Desiccant Selection Guide for Engineers

Avoid condensation, corrosion and field failures with the right desiccant strategy.

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Why Desiccant Selection Matters

Moisture inside sealed or semi-sealed enclosures can lead to corrosion, electrical failure, mold growth and reduced product lifespan. For engineers designing systems exposed to temperature swings, altitude changes or humid environments, desiccant selection is no minor detail—it is a critical design decision.

Even low quantities of moisture can condense as temperatures decrease, creating conditions that compromise materials, components, or instruments.

Common failure risks:

- Condensation on electronics during temperature cycling
- Corrosion and rusting of metals during storage or transport
- Fogging of optics and performance degradation in aerospace systems
- Mold or material breakdown in long-term storage

Selecting the type of desiccant for your application, and installing it in appropriate amounts, helps maintain internal humidity levels and ensures long-term reliability.

Key Factors to Consider

Desiccant selection is not one-size-fits-all. The right choice depends on your application's environment, performance requirements and lifecycle expectations.

When looking for an appropriate desiccant, consider the four following criteria:

1. Volume of Air to Be Dried

The internal volume of your enclosure determines how much moisture is present.

- Larger volumes require more desiccant
- Free air space (not occupied by components) is what matters most
- Irregular shapes still follow the same principle: total internal air volume

2. Environmental Conditions

Consider both initial conditions at installation, and real-world exposure while stored or in the field:

- Temperature range (e.g., -40 F to 160 F)
- Relative humidity during packaging or sealing
- Exposure to outdoor, marine or high-humid environments
- Altitude changes (pressure cycling in aerospace applications)

These factors directly affect how much moisture enters the system over time.

3. Required Dryness Level

Not all applications require the same humidity level.

- General storage: moderate humidity reduction
- Electronics: low humidity to prevent condensation
- Military/aerospace: extremely low humidity, often MIL-SPEC driven

Define your target humidity or dew point early — it drives material selection.

4. Duration of Protection

How long does the desiccant need to last?

- Short-term shipping (days to weeks)
- Long-term storage (months to years)
- Lifetime protection within sealed systems

Longer durations require higher capacity materials or larger quantities.

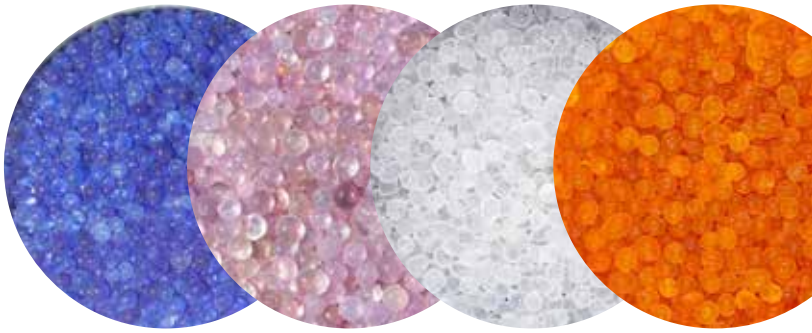
Types of Desiccants

Different desiccant materials perform differently depending on humidity and temperature conditions. For this reason, it's very important to consider the conditions under which your application will operate. See "Key Factors to Consider" for things to review, as they will help determine which desiccant is best for you.

Silica Gel

- Most commonly used
- Performs well across a wide range of humidity levels
- Cost-effective for general applications

Best for: Packaging, storage, general moisture control



Molecular Sieve

- Maintains fast adsorption rate until saturation
- Maintains performance at low relative humidity
- Higher cost but higher performance

Best for: Aerospace, electronics, critical low-humidity environments

Engineered Desiccants

In applications where standard packets or bulk options are not sufficient or prove difficult to work with, engineered desiccants provide improved performance, durability and integration.

H2OLock®

Pressed Desiccants

- Solid, pressed desiccant structure
- Designed for durability in high-vibration environments
- Reduces dusting and particle contamination
- Suitable for long-term or permanent installations
- Eliminates need for separate packets or cartridges
- Enables custom shapes and tight integration into assemblies

Best for: Aerospace, defense and ruggedized systems requiring reliable, low-maintenance moisture control.

H2OLock®

Injection Molded Desiccants

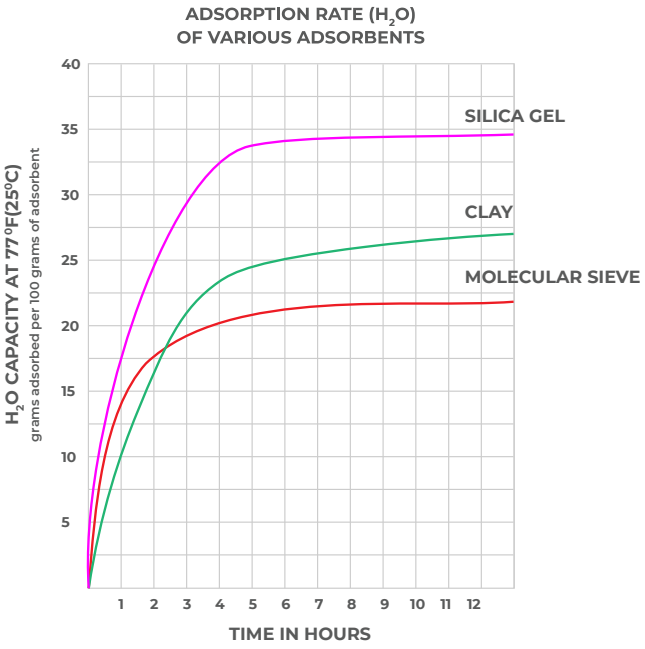
- Desiccant is shaped into molded components using injection molding
- Enables custom shapes and tight integration into assemblies
- Eliminates need for separate packets or cartridges
- Consistent performance and repeatability in production

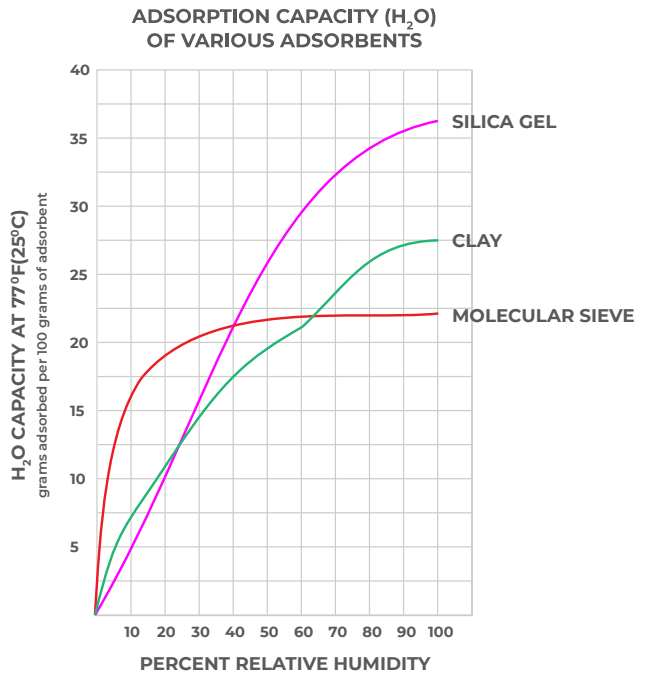
Best for: Space-constrained designs, high-volume production and applications requiring integrated moisture control.

Clay

- Low cost
- Moderate performance
- Limited effectiveness at low humidity levels

Best for: Basic packaging and non-critical applications





How Much Desiccant Do You Need?

Determining the quantity can be tricky to get right. Too little desiccant leads to early saturation and failure. Too much can add unnecessary cost and space.

General approach:

- Calculate internal volume
- Determine environmental exposure
- Define protection duration
- Include a tolerance margin for real-world conditions

Keep in mind that it's easy to underestimate moisture ingress over time — especially in non-hermetic systems. For this reason, error on the side of more when possible.

For assistance in determining desiccant requirements for your application, AGM provides a free desiccant calculator on their website. Additionally, AGM engineers are available to discuss your project requirements whenever you have questions.

Desiccant Units and General Quantity Specifications

According to MIL-D-3464, a desiccant unit is the quantity of desiccant that will adsorb 3.00 grams of water vapor at 20%RH and 25°C, as well as 6.00 grams at 40%RH and 25°C. Therefore, a unit of desiccant differs depending on the type of desiccant measured. For example, one unit of silica gel is equivalent to 26 grams, while one unit of molecular sieve corresponds to 28 grams. Furthermore, a minimum of 1.2 units of desiccant per cubic foot of air volume is recommended as a general best practice.

Recommendations:

Application condition	General Recommendation
Small, sealed enclosure with short-term protection needs	Silica gel is often a practical starting point
Very low humidity requirement	Consider molecular sieve
Long-term storage or harsh temperature swings	Increase desiccant capacity and apply a safety factor
Non-hermetic enclosure	Plan for ongoing moisture ingress, not just initial trapped air
Tight space or vibration-sensitive design	Clay may be acceptable
Cost-sensitive, non-critical packaging	Small, sealed enclosure with short-term protection needs
Electronics or aerospace application	Prioritize performance and integration over lowest cost

Important: These are starting points only. Final sizing depends on enclosure volume, sealing conditions, exposure environment and required service life.

Example: Desiccant Determination

The determining process may look like this:

- Start with the enclosure's free air volume, not the total outer dimensions.
- Consider the humidity and temperature at the time of sealing.
- Account for the lowest expected operating temperature.
- Factor in the length of protection required and whether the enclosure is truly sealed.

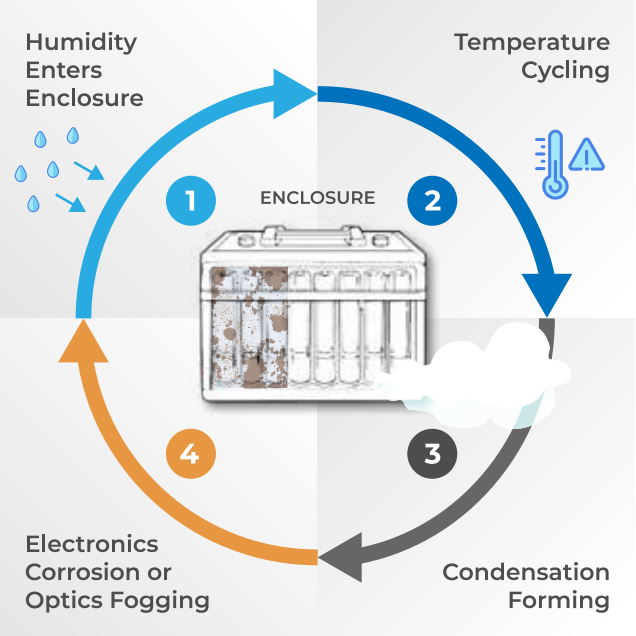
If we're given an electronics enclosure (such as an IP or NEMA rated cabinet), we may find that:

- The enclosure has 24 cubic inches of free internal air volume
- Is initially sealed at 77 F at 50% relative humidity
- Later, the enclosure may be exposed to temperatures as low as -40 F
- The cabinet will be installed for an undetermined length of time but will be used and inspected regularly.

In such an application, the goal is to reduce the risk of internal condensation when temperatures drop.

Accordingly, in this example, a small packet may be enough for short-term protection, but a more conservative design may call for added capacity if the enclosure will see repeated temperature cycling or long service life.

MOISTURE FAILURE MECHANISM DIAGRAM



Integration Considerations

Selecting the desiccant is only part of the solution. How the material is integrated matters just as much.

Packaging Options

- Bags or packets
- Rigid cartridges
- Molded desiccants integrated into the design

Design Considerations

- Placement within airflow path
- Accessibility for replacement (if required)
- Resistance to shock and vibration
- Compatibility with surrounding materials (low outgassing, etc.)

For long-life or sealed systems, engineered desiccant solutions—such as molded or solid-form desiccants—often provide greater reliability than loose packets.

When to Move Beyond Packets

Generally, when any one or more of the three considerations below are present, or if guaranteed performance is required, an engineered desiccant is the preferred option. Refer to section "When to Consider a Custom Solution" for more information.

- Vibration present
- 1+ year lifespan
- Sealed electronics
- Aerospace or MIL requirements

Common Mistakes to Avoid

Even well-designed systems can fail due to simple oversights.

Watch for:

- Under sizing desiccant capacity
- Ignoring temperature cycling effects
- Assuming a sealed system is truly airtight
- Not accounting for long-term moisture ingress
- Selecting material based on cost alone

A small upfront design decision can prevent costly field failures later.

When to Consider a Custom Solution

Standard desiccant packets work for many applications—but not all.

- You may need a custom solution if:
- Space is limited or irregular
- Long-term or lifetime protection is required

- The system experiences vibration or harsh environments
- Integration into the product design is preferred

Custom-engineered desiccants can improve performance, reduce maintenance and simplify assembly.

Advanced Desiccant Solutions

While traditional desiccant packets work well for many applications, some designs require more robust and integrated solutions.

Engineered desiccants can improve reliability, reduce maintenance and simplify assembly—especially in demanding environments.

Consider advanced desiccants when:

- The system is exposed to shock or vibration
- Long-term or lifetime moisture protection is required
- Loose particles or dust must be avoided
- Space is limited or geometry is complex
- The desiccant must be integrated into the product design

Integrated and Structural Desiccant Solutions

H2OLock®

Advanced Desiccant

A solid, durable desiccant designed for harsh environments where traditional packets may degrade or shift over time.

H2OLock®

Injection Molded Desiccants

Custom-engineered components that combine structural elements and moisture control into a single part—ideal for high-performance and space-constrained designs.

Engineering Support

Selecting the right desiccant involves balancing environment, performance and design constraints.

If your application has unique requirements—such as aerospace exposure, long-term storage or tight integration — working directly with a design engineer can help ensure the correct solution.

Need help sizing or selecting a desiccant?

AGM works with engineers to develop solutions tailored to specific applications and environments. **Call AGM** at (520) 881-2130, or **email engineering** at www.agmcontainer.com

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