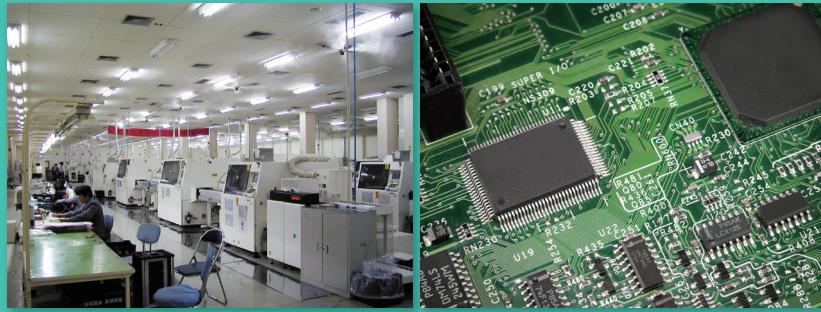


7 benefits of Dry Fog Humidification in SMT processes



Thank you for downloading

Thank you for downloading "7 Benefits of Dry Fog Humidification in SMT Processes".

In surface-mount technology (SMT) processes, humidity control is essential to prevent electrostatic discharge (ESD) damage and problems with static electricity or dry air.

This literature introduces seven benefits that the Dry Fog Humidification system from IKEUCHI achieves.

Hopefully this is helpful to solve the problems in your SMT processes.

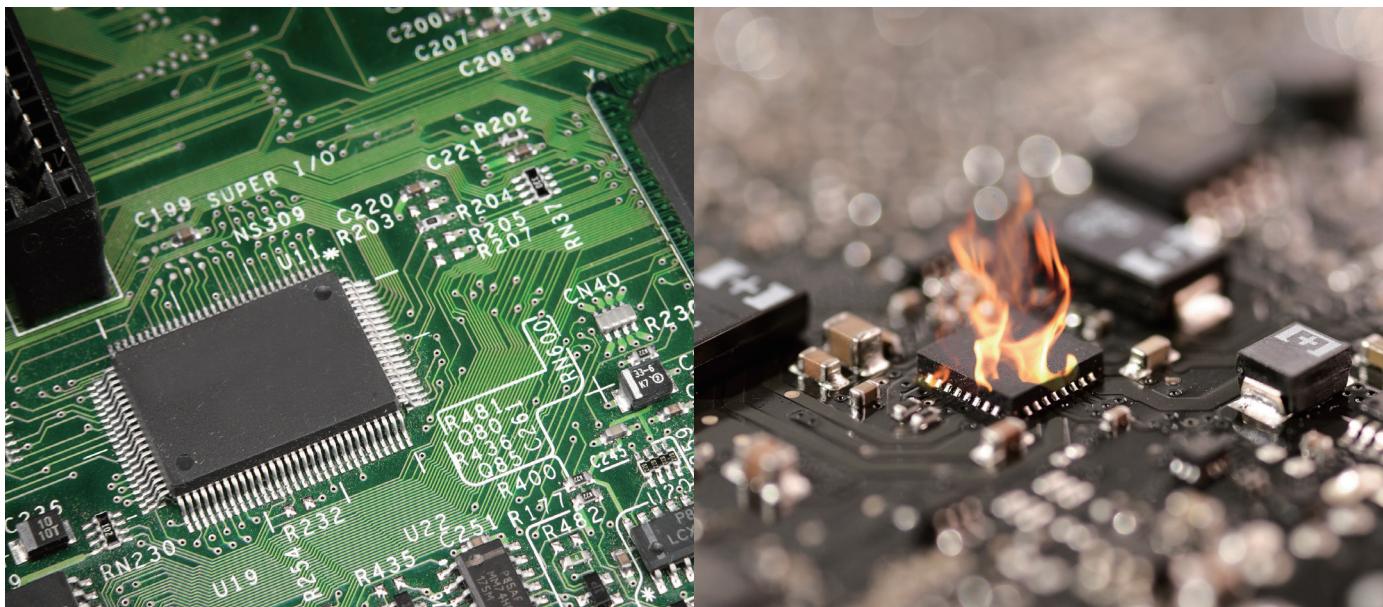
Please feel free to contact IKEUCHI with any questions you might have.

Table of Contents

1. Preventing ESD damage	Part 1
2. Reducing pick-and-place errors	Part 1
3. Maintaining consistent solder print quality	Part 2
4. Reducing airborne particles	Part 2
5. Significant reduction in operating costs	Part 2
6. Reducing cooling costs	Part 2
7. Less sick leave	Part 2
Summary 7 benefits of Dry Fog Humidification in SMT processes	Part 2

Preventing ESD Damage in SMT (Part 1)

7 Benefits of Dry Fog Humidification



Preventing electrostatic discharge (ESD) damage and problems with static electricity, or dry air

1. Preventing ESD damage

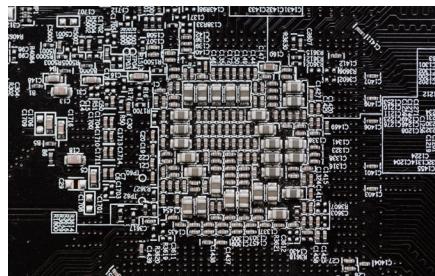
When a human body charged with static electricity comes into contact with a conductor, static electricity is discharged and an electric current flows. It only takes a fraction of the possible electricity a human body can discharge to destroy the circuitry or damage the inside of these sensitive components. This is called electrostatic discharge damage or ESD damage.



In recent years, as electronic devices have become smaller and smaller and are equipped with more advanced features, their electronic components are also becoming smaller and smaller. The size of chip resistors and multilayer ceramic chip capacitors mounted on smartphone circuit boards is mainly 0402 (0.4 × 0.2 mm), but with the introduction of the 0201 (0.25 × 0.125 mm) size in 2019, further miniaturization is expected.

However, as the size of the components decreases, the withstand voltage of the components is also reduced, making them more susceptible to damage. This requires that

SMT processes which handle these components, including ICs, take more active precautions.



A first and basic measure is wearing a grounding wrist strap and connecting it to the proper grounding equipment, this will release any electrostatic immediately and protect the components from ESD damage.

In addition, an ionizer (static eliminator) can be used to remove the static charge built up on products or equipment. However, the ionizer is not a perfect solution to prevent ESD damage, since it needs to be

installed wherever static electricity is generated, requiring sufficient space for installation.

It is the prevention of static electricity through air humidification that complements the measures taken with ionizers.



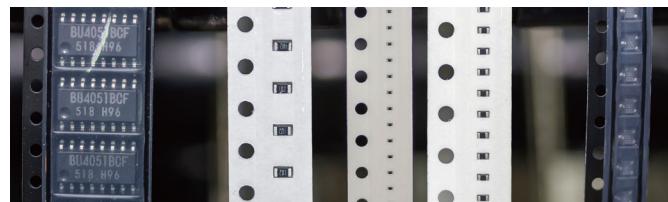
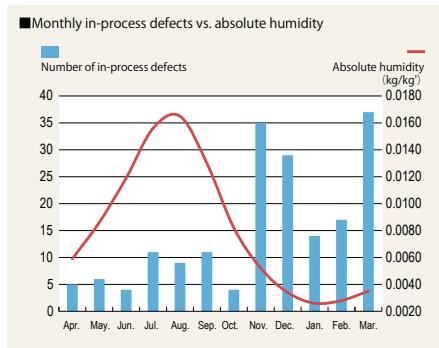
IKEUCHI's industrial "Dry Fog Humidification System" raises the humidity to an appropriate level creating a way for the electrostatic to dissipate making the entire work environment, not just certain areas, less susceptible to electrostatic charge.

Since humidification with Dry Fog helps moisture to directly dissolve into the air, it effectively increases humidity without wetting products, machines, or floors, and prevents static electricity itself from being generated. The system is equipped with a humidity controller that enables automated operation to maintain a uniform humidity level even in large spaces.



The graph below shows the number of in-process defects and humidity levels for each month in a one year period at an IC memory manufacturer prior to installing our humidification system. It indicates that most of the defects occurred during the dry season from November to March.

The installation of the humidification system successfully prevented static electricity from being generated due to low humidity in wintertime and greatly reduced the number of the defects caused by the electrostatic discharge (ESD).

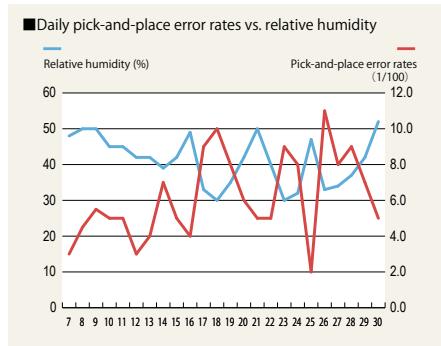


Surface mounting is a process in which multiple nozzles located on the mounting machine pick up the components out of the carrier tape pockets and place them in their predetermined positions on a printed circuit board.

During this process, the feeder peels off the cover tape to expose the components as the carrier tape moves forward and the head with the nozzle moves into position to pick up the components. However, the static electricity generated by the removal of the cover tape can cause components to stick to the tape or pop out of the pocket, resulting in a pickup error due to the missing component.

While unmounted components will be detected in a following inspection, it causes additional work and inspections, which means that a pick-and-place error directly affects productivity.

The graph below shows the relation between the number of pick-and-place errors and the humidity in a surface mount facility, recorded every day for a month. The scale on the left shows the relative humidity level and it clearly indicates that on the days the humidity falls below 40% there is a drastically higher rate of pick-and-place errors. In other words, with appropriate humidity control productivity can be increased by preventing ESD damage and



2. Reducing pick-and-place errors

Electronic components for SMT processes are typically supplied on packaging tape rolled into reels which are set in the feeder section of the mounting machine. The packaging tape consists of a carrier tape with pockets to carry the components to the mounter head, and a cover tape that seals the components into the pockets.



*A fog formed out of ultrafine water droplets, each measuring 10 μm or less in diameter, which are created by specialized spray nozzles, to instantly evaporate into the air or bounce off any object instead of bursting on impact.

Preventing ESD Damage in SMT (Part 2)

7 Benefits of Dry Fog Humidification

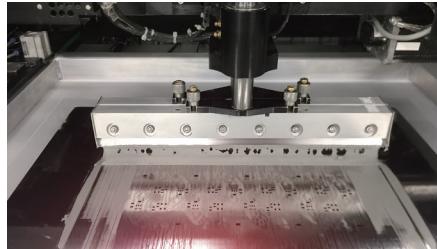


Preventing electrostatic discharge (ESD) damage and problems with static electricity, or dry air

3. Maintaining consistent solder print quality

Humidity control is also essential when printing solder onto the circuit board using a metal stencil. Low humidity will cause solder to dry faster and clog the stencil openings, resulting in inadequate application of solder onto the board. This in turn has a significant impact on the reliability of solder joints.

If the humidity is too high, solder will absorb moisture resulting in excessive solder application, causing defects such as solder bridges, which lead to short circuiting, or causing components to stand up (tombstone or Manhattan phenomenon) during reflow soldering, leading to open circuits.



Appropriate humidity control helps maintain solder printing quality and product reliability. There are several methods to control humidity, but the use of this Dry Fog humidification system is very efficient due to its operating costs which will be described later.

4. Reducing airborne particles

Humidification suppresses airborne particles during the manufacturing process, reducing defects caused by particles adhering to the product. The following table shows the number of airborne particles measured before and after a humidity increase from 25% to 50% and clearly shows the number of particles decreasing drastically with an increase in humidity.

The number of airborne particles at RH 25% (before installation) and 50% (after installation)

Before & After	Humidity	Particle Sizes				
		10 µm	20 µm	30 µm	50 µm	100 µm
Before installation of Dry Fog Humidifier	RH 25%	19	10	4	0	0
After installation of Dry Fog Humidifier	RH 50%	2	1	0	0	0

Measured with the airborne particle counter KC-20A by RION Co., Ltd.



5. Significant reduction in operating costs



From all the available humidification methods, to show the drastic savings in operating costs, the steam humidification system using fuel oil was chosen to compare with the Dry-fog humidification system.

The table below shows a case where the operating costs were reduced by 68%, which comes out to a savings of \$50K, along with a CO2 emissions reduction of 70%. This is also a significant contribution towards the Sustainable Development Goals (SDGs).

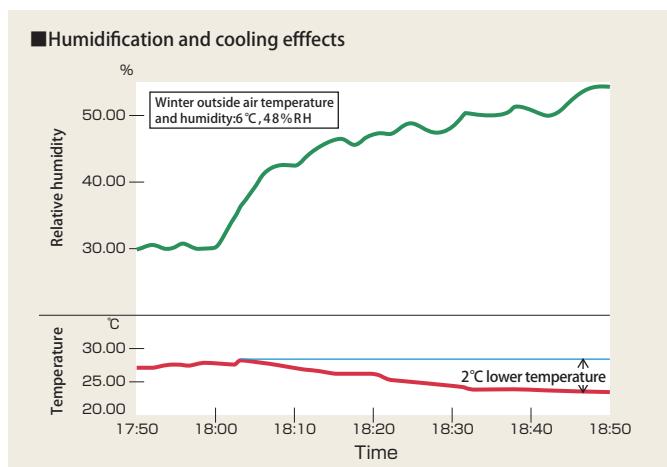
Reduction targets	Dry Fog Humidification System	Steam humidification system (using LP gas)	Steam humidification system (using fuel oil)
Operating costs	\$24,000 a year	A saving of \$51K \$82,000 a year	\$75,000 a year
CO2 emissions	100 tons a year	A 70% reduction 360 tons a year	340 tons a year
Air conditioning energy saving effects	Yes	A saving of \$18K No	No

Note that the above number are estimation only.
Estimating conditions: humidification volume 420 L/h with 52 Dry Fog Humidifiers, operating hours 4,000 hours a year with continuous air conditioning.

6. Reducing Cooling Costs

Using the Dry Fog humidification system indoors, the cooling effect of the fog also lowers the ambient temperature by approximately 2 degrees C. In a surface-mount facility equipped with reflow soldering ovens the air conditioning runs year-round to counter the increased room temperature caused by the exhaust heat of the ovens. Operating the Dry Fog system not only stabilizes the humidity level but also reduces the operating costs for the A/C.

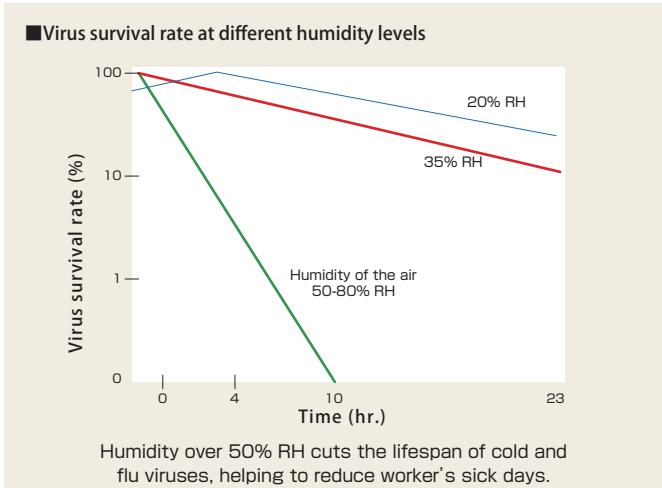
As shown in the above table, one of our clients saved \$18K/year in cooling expenses.



7. Less sick leave

Lastly, the Dry Fog humidification system reduces the number of sick days taken by employees due to cold and flu, by creating a healthier work environment.

It is well known that maintaining a relative humidity of 50% or above significantly reduces the survival time of cold and flu viruses. As a matter of fact, many of our clients who installed the Dry Fog humidification system have noticed a significant drop in sick leave during the winter months and welcome the side effect of better employee health.



Summary | 7 benefits of Dry Fog Humidification in SMT processes

Controlling humidity in SMT processes provides seven benefits. Among all the methods to control humidity, the Dry Fog Humidification system from IKEUCHI is the only one able to achieve all of these benefits.

1. Preventing ESD damage
2. Reducing pick-and-place errors
3. Maintaining consistent solder print quality
4. Reducing airborne particles
5. Significant reduction in operating costs
6. Reducing cooling costs
7. Less sick leave