

Technologies Creating Change

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1. Introduction

SANYO DENKI's product lineup is extremely diverse, ranging from AC fans to DC fans, the Long Life Fan, Splash Proof Fan, Counter Rotating Fan, Oil Proof Fan, Wide Temperature Range Fan, Centrifugal Fan, PWM Controller and more. Initially after development, these products were adopted to meet certain requirements in the market. However, each product has defining features, and in some cases, this leads to the product being adopted in new markets. For example, when our Long Life Fan was initially developed, it was primarily used to cool telephone switchboards. In recent years, the reliability of the product has received much attention, and this product is now used in high-reliability servers where constant availability is essential. In this way, products with defining features are creating changes in demand.

Focusing on fans with features that create change, this article will use the environmentally durable Endurance Fans series—namely the Long Life Fan, Splash Proof Fan, Oil Proof Fan, Wide Temperature Range Fan, and G Proof Fan—as examples to introduce both the circumstances that created market changes as well as the technologies found in our products.

2. Background to the Development of Endurance Fans and Market Changes

2.1 Long Life Fan

As the very first of the Endurance Fans series, the Long Life Fan was launched in 1991. Currently, this product is available in 12 sizes, ranging from 40 × 40 × 28 mm to ø172 × 51 mm, and features improved cooling performance.

When this fan was first developed, it had a shorter service life than the ICT equipment it was used in (e.g. telephone switchboards) and had to undergo maintenance every three to five years. High costs of maintenance lead to strong

demand from customers to extend the service life of this fan, thus achieving a maintenance-free device. In response to this need, SANYO DENKI developed the Long Life Fan.

As a result of the Long Life Fan offering longer service life and maintenance-free features, the demand for it grew among customers wanting to improve the reliability of their products. For example, the product came to be adopted in high-reliability servers, public transportation facilities, data processing equipment for financial institutions, emergency UPS, PV and wind power generators, industrial inverters, medical equipment, and many more devices of new markets that did not exist when the fan was first developed.

2.2 Splash Proof Fan

The Splash Proof Fan was launched in 1996. Currently, this product is available in 12 sizes, from 40 × 40 × 28 mm to ø172 × 51 mm, and also features improved cooling performance.

At the beginning of this fan's development, base stations were increasing with the spread of mobile phones. Initially, fans were mounted within waterproof enclosures and circulated air to naturally cool large heat exchangers. However, as more devices became increasingly sophisticated and compact, forced air cooling became necessary. A demand emerged for a waterproof fan that could supply and discharge outside air, thus leading to SANYO DENKI's development of the Splash Proof Fan.

With its water-resistant features, the Splash Proof Fan harbors the potential to create a demand for use in all outdoor devices. Specifically, this fan is used in various new outdoor products including large LED displays, digital signage, EV quick charging station, and LED lighting. The Splash Proof Fan is also increasingly found in indoor devices that operate near water or moisture like food processing machines, plant factories, and dishwashers.

2.3 Oil Proof Fan

The Oil Proof Fan was launched in 2004 and is available in 9 sizes ranging from 40 × 40 × 15 mm to 120 × 120 × 38 mm.

When this fan was first developed, the cooling fans used in control amplifiers of FA machine tools and industrial robots would frequently lock up and fail due to built up dust and cutting oil from operating in oil mist. Such fan failures meant that maintenance was unavoidable. The Oil Proof Fan was adopted to meet the need to minimize breakdown frequency.

Thanks to its oil-proof performance, the Oil Proof Fan is used in industrial inverters and other factory equipment. In addition to factory equipment, this fan is also becoming increasingly popular for adoption in environments using cooking oil, such as food processing machines.

2.4 Wide Temperature Range Fan

The Wide Temperature Range Fan was launched in 2014, and is available in 6 sizes, ranging from 40 × 40 × 28 mm to 120 × 120 × 38 mm.

When this fan was first developed, photovoltaic and wind power generation had just begun growing in popularity. The fan was developed to meet the demand to withstand operating temperatures as low as -40°C and as high as 85°C, as it was assumed that such would be required in natural environments with harsh operating conditions.

The Wide Temperature Range Fan can operate in a wide

range of operating temperatures, therefore it is used in LED displays, LED lighting, and other devices used outdoors that are exposed to severe temperature changes. In addition to catering to natural environments, this fan also has the potential for adoption in temperature-controlled devices such as freezers or high-temperature testing equipment.

2.5 G Proof Fan

The G Proof Fan was launched in 2017, and is available in 2 sizes: 120 × 120 × 38 mm and ø172 × 51 mm.

This fan was initially developed as a cooling fan able to withstand the large G-forces created by the gantry of medical CT scanners which rotates at high speeds.

Because the G Proof Fan features G-force tolerance, it can be adopted in devices with high-speed movement. For example, it could be used in amusement park rides allowing thrill-seekers to experience rapid acceleration, or used to cool elevator equipment.

Table 1 shows the initial and expanded target applications for each product series. Moreover, by developing and launching products with unique features, we anticipate that even more demand will be created.

Table 1 Initial target applications and expanded target applications

Series name	Initial targets	Expanded targets
Long Life Fan	ICT equipment	Public service devices Network communication systems Industrial printers Industrial power supplies UPS High-reliability servers PV / wind power generators Industrial inverters Base stations Medical devices
Splash Proof Fan	Base stations	Quick charging station Industrial inverters Displays Digital signage Food processing machines Dishwashers Plant factories LED lighting
Oil Proof Fan	Servo amplifiers	Industrial inverters Motor cooling Food processing machines
Wide Temperature Range Fan	PV / wind power generators	Quick charging station Displays Freezer/refrigerator related Plant factories LED lighting
G Proof Fan	Medical CT scanners	Amusement devices Elevators

3. Features and Technologies of Endurance Fans

This section introduces the features and technologies of the Endurance Fans that created changes in demands.

3.1 Features and Technologies of the Long Life Fan

[Feature] Maintenance-free

In order to minimize the maintenance work required for fans, the Long Life Fan has an expected life of over 2.5 times that of SANYO DENKI's standard fan (100,000 hours, L10, 60°C, rated voltage, in free air).

[Technologies]

To achieve long service life, we used material with improved durability for our magnets and other components, and selected parts and materials that do not change over time. Moreover, as bearing life is most affected by grease degradation in line with temperature increase, we adopted a frame with excellent thermal conductivity (aluminum die-cast) and improved motor efficiency, thus suppressing temperature increase. We also reduced bearing load and revised the grease type. These efforts improved bearing life. We reduced the usage ratio of the motor drive circuit and increased reliability.

Figure 1 shows the expected life of the standard fan and the Long Life Fan.

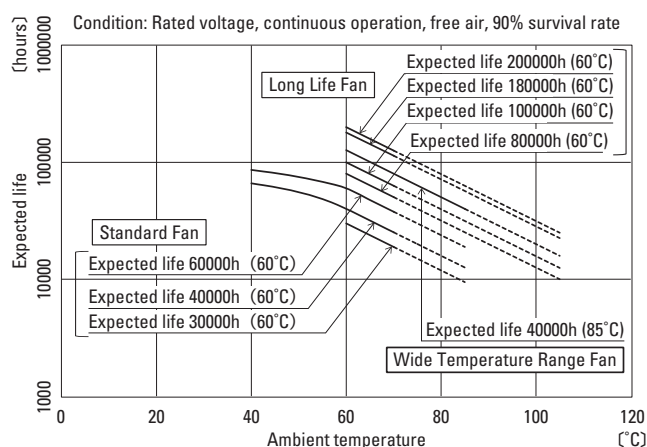


Fig. 1 Expected life of DC fans

3.2 Features and Technologies of the Splash Proof Fan

[Feature] Waterproof performance

Protection code: Waterproof and dustproof performance of IP68 and IP55* have been achieved.

[Technologies]

To ensure waterproof performance, we completely

covered the coil and live parts with waterproof material and utilized highly water resistant material for the magnet and other parts exposed to air. We applied further waterproofing treatment to the frame and other components exposed to the air to improve rust resistance.

Figure 2 shows how the live parts of the Splash Proof Fan and the Oil Proof Fan are protected.



Fig. 2 Protection of live parts

3.3 Features and Technologies of the Oil Proof Fan

[Feature] Oil-proof performance

This fan was designed to prevent failures caused by dust and oil build-up making it ideal for environments exposed to cutting oil mist.

[Technologies]

To ensure oil-proof performance, we completely covered the coil and live parts with oil-proof material, and utilized highly oil resistant material on the frame, impeller, magnet, and other parts exposed to air. By increasing the clearance between the tip of the impeller blades and inner surface of the frame, we reduced the possibility of the impeller locking up even if there was oil or dust build-up.

3.4 Features and Technologies of the Wide Temperature Range Fan

[Feature] Wide operating temperature range: -40 to +85°C

[Technologies]

We verified the thermal characteristics and durability of materials used for components and selected parts and materials which could withstand the target operating temperature range. We selected electronic components with a wide operating temperature range and designed the fan paying close attention to thermal characteristics. We adopted a circuit configuration after sufficiently verifying

its operating temperature range. All of this lead to the successful development of a fan capable of performing in a wide operating temperature range.

3.5 Features and Technologies of the G Proof Fan

[Feature] Ability to withstand G-forces: 75 G (at normal temperature, normal humidity, continuous operation)

[Technologies]

In order to create rotating parts able to withstand a G-force of 75 G, we adopted a structure that integrated the

impeller and rotor cover. Additionally, an aluminum die-cast frame was adopted to achieve high rigidity. Through simulation analysis, we revised the structural design, including part joints, increased strength and, ultimately, achieved a G-force tolerance of 75 G.

Above we have introduced the technologies adopted in each fan series in order to realize their unique features. By adopting the appropriate new technology for each individual feature, we have successfully developed products with new defining features. Table 2 shows the features and technologies of each series.

Table 2 Features and technologies

Series name	Features	Technologies
Long Life Fan	Maintenance-free	<ul style="list-style-type: none"> • Uses parts and materials that change minimally over time • Improved bearing life • Improved reliability of the motor drive circuit
Splash Proof Fan	Splash Proof	<ul style="list-style-type: none"> • Protects live parts using highly waterproof material • Uses materials with excellent water-resistance • Rustproofing on necessary areas
Oil Proof Fan	Oil-proof	<ul style="list-style-type: none"> • Protects live parts using highly oil-proof material • Uses materials with excellent oil-resistance for the frame, impeller, and magnet • Secures sufficient clearance between the blade tips and inner surface of the frame
Wide Temperature Range Fan	Wide operating temperature range	<ul style="list-style-type: none"> • Uses parts and materials able to withstand high/low temperatures • Adopts a circuit configuration enabling trouble-free operation in both high and low temperatures
G Proof Fan	Ability to withstand G-forces	<ul style="list-style-type: none"> • The structure of the G Force Fan features an integrated impeller and rotor cover. • Adopts high-rigidity material for the frame • Adopts a structure of improved rigidity

4. Conclusion

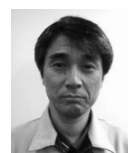
This article introduced the Endurance Fans series as fans that have defining features and have been adopted in devices of new markets differing from the initial target market to show how these fans have created changes in demands.

SANYO DENKI will continue assessing market needs at an early stage and, through existing and new technologies, develop products with features that satisfy such needs and, ultimately, create new demands.

*Shows the protection rating for the *San Ace W* series. The protection rating (IP code), is defined by IEC (International Electrotechnical Commission) 60529 "DEGREES OF PROTECTION PROVIDED BY ENCLOSURES (IP Code)." (IEC60529:2001)
 IP68: Completely protected against dust. Protection against submersion in water.
 IP55: Protection against a level of dust that could hinder operation or impair safety. Devices operate stably even when directly exposed to water from any direction.

Reference

- (1) Kesatsugu Watanabe and 6 others: Development of Long Life Fans
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- (3) Hidetoshi Kato and 3 others: Oil Proof Fans *San Ace 40WF*, *San Ace 60WF*, and *San Ace 120WF*
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- (4) Osamu Nishikawa and 3 others: Wide Temperature Range Fan *San Ace T* Series 9GT Type
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