ENCLOSURE DESIGN CONSIDERATIONS

Saginaw Control & Engineering's enclosures are designed, manufactured, and tested to meet the requirements for enclosure Types 1, 3, 3R, 3S, 4, 4X, 12, 13 and IP ratings up to IP66. An enclosure that is selected to meet a specific rating and standard may not meet all requirements of your application and environment without additional steps that may be necessary to adequately protect your product in your application and environment.

Carefully evaluate your enclosure selection for each of the following listed below in your end use application. Remember this statement, each of the Enclosure Rating descriptions "Provide a degree of protection". See the **Enclosure Type Ratings** document on our website for more information.

- Rain, Snow and Ice
- Corrosion - Exposure to Salt Water and Other Chemicals
- Thermal Conditions & Management
- Materials
- Installation
- Hazardous Locations
- Load Capacity
- Seismic Locations
- EMI/RFI
- Sanitary/Hygienic Locations

SAGINAW CONTROL & ENGINEERING

Your Enclosure Source ®

1 Rain, Snow, and Ice

A common misconception is that a Type 4, 4X enclosure can be used in any indoor or outdoor application, regardless of its environment, exposure, or installation, and will remain "water tight". This is not true. Additional steps may be necessary to properly protect your product in its environment. (Not Water Proof)

What does the Type 4 & 4X test involve?

Protection against the ingress of water - hose down test. The enclosure and its external mechanisms are subjected to a stream of water from a hose that has a 25 mm (1 in) inside diameter nozzle that delivers at least 240 L (65 gal) per minute. The nozzle is held from 3.0 to 3.5 m (10 to 12 ft) from the enclosure, and the spray of water is directed at all points of potential water entry, such as seams, joints, external operating mechanisms, and the like. The nozzle is moved along each test point one at a time in a uniform nominal rate of 6 mm/sec (¼ in/sec). A conduit is installed to equalize internal and external pressures. At the end of the test no water has entered the enclosure. See UL 50E and CSA 22.2 for complete requirements.

Outdoor Applications

For all enclosures in outdoor applications with direct exposure to rain, snow, and ice, a drip shield is always recommended, and in most applications it is required. Drip shields minimize risk related to long term exposure to rain and damaging effects of snow and ice being trapped in the external cavity of the door and enclosure body and prolonged exposure to water that may lead to water being absorbed into the gaskets.

Proper Ventilation

An enclosure that is not adequately vented and in an outdoor or wash down environment may lead to leakage due to drastic temperature changes caused by rainfall or hose down with cold or hot water.

An enclosure that is subjected to a temperature differential of just 20 to 30 degrees, for instance one with an internal temperature of about 85°F which has hose directed water applied with city water (average temperature of 55°F), can result in damage to the seal. When the water is applied, the temperature inside the enclosure rapidly drops, the air contracts and creates a vacuum inside the enclosure that starts to draw water through at the weakest link, or even pull water through the gasket, almost immediately and until the pressure is equalized. The smaller the enclosure or part the quicker this reaction occurs. An enclosure in an outdoor application will be exposed to conditions that are far more severe taking in to consideration the solar gain and the internal temperature rise of the enclosure and rain temperatures that can be as low as 32°F.

In some installations of enclosures, a wire conduit may be found to be adequate to serve as its vent and equalize the pressure, but in most applications is not enough. In Type 4 and 4X Enclosures, no drain holes are required or provided, so it is increasingly important that sufficient ventilation exists or Type 4, 4X breathers or Type 4, 4X drain/breathers are added to equalize pressure.

Type 3R Rainproof

A Type 3R Rainproof enclosure is provided with drip shield and drainage holes that also serve as ventilation to equalize pressure as required. A multi-listed enclosure such as an enclosure listed as Type 3R, 4 & 12 is provided with additional instructions for installation of a drip shield and drainage holes.

What does the Type 3R Rain test involve?

Enclosures with a conduit connected shall be mounted as in actual service, the test apparatus consists of at least three spray heads mounted in a water supply pipe rack. The enclosure is positioned in the focal area of the spray heads so that the greatest quantity of water is likely to enter the enclosure. The water pressure is maintained at 34.5kPa (5 psi) at each spray head and a continuous water spray shall be applied for one hour. Type 3R enclosure is considered to have met the requirements if at the conclusion of the test a) There is no accumulation of water within
the enclosure; and b) No water has entered the enclosure at a level higher than the lowest live part.

Attention! *Saginaw Control & Engineering recommends the use of drip shield, ventilation and drainage when installed in full outdoor exposure and extreme weather environments. Saginaw Control & Engineering does not recommend the use of polycarbonate viewing windows for use as type 4 or 4X when installed in full outdoor exposure and extreme weather environments. Recommend Type 3R rating for this application. Carefully considered and evaluate your end use environment for the reasons described above.*

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2 Corrosion - Exposure to Salt Water or Other Chemicals

Evaluate the environment of the end use location and the chemicals that the enclosure may be exposed to.

Corrosion Protection Requirements

The corrosion protection requirements for a Type 1, 12, 3R, 4 and 4X are very specifically targeted and an enclosure may be manufactured out of a combination of materials that meet the corrosion requirements for the enclosure type, although may not be adequate for your application without making changes.

What does the Type 4X Corrosion test involve?

Indoor Type 1 & 12 - 24-hour salt spray. The test apparatus shall consist of a fog chamber, a salt-solution reservoir, a supply of compressed air, atomizing nozzles, support for the enclosure, provision for heating the chamber, and means of control. Type 3R, 4, 4X. 1200-hour moist carbon dioxide-sulfur dioxide-air, 600-hour salt spray. (Two un-scribed specimens and two specimens scribed) Outdoor Type 3RX, 4X. 1200-hour moist carbon dioxide-sulfur dioxide-air, 600-hour salt spray (Two un-scribed specimens and two specimens scribed) and an additional 200-hour salt spray. See UL 50E and CSA 22.2 for complete requirements.

The primary targets of the corrosion test requirements are with respect to water, salt water, and basic air pollutants. Salt water should be considered when applications are near coastlines and roadways, effects of salt air can be a concern from 5 miles to 25 mile inland depending on the region. The effects of salt water can be extreme even with type 304 stainless steel although the effects are more cosmetic than structural or functional. If cosmetics are critical, then type 316 stainless steel may be a better choice, yet it is not impervious to rust and staining caused by airborne debris and chemicals that may end up on the material surface.

Other chemicals, such as acids, solvents, fluoride, chloride, cleaning detergents and hundreds of other chemicals in a multitude of different concentrations, can severely effect even the most resilient materials, for instance type 316 stainless steel, and are not considered part of their corrosion performance evaluation.

Galvanic Compatibility

Galvanic corrosion (sometimes called dissimilar metal corrosion) is the process by which materials in contact with one another oxidize or corrode, accelerating the deterioration of one of the metals. In some instances, galvanic corrosion can even be helpful in some applications. For example, if pieces of zinc or copper are attached to the bottom of a steel water tank, the zinc or copper will become the anode, and it will corrode. The steel in the tank becomes the cathode, and it will not be affected by the corrosion. This technique is known as cathodic protection. The metal to be protected is forced to become a cathode, and it will corrode at a much slower rate than the other metal, which is used as a sacrificial anode.

Attention! ***Saginaw Control & Engineering recommends the application and environment is carefully considered and evaluated for the reasons described above. There may be chemicals, acids, solvents, or gasses outside the scope of the corrosion resistant requirements in your application or environment that will adversely affect the performance of the enclosure or materials used in its construction.***

3 Thermal Conditions & Management

Evaluate environment of end use location and its exposure to ambient heat, internal heat, and solar gain.
The temperature, both outside the enclosure and inside the enclosure, must be carefully considered for the application, regardless of the enclosure type. Excessive heat or cold can seriously compromise both the performance and functionality of enclosure in its end environment as well as the equipment it houses.

What temperatures can an enclosure sustain?
Plastics, windows, gaskets, and coatings are tested for their performance – (Resistance Hot and Cold). Cooled to a temperature of minus 30°C (minus 22°F) for a period of 24 hours and then subjected to an impact and crush resistant test. Heat - Max. temperature for outdoor application 60°C/140°F test in circulating air for 168 hours have a tensile strength of not less than 75 percent and an elongation of not less than 60 percent of values determined for unaged samples. At the conclusion of the tests, there is no visible deterioration, deformation, melting, or cracking of the material. See UL 50E and CSA 22.2 for complete requirements.

Internal Heat Load
Internal heat produced by the electronic components can considerably increase the internal temperature (Heat Rise). Just 1 watt added to 1 cubic foot of space can increase the internal temperature by as much as 3°F. Different base materials have different thermal conductivity (K Value), stainless, aluminum, fiberglass, and steel, as well as their finish, greatly influence internal heat dissipation and heat rise, so they must be considered when determining the proper thermal management options for the application. Choosing the incorrect thermal management option can compromise the performance, components, electronics and environmental rating of your enclosure.

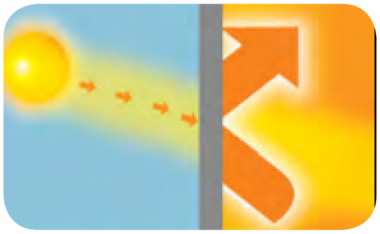
Solar Gain, High Ambient Conditions
Solar Gain refers to the increase in temperature in a space that results from solar radiation. The amount of solar gain increases with the strength of the sun. Shading, reflection, and color can be used to minimize the effects and cooling requirements.
An enclosure in a location with full exposure to the sun and 0 watts of internal heat load can reach temperatures that exceed 160°F degrees and exceed the performance limitation of test requirements and performance limitation of some materials, such as polycarbonate windows.
As a result of the Internal heat load, higher temperatures, solar gain or the combination of some or all of these conditions, cooling systems, such as Air Conditioners, Heat Exchangers or Chillers are often required in many applications whether the enclosure is indoors or outdoors, insulated or un-insulated.

Low Ambient Conditions
Heat may be required to raise the temperature of the control panel, for freeze protection, reduce humidity, prevent damage to the electronic components or improve efficiency of electronics. As the complexity of electronics increase it becomes even more critical to safeguard the enclosures.

Mounting heaters along with a thermostat near the bottom of the enclosure provides the best performance. Thermostats can be incorporated as part of the heater or as a standalone item. The controller should be positioned in a neutral location that will provide an average humidity or temperature reading. Placing the thermostat too close to the heater may provide a reading that is influenced by the direct heat of the heater.

SCE Thermal Calculator
http://www.saginawcontrol.com/resources/thermal-calculator/

Attention! ***Saginaw Control & Engineering recommend the use of drip shield, ventilation and drainage when installed in full outdoor exposure and extreme weather environments. Saginaw Control & Engineering does not recommend the use of polycarbonate viewing windows for use as type 4 or 4X when installed in full outdoor exposure and extreme weather environments. Recommend Type 3R rating for this application. Carefully considered and evaluate your end use environment for the reasons described above.***



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4 Materials

A combination of the following materials may be incorporated into your standard enclosure design and should be considered when evaluating for its end use environment. These materials meet the environmental test requirements for their intended purposes. See page 1, 2, & 3 for additional details that need to be considered when choosing materials.

Materials that may be used in Enclosure Types

	1	3, 3R	4	4X	12
Enclosure Base Materials					
Carbon Steel	c	c	d	a,d	c
Stainless Steel (Type 304)	b	b	b	b	b
Stainless Steel (Type 316/316L)	b	b	b	b	b
Aluminum (Type 5052)	b	b	b	b	b
Galvannealed Steel	c	c	c	a,d	c
Enclosure Hardware, Components					
Carbon Steel	c	c	d	e,f	c
Galvanized Steel	b	b	b	e,f	b
Stainless Steel (Type 304)	b	b	b	b	b
Stainless Steel (Type 18-8)	b	b	b	b	b
Polycarbonate	b	b	b	b	b
Polyamide P66 (Nylon)	b	b	b	b	b
Polyester (PBT)	b	b	b	b	b
Zinc Die Casting (Zamak 5)	c	c	c	c	c
Polyurethane Sponge Rubber	b	b	b	b	b

a - Not recommended
b – May be used on interior or exterior of enclosure with No additional protective coating
c – May be used interior or exterior of enclosure with additional protective coating 1, 2, 3, 4, 5
d – May be used interior or exterior of enclosure with additional protective coating 1, 4, 5
e – May be used on interior of enclosure with No additional protective coating
f – May be used on exterior of enclosure with additional protective coating 1, 4, 5

Protective Coating

1 - Zinc & Clear Plated
2 - Zinc plated
3 - Chrome
4 - Polyester TGIC Powder Coat
5 - High solids Monobake & Peraclad

5 Installation

Verify your installation – An enclosure, regardless of the environmental rating of the enclosure, depends on four simple features that maintain the seal of the enclosure: gasket contact, location, compression, and fastener torque. If any one of these features have been compromised, it may result in leakage. To ensure a proper seal on metal to metal contact of parts, apply a thin film of sealant, such as RTV or similar product, to the contacting surfaces before installation.

Proper installation is extremely important and the most common aspect overlooked. An enclosure installed to equipment, wall, or concrete slab must be properly installed in order to have proper door alignment to maintain the seal to the enclosure body due to body twist. Securing to an uneven surface, wall, floor or frame, will cause the body to twist and misalign doors; or on an unsupported enclosure, the weight of the door may cause body twist, as the entire load is carried by the hinge side while the latch side is entirely unsupported and visible in every enclosure, increasingly so on large wall mount and floor mount models with small flange construction prior to proper installation. A properly installed enclosure will have an equal dimension on the left and right side when measured from the top of the door to the top of the enclosure. Any enclosure installed in a manner other than its intended purpose must be carefully evaluated and may need additional reinforcement or additional support in order to maintain its integrity in its application.

All Installation Instructions can be found at Saginaw Control & Engineering's website
www.saginawcontrol.com

http://www.saginawcontrol.com/resources/installation-manual-index/

Door Alignment
www.saginawcontrol.com/instman/door-alignment.pdf

Center-Channel Installation
Re-installation of components such as center channels, door hardware, and fasteners must be re-installed with the proper seals, sealant, and torque to maintain the integrity of the seal.
www.saginawcontrol.com/instman/center-channel-instman.pdf

Sealing Washer
Proper installation and torque
http://www.saginawcontrol.com/instman/sealingwasher-instman.pdf

Fastener Torque
Standard Fastener Torque

Fastener Size	Min Torque	Max Torque
	Inch lbs.	*Inch lbs.*
6-32	6	11
8-32	11	22
10-32	20	30
1/4-20	70	110
5/16-18	80	120
3/8-16	145	215
1/2-13	310	460

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6 Hazardous Locations

A Nema enclosure with pressurization is generally used for electrical equipment that cannot be protected by other means, either because it is too large to be made explosion-proof, or too high-powered to use intrinsic safety.

Any Nema enclosure can be purged, although the recommended enclosures for these applications are our Nema Types 4, 4X, & 12 Dust-tight to minimize purge gas usage or loss.

Most applications require a minimum enclosure pressure of 0.10 inches of water to protect against ignitable dust 0.50 inches of water, and in some rare situations as much as 2.5 inches of water. (1 psi = 27.7 inches H2O (water) @ 62°F)

The enclosures are tested to withstand an internal pressure of five (5) inches of water or 0.18 psi without permanent deformation and minimal loss of pressure.
Purge controlled and pressurized enclosures provide an equivalent degree of safety to flameproof (explosionproof) or intrinsic safety techniques. It also offers significant advantages of safety and durability. The pressurization process is very simple. Purge gas, normally compressed air, keeps the internal pressure of an enclosure above the pressure outside the enclosure. External flammable gas cannot enter the enclosure while it is pressurized.

Before power can be switched on, the enclosure must be purged to remove any flammable gas that may have entered the enclosure before it was pressurized. Purging is the action of replacing the air inside an enclosure with air known to be free of flammable gas.

Applications where purge can be used include:

Pharmaceutical manufacturing	Paint users and manufacturers
Oil and gas production	Original equipmente manufacturers
Chemical processes	Dusty Environments
Petroleum industry	Powder, fiber, and related manufacturing processes
Refineries and terminals	

Hazardous Locations

Zone 1 - Class I, Div 1
Zone 1 - Class II, Div 1
Zone 2, Class I, Div 2
Zone 2 - Class II, Div 2

Gas Groupings

Gas, Dust, or Fiber - NEC (500)

Class I, Group A, B, C, D
Class II, Group E (Div 1 only)
Class II, group F, G

ATEX Directive 99/92/ECAT
ATEX Group II Categories and Applications (Ex)

Classes

The class defines the general nature of hazardous material in the surrounding atmosphere.

Class	Hazardous Material in Surrounding Atmosphere
Class I	Hazardous because flammable gases or vapors are present in the air in quantities sufficient to produce explosive or ignitable mixtures.
Class II	Hazardous because combustible or conductive dusts are present.
Class III	Hazardous because ignitable fibers or flyings are present, but not likely to be in suspension in sufficient quantities to produce ignitable mixtures. Typical examples are wood chips, cotton, flax, and nylon. Group classifications are not applied to this class.

Divisions

The division defines the probability of hazardous material being present in an ignitable concentration in the surrounding atmosphere.

Division	Presence of Hazardous Material
Division 1	The substance referred to by class is present during normal conditions.
Division 2	The substance referred to by class is present only in abnormal conditions, such as a container failure or system breakdown.

Groups

The group defines the hazardous material in the surrounding atmosphere.

Group	Presence of Hazardous Material
Group A	Acetylene
Group B	Hydrogen, fuel and combustible process gases containing more than 30% hydrogen by volume or gases of equivalent hazard such as butadiene, ethylene, oxide, propylene oxide and acrolein.
Group C	Carbon monoxide, ether, hydrogen sulfide, morphline, cyclopropane, ethyl and ethylene or gases of equivalent hazard.
Group D	Gasoline, acetone, ammonia, benzene, butane, cyclopropane, ethanol, hexane, ethanol, methane, vinyl chloride, natural gas, naphtha, propane or gases of equivalent hazard.
Group E	Combustible metal dusts, including aluminum, magnesium and their commercial alloys or other combustible dusts whose particle size, abrasiveness and conductivity present similar hazards in connection with electrical equipment.
Group F	Carbonaceous dusts, carbon black, coal black, charcoal, coal or coke dusts that have more than 8% total entrapped volatiles or dusts that have been sensitized by other material so they resent an explosion hazard.
Group G	Flour dust, grain dust, flour, starch, sugar, wood, plastic and chemicals

The specific hazardous materials within each group and their automatic ignition temperatures can be found in Article 500 of the National Electrical Code and in NFPA 497.

Group A, B, C and D apply to class I locations. Group E, F and G apply to class II locations.

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Temperature Code

A mixture of hazardous gases and air may ignite on contact with a hot surface. The condition for ignition depends on several factors, such as surface area, temperature, and concentration of gas.

Equipment approved receives a temperature code indicating the maximum surface temperature of the equipment.

Temperature Code	Maximum Surface Temperature F°	C°
T1	842	450
T2	572	300
T2A	536	280
T2B	500	260
T2C	446	230
T2D	419	215
T3	392	200
T3A	356	180
T3B	329	165
T3C	320	160
T4	275	135
T4A	248	120
T5	212	100
T6	185	185

ATEX Directive 99/92/EC (also known as 'USE' or ATEX 137) refers to the safety and health protection of workers potentially at risk from explosive atmospheres. The directive highlights what the employer must do to prevent and protect against explosions as well as classifies hazardous areas into zones, as defined below:

Gas, Mists, or Vapors

ATEX Directive 99/92/EC (also known as 'USE' or ATEX 137) refers to the safety and health protection of workers potentially at risk from explosive atmospheres. The directive highlights what the employer must do to prevent and protect against explosions as well as classifies hazardous areas into zones, as defined below:

- **Zone 0** - An atmosphere where a mixture of air and flammable substances in the form of gas, vapor or mist is present frequently, continuously or for long periods.
- **Zone 1** - An atmosphere where a mixture of air and flammable substances in the form of gas, vapor or mist is likely to occur in normal operation occasionally.
- **Zone 2** - An atmosphere where a mixture of air and flammable substances in the form of gas, vapor or mist is not likely to occur in normal operation but, if it does occur, will persist for only a short period.

- **Zone 20** - An atmosphere where a cloud of combustible dust in the air is present frequently, continuously or for long periods.
- **Zone 21** - An atmosphere where a cloud of combustible dust in the air is likely to occur in normal operation occasionally
- **Zone 22** - An atmosphere where a cloud of combustible dust in the air is not likely to occur in normal operation but, if it does occur, will persist for only a short period.

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ATEX Group II Categories and Applications				
Category	**Design of Safety**	**Design Requirements**	**Application**	**Zone of Use**
1	Very high level of safety	Two independent means of protection or safe with two separate faults	Where explosive atmospheres are present continuously or for lengthy periods	Zone 0 Zone 20
2	High level of safety	Safe with frequently occurring disturbances or with an operating fault	Where explosive atmospheres are likely to occur	Zone 1 Zone 21
3	Normal level of safety	Safe in normal operation	Where explosive atmospheres are likely to occur infrequently and be of short duration	Zone 2 Zone 22

7 Load Capacity

All weights are based on static load with no additional reinforcements and weight distributed equally over the entire surface with standard catalog part construction

Sub-Panel stud mounted to the back of the enclosure - 25 lbs per square foot.

Sub-Panel channel mounted with standard mounting kit (ref. Free-Standing enclosure and SCE-FSPS mounting kit) - 20 lbs per square foot.
Sub-Panel channel mounted with Heavy Duty panel supports - 30 lbs per square foot.

Surface Load (Top, Bottom, Back, Right, or Left Sides)
- -Wall-Mount enclosures 25 lbs per square foot.
- -Free-Standing enclosure 35 lbs per square foot.

Doors (Concealed and continuous hinge) - 15 lbs per square foot

Eyebolt lifting capacity
http://www.saginawcontrol.com/instman/005.pdf

Large Enclosure Handling Guide
http://www.saginawcontrol.com/instman/Large%20Enclosure%20Handling%20Guide%20SCE.PDF

8 Seismic Locations - Zones 0 to 4

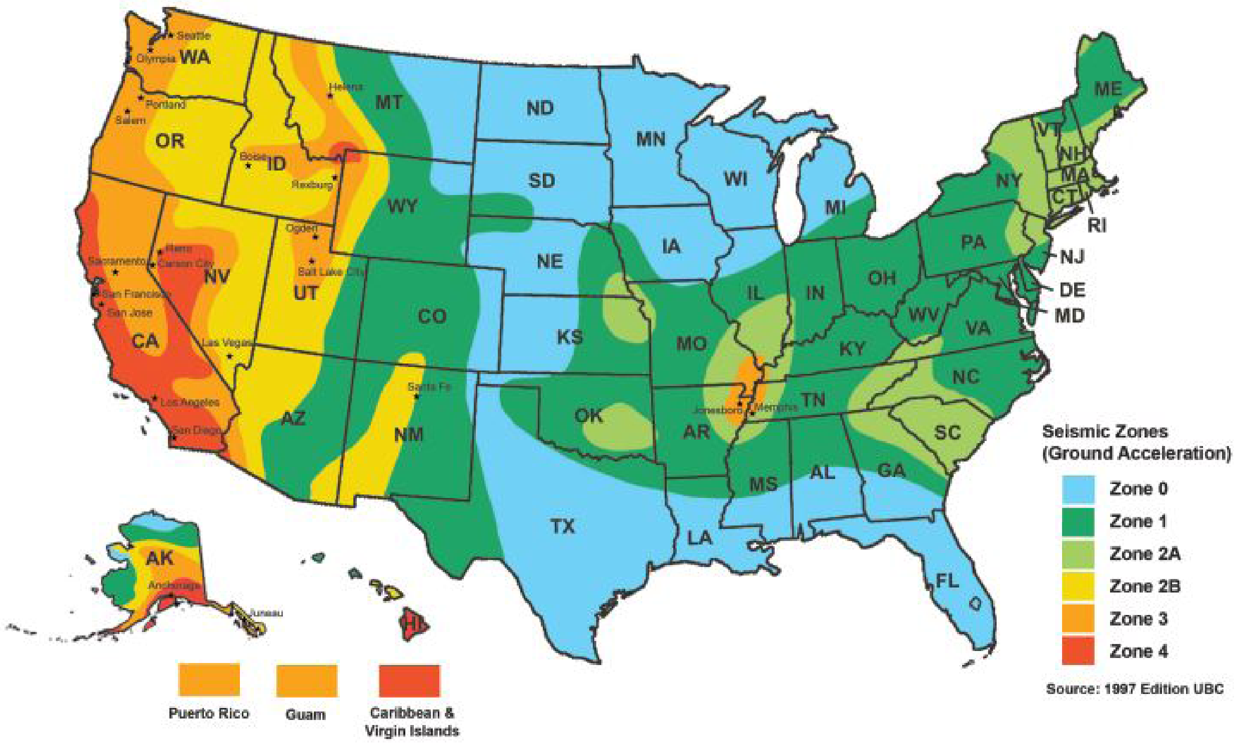
For seismic certification one or both of the following may apply

1) Completed unit with all equipment installed tested to Telcordia GR-63-CORE by a nationally recognized testing laboratory.

2) Installation certified by a licensed structural engineer.

Saginaw Control & Engineering enclosures are designed to withstand concurrent forces in any horizontal direction equal to 0.5 times the equipment weight, and a static force in any vertical direction equal to 0.4 times the equipment weight. Equipment weight should not exceed 1.5 - 2 times the enclosure weight to maintain structural integrity.

Enclosures made of 0.075”, 0.104”, and 0.125” carbon and stainless steel construction maintain tensile strength of 70/80 ksi and a yield strength of 60/75 ksi. ANSI specification C1010.



9 EMI/RFI

What is EMI

Electromagnetic radiation that adversely affects circuit performance is generally termed EMI, or electromagnetic interference. Many types of electronic circuits are susceptible to EMI and must be shielded to ensure proper performance. Conversely, emissions radiating from sources inside electronic equipment may threaten circuits within the same or nearby equipment. To protect the performance integrity of electronic equipment, electromagnetic emission from commercial equipment must not exceed levels set by the FCC, VDE and other organizations. Further standards set EMI levels to which electronic equipment must itself be immune.

What is EMI Shielding?

Shielding is the use of conductive materials to reduce radiated EMI by reflection and/or absorption. Shielding can be applied to different areas of the electronic package from equipment enclosures to individual circuit boards or devices. Effective placement of shielding causes an abrupt discontinuity in the path of electromagnetic waves. At low frequencies, most of the wave energy is reflected from a shield's surface, while a smaller portion is absorbed. At higher frequencies, absorption generally predominates. Shielding performance is a function of the properties and configuration of the shielding material (conductivity, permeability and thickness), the frequency, and distance from the source to the shield.

What does Grounding have to do with Emi Shielding?

Grounding issues affect both safety and EMI emissions. Conductive components are grounded to protect equipment users from electric shock. If a system is properly grounded, and all conductive elements which a user might touch are theoretically at zero, protection shielding against EMI emissions is commonly provided by a conductive enclosure. The separate parts of the enclosure must be electrically bonded together and grounded for the shielding to work. Disruption in the conductive continuity between parts adversely affect shielding performance. Proper grounding of PCBs and shielding enclosure components is also a method for reducing board-generated EMI. However, improper or ineffective grounding may actually increase EMI emission levels, with the ground itself becoming a major radiation source.

A word about Emi Regulations

Government regulations in the US and many other countries prohibit electronic products for emitting EMI that could interfere with radio and television receivers. European regulations also include EMI immunity levels, which are expected to find their way into future US (FCC) standards.

Where is Emi Shielding needed?

EMI shielding is used for computers, medical devices, telecommunication, and many other types of electronic equipment. As new emission and immunity requirements are placed on these devices, the importance of shielding grows. Among the typical applications for EMI shielding are the following:

Enclosures

Metal housings for electronic systems provide inherent levels of EMI shielding, dependent on factors such a metal type and flange surface thickness. Plastic and other non-conductive material used for lightweight housings can be metallized with sprayable conductive paints, thin film metal coatings, or plating. Laminates of metal foil and plastic film can be formed and die cut into Faraday cages and shadow shields.

Apertures

Doors, cable ports, vents, windows, access panels and other openings in an otherwise shielded electronic package are pathways for radiated EMI. A variety of gaskets and specialized conductive materials are available for adding shielding around door seams and the perimeters of other openings. Shielding vents and windows are designed to reduce the amount of EMI passing through them. The amount of EMI leakage through an opening is a function of the maximum dimension of the opening. A long, narrow slit, like the gap around the edge of a door, will leak much more radiation than a round hole of the same area. The imperfect joints between panels or covers and enclosure walls are typical "slots" where EMI can efficiently escape or enter a shielded enclosure. Conductive EMI gaskets inserted between panel mating surfaces will provide low resistance across the seam and thereby preserve current continuity of the enclosure.

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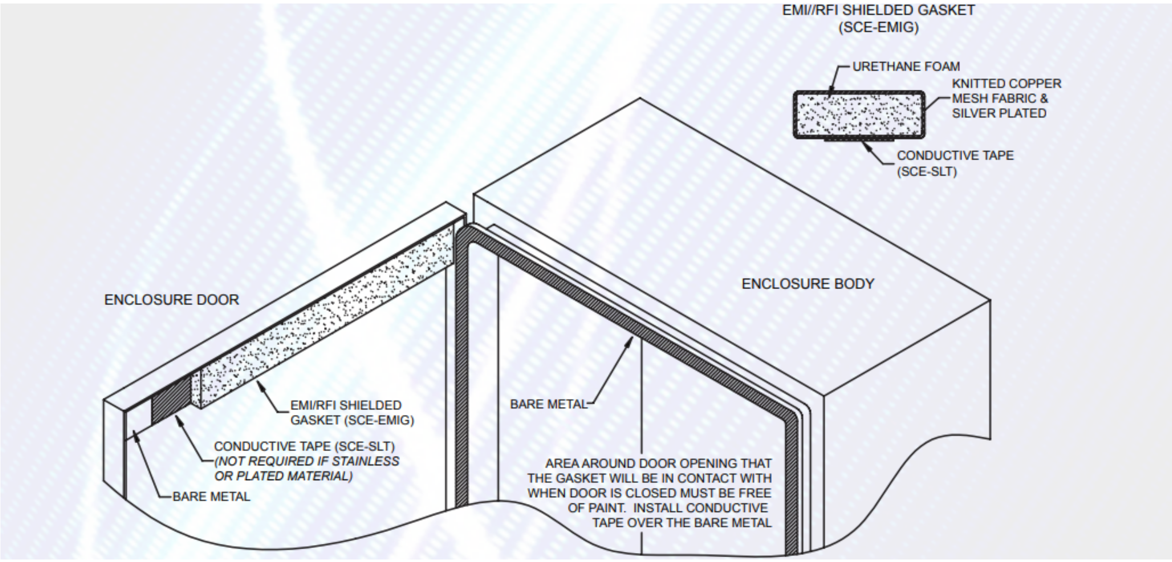
Shielding Effectiveness
Shielding requirements for commercial electronics generally range from 40 to 60 dB. Finding a system's overall shielding needs involves determining the radiated emission spectrum of the equipment, and the specifications the unit must meet (e.g. FCC Port 15).

How is an Enclosure Tested for Shielding?
The most widely used method for determining a large enclosure's shielding effectiveness is MIL_STD_285, which requires a shielded room. Using an RF transmitter and receiver, a reference field strength measurement is taken in free space (outside the enclosure). A receiving antenna is then placed inside the enclosure and the drop in field strength is determined. The drop is the measure of shielding effectiveness. When a signal analyzer is connected to the receiving antenna, field strength can be measured at any point inside the enclosure.



Standard Construction
Enclosures are continuously welded for maximum shielding protection, all door openings are masked off prior to painting, in preparation for shielding gaskets to be applied for indirect bonding of enclosure and enclosure doors.

All door openings that are masked off will be coated with a conductive tape over the bare metal surfaces to maintain conductive contact and to help prevent rusting or corrosion - not required if stainless steel or plated material.

Shielded gasket and tape is applied to the enclosure door and door opening depending on the enclosure design.

Standard gasket used is a urethane gasket wrapped in a woven copper fabric and silver plated, with a conductive adhesive on one side. To provide protection against dust, falling dirt, dripping non-corrosive liquids, lint, fibers, external condensation of non-corrosive liquids, and light splashing water, NEMA 12.

All door hardware is installed with earth nuts for direct bonding, and a ground stud on all doors and body for additional indirect bonding.

Any other cutouts or openings in the enclosure may require additional shielding.

*Attention:
Enclosures are designed to provide maximum shielding for RF energy.

Shielded Type 12 enclosures can provide attenuation greater than 100dB from 14.5 khz. To 430 mhz. For electric fields, 40 to 100d8 at 1 ghz.

A standard non-shielded enclosure can attenuate about 20dB at 1 ghz.

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10 Sanitary / Hygienic Locations

Evaluate and understand the intended use and purpose for your enclosure. The requirements can be vastly different depending on the Zone or application it's used in. Type 4, 4X enclosure are commonly used in these environments but do not necessarily meet some of the more intense wash down requirements or cleaning/sanitizing chemicals used in the application or locations.

There are three primary zones equipment can be subdivided into and the requirements for construction can be vastly different. Evaluate the proper design and materials for your application.

1. **Contact Zone / Food Zone** - Equipment surfaces intended to be in direct contact with food
2. **Splash Zone** - Equipment surfaces may contact and then drain drip, or splash back into food or onto surfaces that are intended to be in direct contact during operation of equipment.
3. **Non-Contact / Non-Food Zone** - Exposed equipment surfaces other than those in food zone or splash zone.

Enclosures are primarily found in the Non-Contact Zones but not always!

Food equipment organizations

3A Sanitary Standards
NSF/ANSI/3A 14159-1 Food Equipment for use in food processing areas
NSF/ANSI 169 Special Purpose Food Equipment
NSF/ANSI 51 Food Equipment Materials
ANSI/ASB/Z50 American National Standard for Bakery Equipment
MPID / Meat and Poultry Inspection Division - Equipment Guidelines

In some applications High Pressure wash down may be required.
IP69K High Pressure Wash down 1160-1450 psi, at a rate of about 4 gallons/minute, the nozzle from which the water is sprayed is between 4 and 6 inches from the product. The spray is applied at the angles of 0°, 30°, 60°, and 90°, for duration of 30 seconds at each angle, while the product is rotated at 5 rpm or IP69K adding heat at a temperature of 176°F.
These requirements are not comparable to the Requirements of type 4, 4X Hose directed water test.

Don't think that because it is a type 4 or 4X that it would meet this type of wash down!

Type 4 & 4X test Hydro Test
Protection against the ingress of water - hose down test. The enclosure and its external mechanisms are subjected to a stream of water from a hose that has a 25 mm (1 in) inside diameter nozzle that delivers at least 240 L (65 gal) per minute. The nozzle is held from 3.0 to 3.5 m (10 to 12 ft) from the enclosure, and the spray of water is directed at all points of potential water entry, such as seams, joints, external operating mechanisms, and the like. The nozzle is moved along each test point one at a time in a uniform nominal rate of 6 mm/sec (¼ in/sec). A conduit is installed to equalize internal and external pressures. At the end of the test no water has entered the enclosure. See UL 50E and CSA 22.2 for complete requirements.

Evaluate the material you select such that it can be adequately cleaned and sanitized and are resistant to daily exposure to the corrosive food products, cleaning and sanitizing chemicals its being exposed too.

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Evaluate the material you select such that it can be adequately cleaned and sanitized and are resistant to daily exposure to the corrosive food products, cleaning and sanitizing chemicals its being exposed too.

General design and construction criteria required of enclosures include:

- Concealed with removable pins min. of 3/16 inch Diameter– easily cleanable while in place and designed to be disassembled (with the use of tools) for routine cleaning.
- Continuous hinges shall not be used in a food zone.
- Flange trough gutter above the enclosure door opening
- Seams wider than ⅛ in (0.13 in, 3.2 mm) shall be sealed by continuous weld or shall be flashed and sealed.
- Welded joints and seams that have been de-burred
- 300 series stainless Steel - Type 304 or Type 316 stainless steel most commonly used metal
- If Coated Steel - Organic coating is required such as Powder coat.
- Coatings, including metallic coatings such as zinc (galvanized), zinc alloys, or chrome plating, shall not be used to render exposed materials corrosion resistant except on hinges, latches, and similar replaceable hardware.
- Easy-to-clean fasteners including slot-head quarter-turn latches
- No exposed threads or projecting screws or studs in a food or splash zone
- Leg stands that provide a minimum unobstructed clearance of 6 in. beneath the enclosure
- Shall not be mounted directly to a wall 2 inch minimum clearance

Attention! ***Saginaw Control & Engineering recommends that when type 4 or 4X when installed were extreme temperature change may occur evaluate that adequate ventilation is present or add proper ventilation, breather or drainage vent in order to equalize internal pressure of the enclosure.***

Carefully considered and evaluate your end use environment for the reasons described above. There may be chemicals, cleaning/sanitizing chemicals, wash down pressures and temperatures that may be outside the scope of the requirements in your application or environment that will adversely affect the performance of the enclosure or materials used in its construction.