Mechanical Technology of Sensors and Instruments

Protection Classes for Enclosures and Connectors
Technical Tutorial

1) Introduction

Sensors and Instruments are often located in places with harsh environmental conditions: Dust, Water, and Humidity. Sometimes corrosive influences have to be considered, like Saltwater and chemical vapours.

Therefore the **Enclosures, Connectors and Cable Inlets** have to be designed to withstand these harsh conditions and protect the electronic equipment from disturbing and destructive influences.

The protection against various degrees of environmental conditions is classified.
The reasons to have different degrees of protection are economical: high levels of protection are very expensive. Therefore the engineering rule:

Select the Protection Class, which is necessary to protect your equipment safely, but do not select unnecessary high protection levels.

In Europe the **Industrial Protection Classes** are defined by **IP Numbers**:
The left digit defines the protection against the ingress of foreign objects and dust.
The right digit defines the protection against the ingress of water and other liquids.

The most important IP numbers are:

IP 41
Protection against objects > 1.0 mm diameter touching internal parts. Vertically falling water will not have any harmful effect.
IP 54
Protection against objects < 1.0 mm diameter touching internal parts including dust protection to the extent that it will not effect product performance. Water splashing against the object from any direction will not have a harmful effect.

IP 56
Protection against objects < 1.0 mm diameter touching internal parts including dust protection to the extent that it will not effect product performance. High-pressure water jets from any direction will not have any negative effect.
IP 64
Complete dust protection. Water splashing against the object from any direction will not have a harmful effect.
IP 65
Complete dust protection. Water jet sprayed at any direction will not have any negative effect.
IP 66
Complete dust protection. High-pressure water jets from any direction will not have any negative effect.
IP 67
Complete dust protection. Temporary water immersion up to 1m depths will not have any negative effect
IP 68
Complete dust protection. Permanent water submersion will not have any negative effect.

In the USA There are the **NEMA Protection Ratings** available for enclosures (NEMA = National Electrical Manufacturers Association).

The most important NEMA Protection Ratings are:

NEMA Type 2
Intended for indoor use primarily to provide protection against limited amounts of falling dirt and water.
NEMA Type 3
Intended for outdoor use primarily to provide protection against rain, sleet and dust.
NEMA Type 4
Intended for indoor and outdoor use primarily to provide protection against dust and hose directed water.
NEMA Type 6
Intended for indoor and outdoor use primarily to provide protection against limited water immersion and hose directed water.

NEMA equivalents for some IP classifications:

NEMA Type 3 corresponds to **IP 54**

NEMA Type 4 corresponds to **IP 56**

NEMA Type 6 corresponds to **IP 67**

Materials:

Enclosures are mostly made from ABS (Acrylonitrile Butadiene Styrene) Plastic Material; this material is robust and has good mechanical and chemical properties.

Mounting of Enclosures

Enclosures have ether mounting holes (outside the sealed space for the electronics) or feet for easy fixing of the enclosures to walls, machinery or within cabinets.

Sealing for removable Lids:

Small enclosures are sealed without a removable lid.

Larger enclosures have a removable lid with a neoprene (a sort of rubber) gasket to seal the lid.

The sealed space usually includes only the electronic area and excludes mounting holes and the screws for fastening the lid.