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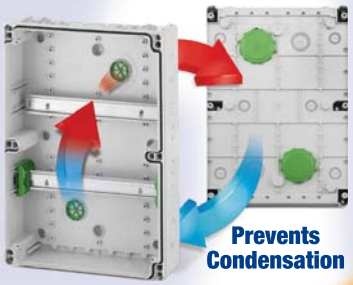
THINKING INSIDE THE BOX: ENCLOSURES

5 Quality UL Enclosure Series

TK Series

Small to medium enclosures
50 x 52 x 35 to 360 x 254 x 165 mm
1.97 x 2.05 x 1.38 to 14.2 x 10.0 x 6.50 in

- 18 different enclosures with up to 3 different cover heights
- IP66 (UL Type 4X)
- Polycarbonate
- Gray or tinted transparent covers
- Smooth sidewalls or sidewalls with knockouts
- Corrosion, impact and flame resistant



AKIII Series

Medium to large size enclosures
315 x 300 x 155 to 315 x 750 x 155 mm
12.4 x 11.8 x 6.1 to 12.4 x 29.5 x 6.1 in

- Integrated air ventilation
- Top/bottom interchangeable flange endwalls
- Height-adjustable mounting rail
- Optimized hinged window
- Combinable
- Fits 14-56 circuit breaker poles
- DLG focus test: Ammonia resistance
- IP65 (UL Type 3R)

EK Series

Small to medium size enclosures
130 x 94 x 80 to 361 x 254 x 110 mm
5.12 x 3.70 x 3.15 to 14.21 x 10.0 x 4.33 in

- IP65 protection (UL Type 4X)
- 5 sizes available
- Fits 2 to 24 circuit breaker poles
- Hinged transparent door
- High mechanical strength
- Corrosion and maintenance free

GEOS Series

Medium to large size enclosures
300 x 300 x 180 to 400 x 500 x 226 mm
11.8 x 11.8 x 7.1 to 15.8 x 19.7 x 8.9 in

- UV and weather resistant
- Gray or transparent covers
- Corrosion resistant
- High impact resistance - IK 09
- Modular component mounting
- Air Ventilation element option
- IP 66 / IP 67 protection rating
- UL TYPE 4X approved
- Drain Protect - Water Protection

TG Series

Small to medium enclosures
84 x 82 x 55 to 302 x 232 x 110 mm
3.31 x 3.23 x 2.17 to 11.89 x 9.13 x 4.33 in

- 16 sizes available
- IP67 (UL Type 4X)
- Gray or transparent covers
- Quickturn screw option
- Stainless Steel cover screws
- Integral cover retainers
- Recessed cover for label inlays or membrane keypads

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Your Source for Automation & Control Components

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THINKING INSIDE THE BOX: ENCLOSURES

CONTENTS

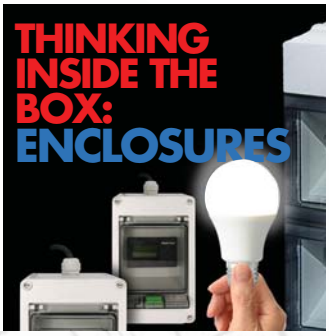
INTRODUCTION

Bob Vavra, Senior Content Manager

ENCLOSURES are like offensive lineman in football—you don't talk much about them unless something goes wrong. They are designed to protect your important assets. In football, it's your quarterback; in manufacturing, it's your sensitive electronic equipment and data systems.

Yet these enclosures should be seen not just as a box wrapping your assets, but an asset in itself. The materials it is made of and the function it performs will vary based on what's inside and where it is located. Indoor enclosures have a specific set of needs based on issues including safety and power management; outdoor enclosures must manage all of this and withstand environmental impact.

It's important to look past the initial cost of any asset, but it might be easy to overlook the nuances of an enclosure. This eBook is designed to give you an in-depth look at enclosures from every angle. The science around enclosures looks at many factors, from inside the box itself to its relationship with the environment and people around it.



CHAPTER 1:

Designing the ‘Emission-Proof’ Enclosure

Access hardware and gaskets can combat the effects of electromagnetic interference.

It is no secret that electronic equipment is becoming ubiquitous, smaller, and ever more closely packed. Digital circuitry operates at increasingly high clock rates. It is increasingly difficult to keep the resulting electromagnetic radiation in its place. A complicating factor is that as digital circuits supersede analog, the type of radiation changes from primarily electric-field mode to mostly magnetic-field mode. Magnetic-field mode energy is less easily reflected by a conductive surface than electric-field mode, making shielding more difficult.

Shielding is not the only answer, but often it is the most cost effective one. Cabinets that incorporate shielding keep internally generated radiation from disrupting other equipment and can keep out externally generated EMI that might otherwise garble signals within the enclosure.

A typical enclosure falls short of the ideal Faraday cage primarily around door edges and through cut outs for handles, latches, hinges, ventilation, and cables. This is known as aperture leakage. It is an increasing problem with higher frequencies.

Shielding (attenuation) is usually measured in decibels, denoted dB. This is a log scale, and some of the approximate reductions in intensity of electromagnetic radiation are shown in the table.

Weakening (%)	Attenuation (dB)
90	20
99	40
99.9	60

Low-frequency emissions can better penetrate shielding material whereas higher frequencies with shorter wavelengths infiltrate through even small openings. Thus shielding materials are not uniformly effective across the whole frequency range. So material sup-

pliers show attenuation qualities as graphs.

Examples of the frequency ranges include electrical devices such as circuit breakers that typically emit noise at frequencies between 100 kHz and 300 MHz. In addition, relay noise can run from 10 kHz to 200 MHz, and motor noise from 10 to 400 kHz. Telecom equipment requires shielding at higher frequencies, over 1 GHz in some applications.

Door Edges

Most gaskets don't seal securely over a large range of gasket deflections unless they use a high closure force.

The more force a gasket requires to form a seal, the more the door bends. If the door bends appreciably, it may not compress the gasket at points remote from the latch or latches. This has been a problem for those who build cabinets to NEMA-12, NEMA-4, or to other standards with similar environmental requirements. This is why a good gasket must seal at low compression forces and over a wide range of compression distances. Emka bubble-type gasketing supplies those two properties and is widely used. In contrast, enclosure manufacturers that employ other gasket types must either build in more latching points than would be necessary, or stiffen the door.

EMI shielding has many of the same requirements as environmental sealing. It must have good conductivity to work effectively over the whole range of frequencies. Moreover, there must be good conductivity between the gasket and the door as well as between the gasket and frame. Obviously, the gasket must intimately contact both the frame and the door of the enclosure to insure this conductive path.

For example, suppose an enclosure has a latch installed in a lower corner. This exaggerates and clarifies the interaction between enclosure frame, gasket, and door. There's a force on a cam inside the door frame to keep the door closed. This force comes from compression on the gasket when the door is pushed closed and locked. However, the gasket pushes back on the door with the same force.

With a perfectly stiff door, the gasket would push against the door equally at all points. But the latch placement is such that there is a longer length of door above it than below it. This geometry twists the door, away from the enclosure at the top and towards it at the bottom.

Compression on the gasket drops as the door twists away. So the top of the door may not even touch the gasket. Gasket material at the bottom of the door is probably over compressed and will fail prematurely. It is the compression on a gasket that forms the all important seal.

In cabinet designs with one latch in the center, the door tends to bow out at the top and bottom. Doors with latches on the top and bottom will bow out in the middle. Exactly the same happens on the hinge side at the top and bottom door edges.

Designers can solve the problem in several ways. One is to stiffen the door. Typical methods use heavier-gauge metal, welded in stiffeners, or flanges made deeper or bent back. All these tactics cost money and add weight. They would probably be prohibitively expensive on a large cabinet.

Another approach might be to use another latch and possibly another hinge. The system would have more uniform gasket compression. This is the main reason for three and multi-point locking systems. A third hinge not only improves the consistency of compression on the door's hinged edge, but stiffens the whole door. Again, extra hardware and assembly

time boost cost.

A third option would be a gasket that compresses at low forces. The bubble-type gasket, for example, typically needs only 25% of the compression force for a foam gasket. This translates into approximately 75% less deflection in the door. Therefore. the door can be less stiff or incorporate fewer latching points.

Gasketing that works over a wide range of compression can handle more twist without leaking. Bubble-type gaskets have an operational range of compression of up to 11 mm. This capability tolerates more twist thus further reducing the need for stiff doors and multipoint latching systems.

All in all, gasketing shouldn't be an afterthought. The type of gasketing should be a factor in deciding on how to design flanges, doors, and other features. Designs aiming for maximum cost effectiveness should consider them from the beginning.

An additional advantage of the bubble-type gasketing is its availability in EMI shielding versions. Cabinets employing this method can be easily upgraded to EMC standards.

Several factors can effect gasket shielding reliability. For example, paint and powder coatings are insulators, and should be eliminated from the gasket area. Unfortunately this allows corrosion. Corrosion can reduce EMI shielding by 20 to 32 dB over several years, depending on humidity, without special measures. Loss of attenuation arises from non or semiconductive oxides which are products of corrosion. They increase electrical resistance at the metal-to-gasket junctions.

Ironically, the very conductivity of conductive gaskets means they support galvanic corrosion. Galvanic corrosion occurs when two dissimilar metals make electrical contact in the presence of an electrolyte, which can be moisture.

However, corrosion does need to be prevented. Though plating is often ineffective against galvanic corrosion, there are proprietary coatings which can be successful with the proper care.

Conductive tape can be an economical and reliable way to provide a conductive circuit and eliminate corrosion. This tape goes on the cabinet prior to painting. Production personnel apply it to the metal where the gasket will touch. The cabinet then gets coated and baked. Workers later remove an outer layer of release paper on the tape to reveal a permanent, corrosion resistant, conductive surface for gasket installation.

Durability

Effective shielding is important not just when the cabinet is new, but throughout its life. Besides experiencing corrosion, gasket shielding can degrade in other ways. One is through repeated flexing from door openings and closings. Here conductive particles become electrically isolated from the surrounding substrate reducing effectiveness.

Another source of degradation comes from gaskets taking set when they repeatedly compress and relax. They effectively stop springing back to their original shape. This phenomenon can increase resistance or even cause an air gap between the metal and the gasket.

The sliding motion of a door across a gasket can wear the gasket surface, eventually causing conductivity loss. The obvious way to solve this problem is with a door design that avoids any sliding action

Finally, designers must be aware that the physical qualities of elastomers change with age. The presence of heat, ozone, water, sea water, UV light, oils and other chemicals

exacerbates the effects. Most commonly, elastomers become hard and crack, causing problems in both environmental and EMI sealing.

The elastomeric substrate of choice for most applications is EPDM, which works well in harsh environmental conditions. Compression set is minimal and can be further reduced through profile design. In addition, the rubber flexes instead of compressing, mitigating the effects of repeated opening and closing.

Vulcanizing a complete wrap of conductive nylon fabric to a bubble type EPDM substrate achieves the optimum in EMI shielding. A complete 360° wrap gives two layers of shield. Emka uses a woven fabric with silvered fibers further coated with an organic anticorrosion layer. This ensures permanent conductivity throughout the surface of the gasket.

Handle and hinge cut outs

It is possible to virtually eliminate radiation leakage through handle and hinge cut outs in the doors: just design the latching system to work outside the gasket. This approach is simple and costs about the same as an "inside the gasket" system. There is however, a trade-off. For a given cabinet width, the opening will be slightly narrower. The difference can be as little as a half inch with careful design, and the use of handles specifically designed for this purpose. Of course, it is impractical in some designs to keep latches outside the gasket. Here the first precaution is to make cut outs as small as possible. For example small quarter-turn latches can often serve in place of larger flush-swing handles.

Second, metal or metal-plated handles can help. They should be grounded to the door. As an example, the Emka 1150 standard zinc die-cast handle has an attenuation of up to 70 dB. A Nylon 1125 handle attenuates 60 dB or less for most of its range. Chrome plating the 1125 boosts attenuation to over 100 dB. The cut out is larger on the 2100 handle, limiting peak attenuation to about 95 dB even with chrome plating and good grounding.

A few guidelines for hinge selection can help ensure a well-shielded enclosure. Well-grounded metallic hinges with minimum-sized cut outs work well. Weld-on types would be the first choice, but clamp-on or screw-on types with grounding plates or nuts are usually successful and cost less to install.

A successfully shielded enclosure must also work reliably in practice. Flexibility is important as well. Latches and hinges should be able to accommodate both right-hand and left-hand opening doors. In addition, interchangeable hardware can make for easy upgrades. Hardware commonality, for example, can let designers change a standard cabinet to an EMI-shielded version, or to a shielded NEMA version without reengineering and using the same inventory. In all, designers can reduce the effects of EMI at reasonable cost with some thought during initial design.

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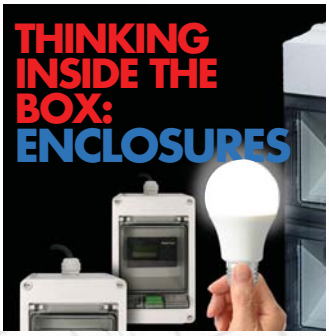

Polycarbonate GEOS enclosure.

CHAPTER 2:

Non-Metallic Enclosures Compared to Metallic Enclosures

What you want from your enclosure is long-term, productive service. Knowing your application and the environment in which it will be located will help, but understanding the materials available will complete your research so that you can make the right decision for your particular application.

What you want from your enclosure is long-term, productive service. Knowing your application and the environment in which it will be located will help, but understanding the materials available will complete your research so that you can make the right decision for your particular application.

Often in the design process, enclosure selection is one of the last things to consider. Alternately, the enclosure is selected up front, but based solely on what was used before or what is familiar and not what the application and environment might demand. There are many design engineers who believe that their only enclosure selections are between metal and plastic enclosures. This, of course, is only partly true.

When making the decision for purchasing the right enclosure for your application, there are a number of considerations to think about—besides environment, which includes corrosion resistance **(see Sidebar I)**, temperature, size, weight, and more. Other things to examine in your research include electrical safety, conductivity, and shielding properties; security access in the event of vandalism; cooling or

Outside application photo of polycarbonate enclosure.

SIDEBAR 1: Recommended Materials for Corrosive Environments

Recommendation	Acids	Alkalines	Solvents
Highly Recommended	• Stainless Steel • Fiberglass	• Fiberglass • Stainless Steel	• Fiberglass • Stainless Steel • Aluminum • Powder Coated Steel
Acceptable	• Polycarbonate • PVC • Powder Coated Steel	• Polycarbonate • Galvanized Steel • Powder Coated Steel	• Galvanized Steel
Limited or Unacceptable	• Aluminum • Galvanized Steel	• PVC • Aluminum	• Polycarbonate • PVC

heating requirements; the aesthetics of the device based on whether it will be visible or not; and the overall value and cost of the system when taking into consideration time in service and initial costs.

The Basics of Metal Enclosures

Design engineers often think about purchasing metal enclosures first, based primarily on the idea that they are stronger and more durable than most other materials. This may or may not be the case dependent on the application but, more importantly, these considerations may not be necessary in the first place. For example, you may not need an enclosure that is durable if the components being protected are housed deep inside a piece of equipment that already has its own environmental control, and is not subject to the outside environment at all—think subsystems, additional Wi-Fi circuits, or an upgraded sensor system.

When considering some of the factors mentioned above, size and weight can be a bigger issue than simply protection. This is especially the case in many automotive, medical, marine, and agricultural applications where compactness and minimal weight are key features. Further, metal enclosures often require additional sealing to keep out moisture and water. They are mechanical in nature, requiring either hinges and doors or two sections that must be bolted or screwed together.

Corrosion resistance is an important item to think about when using metal enclosure materials. Most metals corrode, under particular conditions and at rates that depend on the type of metal used and the environmental conditions in which it is located. Consider the food and beverage industry where continual washdowns—often with detergents and chemicals— are part of the daily or weekly environment. Such regular abuses might preclude the use of company labeling and branding opportunities as well. Stainless steel and aluminum, for obvious reasons, are common choices for enclosure material, based on their high resistance to corrosion. When designing a system that will be used in harsh environments, these choices may provide you with reliable protection where other metals do not. Stainless steel enclosures are often highly expensive to purchase, making them difficult to purchase when project budget is an issue.

Strength and toughness can be a clear factor when deciding on the right enclosure. Strength is a measurement of the material's resistance to failure. Toughness, on the other hand, measures a material's ability to withstand sudden impacts. These two features work together, in that increasing toughness usually decreases strength and vice versa. When

using a metal enclosure, such as stainless steel or aluminum you may get high strength, but units may dent easily, reducing the integrity of the box—and possibly breaking the sealing ability of the unit dependent on the type and material of the seal used.

For example, when an enclosure is not flush and the seal loses its properties, the enclosure is no longer water or air-tight; moisture and particulates are key reasons some electrical and electronics components fail. Plus, the internal controls and circuits can also become easier to access, reducing security of the system overall.

The Basics of Non-Metal Enclosures

Some of the most used materials for non-metal enclosures include polycarbonate, polystyrene, and ABS. It's important to note that regular advancements are being made in plastics technology. What you may have found unavailable one year may be available the next.

When it comes to polycarbonates, some are available that feature UV stabilizers used to protect the material from sun overexposure. Others may include a formulation that includes glass fibers, which can significantly increase tensile strength, flexural strength, and flexural modulus, in addition to providing greater heat deflection for temperature sensitive applications.

Plastics are often more amenable than metals to be worked, molded, and modified to fit a specific application. This versatility allows such materials to be used in a wide variety of applications, because having flexibility in material components makes it easier to fit a specific need. Plastic enclosures have the added benefit of being lighter in weight, which makes them easier to handle and ideal for handheld devices, as well as for mounting on delicate surfaces such as sheetrock.

Some additional features that plastic enclosures make available: UV performance, broad temperature range, chemical resistance, waterproof, non-magnetic and electrical insulating, ease-of-processing, self- extinguishing flammability properties, and ease of modification. There are plastics that won't dissipate harmful gasses in the event of fire, and there are some chemicals that react negatively to metals where plastic enclosures are more suitable. Note also that most often plastic enclosures are less expensive than metal

Shown are stainless, aluminum and painted steel enclosures.

SIDEBAR 2: Pros and Cons for Primary Metal and Non-Metal Enclosure Types

Metal Enclosure Types	Pros	Cons
Stainless Steel	• Corrosion resistant • Impact resistant • RFI/EMI shielded	• More expensive than low carbon steel or aluminum
Low Carbon Steel	• Inexpensive metal • RFI/EMI shielded	• Requires coating to prevent rust • Will rust if coating wears off
Aluminum	• Rust resistant • Lighter than steel	• Lower impact resistance than steel
Non-Metal Enclosure Types	**Pros**	**Cons**
Polycarbonate	• Highly impact-resistant • Nice appearance • Allows for RFI/EMI transmissions	• More expensive than PVC, ABS, and Polystyrene
• PVC • ABS • Polystyrene	• Cheaper than polycarbonate • Allows RFI/EMI transmissions	• Lower impact resistance • Limited temperature range
Polymer-fiberglass composites	• Corrosion resistance • Weight to strength ratio • Allows RFI/EMI transmissions	• Blooming

enclosures and have shorter lead times, especially when semicustom or custom elements are needed.

Consider the Application

Manufacturing control systems, as well as process control systems are often direct-wired and may depend on being RFI/EMI shielded from the electrical noise present in those applications. When a metal enclosure is used, the components inside are automatically protected against such outside interference, making the overall system robust in nature. This same shielding works well with other heavy machinery, such as equipment found in the machine tool industry. Such applications often have additional needs for chemical resistance.

For these types of applications, non-metal enclosures may need to have additional shielding to maintain a safe place for sensitive electronics. Further, such enclosures may need to have special seals or use particular materials that allow them to operate in the harsh environments of the factory floor. In either case, if the enclosure houses delicate electronic circuitry there may also be a need for cooling hardware to be installed. Metal and non-metal enclosures have their value **(see Sidebar II).**

Since so much equipment and systems are being upgraded with wireless communications built into them, the enclosure market has had to keep up. When using metal enclosures, the user may need to install an external antenna in order to get optimal use from the system. If the environment dictates that a metal enclosure is necessary, be sure to also research any antenna network you plan to use with it to be sure that the antenna can also handle the harsh environment.

Consider that external antennas are often vulnerable to environmental elements, such

as corrosion, ferrous oxide deterioration, and natural ambient interference from the environment itself. This may be the biggest reason why design engineers are switching to non-metal enclosures in communications applications: They allow for free transmission of electronic signals.

Because most non-metal enclosures enable electronic signals to transmit through the enclosure itself, the choice of enclosure material becomes more dependent on its ability to resist corrosion, tolerate the use of harsh chemicals, maintain a strong and tough exterior, and sustain its thermal capabilities. In addition, non-metal enclosures provide engineers with an attractive finis, and can be easily adjusted for changes added later. These include cutouts for additional access to the electronics, whether for quick security checks, to download information, or for audio/video connections.

Non-metal enclosures have, over the years, proven to be durable, never rust or corrode in harsh environments, and provide secure and lockable lids to prevent unauthorized access. They are more resilient to impact (they give rather than dent) and allow wireless systems to easily operate without an external antenna.

The one negative consequence of using metal enclosures is the compromise of the gasketed seal, which is extremely important to prevent moisture, dust, and other environmental factors from damaging internal controls. Non-metal enclosures usually have the seal inside a groove in the lid, which protects it from direct damage. All of this helps to explain why non-metal enclosures are frequently replacing metal enclosures in many applications.

In conclusion, remember that your application is the most important guide to what type of enclosure you will want to purchase. As mentioned, going with the same enclosure for every application typically isn't the right path to take. When doing your research, find companies that have multiple options available, have been doing business for a long time, and have experience and expertise in how to select and implement enclosure technology. Enclosure needs, like other vital components inside your application, should be selected carefully and confidently.

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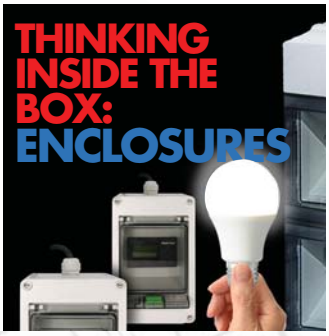

CHAPTER 3:

Non-Metallic Enclosures Offer Clear Benefits in Agriculture

Electrical and electronic cable, connectors and related subsystems need rugged enclosures for the harsh agricultural environment, where non-metallic enclosures offer distinctive benefits compared to conventional units.

It is well-known that many industrial installations and production facilities are often harsh settings, with oil, dirt, vibration, physical abuse and other numerous issues. In contrast, many people envision an agricultural setting as crops in the field, often with animals quietly grazing or resting in their barn. The image is all peaceful and benign **(Figure 1).**

Despite this image, the reality is quite different — and it is a harsh one.

A modern agricultural operation can be as bad as or even worse than an industrial environment.

There are constant dirt, crop dust and discards, physical impact, extreme temperatures (both hot and cold), extreme weather (storms, flooding) and more. Further, unique to the farm environment is the presence of animal waste (primarily ammonia), which is corrosive to many materials.

Therefore, rugged enclosures are needed to enable effective and reliable modern farm work. These enclosures

Figure 1. A farm may seem a quiet and clean operation compared to an industrial facility, but it is actually more challenging in terms of dirt, dust, waste, impact and corrosive environment. Source: Altech

Figure 2. Non-metallic polycarbonate enclosures, such as the dust- and moisture-proof TK and TG series from Altech Corp. offer many useful performance advantages and attributes in the farm/agriculture environment, as compared to metallic units. Source: Altech

house and protect electrical lines, lighting controls, switchgear, safety and security wiring, even sophisticated electronics; they are also critical for user and livestock safety.

Enclosure Considerations Define Selection

The common solution is to select a suitable metallic enclosure, either steel or aluminum, to provide the needed ruggedness and protection. However, in the case of farms, a non-metallic polycarbonate enclosure **(Figure 2)** can be the better choice, as it resists moisture, corrosion, chemicals and even ammonia.

Polycarbonate enclosures offer other advantages in addition to basic ruggedness. Obviously, they are rust-proof and have no surface finish that can wear or chip, thus allowing rust to take hold. Further, these non-metallic units meet various relevant standards, among them:

- UL94 (Flammability of Plastic Materials);
- NEMA IP66/67 (particle and water ingress);
- VDE 0471 (fire hazard);
- IK07 (impact);
- Wide operating-temperature range of -35 degrees C to +80 degrees C.

A special feature of polycarbonate enclosures is that they can tolerate high concentrations of ammonia, meeting the stiff certification requirements of the German Agricultural Society (Deutsche Landwirtschafts-Gesellschaft, or DLG). They can withstand an ammonia concentration of 750 ppm (parts per million) at 70 degrees C and 70 percent humidity over 1,500 hours of continuous testing.

Customization Opportunities Make an Additional Difference

While the physical sizes of polycarbonate enclosures are standardized, this is not a serious constraint, as they are available in a wide range of height, width and depth dimension combinations. Once a basic enclosure is chosen, many attributes and features can easily be customized. Vendors can do value-added work to reduce end-user effort even for moderate volumes, typically beginning at just 25 units **(Figure 3).** Among these are:

- Choice of hinge type (internal, external);
- Choice of mounting style and orientation;
- Panel cutouts for displays, indicators, keypads and other functions;

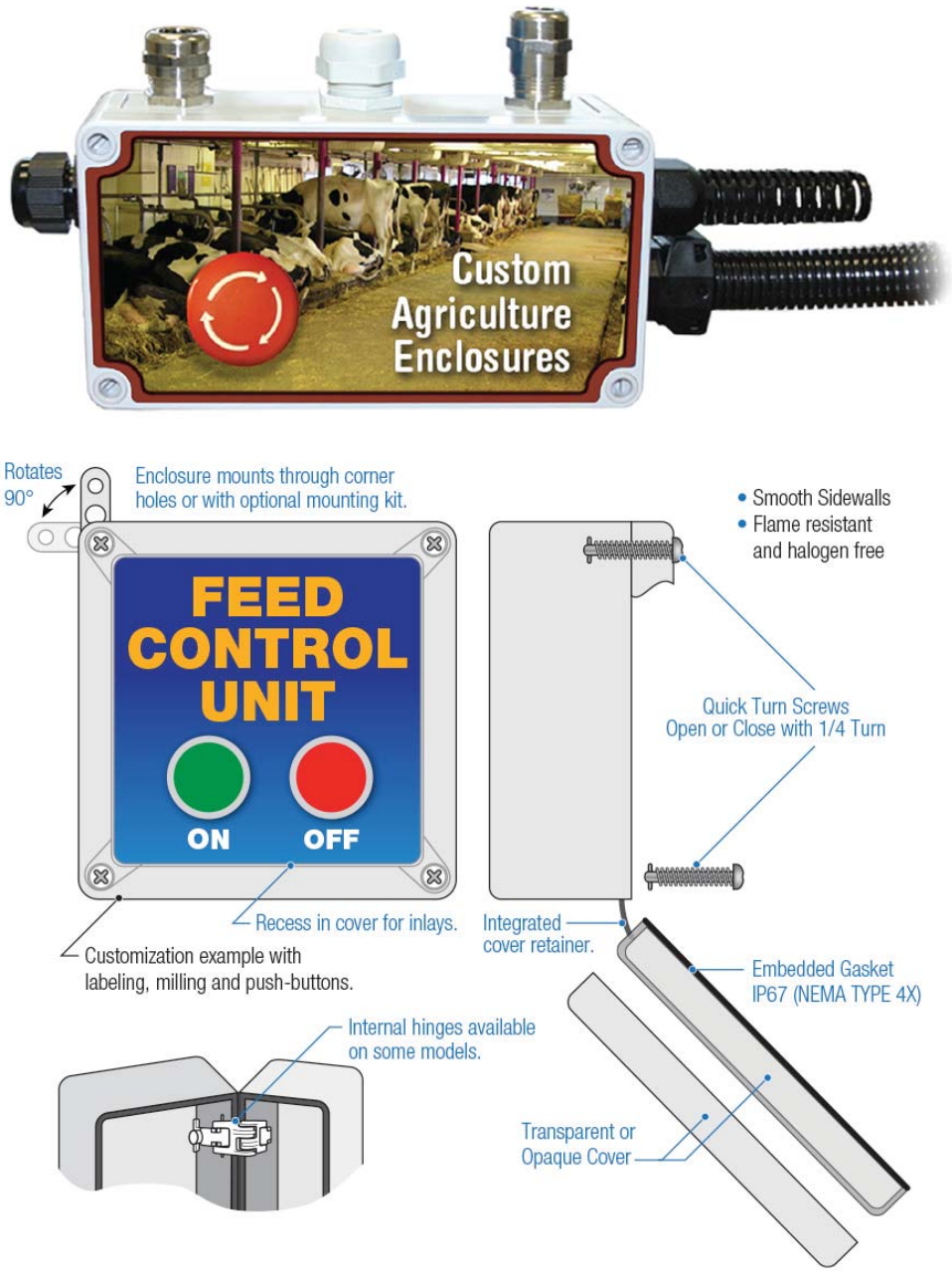

Figure 3. Non-metallic polycarbonate enclosures are offered with many standard options as well as customizable options. Source: Altech

- Pre-packaged connectors and pushbuttons;
- Imprinting and labeling;
- Choice of transparent or opaque cover.

Polycarbonate Enclosures: An Attractive Alternative

Non-metallic polycarbonate enclosures can be a superior and flexible match for harsh applications such as agriculture, especially due to their corrosion and ammonia resistance. They meet and exceed all relevant industry standards for corrosion, impact resistance, ingress protection, flammability and more. Further, the vendor can customize many aspects of these enclosures to meet specific user requirements and preferences.

For more information on choosing and using non-metallic polycarbonate enclosures, contact Altech Corp.

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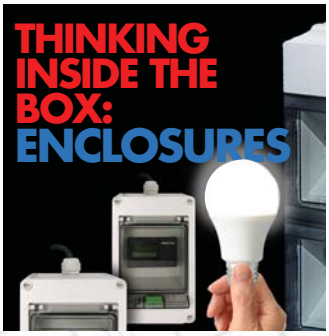

CHAPTER 4:

Key Steps in Achieving Recognition Certification for Electrical Encoders

A new recognition certification from the UL for access hardware components helps electrical enclosure accelerate to the market.

Until recently, electrical enclosure manufacturers faced a challenge: In order to build enclosures that were UL 50E Type rated, additional testing and evaluation of the enclosure was almost always required due to the unknown compliance status of components, such as hinges and latches used in these enclosures.

However, UL recently released FTTA2/FTTA8, a new Recognition Certification for the U.S. and Canada. This new Recognition Certification for enclosure accessories assists manufacturers who wish to utilize Type or rated hinging and latching accessories in enclosures complying with the requirements of UL 50E, respectively.

UL 50 and UL 50E are two UL Standards for electrical enclosures. UL 50 applies to enclosures for electrical equipment intended to be installed and used in non-hazardous locations in accordance with the Canadian Electrical Code, Part I, CSA C22.1, the provisions of the National Electrical Code, NFPA 70 and the provisions of Mexico's Electrical Installations.[1] UL 50E covers additional environmental construction and performance requirements for these types of enclosures.

With the new FTTA2/FTTA8 certification, enclosure manufacturers may be able to reduce the significant time and cost associated with having to put their enclosure through all facets of UL 50E testing (e.g., corrosion resistance, gasket integrity, and plastic concerns such as UV, water exposure and immersion, and flammability requirements). By properly and pre-emptively selecting registered components under FTTA2/FTTA8 and leveraging exemptions for other materials used to construct the enclosure, enclosure designers can achieve their desired Type Rating with a final hosedown test of the end-item.

This makes it possible for enclosure manufacturers to accelerate market access efficiently without compromising product safety. Risks from sourced components are mitigated, as there are no latching and hinging hardware corrosion protection and plastic requirements, gasket testing and traceability issues that the enclosure manufacturer must test for and document on their own. Although a final hose down test is always required, latching and hinging hardware is also vetted for different levels of water ingress testing in isolation.

Enclosure manufacturers face many challenges when certifying their end product to meet environmental compliance. By properly and preemptively selecting UL Recognized components under FTTA2/FTTA8, enclosure designers can achieve their desired Type Rating with a final hosedown test of the end-item.

Using UL Recognized components in electric utilities enclosures can safeguard against the possibility of equipment failure, helping to prevent power outages, upset residential and commercial customers, and expensive repairs.

Understanding UL Recognition Certification

To understand FTTA2/FTTA8, it is useful to understand how UL evaluates and certifies components according to UL standards. A complete product is ultimately an assembly of components, often thought of as building blocks. Components can be either Listed or Recognized by UL. The simplest method by which to comply, on a component level, is to start with certified components.

With UL's component recognition service, UL determines that a manufacturer has demonstrated the ability to produce a component for use in an end product that complies with UL's requirements. This type of investigation takes into account the performance and construction characteristics of the end product and how the component will be used in that product.

The new FTTA2/FTTA8 Recognition Certification covers a broad range of enclosure accessories, including:

- 3-point handles
- Butt and concealed hinges
- Draw latches and compression latches
- Captive fasteners
- Quarter-turn fasteners
- Swing handles

The environmental testing and certification provided by UL can potentially eliminate common "pain points" that enclosure manufacturers can encounter when trying to comply with UL 50E, most notably during the product development process.

If component products do not comply with UL 50 and/or UL 50E, the entire enclosure needs to be refitted and tested again, which can lead to a continuous loop of cost and testing time. To illustrate the cumulative impact of this loop, it can add up to 50

days or more to the timeline for completing one FTTA2/FTTA8 corrosion test – a major disruption of a manufacturer's development plans.

Testing can range in complexity, manufacturers may not have the equipment needed to test under certain environments, or may not have the manpower to perform these tests. Ultimately, this type of testing can exhaust the resources of the enclosure manufacturer and extend their end product's time to market.

Using components that already comply with FTTA2/FTTA8 provides added peace of mind to the manufacturer's end customer, in that the functionality of that enclosure will not be affected when used by operators in the field. For instance, using certified hardware in electric utilities enclosures can safeguard against the possibility of equipment failure, helping to prevent power outages, upset residential and commercial customers, and expensive repairs.

UL Testing and Evaluation Process

UL conducted three highly rigorous environmental exposure tests to assess the samples selected from the hinges, latches and other products submitted.

- A 25 day/600-hour salt spray test where the test sample is compared to G90 galvanized steel
- A 50 day/1200-hour moist air carbon dioxide (CO_2)/sulfur dioxide (SO_2) test where the test samples are subjected to moist carbon dioxide-sulfur dioxide-air exposure in an assessment protocol, which includes numerous compliance criteria for determination of the test results
- A 200-hour salt spray test where the test sample is compared to 304 series stainless steel

For the moist air CO_2/SO_2 test, samples are immersed in the test chamber with the pre-

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scribed mix of gases and moisture for the required time period. Once the exposure is completed, samples are evaluated by performing a visual inspection. The UL Lab Technicians look for certain levels of corrosion and pitting, and perform blister analysis and creepage analysis.

The test simulates a long-term exposure to the environment for a particular material, which corresponds to simulating a 20 to 30-year lifecycle of the product. The test is designed to assess if the hinge or latching hardware can withstand this kind of exposure over multiple years in outdoor applications. The testing and evaluation for the other two tests follows a similar process. The 600-hour salt spray test also benchmarks the test sample against G90 galvanized sheet steel. Passing both the 600-hour and the 1200-hour test is required to achieve a UL 50E Type Rating suitable for outdoor applications.

In the case of the 200-hour salt spray comparison, the bar is set higher as the products tested are compared with standard 304 series stainless steel to assess that zero pitting, cracking, bubbling or scaling has occurred during exposure. Passing all three tests earns an extra degree of corrosion resistance, designated by an "X" in the Type Rating (e.g., 3RX, 4X).

UL also conducted testing on gasket materials that are typically included in latch kits. Instead of corrosion, the testing evaluates the deterioration of the gasket when it's exposed to certain environments: elevated temperature and oil-based contaminants.

Flange gaskets and O-rings are critical components contributing to the sealing features of latches and fasteners. Naturally, the gasket swelling, shrinking or losing its elasticity may be a problem. To rule this out, oil immersion at room temperature as well as tensile strength and elongation tests are performed before and after oven aging to evaluate gasket materials and their ability to provide secure latching over a long period of use and exposure to environmental conditions.

Simplifying Enclosure Certification

Enclosure accessories that receive the FTTA2/FTTA8 Recognition Certification can be used by manufacturers who create or use Type rated enclosures that comply with UL 50 and UL 50E, which streamlines the process of bringing Type rated enclosures to market.

For example: Type 4X rated enclosures are certified for outdoor use, providing an established degree of protection against hose down, splashing water, windblown dust, rain, snow and sleet, and are constructed of materials and components that remain undamaged by the formation of ice on the enclosure.

So, if all the other Type 4X conditions are met -- constructing the enclosure out of materials exempt from corrosion testing such as 304 or 316 stainless steel, using pre-qualified UL approved gaskets to line the enclosure, and choosing accessories with the new FTTA2/FTTA8 recognition – all enclosure manufacturers will need to do is perform a hose down test to document that their enclosure can be Type 4X rated by UL. By pre-qualifying the enclosure for outdoor applications, it's been estimated the manufacturer will save at least 50 days of testing time as well as the cost of test samples.

How to Earn FTTA2/FTTA8 Recognition for Select Enclosure Hardware Components

Southco, Inc. of Concordville, PA (www.southco.com) engineers access hardware solutions and is a key supplier of the types of enclosure accessories covered by FTTA2/

FTTA8. The company recently completed testing and Recognition Certification of a select portfolio of its hinge and latch products according to FTTA2/FTTA8.

With the new certification, UL is testing to the same standards, but also adds important environmental factors. This will make it much easier for enclosure manufacturers to create solutions that fully satisfy the requirements of UL 50 and UL 50E.

UL (www.ul.com) is recognized worldwide for helping companies demonstrate safety, confirm compliance, deliver quality and performance and build workplace excellence through services such as: inspection, advisory services, education and training, testing, auditing and analytics, certification and marketing claim verification.

According to UL representative John Kovacik, Principal Engineer, a company seeking Recognition Certification for its products will be required to submit a range of products from the family of products to be evaluated.

Compression latches, like Southco's E3 VISE ACTION® Series provide quick, secure closure and environmental sealing for gasketed doors to protect the

"We select certain samples from the products that are submitted by any manufacturer interested in obtaining this coverage," he said. "We would select samples that were representative of a family. For example, if they were submitting different kinds of latches and there were many that a company wanted covered, we would select samples that if we tested and found acceptable, would then give them coverage for the entire line of latches."

Southco submitted select product classes to UL for testing, including over 100 representative latches and hinges to UL for testing and investigation under FTTA2/FTTA8, to evaluate these components' resistance to corrosion and performance degradation due to environmental conditions and usage over time. These product classes included the E5 Cam Latch and E3 VISE ACTION® Compression Latch series, TL and V7 Draw Latch series, ST Constant Torque Positioning Hinges and M3 Multi-Point Compression Latching System, spanning over 100k product configurations based on finishes, materials and panel preps.

Hinges that can withstand corrosion and exposure to the outdoors, like Southco's N6 series provide superior durability and corrosion-resistance in demanding environments.

Results of UL Evaluation

Upon completion of testing, UL will post information about products that have received the FTTA2/FTTA8 Recognition Certification in the UL Online Certifications Directory. Products that have received the Recognition will be listed by company and categorized by product category, and the Type rating for which the components can be used.

Once an enclosure manufacturer establishes a need for a UL 50E Type rated accessory, they can review the available options in the online

directory. It makes sense to do this early in the design process, while other design considerations are being addressed, such as panel thickness, grip, enclosure color and style.

Working with an accessories supplier that understands compliance requirements, and has proven experience in meeting the core functional needs of the application can help ensure that the design is successful; for example, suppliers can help manufacturers avoid future testing and design issues.

It is important to note that selecting accessories with FTTA2/FTTA8 Recognition does not mean the enclosure manufacturer can bypass final testing of a completed enclosure. It simply means that the accessories themselves do not require additional testing. The manufacturer must still work with UL to complete the required testing of the enclosure as a whole under UL 50/50E.

However, selecting Recognized accessories can save significant design, testing and certification costs, enabling faster market access for new enclosure designs that satisfy end-user requirements for Type rated applications.

1. UL 50, Section 1.1, https://standardscatalog.ul.com/standards/en/standard_50_13

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