

IP Rating Reference Chart for Sheet Metal Enclosures

This IP rating reference chart helps engineers compare enclosure protection against solid objects, dust, water, and access to hazardous parts, then translate the selected rating into practical sheet metal enclosure design checks.

Important: IP ratings are assigned to an enclosure or finished equipment assembly tested in a defined configuration. They are not a universal performance guarantee for an unassembled sheet metal panel, a coating by itself, or a product used outside its tested conditions. IEC 60529 is the controlling standard for the IP code; confirm the required edition, test setup, accessories, and application standard before release.

First Numeral — Solid-Object & Dust Protection

An IP code normally has two numerals: the first addresses protection against solid objects and dust; the second addresses protection against water. The metric values in the tables are the controlling reference values. Inch equivalents are rounded convenience conversions, so the metric values should control the drawing and test requirement.

First Numeral	Protection Level	Practical Interpretation for an Enclosure
0	No protection	No stated protection against solid-object ingress.
X	Not rated	No first-numeral rating is stated; do not infer protection.
1	Objects greater than 50 mm (1.97 in)	Protection against large solid objects; this is not a dust rating.
2	Objects greater than 12.5 mm (0.49 in)	Protection against finger-sized objects and larger.
3	Objects greater than 2.5 mm (0.10 in)	Protection against tools, wires, and similar objects above the stated size.
4	Objects greater than 1.0 mm (0.04 in)	Protection against finer tools, wires, and similar solid objects above the stated size.
5	Dust-protected	Dust ingress is not completely prevented, but the permitted ingress is limited so it does not interfere with satisfactory operation or safety under the applicable test.
6	Dust-tight	No dust ingress under the applicable test conditions.

The object-size values are maximum object dimensions used by the rating system, not allowable gaps for every joint or opening in a fabricated enclosure. A cable entry, ventilation opening, hinge, latch, or seam may require its own IP-rated component or design treatment.

Second Numeral — Water-Ingress Protection

SECOND NUMERAL	PROTECTION LEVEL	PRACTICAL INTERPRETATION FOR AN ENCLOSURE
0	No protection	No stated protection against water ingress.
X	Not rated	No second-numeral rating is stated; do not infer water protection.
1	Vertically falling drops	Protection against vertically falling water drops under the applicable test.
2	Vertically falling drops when tilted up to 15°	Protection when the enclosure is tilted up to 15° from its normal position.
3	Spraying water	Protection against water spray up to 60° from the vertical.
4	Splashed water	Protection against splashing water from any direction under the applicable test.
5	Water jets	Protection against water jets from any direction at the specified test pressure and flow.
6	Powerful water jets	Protection against more powerful water jets from any direction at the specified test pressure and flow.
7	Temporary immersion	Protection during temporary immersion under defined conditions; common reference summaries describe a test up to 1 m (3.28 ft) for up to 30 minutes.
8	Continuous or extended immersion	Protection during more severe or extended immersion conditions defined for the product and test arrangement; the code alone does not state a universal depth or duration.
9	High-pressure, high-temperature water jets	Protection against high-pressure hot-water jets from different angles under the applicable test.

The second numeral is not a simple “higher is always better” scale. Immersion ratings such as IPX7 and IPX8 do not automatically mean that the enclosure has also passed IPX5 or IPX6 water-jet tests. If both hazards matter, specify the combined marking or test sequence required by the applicable product standard and test laboratory.

IP65 vs IP66 vs IP67 vs IP68

These ratings are often compared during enclosure selection, but they address different exposure types.

RATING	SOLID PROTECTION	WATER PROTECTION	TYPICAL DESIGN QUESTION
IP65	Dust-tight	Water jets	Will the enclosure resist dust and directed washdown-style jets?
IP66	Dust-tight	Powerful water jets	Is the enclosure exposed to a stronger jet or more demanding washdown?
IP67	Dust-tight	Temporary immersion	Could the enclosure be briefly submerged, and has the complete assembly been tested in that condition?

RATING	SOLID PROTECTION	WATER PROTECTION	TYPICAL DESIGN QUESTION
IP68	Dust-tight	Extended or continuous immersion under defined conditions	What depth, duration, temperature, and installation conditions are written into the product requirement?
IP69	Dust-tight	High-pressure, high-temperature jets	Does the application require the specific hot-jet test associated with this code?

These are reference interpretations, not automatic application approvals. For a real part, state the target IP code, standard, assembled condition, orientation, access-panel condition, and any required simultaneous ratings on the drawing or procurement specification.

Design Checks Before Releasing a Drawing

#	DESIGN CHECK
1	State the complete IP code, the controlling standard or product standard, and the required test condition.
2	Identify whether the rating applies to the enclosure alone or to the fully assembled equipment.
3	Define normal orientation, door or cover position, removable-panel condition, and service configuration during the test.
4	Identify every opening and penetration, including cable glands, connectors, vents, drains, hinges, locks, windows, and fastener holes.
5	Specify the gasket or sealing system, mating surfaces, joint continuity, corner treatment, and replacement requirements.
6	Check bend radius, flange length, flatness, weld distortion, and alignment at the sealing interface.
7	Confirm whether dimensions and inspection occur before or after coating, plating, or other finish.
8	Confirm that the selected components have their own compatible IP ratings and installation instructions.
9	Decide whether both jet and immersion protection are needed; do not infer one from the other.
10	Define the inspection record or test report required for production approval.

Common IP Rating Design Problems

PROBLEM	WHY IT HAPPENS	EARLY DESIGN RESPONSE
The enclosure body passes review but the assembly leaks	Penetrations, gaskets, or accessories were excluded from the review	Review the complete assembled ingress path and component interfaces.
IP65 is selected for an immersion exposure	A jet rating was treated as a general waterproof label	Select and verify the immersion rating needed for the application.

PROBLEM	WHY IT HAPPENS	EARLY DESIGN RESPONSE
IP67 is assumed to include powerful water jets	Immersion and jet ratings were treated as cumulative	Specify both tests or a combined marking when both exposures are expected.
A door gasket does not seat evenly	Flange width, flatness, corner geometry, or fastener loading is inconsistent	Check the sealing land, formed geometry, closure method, and post-process dimensions.
A coated panel no longer assembles consistently	Finish thickness or masking was not included in the fit review	Define the finish state for critical interfaces and inspect after finishing.
A welded corner distorts the mating face	Heat input and sequence were not considered in the enclosure design	Identify critical sealing datums and review weld sequence, fixturing, and inspection.
A late cable-entry change breaks the target rating	The new gland or connector has a different cutout or sealing method	Approve the penetration component, panel interface, and installation method together.

What to Do When the Target Rating Is Difficult to Achieve

OPTION	WHEN IT HELPS	TRADE-OFF
Simplify the enclosure seam	Long interrupted seams or complex corner transitions create multiple leak paths	May reduce service access or change the external appearance.
Add or redesign the gasket land	The seal is narrow, discontinuous, or close to a bend or cutout	Uses more panel area and may require a larger enclosure or new tooling.
Reduce or relocate penetrations	Many cable entries, windows, and accessories make the sealing system complex	Can affect wiring, serviceability, thermal management, or user access.
Use qualified IP-rated glands, connectors, vents, or windows	The sheet metal interface is workable but the accessory is the weak link	Adds component cost and requires correct installation and replacement control.
Separate jet and immersion requirements	The application was over-specified with one rating that does not match the actual hazards	May require two verification tests or a more explicit product specification.
Revisit forming and weld sequence	Distortion or springback prevents repeatable mating-surface contact	May add fixtures, secondary operations, or inspection time.

Reference chart for engineering review. IP ratings are assigned to a tested enclosure or finished equipment assembly, and IEC 60529 is the controlling standard. Inch conversions are rounded convenience values; the metric values control. Confirm the applicable standard edition, test setup, accessories, and application conditions before release.