

San Ace Company — Technology and Strengths

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1. Introduction

The San Ace Company has developed and released various cooling fans and related products over the years. As technology and customer needs have evolved, market demand has expanded from simple cooling applications to include suction, ventilation, and air circulation. Through these changes, we have developed a deep understanding of the challenges our customers face and the performance they require, enabling us to create products that deliver high performance, quality, and reliability.

In addition to new product development, we also excel at customizing products already in the market. By working closely with customers, we have continuously created added value and helped resolve technical issues in their manufacturing processes.

Our expertise in design, production, and quality control enables us to deliver products with advanced performance, assured quality, and high reliability.

In this issue, we will introduce technologies and strengths of each department.

2. Design Department — Technologies and Strengths

Our Design Department focuses on developing cooling fans that feature high airflow, high static pressure, low noise, low power consumption, and high reliability.

This section introduces the technologies that support the development of cooling fans and related products, the proprietary in-house equipment we have developed, and the added value we offer to customers.

2.1 Technologies and strengths in cooling fan development

2.1.1 Cooling fan design

We have built an automatic design system that combines fluid and motor simulations with optimization software,

enabling quick and efficient development of advanced performance and highly reliable cooling fans.

This system can rapidly optimize various design parameters, helping shorten development lead times.

The impeller and frame shapes obtained through simulations are prototyped using the 3D printer in the Design Department. Their actual performance is measured and fed back into the simulation process, enabling continuous improvement in accuracy. Figure 1 shows a simulation of a cooling fan.

By leveraging optimized impeller and frame designs produced through this process—along with the expertise, accumulated know-how, and ideas of our designers—we continue to pursue higher cooling fan performance.

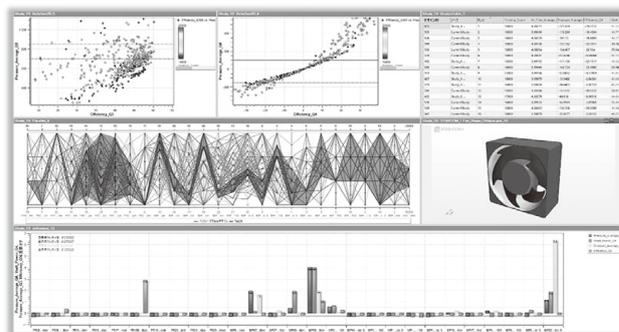


Fig. 1 Cooling fan simulation example

2.1.2 Cooling fan measurement equipment

We have built an environment that enables rapid inspection of many samples, from 3D-printed prototypes based on simulation results to molded components.

Our facilities include multiple double-chamber measuring devices for airflow vs. static pressure characteristics—fundamental indicators of cooling fan performance—as well as anechoic chambers for noise measurement. The data obtained from this equipment is used not only in product development but also to meet various customer requirements.

Figure 2 and 3 show a double chamber system and an anechoic chamber, respectively.

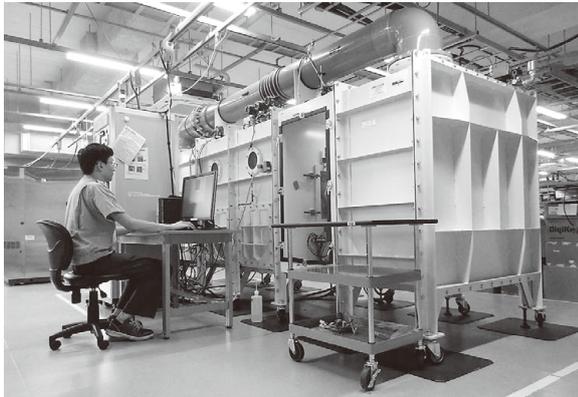


Fig. 2 Double chamber system for airflow vs static pressure characteristics



Fig. 3 Anechoic chamber

Air velocity distribution and noise under load are also important factors in evaluating cooling fans.

Our airflow velocity distribution system automatically measures airflow around the fan and visualizes the distribution.

The load noise measurement system captures noise levels automatically across nearly the entire airflow vs. static pressure operating range. Both systems were developed in-house, allowing us to support customer products with detailed evaluations conducted using our own equipment.

Figures 4 and 5 show the airflow velocity distribution system and the load noise measurement system.

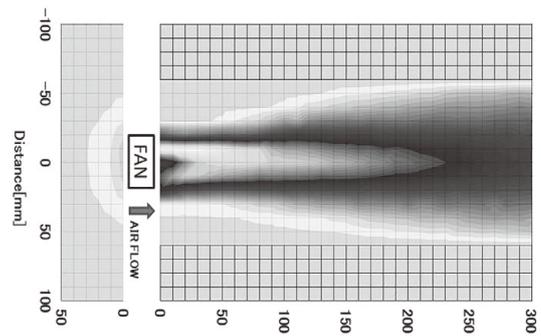
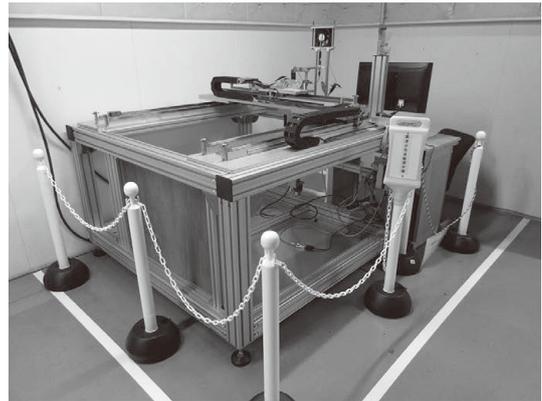


Fig. 4 Air velocity distribution system with its distribution chart

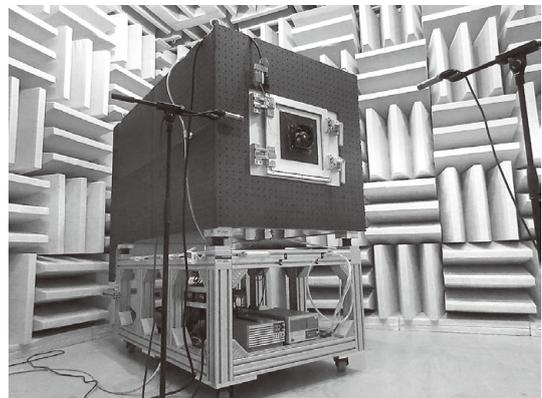


Fig. 5 Load noise measuring system

2.1.3 Impeller strength evaluation

As our customer products become more compact and advanced, demand for cooling fans capable of higher airflow or higher speed continues to rise. Ensuring impeller strength therefore remains essential to maintaining reliability. Because rotating impellers are difficult to observe directly, strength verification has traditionally relied on simulations.

To further improve impeller verification accuracy, we have introduced our proprietary impeller strength test system that evaluates impeller strength at various speeds and ambient temperatures. This increases the reliability of strength verifications and enables the development of

cooling fans with even higher airflow performance.

Figure 6 shows the impeller strength test system.

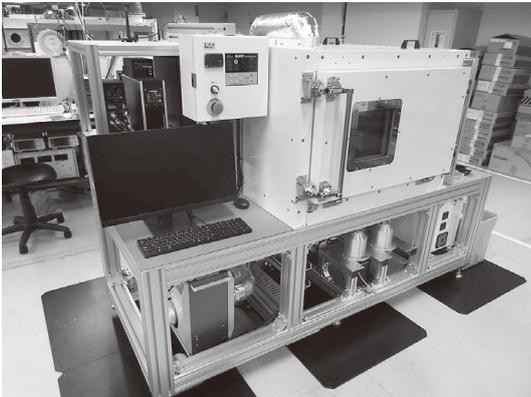


Fig. 6 Impeller strength test system

2.2 Development of fan-related products

We also actively develop fan-related products by leveraging the technologies and knowledge we have cultivated to date.

Examples include:

- a *PWM Controller* for easy fan-speed control,
- a portable *Airflow Tester* for airflow vs. static pressure measurements,
- the *San Ace Controller* for remote fan-speed control and cloud-based data storage, and
- the *San Ace Clean Air*, an air purifier for offices and other large spaces.

These products offer added value by allowing customers to use our fans more effectively and conveniently.

Figure 7 shows the cooling fan-related products.

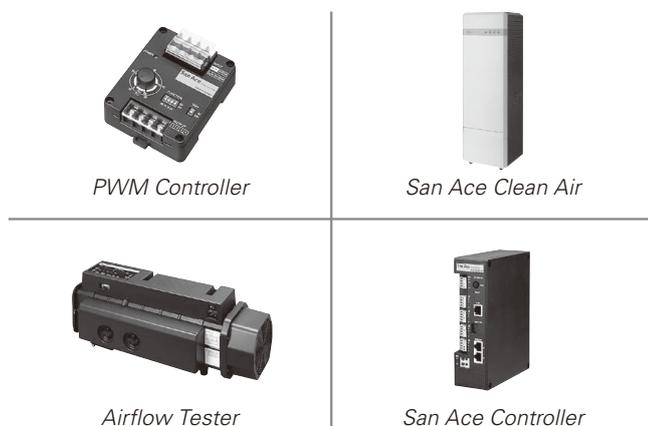


Fig. 7 Fan-related products

2.3 Cooling fan customization

We have a system that enables rapid, flexible response to a wide range of customization requests for cooling fans after their release to the market.

One example is a proprietary tool we developed to shorten lead times for additional wiring harnesses, which represent more than 80% of customization requests. This tool allows harness specifications to be finalized during sales meetings, significantly reducing the time needed for the Design Department to prepare drawings.

We have also released many fan units that integrate our cooling fans in response to customer requests both in Japan and overseas.

Figure 8 shows some examples of fan units.



Fig. 8 Example of fan units

2.4 Technical support for customer products

As part of our customization services, we offer technical support to help customers optimize the cooling performance of their products and integrate our fans effectively.

For many years, we have used our in-house measurement equipment to collect data under various conditions and to perform on-site measurements for customer products at our facilities.

More recently, we introduced a CFD Simulation Service, which applies our fluid-simulation technology to help customers resolve cooling challenges and select suitable fans.

3. Production Department — Technologies and Strengths

Our Production Department focuses on maximizing production efficiency through in-house technologies and

production automation. This section outlines the advantages of our in-house mold manufacturing capabilities and how they are leveraged to production.

3.1 In-house mold manufacturing advantages

Figure 9 shows Production Department’s integrated mold manufacturing system.

By unifying mold design, manufacturing, molding, and quality evaluation, we can fully utilize our mold technology to ensure rapid and accurate feedback during product development. This integrated system helps improve product competitiveness by ensuring that molded components precisely reflect development requirements.

Figure 10 shows an example of in-house molds manufacturing.

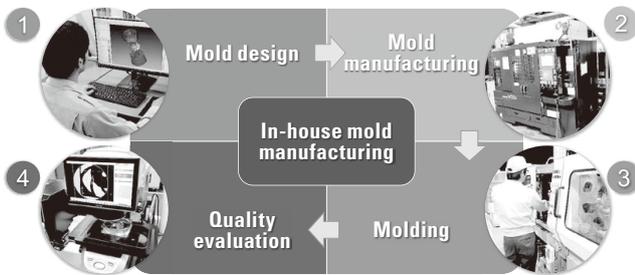


Fig. 9 Integrated production system of molds

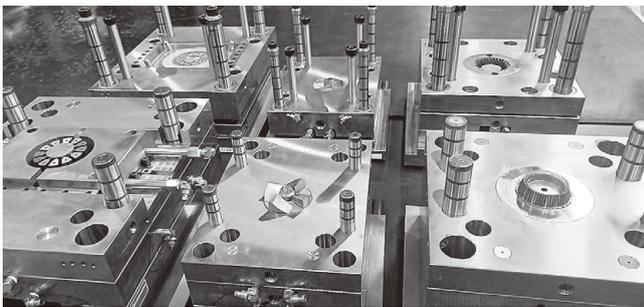


Fig. 10 Production example of in-house molding

3.2 Examples of in-house mold manufacturing technologies

This section introduces examples of how in-house mold technology is used to improve cooling fan performance, reliability, and production efficiency.

3.2.1 Mold manufacturing under optimal conditions

A key advantage of in-house mold manufacturing is the ability to design and build molds that are optimized for each component based on a detailed understanding of product

specifications.

As cooling fans become more advanced, molded impellers must exhibit excellent balance at high speeds and greater structural strength. The Production Department evaluates multiple molding conditions to optimize component quality.

For example, a single-gate mold design allows resin to flow uniformly from the center of the impeller, improving balance and reducing the formation of weld lines, which are typically structural weak points.

Figure 11 shows a comparison of gate types.

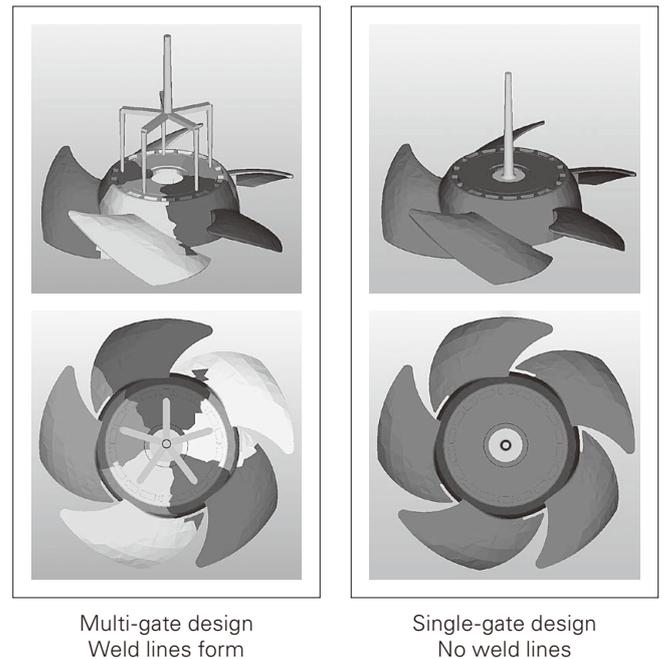


Fig. 11 Example of comparative analysis between gate types

3.2.2 In-mold automatic gate cutter technology

Figure 12 shows the gate-cutting process required for components molded with single-gate molds.

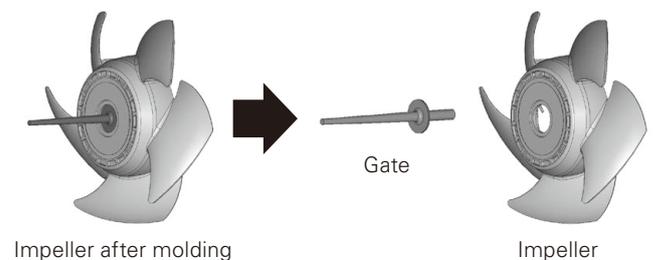


Fig. 12 Gate cutting

Although single-gate molds improve component balance, they also require manual removal of the gate after molding. To eliminate this manual step, the Production Department

developed in-mold automatic gate cutting technology, which uses a hydraulic cylinder built directly into the mold. This mechanism cuts the gate during the molding process, enabling automated production.

Figure 13 shows the mold design with this integrated hydraulic cylinder.

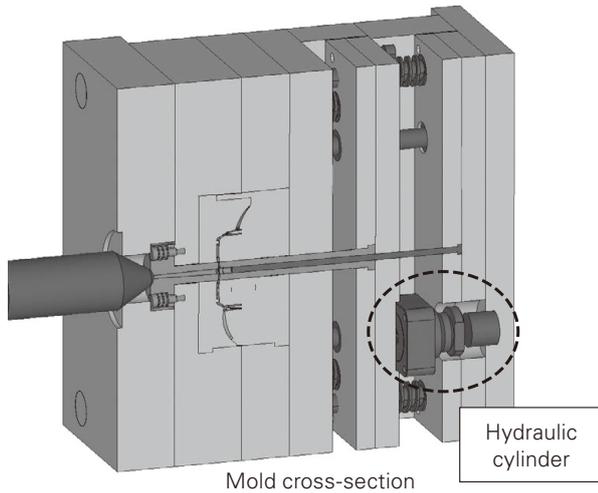


Fig. 13 Mold design integrating hydraulic cylinder

Using this technology improves impeller quality by enhancing balance performance, reducing vibration, increasing strength, and eliminating weld lines—while also removing the need for manual gate cutting.

3.3 Expansion into external mold sales

Since introducing in-house injection mold production in 2000, the Production Department has designed, manufactured, and molded more than 600 tools. Leveraging our high-precision machining capabilities and integrated production system, we now offer external mold manufacturing services, enabling the rapid delivery of high-quality injection molds to customers.

4. Quality Control Department — Technologies and Strengths

Our Quality Control Department is engaged in ensuring high quality. This section introduces our automation technology for acoustic and vibration inspection—areas that have traditionally been difficult to automate.

4.1 Product inspection

Cooling fan inspection includes checks for noise and vibration.

We perform several inspections, including:

- Acoustic inspection to verify that no abnormal noise occurs during operation
- Vibration inspection to check for unusual vibration
- Waveform inspection to confirm that motor current and sensor output show no anomalies
- Visual inspection to check frames and impellers for damage or defects

Acoustic inspection relies on hearing, vibration inspection on touch, and waveform and visual inspection on sight. For this reason, only inspectors who have completed internal certification programs are permitted to conduct these evaluations.

4.2 Technologies for addressing inspection challenges

Acoustic and vibration inspections are essential, yet accuracy can vary when tests rely on human perception. This variation arises because:

- Perception differs among individuals
- Daily changes in a worker's physical condition affect sensory accuracy

To overcome these issues, we introduced automated inspection systems to shift from subjective evaluations to highly reliable quantitative measurements.

Figure 14 shows our inspection equipment.

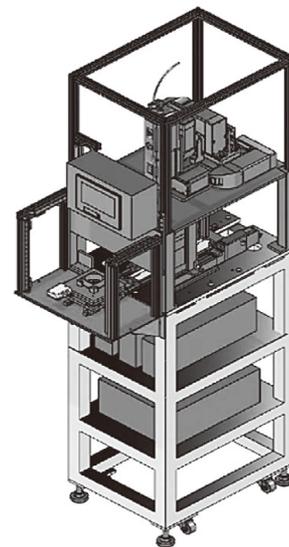


Fig. 14 Inspection equipment

4.2.1 Vibration inspection

Vibration inspection typically uses either contact or non-contact vibrometers.

Contact vibrometers require attaching a sensor to the fan. This adds mass to the fan, making it unsuitable for automation—especially when measuring small, lightweight

models where accuracy is affected.

Non-contact vibrometers avoid this problem and allow measurements without influencing vibration levels. Based on this advantage, we adopted a laser vibrometer as the core device for our automated vibration inspection system.

Figure 15 shows vibration inspection equipment.

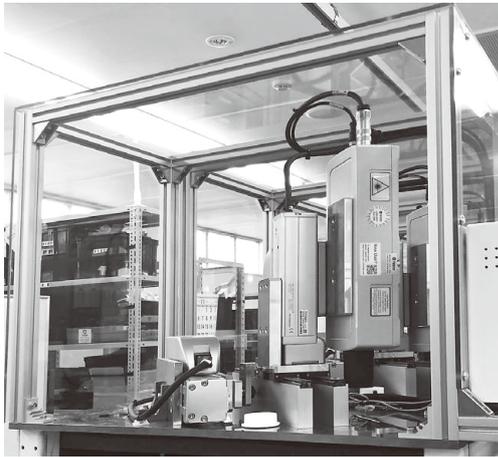


Fig. 15 Vibration inspection equipment

4.2.2 Acoustic inspection

We transitioned from human-based hearing to automated acoustic inspection using microphones.

Abnormal noise typically arises from bearing issues such as brinelling, contact between components, or foreign matter. Each of these noise types presents distinct frequency characteristics, which must be accurately identified during acoustic inspection.

However, because frequency and peak amplitude vary by fan model, defining consistent criteria across models was challenging.

To resolve this, we used the Mahalanobis-Taguchi (MT) method⁽¹⁾, an AI-enhanced technique.

Using the MT method, data from normal products are first collected within a decision space. The distance between the new measurement data and this decision space is then calculated. This distance determines whether the sound is normal or abnormal. Figure 16 illustrates the MT-method concept.

Applying the MT method to our acoustic inspection allows us to create a decision space using frequency-analysis data. This enables precise detection of abnormal noise with different tonal characteristics, supporting full automation of the inspection process.

Figure 17 shows the automated acoustic inspection equipment.

These automated systems have clarified trends and root

causes of abnormal noise and vibration in manufacturing, contributing to more efficient assembly processes, optimized component management, and refined product design.

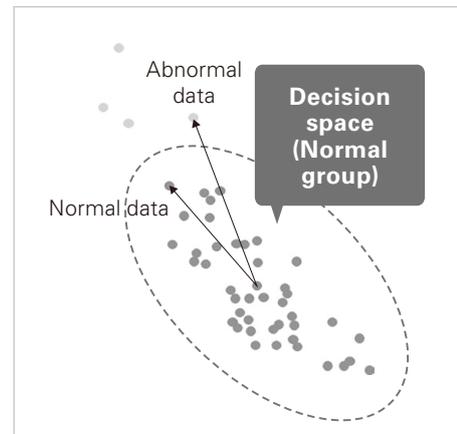


Fig. 16 Concept of the MT method

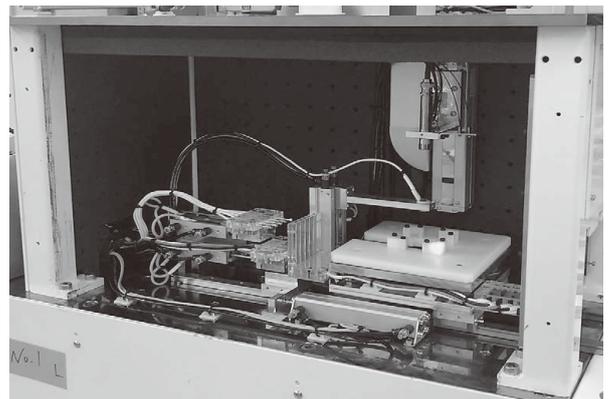


Fig. 17 Acoustic inspection equipment

5. Conclusion

This article has presented our technologies and strengths across the three departments: Design, Production, and Quality Control.

To enhance product performance during development, we employ simulation technology and proprietary measurement equipment to achieve high-precision product designs.

For manufacturing molds, which transform designs into products, we have established an integrated system for design, manufacturing, molding, and quality evaluation, enabling rapid production of high-quality products.

With our system, even slight abnormalities in finished cooling fans can be reliably detected. By incorporating advanced inspection methods and AI technology, we deliver highly reliable products with assured quality.

We will continue addressing customer challenges by leveraging our proprietary technologies in product development, thereby creating new value.

Reference

- (1) Masato Suzuki, Introduction to the MT System Analysis Method:
Mastering Quality Engineering Through Experimentation
Note: The book title is an unofficial English translation provided only for reference.

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