

# Understanding IP65 Rating: Enhanced Protection Against Dust and Water

Most [outdoor displays](#), digital signage, and out-of-home advertisement displays are made using LED display technology. These LED displays need high-level protection from environmental conditions that could affect their performance. Owing to that, these devices need to be protected against water and dust particles. Dust and water particle protection is stipulated by the IP65 rating standards. In this article, we will cover everything that you need to know about this rating.

## What is Ingress Protection (IP)



“IP” in the IP65 rating is an acronym that stands for ingress protection. It is a term that is used in many industries to imply the same thing. Internationally, it is described as [IEC 60529](#).

Ingress protection is a grading system that indicates the resistance level a device has to solid and liquid particles. In other words, how well can a device keep out water or dust from interfering with its internal components?

Ingress is another word for ‘entry’. The surface of most devices is usually covered by protective and resistant materials such as glass, plastic, and metal. However, on the inside, these devices have delicate components such as conductive motherboards and electrical connections that react negatively when in contact with dust or water.

This sensitivity to dust and water is the main reason why IP ratings focus on grading the level of resistance based on these two freely occurring particles.

Ingress protection is assigned two numbers. Each number has a scale of low or high, depending on the level of resistance to these particles.

The first digit in the IP rating shows the level of resistance to solid particles. Dust protection is graded on a scale of 0 – 6, with 0 being the lowest and 6 the highest. For instance, in the case of IP65, it means the device would have high resistance to dust ingress.

On the other hand, the second numeral shows the resistance to water particles. This is graded on a scale of 0 – 9, also, with 0 being the lowest, and 9 being the highest. Water ingress is hard to contain. As such, a 5 rating is pretty standard and shows the device is water-tight.

## IP65 rating explained

We have established a basis for the IP rating above. From that knowledge, we can now try to understand what IP65 means. Let us discuss the different ways in which IP65-rated devices prevent water and dust from damaging their internal components.

### Dust protection (first digit ‘6’)

There is dust all around us. Dust exists as solid particles which vary in size. These particles are known to have quite adverse effects on electronic components. We will look at these effects in another section of this article.

Dust entails the fine and granular particles of earth matter. This could include soil particles, wood chips, smoke, ash, and much more. Due to their small size, they roam freely in the atmosphere, making it easy for them to penetrate devices.

Protecting devices from the ingress of dust particles is essential. LED display manufacturers have different ways of restricting the entry of dust particles into these devices. They could use gaskets, sealants, and other advanced sealing techniques to achieve a ‘dust-tight’ enclosure. Displays that are rated as dust-tight tend to be attractive to most customers.

Specifically, for the IP65 rating, dust protection has a rating of 6, out of the possible 6. That means devices with this rating have the highest possible level of protection against the intrusion of dust particles, regardless of their size.

If you find yourself weighing options based on dust protection, you will be on the safe side if you pick an LED display with an IP65 rating.

### Water protection (second digit ‘5’)

Like dust, there is always water around us. Water exists in many forms. There is the known liquid and then there are the small molecules that are hard to spot using the naked eye. This type of

water is known as vapor and exists freely in the atmosphere. Water vapor is essentially water in its gaseous state.

Water has many damaging effects, especially on electrical devices. In that case, devices like LED displays need to be protected from water. This protection can take different forms, depending on the device manufacturer. Nevertheless, the goal is the same across the board.

LED displays are used in both outdoor and indoor situations. Water protection is primarily meant for outdoor LED displays. These displays are prone to moisture in the atmosphere, or the water from a downpour or humid conditions.

Technically, displays with an IP65 rating are designated as water-resistant. That means they are protected from water jets or splashes of water. However, these devices cannot withstand being submerged in water for long periods. This means that protection has its limits, and submersion is one of them.

Compare these higher water protection with higher IP ratings;

- **IP65** – Water resistant. Cannot be submerged in water.
- **IP67** – Water resistant plus. Can sustain temporary submersion, for up to 10 minutes.
- **IP68** – Waterproof. Can be submerged in water for depths of up to 3 meters.

From the above comparison, you can tell that the higher the IP rating, the more protection against water and its derivatives. However, this does not mean that IP65-rated LED displays are poorly designed. A rating of 5 is sufficient for water protection since contact with water can be limited using other techniques.

## Achieving dust and water protection in IP65-rated LED displays



Both the front and back of the cabinet can reach IP65 rating

The task of ensuring devices are protected against water and dust has become an industry standard. This means more and more manufacturers have included various techniques in their

manufacturing processes to achieve these. This includes researching fitting tools and components to seal openings that could allow water and dust to damage devices.

Let us discuss some of the general strategies used by the majority of LED display manufacturers to achieve dust and water protection. Remember that some manufacturers use proprietary techniques that are kept secret for legal reasons.

## Sealed enclosures

LED displays have several ports, openings, and crevices. Most of these openings are functional and strategically designed. As such, they are inevitable. When such a device needs to be left out in the open, these openings need to be sealed to protect it from dust and water.

In the electronics industry, there are many sealants used for these openings. Silicone has been used in its solid and liquid forms as the sealant of choice. This polymer is used for its resistance to water, and temperature, among other environmental stressors.

The sealants used in these conditions ensure that the ports and holes are still functional, but the entry of foreign elements is prevented. This is what makes IP65-rated LED displays resistant to water and dust.

## Gaskets

These are tools that seal gaps between two surfaces. Gaskets are used to seal connections between components to ensure that the device is dust and waterproof. They act as adhesives since they can withstand compression forces and still maintain form.

In the case of LED displays, gaskets are used on the panel, backlit plates, and other applicable sections in the whole system. Placing gaskets in these regions will ensure that the device is tightly enclosed in all areas where these foreign materials could penetrate through.

## Sealed connectors

LED displays require several connectors. These include power, I/O systems, and other auxiliaries that feed information to or from the system. Connectors such as USB and HDMI cables need to be sealed completely for IP65-rated displays. Failure to will result in more vulnerable ways in which the device will absorb water or dust.

Depending on the manufacturer, there are many components or methods used to seal these connectors. Some will use polymeric or plastic materials while others will use proprietary methods. Whichever the case, the goal remains to protect the LED displays against unwarranted entry of dust or water.

## Water-resistant materials

There are many water-resistant materials used in the electronics industry to protect the internal components of a device. Materials like these have hydrophobic properties that make them repel

water. As they are impervious to water, they will stop this water from flowing further, thereby preventing water damage.

Water-resistant materials include silicone, latex (natural rubber), acrylic, and other synthetic materials. These materials have a high degree of resistance to water and hence they are highly relied upon in the manufacture of LED displays.

## Ingress prevention

This is a culmination of all the tactics used to prevent the entry of dust and water particles inside an LED display. There are many preventative measures used on top of sealing connectors and enclosures, and using water-resistant materials.

Some of the common ingress prevention strategies used include installing the LED display in an area where it is less prone to dust and water. For instance, this includes having a shade over them for outdoor installations.

Another ingress prevention method used is using filters to prevent dust from entering. This method mostly prevents the larger particles of dust. The filters can be placed on the opening of an LED display where there is a likelihood of dust penetration.

## Effects of dust and water on LED displays

One might wonder why manufacturers are so keen on limiting the ingress of foreign materials in the insides of an LED display. For one, the internal components of an LED display are sensitive to water and dust. This sensitivity yields many damaging results. Here are some of the major ways in which dust and water an LED display.

### Heat build-up

Ventilation is essential in an LED display makeup since it helps the system dissipate excess heat to the surroundings. This heat needs to be expelled, otherwise, it would ruin the internal components of the LED display.

Dust and water contribute to heat build-up in several ways. First, dust particles can block the vents where the heat is supposed to be expelled, thereby increasing heat buildup. Blockages are a threat not only to the cooling system but also to the overall safety of the display. This is why IP65 LED displays are guaranteed more safety and longer lifespan.

### Visual artifacts

You have probably experienced artifacts before. Artifacts are distortions of graphics in a video or image that affect the overall image quality for the naked eye. They include glitches, flicker effects, [Moire](#) and so much more. Most displays are prone to these visual defects.

Visual artifacts can be caused by a number of things, including dust and water. The dust can accumulate and block some of the LED chips, which could contribute to issues like flicker and Moire effects. On the other hand, water can also short-circuit the LEDs and hence contribute to their damage, which in turn will cause inconsistencies in lighting.

## Dead pixels



Dying of pixels is a common occurrence for most LED displays. These tiny LED chips are made of organic or inorganic semiconductor material that is vulnerable under certain conditions. Water and dust are common culprits that contribute to LED death.

LED chips that require transistors will most likely experience death. It happens when these transistors fail to channel the voltage required to light up the pixel. In systems where the LEDs light up independently, this will lead to some parts of the screen being black. This observation will lead to inaccurate color representations, and hence poor visual quality.

Dying of LED pixels is not uncommon. However, major contributing factors such as water and dust need to be prevented from ingress to alleviate the chances of it happening. That is why IP65-rated LED displays are less likely to experience pixel death from dust or water.

## Increased maintenance

While maintenance is essential, it needs to be done moderately. Some manufacturers actually stipulate that too much maintenance can void a warranty. Maintenance of an LED display could include repairing, cleaning, or replacing components.

An LED display is likely to undergo regular repairs and replacement of components if it is not protected from dust and water ingress. These foreign particles will damage the internal components that will eventually get spoilt and require repairs.

Since most of the internal components of an LED display are electrical, the chances of them being damaged by water are high. Issues like short-circuitry are quite common for non-IP-rated LED displays.

## Color irregularities

Color accuracy is one of the major properties of LED displays. This accuracy can be affected if the internal components of the display are affected by water or dust.

Some LED displays have a color-filtering layer that helps reproduce the color gamut that is supported by the display. If this layer is blocked by dust particles, there are increased chances of incorrect color filtering. As a result, this leads to irregular colors of the display. While the inaccuracies might be subtle, they can affect the overall image quality.

## Electrical damage

Most electrical devices are significantly affected by water. The problem with these electrical damages is that they will most likely affect your other electrical devices. For instance, a power surge could cut out a fuse and affect other devices.

LED chips and their boards are subject to short circuitry from water. This water damages connections in the motherboard by corroding sensitive parts. As a result, the power supply is affected, which in turn affects the LED chips.

## Reduced lifespan

The lifespan of an LED display can be reduced by dust and water. Generally, these [displays are expected to last up to 100,000 hours](#) if used under favorable conditions. IP-rated displays on the other hand can last longer.

Using a non-rated LED display in conditions where it will be subjected to dust and water will lower its operational hours. Effectively, this means the device will have a reduced lifespan. This is why IP ratings are quite essential to ensure that an LED display can survive in harsh conditions for extended periods.

## The importance of IP ratings in LED displays

An IP rating is like quality assurance for your LED display. Primarily, it guarantees you protection against dust and water. Beyond that, there is the expected benefit that comes with this level of protection. Let us discuss some of these benefits.



- **Reliability.** When an LED display can withstand rain and dusty environments, it means that you can use it in harsh conditions without worrying. This flexibility means that you are not limited to a specific environment.
- **Uninterrupted performance.** For commercial use cases, downtime can be quite costly. This is why a dedicated and fool-proof LED display will be operational without having to worry about weather changes. This helps a lot, especially in places where the weather conditions are unpredictable.
- **Low maintenance.** If you keep having to clean or repair your LED display, check if its IP rating supports its current environment. Maintenance costs can get high, especially for large LED video walls.
- **Regulatory concerns.** It is a requirement in some regions or situations to follow strict guidelines regarding electronics use, particularly for outdoor setups. IP ratings are some of the regulatory measures followed.

These are just some of the expected benefits that come with an IP-rated LED display. Depending on your use cases, you might even experience more benefits from specifically using an IP65-rated LED display.

## Conditions where an IP65 rating is needed



As we saw in the definition, IP ratings are graded within a range of digits. Each range or level has a specific situation where it applies. In our case, IP65 also has specific conditions where it is most favorable. These are conditions where all the benefits discussed above will be expected. It is also where IP65 the most sense. Some of these conditions include;

### Extremely humid weather

Humidity is defined as the presence of water vapor in the atmosphere. While the atmosphere is mostly humid, these levels fluctuate depending on various factors. For instance, in hot and dry regions, humidity is usually low. However, cold and wet regions have high humidity.



IP65-rated devices are protected from mild showers. As such, there is assurance that an LED display can withstand humid weather. In effect, the system would be protected from the disturbance that is expected when water intrudes sensitive components.

## Duststorm-prone environments

In huge cities like New York where dust storms are frequent, there needs to be measures to curb the aftermath of this dust. There needs to be measures to protect the huge number of LED displays that are seen all over Times Square. And you guessed it, IP65 ratings on these displays can help.

These dusty places are a menace if left uncontrolled. Since most are natural occurrences, people have found ways to co-exist with them. Creating the IP rating system is one of the major solutions to coexist with natural phenomena.

## Most outdoor environments

Dust and water are not exclusive to soil and rainfall, respectively. In other words, there are many sources of solid and liquid particles that can impact the performance of an LED display.

In many outdoor environments, there are various types of dust particles that can penetrate an LED display. These include car fumes, industrial fumes, and factory emissions. While most of these particles are minute, they have a huge impact when they pile up. This is the same case for the various moisture sources that exist around us.

## Ip65 rating test procedure and standards

In the manufacturing and quality assurance processes of LED displays, IP-rated displays must be tested for ingress protection according to the assigned grade.

IP65-rated LED displays will undergo testing according to the specific nature of dust and water that it is expected to withstand. That means, these displays cannot be tested with water immersion since IP65 does not guarantee protection upon immersion.

Displays have to pass the specified tests to be certified as IP65-rated. If they do not, they might have to be assigned a more appropriate rating or be modified to fit the rating.

## Common IP65 tests for LED displays

The tests are divided into two; dust and water. The international community has standards that devices have to follow to be qualified as protected according to the grade.

- **Dust tests:** To test for dust penetration, an LED display panel is subjected to dust emissions in a dust chamber. This chamber is supposed to mimic a dusty environment and it is done in this fashion for control purposes. Afterward, measurements are taken and compared against pre-determined and theoretical values.

- **Water tests:** This test is made to test the impact of water jets on an LED display. It is also carried out in an enclosed chamber to facilitate easy records and other controls. Water tests are supposed to simulate a rainy environment.

These tests are mandatory for certification. IP65-rated displays come with manufacturer warranty information and manuals that stipulate the ratings. Therefore, in case it does not meet the expected protection, you can always raise a concern with the manufacturer.

## How to verify the IP65 rating



Verifying the IP rating is crucial. For one, it helps you make decisions based on what you need and at the same time verify that the correct rating is indicated. Most LED display manufacturers will have this information on easily accessible parts or sections. Let us discuss some ways to find and verify this information.

## Certification labels and markings

It is an industry-standard practice to label packages and products with important information such as IP ratings. This promotes transparency and makes it easy for you to identify this data for verification purposes. Honest manufacturers will keep this information handy and as accessible as possible throughout the LED display and its packaging.

## Consult product documentation and specifications

If for any reason the marks are not available on the packaging or the product itself, you can try to find the documentation that accompanies the product. These include installation manuals, warranty documents, or other handouts.

These specifications might even go into detail about what exactly the device, in this case LED display, is protected from. This is quite important since it paints a better picture of your expectations and helps you make better choices.

## Ask manufacturers and suppliers

This is the most effective method to verify the IP rating on an LED display. Manufacturers or their representatives have to know specific information about their products. Particularly, their sales teams have this information all the time.

Simply asking them for an IP rating is an effective way. This is because you get to get first-hand information from the source. However, take caution and verify for yourself from the documentation or perform tests if you have to. LED displays are costly. Therefore, it is wise to perform due diligence every time.

## Limitations of IP65 rating

While IP65 is sufficient protection against dust and water, it proves to be inferior in certain situations. This means it has some limitations that make it inferior or unfavorable. Let us discuss some of these limitations.

### Low humidity tolerance

Humidity and water splashes are different conditions. For the most part, IP65-rated LED displays can sustain some level of splashes. However, it is limited to how much humidity it can keep out of the device.

Picture an LED television. This TV has ventilations or speaker openings. While these openings could be lined with water repellants, moist air can penetrate. This can happen particularly in situations where the humidity and air pressure are high. Therefore, it means that the LED display will have a low tolerance to humidity.

### Not fully water submersible

Submersible ratings start at IP67. In the 7th grade means that the device can be submerged in water for a brief period. IP65 on the other hand is not designed or equipped to handle being submerged in water.

The main reason for this occurrence is that in submerged situations, there is a high hydrostatic pressure that will push the water toward the surface of the LED display. As a result, the water

pressure will break the components used to protect the penetration of water. Higher IP ratings have techniques to ensure the high pressure does not damage the sealants.

## Limited duration of exposure

Exposing LED displays to water and dust for extended periods will eventually weaken the protection mechanisms used. This is why graders specify the amount of time the device will handle without failing.

Such limitations are important to ensure the LED display is used appropriately. On the other hand, they are limiting in terms of reliability. This double standard is quite common and it helps you make decisions based on what you can and cannot compromise.

## Regular maintenance required

For IP65-rated LED displays to maintain their performance under the conditions we specified, they have to undergo regular maintenance. This includes cleaning, fixing faulty components, and ensuring the ingress protection mechanism is functional.

Failure to perform regular maintenance can be damaging. The LED chips in the display are delicate and prone to failure if neglected.

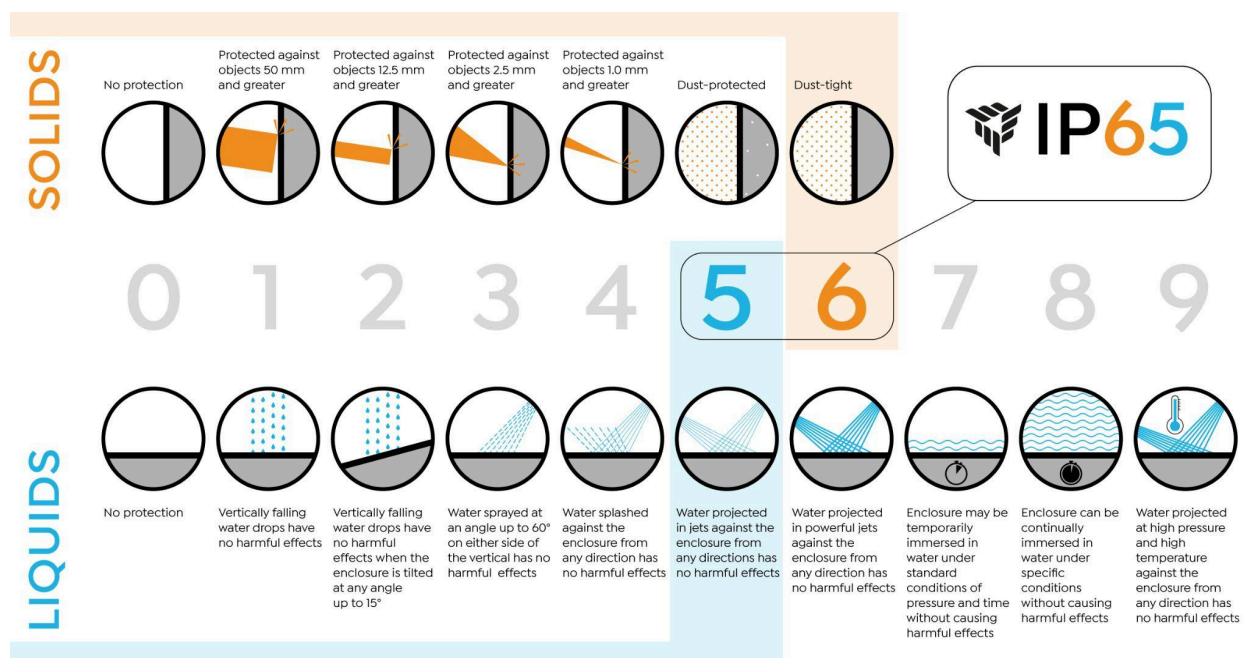
Liaise with your LED display supplier for best maintenance practices with the specific product to ensure the best outcome.

## Costly

For most tech products, the more the convenience, the higher the cost. This means it is expected for LED displays with IP65 ratings to be costly. This is justifiable in that the displays are somewhat weatherproof.

The purchase price of an LED display with an IP65 rating will be generally higher than for one without. The IP grading and enforcement is counted as an extra functionality which is calculated separately from the manufacture of the actual display. This cost is then added to the final cost of the display. That is what makes them more costly.

## How IP65 compare to other IP ratings



IP ratings are assigned depending on the device and its usage. As such, different ratings are used throughout the industry. For LED displays, you will find that IP65 is the standard IP rating. This means most LED displays with an IP rating can withstand dust and water.

Any device with a dust protection rating of 6 and above is considered dust-tight while below that is considered limited. You will find some devices have an IP rating with an X in place for dust-level protection. For instance, IPX7 means that the protection from dust penetration is not specified. This is used mainly for devices that have limited contact with dust.

Devices with IP67 and IP68 are known to be waterproof. This means that they can withstand water splashes and immersion for up to 30 feet for quite a while. These ratings are found on smartphones and underwater gadgets.

There is also an IP54 rating. For these, the devices are considered to have utterly poor protection from both dust and water. Dust protection is limited entirely, meaning that the device will not be able to sustain any amount of dust. Water protection for IP54-rated will be somewhat similar to the IP65 rating. Meaning a device will be able to sustain mild splashes of water.

IP54 rating is closely related to IP44. The difference between the two is minimal in terms of level of ingress protection. What differentiates them is the applications. In other words, the IP44 rating can be used in different products from IP54. For instance, IP54 rating is used in outdoor cameras while IP44 is used in bathroom lighting fixtures.

## Conclusion

Protecting LED displays from environmental stressors should be a priority. This explains why most manufacturers are reinforcing their products to pass an IP65 rating standard test. We have seen that dust and water can have adverse effects on the performance of these displays. Therefore, selecting IP65-rated LED displays is a major step in the right direction.