

WHEN WATER PROTECTS

The importance of humidity in the electronics industry



Humidification, dehumidification and evaporative cooling

CLIMATE CONTROL STANDARDIZED PRODUCTION

Increasingly sensitive components

Today, the electronics industry is one of the largest and fastest growing industrial sectors in the world. Despite its rapid ascendancy, it remains highly competitive on a global scale. To stay ahead, manufacturers must optimize production, standardize processes, and adopt advanced facility technologies, including climate-controlled environments essential for precision and quality.

Smaller, faster, and more intelligent

Over the past several decades, few innovations have impacted our daily lives as deeply as the circuit board. Today, electronic components and semiconductors account for nearly 25% of the electrical market - and they continue to become smaller in size while increasing in performance. This trend toward miniaturization also increases sensitivity to disruptions in the manufacturing process. Ensuring the reliability and longevity of semiconductors requires rigorous quality control. Maintaining a stable production environment relies heavily on key factors such as temperature and, especially, relative humidity both of which are crucial in ensuring consistent product quality.

Protect against electrostatics

One of the fundamental imperatives of almost every electronics company is to protect against electrostatic



discharge (ESD). According to several industry sources and manufacturers, electrostatic discharge (ESD) is responsible for up to 25% of identified electronic component failures, and in some cases even more.1,2,3,4 As components become more ESD sensitive, especially under CDM, ESD control programs must evolve accordingly. While not explicitly forecasted, the EOS/ESD Association's roadmap strongly signals the need for continued investment.⁵ A key aspect for every ESD protection program is to manage humidity. Relative humidity has an immediate impact on the dissipation behavior of materials and components. If the air is too dry, the odds of having to contend with charges increase sharply. At an optimal relative humidity of 40% and 60%, the conductivity of air and material surfaces has increased to the point where electrical charges can easily be dissipated.





Ensuring quality

Maintaining consistent and optimal air humidity is an important quality factor for many processes. If humidity levels are too low, the viscosity of soldering paste can be affected, compromising the stability of the soldering process. Similarly, inadequate humidity during gluing, dispensing, or varnishing can result in adhesion issues. Furthermore, fluctuating air humidity can prevent electrical and functional tests from delivering reliable results.

Healthier environment

Optimal air humidity enhances employee working conditions and supports their health by preventing issues such as dry mucous membranes, respiratory problems, eye irritation, nosebleeds, and other related ailments. It also helps maintain clean and fresh indoor air.



CLIMATE CONTROL THESE STANDARDS PROVIDE SECURITY

Controlled humidity protects

Globally recognized standards are indispensable for quality management. The faster technical progress and global competition are moving forward, the more important it is to have practical standards for achieving optimal quality quickly and at the lowest cost possible. Many relevant standards contain recommendations for controlled humidity.

Standard	Name	Institution
INTERNATIONAL		
IEC 61340-5-1:2016 IEC 61340-5-2:2016	Electrostatics – Part 5-1/5-2: Protection of electronic devices from electrostatic phenomena – General requirements (2016)	IEC International Electrotechnical Commission, www.iec.ch
IPC-J-STD-001F	Requirement for Soldered Electrical and Electronic Assemblies (2014)	IPC – Association Connecting Electronics Industries, www.ipc.org
JESD625B	Requirements for Handling Electostatic- Discharge-Sensitive (ESDS) Devices (2012)	JEDEC Solid State Technology Association, www.jedec.org
USA		
ANSI/ESD S20.20-2014	Protection of Electrical and Electronic Parts, Assemblies and Equipment (2014)	ANSI – American National Stan- dards Institute, www.ansi.org
EUROPE		
DIN EN 61340-5-1: 2017-07 VDE 0300-5-1: 2017-07	Electrostatics – Part 5-1: Protection of Electronic Components against Electrostatic Phenomena – General Requirements (2017) (unchanged from IEC 61340-5-1)	German Institute for Standardization, www.din.de/en VDE (Association of Electrical Engineering Electronics Information Technology), www.dke.de

IEC

All major standards are coordinated and communicated worldwide. Nowadays, the contents of international standards are usually disseminated by the IEC (International Electrotechnical Commission) headquartered in Geneva, Switzerland. The IEC standards are then translated into national standards and guidelines.

IPC

The IPC (Association Connecting Electronics Industries), the world's leading association, is the most important contributor to the IEC and is the only institution to provide a complete set of guidelines for the entire process chain to manufacture circuit board assemblies. The regulations are developed in cooperation with national and international companies as well as institutions.

JEDEC

JEDEC Solid State Technology Association is a US-based organization that develops guidelines for the microelectronics industry and for the standardization of semiconductors.





"The industry committee which developed IPC-J-STD-001 standard provided the industry with a guideline for temperature and humidity in the manufacturing environment to verify that electrostatic discharge control is adequate. A controlled and stable humidity is part of the environmental controls."



Lars-olof Wallin IPC European Representative

IEC 61340-5-2.2016:

"Introducing humidity control within an ESD protected area is a method for reducing electrostatic fields to a permissible level."

IPC J-STD-001F:

"When humidity decreases to a level of 30% or lower, the manufacturer shall verify that electrostatic discharge control is adequate, and that the range of humidity in the assembly area is sufficient to allow soldering and assembly materials to function correctly in the process, based on vendor recommendations or documented evidence of process performance."

JEDEC JESD625B:

"Relative humidity has an impact on the formation of electrostatic charges and can thus support an existing ESD protection program."

Climate control

- The electrical sector is growing
 Importance of semiconductors rises
 ESD protection becoming more important
- 4 SMD components are getting smaller
- 5 Protect employees against air pollution
- 6 Humidifiers ensure quality

ELECTROSTATICS HUMIDIFIED AIR PROTECTS

Optimum humidity equals ESD protection

Safeguarding against uncontrolled electrostatic discharges is essential in the electronics industry. Even low-voltage discharges, as little as 30 volts, can damage sensitive semiconductors and electronic assemblies, often resulting in hidden defects. Maintaining optimal humidity levels helps reduce the tendency of materials to accumulate charge, offering an additional layer of effective ESD protection.

Electrostatic generation

Electrostatic charges arise when two surfaces come into contact and are then separated, especially when they differ in conductivity. In electronics manufacturing, this can occur almost anywhere: between people and equipment, or within machinery itself. When two materials touch, electrons flow from one to the other. Upon separation, the surfaces become electrically charged: one positively, the other negatively.

In highly conductive materials, this charge is typically equalized immediately after separation. However, insulating or poorly conductive materials retain the imbalance potentially accumulating charges of several thousand volts - particularly over larger distances. These stored charges pose a significant risk, as they can discharge unpredictably- either by direct contact or through the air - damaging sensitive electronic components.

Hidden risks from uncontrolled discharges

Electrostatic discharges (ESD) are not only triggered by human operators but can also originate from machines such as soldering irons, pick-and-place systems, or packaging equipment. As electronic components continue to shrink and become increasingly sensitive, even minimal voltage levels can cause significant damage. More problematic than the identifiable total failure of semiconductors are the latent defects that go undetected despite thorough quality control. These hidden faults can result in long-term reliability issues, ultimately reducing the lifespan of the final product and causing consequential damage.



Maintaining controlled humidity year-round significantly enhances any ESD protection strategy by helping to prevent these undetected faults.

No discharge without charge: the role of humidity

Effective ESD protection begins by preventing the buildup of electrostatic charges and ensuring their safe, controlled discharge. Keeping relative humidity between 40% and 60% provides two key benefits: it creates a naturally conductive moisture film on surfaces - even on insulating materials - improving their ability to release static charges during contact and separation; and it enhances the conductivity of the air, allowing stray charges to safely dissipate into the environment instead of damaging sensitive components or equipment.

2		
CONTACT	FRICTION	SEPARATION
×	44 66	555550 p b b 5595555



Δ	Activity	Relative Humidity	
	- Activity	10-25%	> 60%
Work	ing at the table	6,000 volts	100 volts
Packa wrapp	ging paper in plastic Jing	7,000 volts	600 volts
Walki	ng over an artificial floor	12,000 volts	250 volts
Gettin paddii	g up from a chair with foam ng	18,000 volts	1,500 volts
Remo printe	ving plastic packaging from d circuit boards	26,000 volts	1,000 volts
Walki	ng over carpet floor	35,000 volts	1,500 volts

When water protects

5

QUALITY ASSURANCE ALL PROCESSES UNDER CONTROL

From assembly to painting

Minimizing scrap and keeping subsequent work and repairs to a minimum are a must for the production department to remain competitive. In addition to the overriding importance of electrostatic protection, there are numerous processes and production steps which are positively impacted by optimal humidity in terms of quality, time and costs.

Dry air is quite common particularly in the winter months. The waste heat generated by the machinery is another contributing factor. A temperature increase of 1°C (33.8°F) causes the relative humidity to drop by about 3%.

Pick-and-place machines

For both SMD and THT printed circuit boards, error-free machine operation and precise component placement are critical to performance. Maintaining optimal humidity levels positively influences placement speed and accuracy. In dry conditions, electrostatic charges can cause components to cling to the cover film of blister strips, preventing accurate pickup by the pick-and-place machine's nozzle. Additionally, cardboard component straps may shrink or warp due to low humidity, leading to slight twisting or added tension. These deformations

can disrupt component alignment, resulting in misplacements, missing parts, or feeder errors - ultimately causing production delays or line stoppages.

Optimized soldering process

Soldering electronic assemblies demands tightly controlled process parameters to ensure consistent wetting and reliable production flow. Relative humidity plays a critical role by affecting the viscosity of solder paste. In low-humidity environments, the flux within the paste evaporates more rapidly, reducing its flowability. This accelerated drying can lead to uneven soldering, resulting in defective or inconsistent solder joints.

Dust suppression

Increased air humidity helps reduce airborne dust and minimizes deposits on machinery and components. The





thin moisture layer that forms on dust particles makes them heavier, causing them to settle more quickly and reducing the likelihood of them becoming airborne again.

Gluing and painting

Adhesive gluing processes are widely used in final component assembly and circuit board production. However, overly dry air can interfere with curing and weaken the bond strength. During the application of protective coatings, maintaining higher humidity levels supports a smooth, even coating process and ensures optimal adhesion.



- 1 Humidity is important for ESD protection
- 2 Electrostatics are caused by friction
- 3 Surfaces must be conductive
- 4 Humidity reduces charges
- 5 Placement errors due to dry air
- 6 Humidity affects the soldering process
- 7 Quality assurance is a must



HEALTH MORE PRODUCTIVITY WITH OPTIMAL AIR HUMIDITY

Focusing on People

Employee well-being is a key driver of motivation and productivity in the workplace. An important, but often overlooked, factor influencing well-being is indoor climate, especially air humidity. When the air is too dry, it not only creates an uncomfortable environment but can also lead to physical symptoms such as irritated mucous membranes, nosebleeds, and eye discomfort.

Thermal comfort

Thermal comfort is a critical factor in the electronics manufacturing environment, where specific conditions often contribute to climatic stress. Extended production lines, dense machinery layouts, enclosed sterile or cleanroom settings, and substantial waste heat output all challenge temperature and humidity control. When indoor temperatures exceed the recommended 20°C to 22°C (68°F to 71.6°F) and relative humidity drops below 30%, employee comfort and performance can decline significantly. The physiological impact includes increased metabolic strain, added pressure on the circulatory system, and reduced physical stamina. If dry air persists, additional health concerns - such as respiratory irritation and dehydration can emerge - potentially leading to increased absenteeism and decreased workforce resilience.

Irritation of mucous membranes

The mucous membranes of the



respiratory system - including the nasal passages, bronchial tubes, and lungs - are particularly vulnerable to prolonged exposure to dry air. When the protective mucus layer becomes dehydrated or thinned, it loses its ability to filter out dust, microparticles, and allergens, allowing these irritants to reach and inflame the mucosal tissue. Common symptoms include sore throats, hoarseness, persistent coughing, and a frequent urge to clear the throat. The vocal cords may also be affected, potentially resulting in voice strain or even temporary voice loss. Additionally, dry nasal passages are prone to irritation and can lead to frequent nosebleeds.

Degraded immune defense

Insufficient air humidity also impairs the natural self-cleaning function of the mucous membranes, weakening the body's first line of immune defense. When relative humidity falls below 30%, the mucous membranes in the respiratory tract lose their ability to effectively transport and expel





harmful microorganisms. Research further indicates that low humidity significantly increases the risk of infection, as viruses remain airborne for longer periods and retain their viability, leading to higher transmission rates.

Eye problems

Tasks such as manual component assembly, soldering, and optical or visual inspection place considerable strain on the eyes. In low-humidity environments, the protective tear film that shields the conjunctiva from environmental irritants can evaporate more rapidly - and in severe cases, may even break down entirely. This can lead to symptoms such as eye irritation, redness, swelling of the eyelids, burning sensations, and inflammation. These issues not only cause discomfort but also reduce concentration and impair work performance. Prolonged focus on testing stations and microscopes further intensifies the strain.



COOLING EVAPORATIVE COOLING WITH HUMIDIFICATION

Climate for well-being

Elevated temperatures in production environments place significant stress on personnel, equipment, and materials. Conversely, maintaining cooler conditions often demands substantial cooling capacity, leading to increased energy consumption and operating costs. In environments where dry air and heat are concerns, integrating air humidification into the climate control strategy can significantly reduce the reliance on air conditioning systems, resulting in energy savings, equipment reliability, production efficiency, and supporting a safe and comfortable working environment for employees.

Temperature

Temperature is a critical process parameter across numerous stages of electronics manufacturing. For soldering and bonding, materials must remain below specified maximum temperature thresholds to ensure quality and reliability. Additionally, elevated indoor air temperatures directly impact relative humidity, higher temperatures cause humidity levels to drop, which can compromise effective ESD protection (see Fig. 6). Beyond process implications, excessive heat also affects employee comfort and productivity.

Evaporative cooling

Climate control in production environments typically demands substantial cooling capacity, leading to high energy consumption. Integrating direct room humidification offers a

more energy-efficient alternative by leveraging the principle of adiabatic cooling. This process involves the drip-free atomization of cold water into the air, where the complete evaporation of micro-fine droplets draws heat from the surrounding environment. As a result, room temperatures can be reduced without relying solely on traditional air conditioning systems. For example, a high-pressure humidification system using 100 liters of water can absorb approximately 70 kW of thermal energy while consuming just 0.6 kW of electrical power, potentially lowering room temperatures by 2°C (35.6°F) to 5°C (41°F).

Enhanced indoor air quality

An additional advantage of direct room humidification is the noticeable enhancement of indoor air



quality. The ultra-fine, nearly invisible atomization of water allows for rapid, drip-free absorption into the air, creating a fresh and invigorating indoor climate. This contributes to improved comfort by supporting skin hydration, easing respiratory function, and promoting overall physical well-being, ultimately reducing stress and enhancing employee satisfaction. Moreover, maintaining optimal humidity levels between 40% and 60% significantly improves air purity. At this range, airborne dust and fine particles settle more quickly, lowering the risk of inhalation and contributing to a cleaner, healthier work environment.







- 1 Humidity protects mucous membranes
- 2 Fewer airway infections
- 3 Maximum strain for eyes
- 4 High temperatures make work difficult
- 5 Humidification absorbs heat
- 6 Temperature and relative humidity
- 7 High-pressure nozzle humidifier

HUMIDIFICATION TECHNOLOGY AN OVERVIEW OF POTENTIAL SYSTEMS

One goal, multiple options

Various systems and technologies are used in the electronics industry to maintain proper humidity levels. The choice of technology, whether direct or indirect humidification, is determined by structural conditions as well as user requirements regarding energy efficiency, maintenance needs, and humidification performance.

1 Water and high pressure

Humidification Principles

In general, two fundamental principles are used in air humidification: direct and indirect methods. Direct room humidification involves installing standalone humidifier units directly within the room, where they remain visible and operate independently. In contrast, indirect humidification introduces moisture into the air within a central HVAC (heating, ventilation, and air conditioning) system. The humidified air is then distributed throughout the workspace via a network of ducts and outlets. Both approaches are commonly employed in the electronics industry. However, direct room humidification is particularly appealing for retrofitting projects due to its straightforward and flexible installation.

Technologies

Several technologies are available for direct room humidification, each dif-



When water protects

fering in terms of energy use, maintenance requirements, and humidification output.

Evaporative Humidifiers

These systems draw in room air using a fan, passing it over a moist wick or contact medium. Moisture is transferred through natural evaporation. While they are energy-efficient, their humidification performance is relatively low, and they require meticulous cleaning to prevent bacterial contamination.

Steam Humidifiers

These units generate steam by heating water to 100°C (212°F) in either plastic or stainless steel cylinders. The high temperature ensures a hygienic process by eliminating bacteria and microbes. Electrode and resistive steam humidifiers, however, consume significant energy, and their components, particularly the steam cylinders, are prone to lime scale buildup, limiting their service life.

Aerosol-Based Humidifiers

These systems atomize water into ultra-fine droplets, which are dispersed into the air using a fan. The aerosols are quickly absorbed by the room air. Technologies include ultrasonic transducers, compressed-air systems, and high-pressure nozzles. These humidifiers are capable of efficiently humidifying large spaces with minimal energy use but typically require a water treatment system to supply sterile, demineralized water.





HUMIDIFICATION TECHNOLOGY AN OVERVIEW OF POTENTIAL SYSTEMS

High pressure air humidification

Many companies have transitioned from steam and compressed-air humidifiers to high-pressure nozzle systems. These systems utilize a high-pressure pump and precision nozzles to atomize water into an ultra-fine mist directly within the room as part of a virtually silent process. Their energy consumption is only a fraction of what is typically required for steam or compressed air humidifiers.

In addition to efficient humidification, these systems offer the benefit of adiabatic cooling: as cold water evaporates, it cools the surrounding air, contributing to a more comfortable indoor climate. This natural cooling effect can also complement the performance of existing air-conditioning systems. For every kilogram of water evaporated per hour, a cooling capacity of approximately 700 watts is generated.

To ensure hygienic and reliable operation, only ultrapure, demineralized water is used. This water is produced by a reverse osmosis system integrated into the humidification system.

Direct or Indirect?

There is no one-size-fits-all answer to whether humidity should be controlled indirectly via a central ventilation and air conditioning system or directly through in-room humidifiers. The best solution depends on the specific building conditions and user requirements. In many cases, a combination of both methods is ideal: the central (indirect) system provides baseline humidity, while direct room humidification delivers targeted support in specific areas.

A key advantage of direct humidification is its high level of precision and adaptability. It enables targeted control of moisture levels to meet the specific requirements of different production zones - such as SMD assembly and module assembly - which often have varying humidity needs. Furthermore, it allows for the creation of localized "hot spots" with elevated humidity around particular machines or materials that require it.

Ideal for Retrofitting

The decision between direct and indirect humidification often hinges on the building's structural condi-



tions. In older production facilities, installing or upgrading an indirect system can be prohibitively expensive due to missing or undersized ductwork. For retrofit projects, direct room humidification offers a simpler, more cost-effective solution for most electronics industry applications. Moreover, required maintenance can be implemented with less effort due to improved accessibility to the humidifiers and the water-carrying systems.



 Humidification technology

 1
 High-pressure nozzle humidifiers

- 2 Steam humidifiers
- 3 Aerol-based humidfiers
- 4 High pressure system for ceiling mounting
- 5 Direct room air humidification
- 6 Energy-efficient: High-pressure nozzle systems
- 7 Targeted spot or material moistening

DIRECT ROOM AIR HUMIDIFICATION STATE-OF-THE-ART

Into the air with high-pressure

High-pressure direct room air humidification is considered a state-ofthe-art solution for numerous industrial applications. Its advantages - including straightforward installation, reliable control, low energy consumption, and easy maintenance access - make it a compelling choice for use in the electronics industry as well.

Direct Room Air Humidification

With direct room air humidification, the humidifiers are installed directly in the production hall or designated area, rather than integrated into a central HVAC system. Mounted on walls or ceilings, the units release an ultra-fine mist, as needed, which is instantly absorbed into the air and evenly dispersed throughout the space. Microfine atomization, with a droplet size under 15 µm, is achieved through high-pressure technology, where water is forced through high performance nozzles at an operating pressure of 85 bar (1,232 psi). Despite this powerful performance, energy consumption remains minimal at just 700 W, making it significantly more efficient than steam or compressed-air systems.

Simple Installation

Because humidification is separated from ventilation and air conditioning,



the system can be installed independently, with minimal structural modifications. Only high-pressure hoses, roughly the thickness of a finger, along with power and control cables are needed to connect the central water treatment unit to the decentralized humidifiers. This ease and flexibility of installation make direct room humidification an especially attractive option for retrofit applications.

Water Quality Matters

3

Proper water treatment is critical to both performance and hygiene of humidification systems. Raw, untreated water is unsuitable due to the presence of bacteria, particles, salts, and minerals, which can harm human health and sensitive equipment. In the electronics industry in particular, it's essential that humidification introduces no additional dust or contaminants. To achieve this, a





multi-stage water treatment is used to purify, disinfect, and fully demineralize the water before use.

Precise and Responsive Control

Humidity levels are managed by digital control systems that continuously monitor room conditions and ensure consistent relative humidity. Humidifiers are activated with pinpoint accuracy when the humidity falls below the setpoint. As individually defined humidification zones (halls or partial areas) are specified for direct room air humidification, it is possible to use different setpoints for rooms that are used for different purposes.



DIRECT ROOM AIR HUMIDIFICATION HYGIENE AND MAINTENANCE

Maintenance with safety in mind

Air humidification systems are only as effective as the service and maintenance strategies behind them. Even water that looks clean can contain substances that threaten both employee health and operational safety. Adhering to strict hygiene standards and using systems with automated maintenance cycles ensures these risks are reliably minimized.

For hygienic water treatment in humidification systems, reverse osmosis plants are commonly used. However, even with optimal pre-treatment, such as water softening and filtration, unwanted deposits can still accumulate on the reverse osmosis membranes and other critical system components. These deposits can significantly reduce system performance and lifespan, and more importantly, pose serious health risks. To ensure safe and hygienic operation, regular inspections, maintenance, disinfection, and timely replacement of heavily worn parts are essential.

Maintenance is a must

In order to prevent contamination of water-bearing elements and to prevent the uncontrolled propagation of microorganisms, comprehensive hygiene measures are necessary to comply with microbiological limits. As a rule, pumps, reverse osmosis membranes, UV-C lamps and other critical components should be serviced every six months. If the upper limits of germ contamination are exceeded, the inspection intervals must be halved until it can be permanently ascertained that the air humidification systems are in a safe state.

Compliance with standards and certificates

Modular systems that are replaced in fixed time intervals and sent to the manufacturer for maintenance are advantageous. With these automated maintenance programs, users do not have to worry about hygienic measures and can rest assured that they are always operating a functionally



safe and hygienic air humidification system. Details of the hygiene standards of the various humidification systems can be obtained from national and international certificates issued by independent testing labs, and from manufacturers' maintenance and service programs.

Microbiological limit values of the humidifier water according to the current state-of-the-art standards

1) Legionella	<100 CFU / 100 ml
2) Total colony count	<150 CFU / 100 ml
CELL = Colony-forming	unit variable for

quantification of microorganisms



High pressure, hygiene and maintenance

- Constant humidity in production
 Easy to retrofit in any hall
 Digital control
 Water treatment testing
 - 5 Microbes and bacteria must be avoided
 - 6 Routine maintenance

CASE STUDY ASTEELFLASH HERSFELD GMBH, BAD HERSFELD

Air humidification with twice the benefits

The Asteelflash Group is a multinational service provider for electronic manufacturing and offers the complete manufacture of integrated electronic systems. Headquartered in France, the group of companies employs over 5,500 people worldwide. At their site in Bad Hersfeld, controlled humidity not only optimizes the production processes, but also improves the working conditions of the employees and protects their health. Asteelflash, acquired by USI in 2020, is one of the leaders in electronic design, manufacturing service, and modularization with diversified global footprints and miniaturization solutions.



Since their founding in Paris in 1999, Asteelflash has enjoyed significant growth and has become one of the top 20 EMS providers worldwide, and the 2nd largest in Europe. With a total production area of around 160,000 m2 (~2 million ft²), the company now consists of 18 production centers of excellence, which are strategically distributed over four continents. The extensive range of services provided includes PCB assembly through complete system solutions pursuant to individual manufacturing specifications to recycling logistics for customers. The market segments serviced include above all the energy industry, data processing and transport in addition to general industries. At the largest German facility in Bad Hersfeld, the company produces integrated electronics systems and modules for the automotive industry,



among other things.

Motivated and healthy employees

One of the defined goals of the group is to continuously improve their guality and competitiveness. For Felix Timmermann, General Manager EEMEA Region at Asteelflash, standardized processes, sector-specific quality management systems, top ESD security and comprehensive testing and verification facilities are equally important as having a controlled room climate: "We want to offer our customers the best possible conditions for production. Controlling the temperature and humidity is very important for ESD protection, the assembly process, gluing and painting processes and electrical tests." The firm conviction that the quality of services rendered is above all founded upon the know-how and skills of



the employees was another reason for retrofitting with air humidification in Bad Hersfeld: "Just as important as controlling the technical aspects of the production processes is the creation of an optimal working environment in which our employees are motivated and healthy. Having adequate humidity is also a key factor", Felix Timmermann adds.

Impressive overall concept

A direct room air humidification system has been providing standardized humidity in the ESD-protected production areas since 2016. Over 40 high-pressure direct room humidifiers guarantee optimum relative humidity of 45% year-round. For installation, Asteelflash merely required a mains water system and drain, plus an appropriate electricity supply. Everything is supplied to the build-



CASE STUDY

ing from a central mechanical room, where both the water treatment systems and the high-pressure pump are installed. These systems are connected to the humidifiers using specialized high-pressure hoses and control lines. Attached to the wall or ceiling, the small air humidifiers spray a micro-fine "mist" with a droplet size below 15 µm as required, which is immediately absorbed into the air and distributed evenly through the room. The required humidity is regulated using a digital control system. In each of the individually defined humidification zones of the halls. control units measure the current level of humidity and activate the humidifiers when it falls below the set target value. Dominik Baumbach from facility management was convinced by the overall concept from the outset, "The individually positionable humidifiers ensure good distribution of the humidity in the room and meet all hygienic requirements in combination with the professional water treatment."

Fewer production interruptions

Shortly after installation, the controlled humidity already had a positive impact on the pick-and-place machine: "Primarily with very small



SMD components of the 0402 design, we have less scrap and fewer stray components", Shift Director Jens Bick confirms. Optimal air humidity prevents electrostatic charging of the rotating blister straps and provides additional security in terms of preventive protection against early failures in the field. For other processes in the production chain, such as lacquering, controlled humidity is an important quality assurance parameter. Electrical tests and functional tests can also be carried out with utmost precision since the constant ambient humidity ensures a uniform current flow.

Thrilled staff

The climate has also improved significantly for the employees. "The air is much fresher than before, which is most noticeable in the throat and nose. And in the summer the humidification also has a cooling effect", line manager Cristian Ionita describes the positive feedback of his colleagues. Optimal humidity keeps the respiratory mucous membranes from drying out and thus protects against nose bleeds, burning eyes and infections of the airways. For Felix Timmermann, it is clear that the humidification system has more than just one



Fact File	
Humidification:	44 high-pressure fogging units
Rooms:	total 3,000 m ²
Required Humiidity:	45% RH
Start Up:	2016

benefit, "The system is important for optimizing our processes, but at the same time it also has a very positive impact on the well-being and health of our employees."

Asteelflash Hersfeld GmbH

- **1** Felix Timmermann sees two benefits
- 2 Controlled humidity at Asteelflash
- 3 Direct Room humidifiers
- 4 Air humidification in ESD protected area
- 5 Optimal in-line assembly with small components
- 6 Healthy indoor climate for employees

CASE STUDY ZOLLNER ELEKTRONIK AG, ZANDT/VÁC

Everything flows smoothly

Zollner Elektronik AG is one of the world's leading companies in the field of Electronic Manufacturing Services (EMS). Controlled humidity is an integral part of ESD protection at Zollner. Over 300 direct room humidifiers are used in Germany and Hungary for quality assurance.

Zollner AG employs over 13,000 staff worldwide at 25 locations globally. About half of the employees work in the two largest plants in Zandt (Germany) and Vác (Hungary) and offer a broad range of services ranging from electronic assemblies through modules to complete systems. The success story began in 1965 with the one-man operation of the company founder Manfred Zollner. Now, the company group offers complex mechanical systems from development to after-sales service for prestigious customers. "Having a technological edge and a best-costcountry strategy along the entire value chain are a matter of course for us", explains Bernhard Kirst, Head of Marketing at Zollner. The requirements of the customer alone determine the process depth provided by Zollner. Quality assurance is an important aspect in every project.



ESD protection

A direct room air humidification system has been part of the Zandt main ESD protection program since 2009. Over 200 high-pressure humidifiers are used at the location and ensure that electrical charges can be dissipated without uncontrolled discharges and the ensuing damage. Zollner manufactures in a relative humidity range between 30 and 70% pursuant to the international standard J-STD001. Parts of the 300,000 m² (3,229,170 ft²) production area were equipped with the direct room air humidification system in several phases of construction.

Reliable and accurate

Since 2015, the automotive production area in Vác, Hungary is also enjoying high-pressure direct room humidification. "We knew from our German colleagues how reliable these systems are, and we were very





happy about the decision", explains Géza Cser, Head of Building Technology in Vác. In selecting its humidification system, the individual configuration and controllability of the system were particularly important to Zollner. The necessary humidity levels can be individually adjusted for the various production halls in order to establish consistent conditions for ESD protection and the soldering processes. "We know we can rely on this technology, and we were very excited about the precise measuring and control technology of the humidifers from the start", Jürgen Janda, Facility Management Head of Building and Construction at Zollner (until 2015) remembers.

Cleaning the air

In addition to protecting against electrostatic discharges, the additional air humidification at Zollner also protects against contaminants in the



CASE STUDY

air. Processing functionally relevant components and systems requires taking into account environmental contaminants. If macroparticles are floating in the air, the cleanliness requirements cannot be met and this can lead to a functional failure of the product. Particularly in applications such as electromobility and high current technology, precise compliance with air and creepage distances is critical. Sufficiently high atmospheric humidity binds air particles, allows them to fall to the ground faster and keeps them from depositing and being kicked up again in the production halls. In order to comply with the cleanliness requirements, particularly in the electronics industry it is important that no additional dust is carried into the working areas due to the air humidification. To meet these requirements, Zollner uses multistage water treatment for air humidification.

Water and maintenance

Water treatment begins with water softening. Here, the calcium and magnesium salts are replaced with readily soluble sodium salts. In the next phase, the water is purified by being passed through a two-step mechanical filter. At the heart of water treatment is reverse osmosis. The pretreated water is almost completely desalted and sterilized by the membrane separation technique. An additional conductance synthesis completely removes all residual minerals dissolved in the feed water and thus ensures that no additional dust enters into the room. Reverse osmosis, the conductance synthesis and the high-pressure pump are installed in small mobile containers, which enables comprehensive maintenance and disinfection of the plants by simple replacement of the complete system. This standard service is performed by the manufacturer automatically at half yearly

Fact File		
Humidification:	326 high-pressure fogging units	
Rooms:	total 30,000 m ²	
Required Humiidity:	30-70% RH	
Commissioning:	since 2009 in several phases	

intervals. This maintenance concept is a big plus for Géza Cser, "The automatic replacement ensures that the plant is always functional and hygienic. We don't have to worry about maintenance, and everything works without a hitch."



Zollner Elektronik AG

1	For Géza Cser, everything works smoothly
2	Main Zollner plant in Zandt
3	Air humidification for automotive sector
4	More than 300 humidifiers in use
5	Controlled humidity means ESD protection

REFERENCES

¹ Welsher, T., What is the Real Cost of ESD Damage? In Compliance Magazine (2010, May 10), https://incompliancemag.com/the-qrealq-cost-of-esd-damage/

² Desco Industries, Cost of ESD Damage, https://www.descoindustries.com/pdf/CostofESDDamage.pdf

³ Universal Instrucments Corporation, Zopff, J., Challenges of Electro-Static Discharge (ESD) in the Electronics Industry (2015, July 6), https://www.uic.com/challenges-of-electro-static-discharge-esd-in-the-electronics-industry/

⁴ Electronic Design, Agarwal, S., Understanding ESD and EOS Failures in Semiconductor Devices (2014, February 6), https://www.electronicdesign.com/technologies/power/article/21799070/understanding-esd-and-eos-failures-in-semiconductor-devices

⁵ EOS-ESD Association, Inc,Electrostatic Discharge (ESD) Technology Roadmap 2025 (2024, September), https://www.esda.org/assets/Documents/EOS-ESD-Association-Inc.-Technology-Roadmap-2025-Final.pdf

⁶ Düllmann, M. and Mayer, F., National Statistical Offices and ZVEI's own calculations. Global Electro and Digital Insustry - Market Outlook until 2025 (2024, September),

https://www.zvei.org/fileadmin/user_upload/Presse_und_Medien/Publikationen/2024/Oktober/ZVEI-Welt-Elektromarkt-Ausblick_2025/01-ZVEI-Global_Market_Outlook_Electro_and_Digital_Industry_until_2025.pdf

Condair Group, founded in 1948 and based in Switzerland, is the global leader in humidification and a leading manufacturer of dehumidification and evaporative cooling systems. Supported by science, we engineer individual, holistic solutions that customers can trust through the entire lifecycle. With optimal humidity, we increase productivity and create healthier built environments.Condair Group has production sites in Europe, North America and China, its own sales and service organizations in 23 countries, and representatives in 50 locations worldwide.

USA 1021 6th Street, Racine, WI 53403 Canada 2740 Fenton Road, Ottawa, Ontario K1T 3T7 Tel 1.866.667.8321 Fax 613.822.7964 Email na.info@condair.com Website www.condair.com

