SEALING OF ELECTRONIC PRODUCT ENCLOSURES

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Many electronic product enclosures need to be sealed against the ingress or dust, dirt, and water, for many reasons. This whitepaper will discuss planning for sealing on any such product and discuss the impacts of implementing various levels of sealing.

It is very important to define the ingress protection, or "IP standard" for a product early in any project. IP, or Ingress Protection rating defines what environment the product will function in. If the product will work with dust and rain passing through it and getting inside, it could have an IP rating of IP40. If it needs to be dust proof, resist strong jets of water, and be capable of immersion in several metres of water for long periods, at least IP69 rating is needed. The enclosure for IP69 level sealing will be very different than one for IP40 sealing. If the IP rating selected is the wrong one for the environment the product will function in, there could be expensive product failures from leakage / contamination and redesign to address them. The product also may be too expensive if more sealing is designed in than is needed to achieve good function in the working environment.

An explanation of IP codes can be found in Wikipedia at this link:
https://en.wikipedia.org/wiki/IP_Code

Elastomeric seals (ie various types of rubber or rubber-like plastics) at every opening including housing joints, connectors, cable entries, and switch or button actuators will be needed to achieve IP69. Many connectors are not waterproof internally between their pins / sockets and the connector body - connectors must be carefully selected if watertight sealing is required.

Seals take up space, and they need to have carefully designed sealing faces with controlled tolerances in the enclosure's joints. Seals need to be retained mechanically in place to work, or they may slip out of place either during assembly or in service. Many seals have a minimum bend radius, ie they do not work well in sharp corners. Most seals work better if they pass around a gentle curve around corners. Round, or rounded corner enclosure shapes are easiest to seal. O-ring seals and flat washer type seals can require significant mechanical force to compress the elastomer 15 to 20% of its' thickness to achieve sealing. The structure of the enclosure needs to be designed for these loads.

Fasteners must also be sealed if they are inside the perimeter of the enclosure seal. This can often be done with O-rings set in grooves below the fastener heads. The seal must be made on the fastener's head underside face, not on the threads. Threads on fasteners can not be depended upon to seal the enclosure. It is important to design the grooves and the head support features around the groove to avoid squeezing out the seals when the fasteners are tightened. If possible it is wise to place the fasteners outside the enclosure seal perimeter.

If these factors are not planned in the enclosure design early in the process by a mechanical designer experienced with seal design in enclosures, the wrong type of items passing through the enclosure walls or wrong type of connectors could be chosen, or there won't be sufficient room reserved for seals in the product. The enclosure itself may deflect or break in service, or the enclosure fasteners may strip or fail if the sealing forces are not planned into the design. The earlier the IP rating needed is defined for the product, the better, so that features can be designed in to achieve the rating. Often a very brief discussion with marketing staff about the functional environment of the product, and any required regulatory agency compliance, will enable identification of the needed IP rating.

If your firm needs help with sealing design for enclosures, please contact me.

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