	8
	As equipped with a steel wire finger guard (109-139E)	0.51	96%	40.2	100%	29	1

Note 1) The percentage (%) of the maximum air volume as equipped with a finger guard on the basis that the maximum air volume of the fan when handled singly is the standard (100%).

Note 2) The percentage (%) of the maximum static pressure as equipped with a finger guard on the basis that the maximum static pressure of the fan when handled singly is the standard (100%).

Note 3) The increase (dB) in the sound pressure level as equipped with a finger guard on the basis that the sound pressure level of the fan when handled singly is the standard.

Note 4) Measured with Sanyo Denki's double chamber system with a finger guard mounted on the fan suction side.

Note 5) The sound pressure level was measured at a distance of 1m from the unit surface.

Furthermore, on the basis that the maximum air volume and the maximum static pressure of the fan when handled singly are 100%, a typical resin guard (92mm sq.) already on the market has a maximum air volume of 88% and a maximum static pressure of 87%, thus showing a remarkable decline in air volume. On the other hand, when equipped with the new product, the fan achieved great improvements, with a maximum air volume of 96% and a maximum static pressure of 93%. When the new product is compared with a steel wire finger guard as shown in Table 3, it achieved a maximum air volume and a sound pressure level comparable to those of steel wire models except for those 60mm sq. subject to severe dimensional constraints.

[Fig. 10](#) compares the air volume versus static pressure characteristics of the new product with those of a typical resin guard (119mm sq.) already on the market.

3.2 Dimensional Specifications

[Fig. 11](#) shows the outside dimensions of resin guards of different dimensions. The dimensions are matched to those of the standard fans, so that the guards can be mounted on most fans, including Sanyo Denki's fans, just like filter kits. Table 4 shows the model numbers of the resin guards.

Table 4 Model numbers of resin Finger guards

109-1000G	Finger guard 119mm sq.
109-1001G	Finger guard 92mm sq.
109-1002G	Finger guard 80mm sq.
109-1003G	Finger guard 60mm sq.

4. Conclusion

We have so far described the structures and part of the performance of the newly developed filter kits and finger guards.

In the advanced information society represented by the Internet, the reliability of electronics is becoming increasingly important. In addition to the importance of the reliability of different components, circuits, software and other parts mounted in equipment, it is becoming increasingly important to prevent the ingress of dust and foreign matter from outside the equipment in an attempt to increase the overall reliability of the equipment. The filter kits just developed will hopefully meet various needs as products that are easy to install and are maintainable.

The finger guards just developed far outperform traditional resin finger guards, and achieve performance close to that of steel wire finger guards. They are also price-competitive and are expected to find a wide variety of applications.

Last but not least, we would like to express our hearty thanks to the people who gave us instructions and help in our present project of development and commercialization.

References

Edited by Oshima et al.: " Handbook of Thermal Designers, " Asakura Shoten Co., Ltd., pp.215-222

* Patents for the filter kits and finger guards have been applied for.

Hiromitsu Kuribayashi

Joined company in 1996

Cooling Systems Division, Design Dept.

Worked on development and design of fan motors

Tomoaki Ikeda

Joined company in 1990

Cooling Systems Division, Design Dept.

Worked on development and design of fan motors

Yoshikazu Ooya

Joined company in 1995

Cooling Systems Division, Design Dept.

Worked on development and design of fan motors

■ Accessories

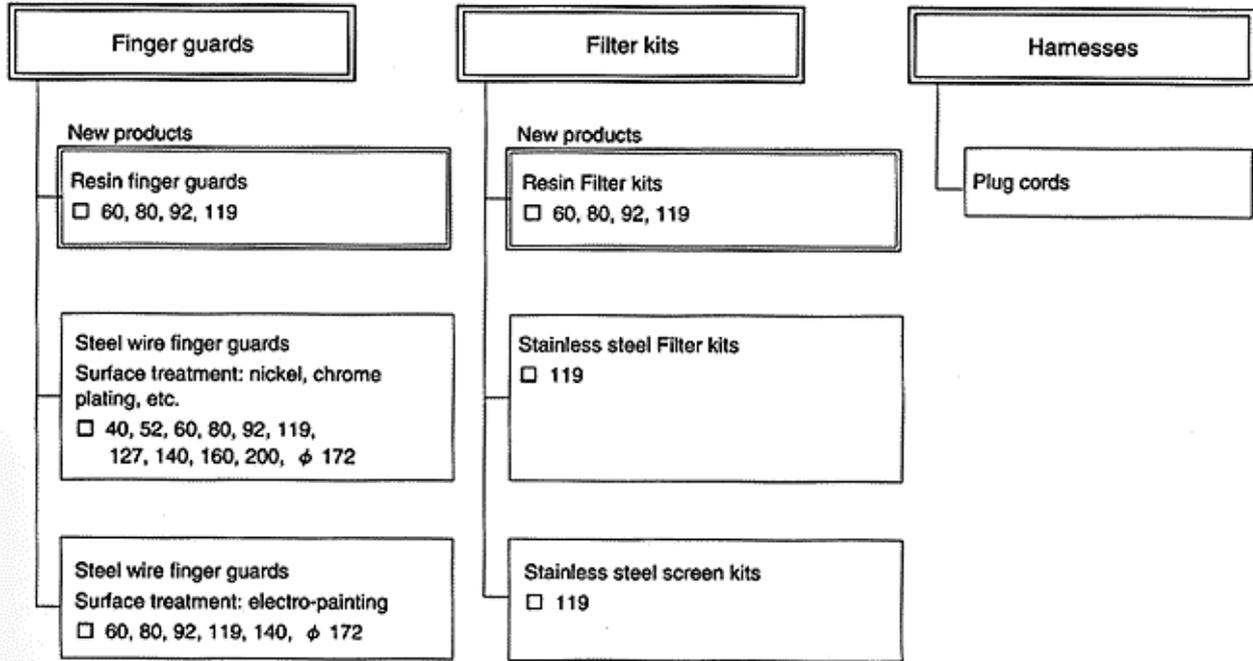


fig. 1 Group of accessory products

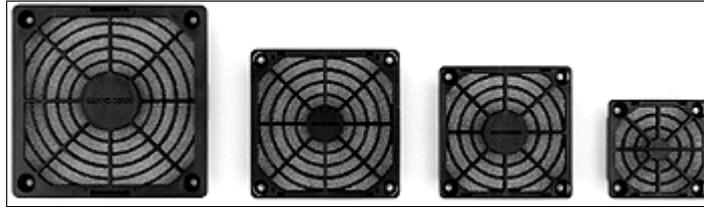


fig. 2 External view of Filter kits

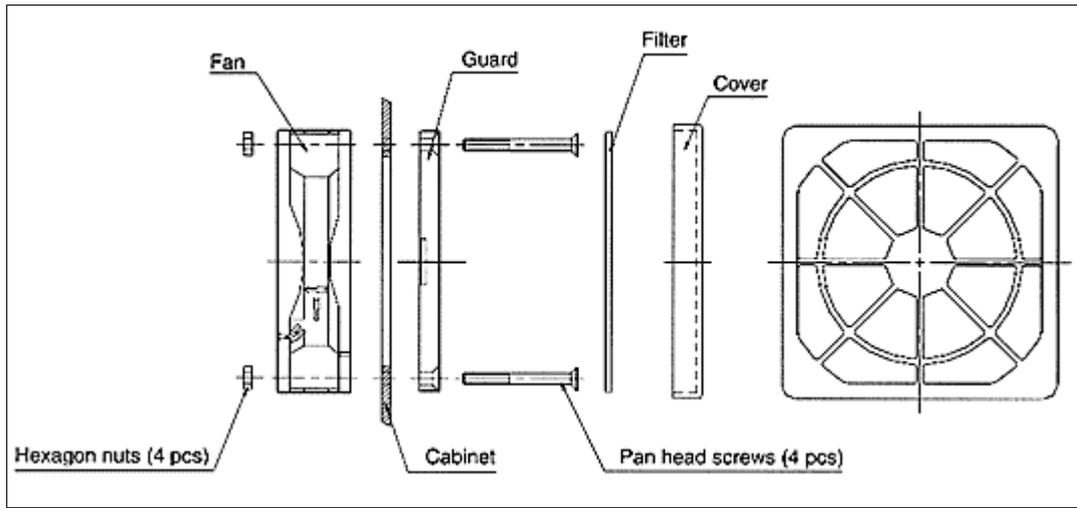


fig. 3 How to install traditional models

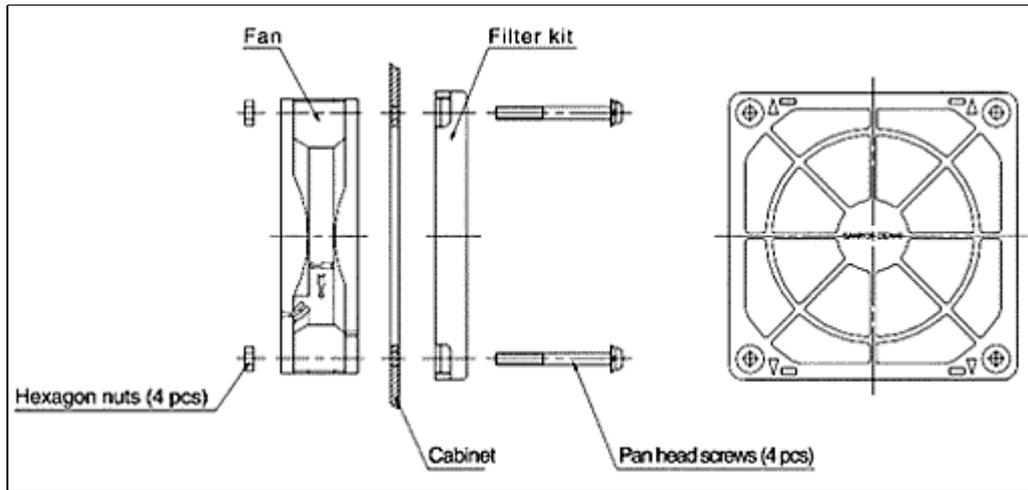


fig. 4 How to install the new product

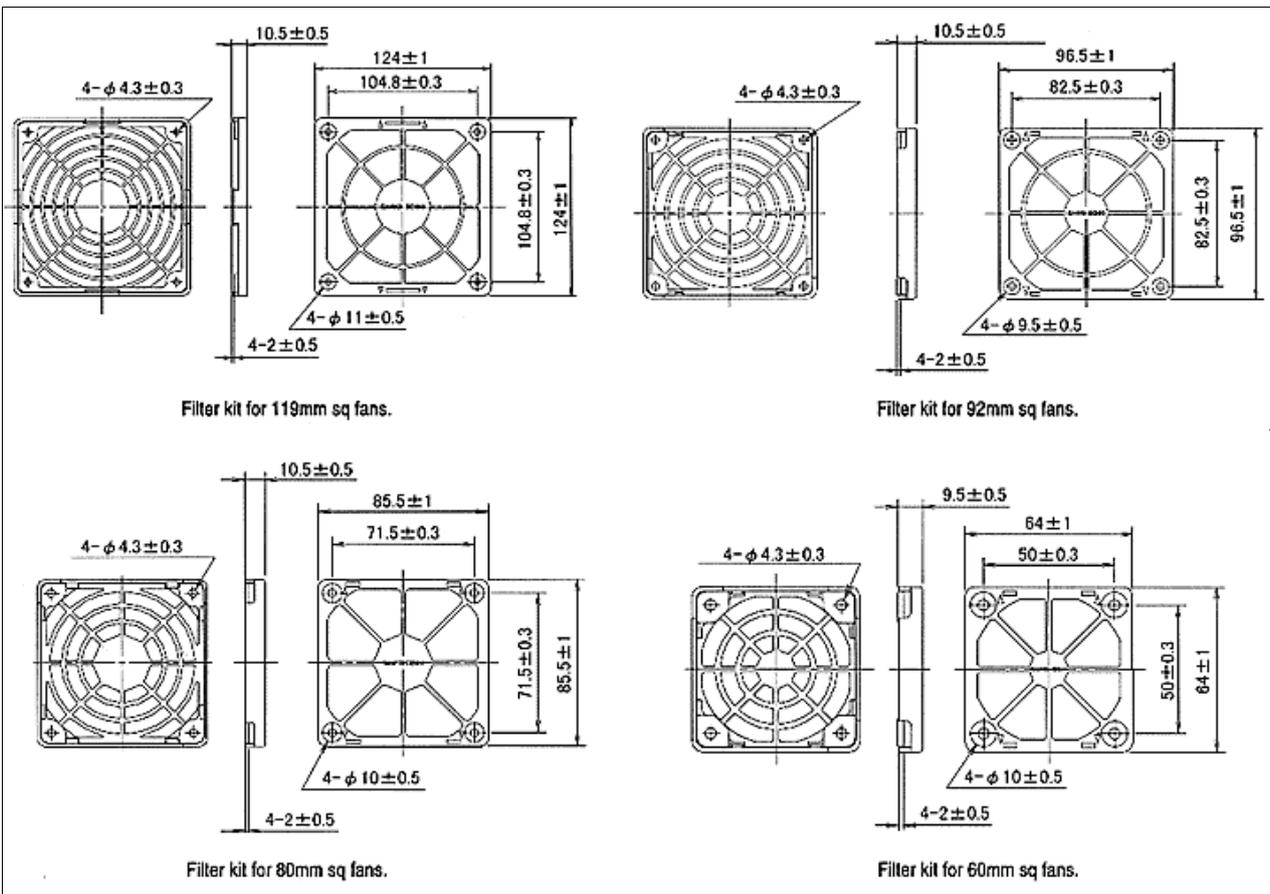


fig. 5 Outside dimensions of Filter kits

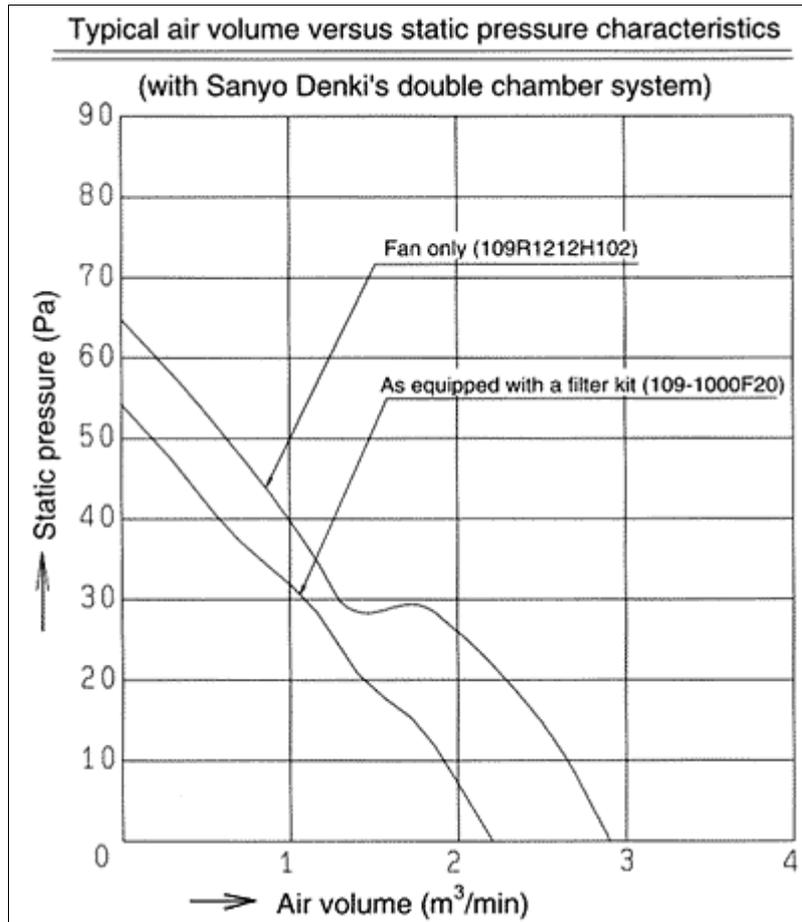


fig. 6 Typical air volume versus static pressure characteristics as equipped with a Filter kit (119mm sq.)

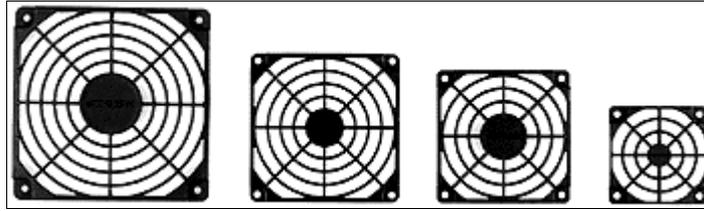


fig. 7 External view of typical Finger guards

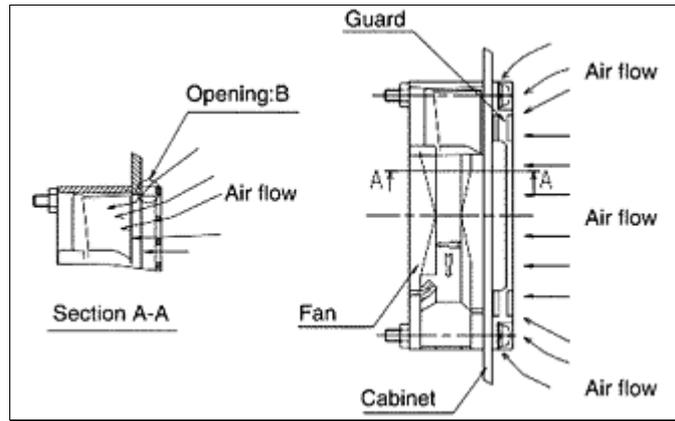


fig. 8 Air flow in the new product as equipped with a resin Finger guard

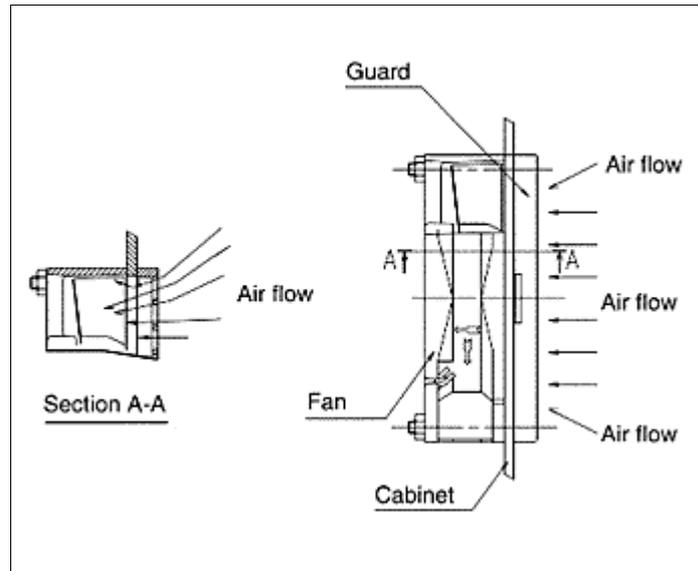


fig. 9 Air Flow in a traditional product on the market, as equipped with a resin Finger guard

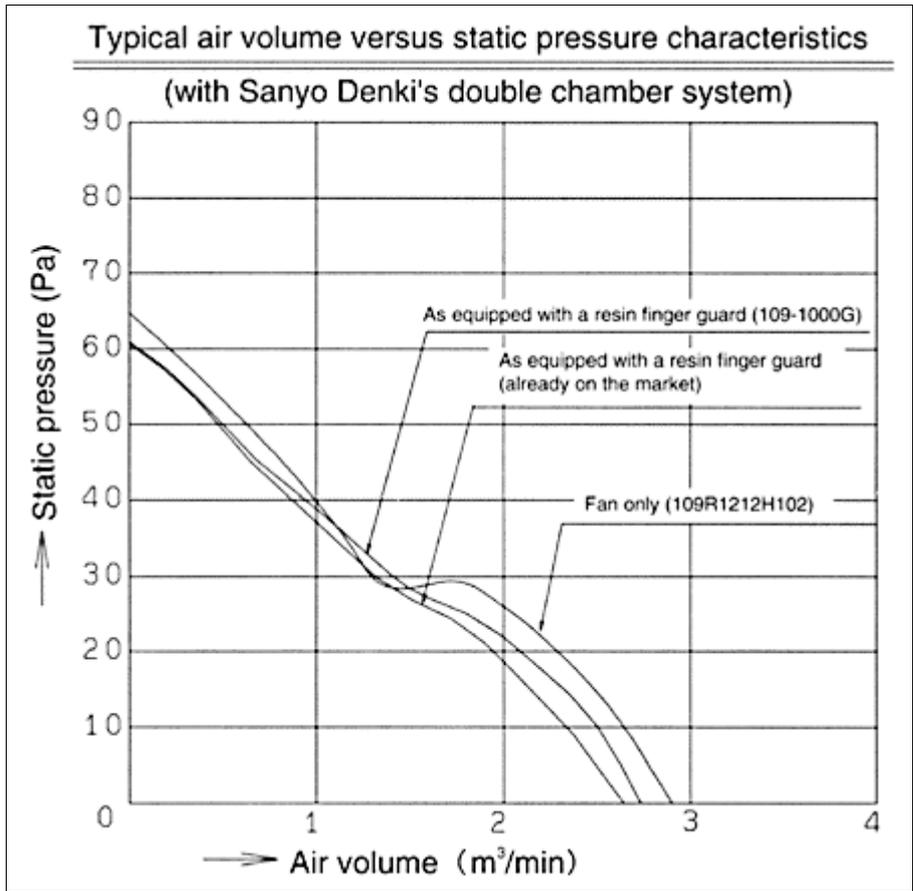


fig. 10 Air volume versus static pressure characteristics as equipped with a resin Finger guard (119mm sq.) as compared to one already on the market

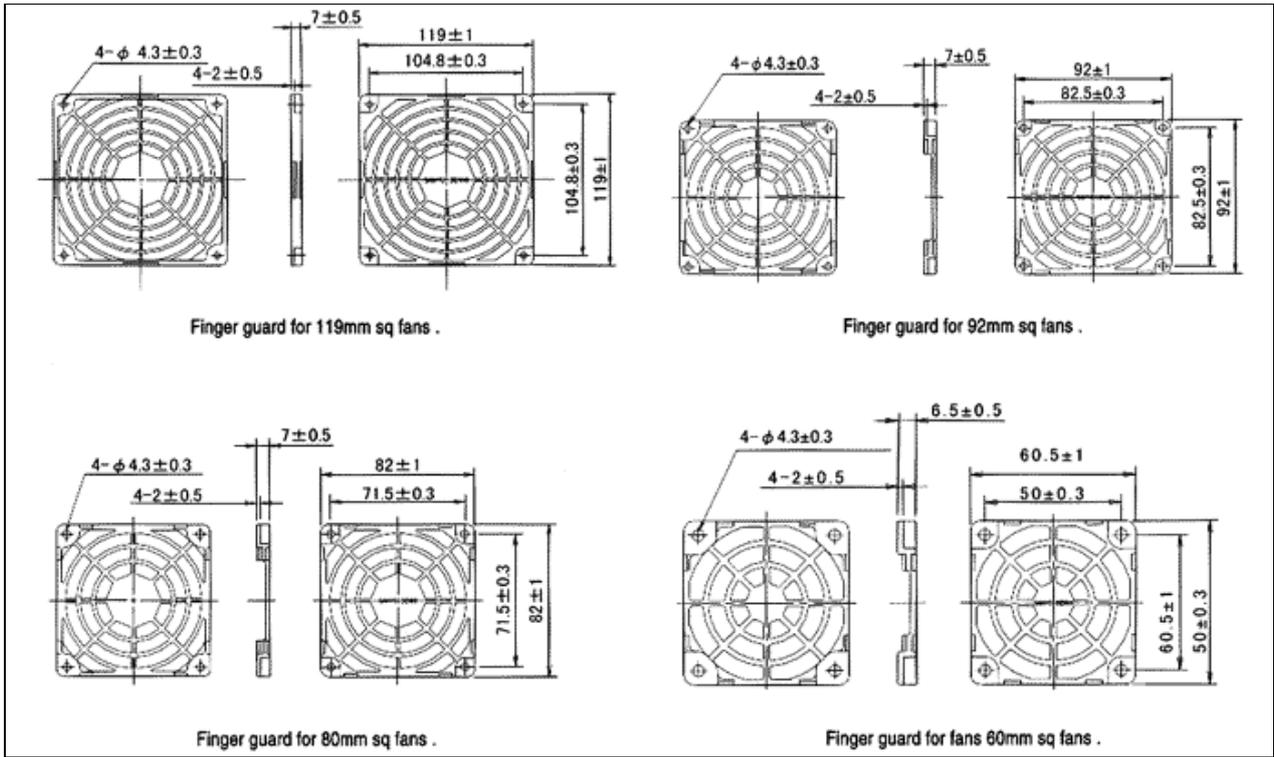


fig. 11 Outside dimensions of resin Finger guards