



Solar energy generation systems

Best practice guide



SOLAR ENERGY GENERATION SYSTEMS – BEST PRACTICE GUIDE

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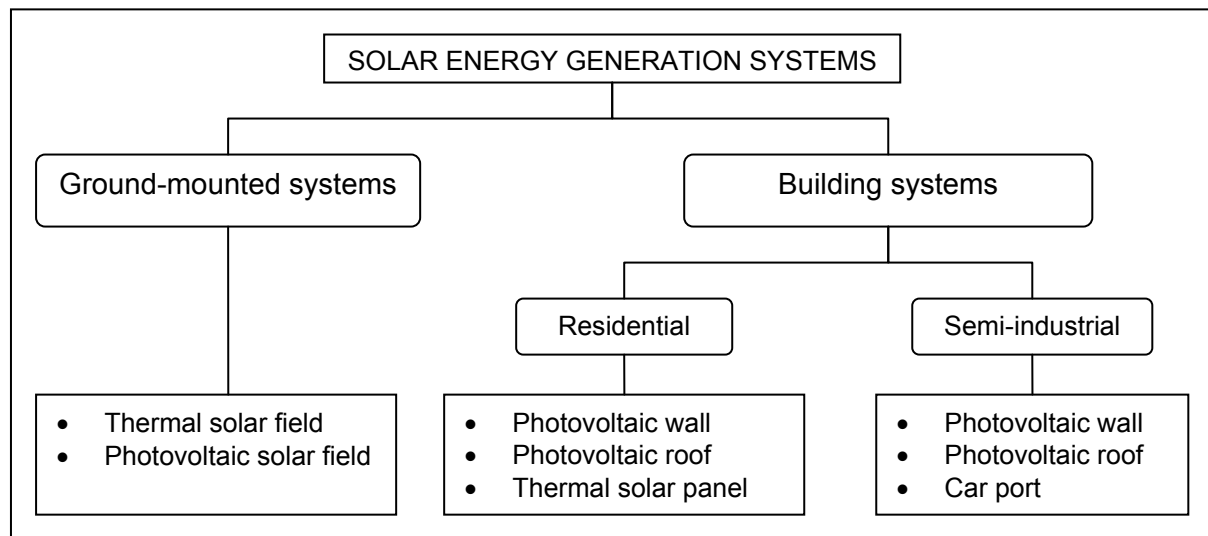
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AN OVERVIEW OF THE SOLAR ENERGY MARKET

The EU27 aims to achieve a 20% share for renewable energy sources in its overall energy consumption by 2020. The production of this energy will be either concentrated in large plants such as solar fields or distributed worldwide at individual building level. Steel is relevant to reach this goal, as the structure for solar fields or as a support or frame for solar panels (photovoltaic or thermal). Steel is the substrate of choice with promising new technologies that contribute to environmental protection. In the near future, steel itself will be used to produce energy.

General description of the different solar energy generation systems

These systems are commonly divided into two main groups: those that are ground-mounted and those that are installed on buildings.

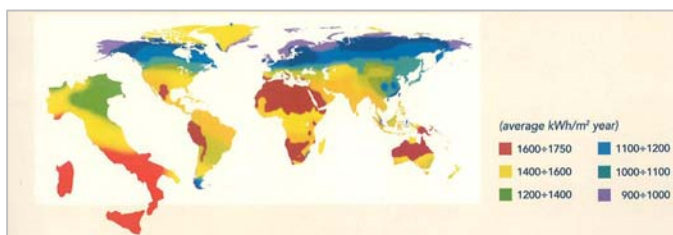


Ground-mounted systems

Thermal solar field

Solar radiation reaches the Earth's surface with a density (kW/m^2) that is adequate for heating systems but not for an efficient thermodynamic cycle for producing electricity. This means that the density has to be increased and the incoming solar radiation concentrated by using mirrors or lenses. Solar power systems use the sun's rays as a high-temperature energy source to produce electricity in a thermodynamic cycle.

The four main concepts used in concentrating solar power (CSP) technologies are solar power towers, parabolic troughs, dish/engine systems and Fresnel reflectors, all based on the same principle: they first generate steam and then electricity. They vary according to the concentration devices, energy conversion methods, storage options and other design variables, and can consist of series of several hundreds or thousands of concentrating units. They are usually fixed onto a concrete base. Naturally, they are located where direct radiation is high enough, i.e. no clouds and not too far from the Equator.



One of the main benefits of a thermal solar field is that it enables energy storage solutions to be developed, a major advantage in responding to consumption peaks and ensuring continuous production, i.e. day and night. These kinds of solar plants can generate electricity, high-temperature

heat and low-temperature heat, giving access to applications like solar cooling or seawater salt removal.



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Solar power tower systems have a single receiver placed on top of a tower surrounded by hundreds or thousands of mirrors (heliostats), which track the apparent motion of the sun in the sky, redirecting and focusing the sunlight onto the receiver. The structure of the heliostats and that of the tower is made of steel.



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A parabolic trough solar collector is designed to concentrate the sun's rays via parabolic curved solar reflectors onto a heat absorber element – a 'receiver' – located all along the optical focal line of the collector. The solar collectors track the sun continuously. The structure supporting the mirrors is made of steel.



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In solar dish/engine systems, parabolic dishes capture solar radiation and transfer it to a Stirling engine – an engine that uses external heat sources to expand and contract a fluid – placed in the focus of the dish. This approach is particularly suitable for decentralised electricity generation.



A linear Fresnel reflector power plant uses a series of long, narrow, shallow-curvature (or even flat) mirrors to focus light onto one or more linear receivers positioned above the mirrors.



Photovoltaic solar field

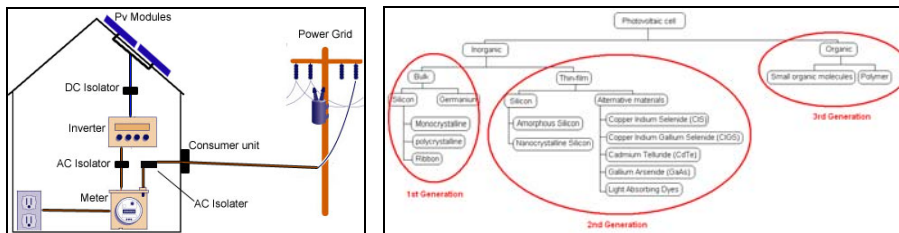
Using photovoltaic systems to convert sunlight into electrical energy is also an environmentally friendly way of generating electricity. Huge PV power plants are built throughout the world, e.g. in China, Canada, Italy, Germany and Ukraine, with nominal production ranging from 50 to 500 MW. Fixed-tilt solar arrays using typical modules of about 15% efficiency on horizontal sites need about 1 hectare/MW in the tropics and this figure rises to over 2 hectares in northern Europe.



Unlike the previous types of massive solar energy generation systems, photovoltaic solar fields generate electricity directly. They are usually decentralised. Their structures are made of steel and are either fixed or can have a controlled orientation.

Building systems

Whereas large-scale energy generation systems are ground-mounted, a second group consisting of medium or small-scale systems is developed for buildings. More than just a protective covering, a steel roof or envelope can also house complete energy-recovery systems in the form of integrated thermal or photovoltaic solar panels. Roofing incorporating PV panels is a forward-looking solution that contributes to the production and rational use of solar energy. PV panels are often installed on the roof, and more rarely on cladding. This situation evolves quickly with the growing numbers of positive energy buildings. Furthermore, new generations of more efficient and/or lower-priced PV cells will soon be on the market.



There are three main kinds of solar panels, as shown in the pictures below: rigid polycrystalline panels integrated on a metal frame, more recent PV laminates and flexible PV cells. Several techniques have been developed so that these panels can be attached to the building. Rails and frames are manufactured from steel thanks to its additional cost advantage compared to other materials.



Residential

Typically generating up to 20 kW, this segment includes rooftop and wall systems on individual buildings and dwellings, and is the largest segment, with a worldwide market share of 68% in 2010. These PV systems are either added to or integrated into the roof. The PV panels are placed either when the building is erected or during renovation.



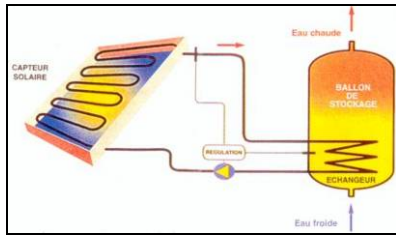
Besides PV panels, residential houses can also have thermal solar panels that produce hot water for domestic/sanitary purposes or to warm pools. These panels are also attached to the building by means of metal structures.

Unlike PV solar panels, a thermal solar panel does not produce electricity but heats a fluid using solar energy. The efficiency of this type of system is about 80%, compared with 5-15% for PV solar panels.

This glazed solar thermal technology is currently used in different kinds of applications:

- domestic hot water systems
- solar heating systems
- solar combi systems for domestic hot water and space heating

- solar air conditioning and cooling systems



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Steel is often used to make the frame and, in the near future, as a thermal absorber.

Semi-industrial

The main differences between residential and commercial/industrial PV solutions are:

- their dimensions (larger for commercial/industrial segment)
- their ability to adapt to the current roofing solutions specifically used on industrial buildings

Agricultural, storage, industrial and commercial buildings belong in the semi-industrial market. This segment also includes rooftop and wall systems for commercial office buildings, schools, hospitals, retail and industrial buildings.



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The major manufacturers are very creative and are rapidly developing elaborate designs for their roof panels made of metallic or organic coated steels, which are combined to form new types of fasteners to simplify installation of the panels and thus save time and money. These new mounting systems tend to maintain the integrity of the roof thanks to the use of fasteners that prevent perforations. This is a huge benefit, considering that the main source of complaint is the loss of roof watertightness after installation of the solar panels.



For these applications, steel has advantages in terms of cost, thermal behaviour (i.e. lower thermal expansion at high temperature) and potential weight/stiffness ratio.

The new PV installations for car parks must also be included in this segment.



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THE REQUIREMENTS DEPEND ON THE APPLICATION

As shown above, the systems supporting PV panels, thermal panels and/or mirrors are mainly made of steel.

The first requirement concerns their structural design. Each type of solar energy generation system has its own specifications.

Systems for thermal solar fields must have tight geometry tolerances to focus the sun's rays onto the energy receiver, whatever the local weather conditions. To meet this first requirement, it is important that the structure should maintain its geometry even when it is subject to high flexion and torsion constraints, mainly due to wind. Small variations in geometry could lead to a drastic drop in energy efficiency.

PV solar systems mounted on the ground or on buildings must also be able to withstand climatic loads, though in this case the constraint is less. Their efficiency will be less affected. This statement is also valid for individual thermal solar panels.

Due to its mechanical properties combined with an efficient structural design, steel can meet these needs.

The second requirement relates to durability, i.e. resistance to corrosion, UV weathering or abrasion. End users expect more than a 20-year life span. Not all materials have such high durability, and not all metallic coatings and organic coated steels offer these performance characteristics.

The durability, safety and resistance tests that PV panels and, to some extent, the supporting structure must undergo are defined in IEC 61215 and IEC 61646 standards.

For building systems, a third requirement concerns their aesthetic appearance. Rigorous aesthetic requirements are combined with the best corrosion resistance for full integration of the building.

There are four main segments, corresponding to different applications and/or markets.

Roofing/Cladding support of photovoltaic panels

This first application relates to residential or semi-industrial buildings. Their envelope is made of metallic and/or organic coated steels, in the form of simple trapezoidal sheets, corrugated panels or sandwich panels. The envelope thickness is often less than 1 mm. Roofing and cladding parts can be new or otherwise. The corrosion resistance and aesthetic quality of the envelope are important factors.

The roofing panels and/or the cladding profiles provide a stable base on which to mount solar panels. In other words, the solar panels are fixed directly on the envelope using dedicated fasteners, screws, adhesive bonding etc.



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Narrow profiles supporting solar panels

This second application also relates to residential or semi-industrial buildings. These profiles correspond to intermediate profiles between the building envelope and the solar panels. They are used to make it easier to mount the panels on a wall or on the roof of a building, for instance when the supporting surface area required is not available or is too narrow. Using these rail-like structures, solar panels can also be attached to standing seam roofs.

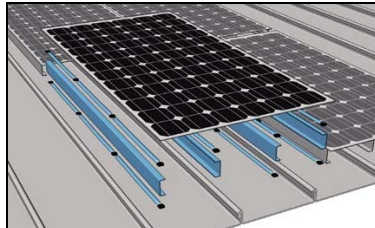
The profiles are made of metallic and/or organic coated steels, and are obtained from metallic coated slit strip by roll forming or bending. The thickness range of the profiles is 1 to 5 mm. Corrosion resistance of cut edges, mainly due to perforation and/or the strip edges, is a major concern.

The solar panels are fixed directly on these narrow profiles using dedicated fasteners, screws or bolts, adhesive bonding etc.

The narrow profiles can also be assembled in order to form a system supporting solar panels, as in the case of structures suitable for a flat roof. They ensure that the solar panels – photovoltaic or thermal – are properly oriented in relation to the sun. They are either fixed to the roof by means of additional profiles or simply weighted, and are highly suitable for industrial and residential flat roofs.



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Adaptive sheets for integration of photovoltaic panels/Casings for thermal panels

The third application deals with parts obtained by deep drawing. A high degree of deformation may occur locally during forming, which is why the steel grade and coating must be carefully selected. The thickness is less than 2 mm. These parts are made of metallic and/or organic coated steels. The corrosion resistance and aesthetic quality of the envelope are important factors.

These element parts facilitate the integration of systems, and can also locally replace the building envelope.

The casings of thermal solar panels belong in this segment, and are used to incorporate all the elements of the thermal solar panel, such as insulation, collectors etc.

These boxes can be obtained by roll forming, but deep drawing is often the most common process used.



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Structures

Not all the segments relate to buildings. In fact, the fourth segment involves structures for solar power plants and car parks. These structures comprise roll formed U, CE, Sigma etc. sections and are made from metallic coated slit strip. Typically, there are lots of perforations and edges. The thickness range of the profiles is 1 to 5 mm. Corrosion resistance of cut edges, mainly due to perforation and/or the strip edges, is a major concern.



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STEEL BENEFITS

Much of the fabric of modern life – cars, ships, railways, buildings, even ski lifts – relies on the strength and versatility of steel. Combining aesthetics and mechanics, it is used by architects, engineers and designers around the world. And steel is set to play an even bigger role in the future, as sustainability and environmental stewardship climb up the agenda for governments, companies and consumers, partly because steel is 100% recyclable. Steel is a sustainable metal. It can be recycled again and again without losing any of its properties. Few materials have this level of recycling efficiency.

The strength and durability of steel is what makes it the construction material of choice.

ArcelorMittal's steel is also being used to boost alternative forms of power generation. Solar energy generation structures require long-term durability and resistance to environmental loads. Steel is the right material thanks to the combination of advanced coatings, wide thickness range and comprehensive selection of steel grades.

Last but not least, steel is very competitively priced compared to other materials.

ARCELORMITTAL PRODUCT RANGE – DESCRIPTION & PERFORMANCE CHARACTERISTICS

The main issue for a solar energy generation system is its durability. This means that the PV panels will still be generating more than 80% of their nominal energy after 20 years and that during this period the structure is safe and continues to support the solar panels. The latter assertion assumes that the structure will withstand dead and climatic loads as well as the effects of corrosion and UV over time.

Depending on market requirements, ArcelorMittal offers various solutions in either metallic or organic coated steels. That is why ArcelorMittal selected four products: two organic coated and two metallic coated steels. Moreover, for solar applications, these materials come with guarantees of up to 25 years.

Organic coated steels

Resistance to red rust and resistance to photo-degradation are two properties that are required for high-quality roofing. Granite[®] HDX and Granite[®] HDS are eco-friendly and contain no heavy metals or chromates.

Granite[®] HDX

Granite[®] HDX is the combination of a 20-micron hot dip galvanised steel and a 55-micron polyurethane paint system. Granite[®] HDX exhibits outstanding corrosion resistance in severe climatic conditions and UV weathering. This flexible paint system coating is combined with a robust metallic substrate, either Z275 or ZA255. Granite[®] HDX is available in thicknesses ranging from 0.20 mm up to 3 mm.

Granite[®] HDS

Granite[®] HDS is the combination of a 16-micron hot dip galvanised steel and a 35-micron polyester paint system. This coil coated steel displays very good corrosion resistance behaviour in severe climatic conditions and UV weathering. Granite[®] HDS is combined with a Z225 metallic substrate. Granite[®] HDS is available in thicknesses ranging from 0.20 mm up to 3 mm.

The following table lists the performance characteristics of these two coil coated products.

Coil coated material performance	Granite [®] HDS	Granite [®] HDX
UV resistance Classification (EN 10169)	RUV4	RUV4
Corrosion resistance Classification (EN 10169)	RC4	RC5

NB: RUV4 and RC5 correspond to the best classes for resistance to photo-degradation and corrosion respectively.

The duration of the guarantee against perforation of the sheet metal (in years) for Granite[®] HDX and Granite[®] HDS can be up to 20 years, depending on the environment.

Solar applications: guarantees in years for Granite[®] HDX and Granite[®] HDS *

Organic coated steel product	Metallic coated steel substrate	Rural un-polluted	Urban and/or industrial		Marine		> 900 m rural
			Normal	Severe	3 to 20 km	1 to 3 km (a)	
Granite [®] HDX*	Z275	20	20	E	15	10	20
Granite [®] HDS*	Z225	10	10	E	10	5	10
* Backing coat 10 microns minimum mandatory except for foamed sandwich panels	E: Guarantee not automatic. Will be provided only after receipt of questionnaire and with paint manufacturer's agreement. (a) < 1 km after receipt of questionnaire and with paint manufacturer's agreement (seafront excluded). Guarantee for North African area, defined only after receipt of questionnaire and with paint manufacturer's agreement.						

Metallic coated steels

Magnelis[®] and Aluzinc[®] are the two metallic coated steels in ArcelorMittal's comprehensive range for the solar energy system market. Both are eco-friendly, ensuring the preservation of natural resources by using less zinc than pure zinc coatings. Moreover, like Aluzinc[®], Magnelis[®] considerably reduces zinc run-off in soil.

Magnelis® ZM310

Magnelis® ZM310 is the best product from the corrosion resistance point of view, with a coating thickness of 25 microns. Its chemical composition – 93.5% zinc, 3.5% aluminium and 3% magnesium – is optimised to ensure exceptional behaviour at cut edges due to self-healing. All these properties make it particularly suitable for structures made from roll formed profiles. Magnelis® ZM310 is available in thicknesses ranging from 0.45 mm up to 5 mm (higher on request).

Magnelis® is particularly suitable for four specific severe environments:

- Areas at least 300 m and up to 2000 m from the seafront
- Humid regions
- Harsh environments combining large temperature differences and corrosive factors (e.g. ammonia), as in agricultural buildings
- Chloride and highly alkaline environments (pH 10-13), in contact with mortar or cement

Aluzinc® AZ185

The name speaks for itself: Aluzinc® AZ185 is an alloy of aluminium and zinc composed of 55% aluminium, 43.4% zinc and a touch of silicon (1.6%). The thickness of the coating is 25 microns. Its corrosion resistance is much better than standard hot dip galvanised materials. Aluzinc® AZ185 is not only a very good metallic coating, however: it is also highly appreciated by architects for its unique silvery spangled appearance. With its excellent reflectivity, Aluzinc® helps maintain climate control in buildings. Many 30-year-old roofs made of Aluzinc® AZ185 still look good today. Aluzinc® AZ185 is available in thicknesses ranging from 0.23 mm up to 2 mm.

Durability of Magnelis® ZM310 and Aluzinc® AZ185

Metallic coated material performance	Magnelis® ZM310	Aluzinc® AZ185
Corrosion resistance Classification	C5	C4

NB: C5 corresponds to the best class for corrosion resistance.

The duration of the guarantee against perforation and rupture due to corrosion of the sheet metal (in years) for Magnelis® ZM310 and Aluzinc® AZ185 can be up to 25 years, depending on the environment and application.

The guarantee is valid in the European geographical area as well as in Morocco, Algeria, Tunisia, Libya, Egypt and Turkey.

Solar applications: warranties in years for Magnelis® ZM310 and Aluzinc® AZ185

Types of system	Segment	Metallic coating	Environment			
			Normal RURAL URBAN INDUSTRIAL (C4,C3,C2)	Severe INDUSTRIAL (C5-I)	AGRICULTURAL (<i>animal sheds- fertiliser storage...</i>) (C4,C5)	SEAFRONT 300 to 2000 m (C5-M)
Building systems Residential and semi-industrial buildings	Roofing/Cladding support of photovoltaic panels	Magnelis® ZM310	25	E	E	20
		Aluzinc® AZ185	25	E	NA	NA
	Narrow profiles supporting solar panels	Magnelis® ZM310	25	E	E	20
	Adaptative sheets for integration of photovoltaic panels, casings for thermal panels	Magnelis® ZM310	25*	E	E	20*
		Aluzinc® AZ185	25*	E	NA	NA
Ground-mounted systems	Structures	Magnelis® ZM310	25	E	E	20

E : Guarantee not automatic. Will be provided only after receipt of a questionnaire
 NA : Not adapted
 * : Granted by specific project
 : preferred solution

The structure has to be able to withstand dead and climatic loads such as snow and above all wind. As a result of its direction and the pressure/depression effect, wind creates stresses in the structure. The structure must be calculated and optimised based on Eurocodes.

Depending on the application and its requirements, different steel grades are available to manufacture solar system components. In other words, the selection of the right steel grade obviously depends on the design of the part, the process used to obtain it and also its expected in-service behaviour.

Most of the parts made of steel are obtained by bending and/or roll forming. The minimum bending radius depends on three main parameters:

- the thickness of the part
- the steel grade
- the coating system

Minimum internal bending radius

Steel grade		Aluzinc [®] AZ185	Magnelis [®] ZM310	Granite [®] HDX	Granite [®] HDS
DX51 to DX57 S220GD to S420GD Hx260LAD to Hx420LAD	Cold forming steels Structural steels Advanced steel	2T (T > 0.75 mm)	2T (T ≤ 0.75 mm) 4T (T > 0.75 mm)	1.5T	2T
NB: T= thickness					

RECOMMENDATIONS

The materials offered by ArcelorMittal for solar energy generation applications are top-class products. Nevertheless, some precautions need to be taken. We strongly recommend referring to the guidelines given in the appropriate brochure. Corrosion prevention must start at the design stage.

Contacts between materials

The steel components used for solar energy generation applications should not be exposed to or brought into contact with fluid emanating from corrosive chemicals of any kind, deposits or particles of heavy metals such as iron, lead or copper, or alkaline products such as ash, cement dust or animal excrement. All contact with wet or impregnated timber, soil or other wet materials must be avoided.

Simple contact between two metals generates an electrochemical cell. Three conditions must be met for galvanic corrosion to occur:

- different corrosion potentials of the metals within a given system
- a conductive connection between the two metals
- an electrically conductive humidity film (an electrolyte) connecting both metals

In other words, galvanic corrosion will not happen if:

- the materials are similar
- there is a non-conductive material between the metals
- the electrolyte – water for example – is not in contact with the different metals

The less noble material – the anode – is preferentially attacked, while the more noble material – the cathode – is protected against corrosion. However, the potential difference alone does not give a reliable indication of the corrosion rate, which in fact depends on the metals present, the environment, the duration of exposure to the electrolyte, and the surface area ratio between the anode and the cathode.

As long as the cathodic surface area (the more noble metal of the galvanic couple) is very small in comparison with the anodic surface area (the less noble metal), no change in corrosion behaviour is observed.

The following table gives the compatibility of materials in ambient air:

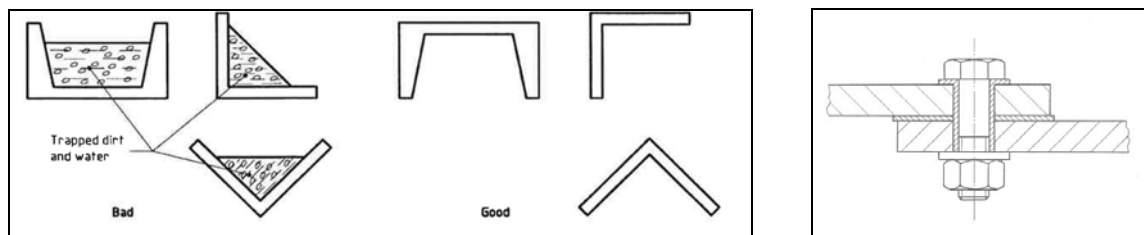
		Material with a small surface area					
		Galvanised	Aluzinc [®]	Magnelis [®]	Aluminium	Stainless steel	Copper
Material with a large surface area	Galvanised	+	+	+	-	+	0
	Aluzinc [®]	0/-	+	0/-	0	+	0
	Magnelis [®]	+	+	+	-	+	0
	Aluminium	0/-	0/-	0/-	+	+	0/-
	Stainless steel	-	-	-	0/-	+	+
	Copper	-	-	-	-	+	+
NB: + good 0 uncertain - poor							

Design considerations

Corrosion can be prevented by adopting good design practices.

The elements and the complete systems must be designed to avoid premature corrosion. A well-designed system will be more sustainable and economic. It is important to take the following points into consideration:

- Avoid perforations of roof panels when other techniques exist
- Avoid deposits accumulating or water retention
- Avoid gaps at connections
- Provide safe and easy access for cleaning and maintenance
- Select the right materials for the environment, and bi-metallic contacts



EN 12944-3

Environment

The solar range is very resistant to corrosion, as demonstrated by corrosivity categories. However, durability can be altered in particularly corrosive or aggressive environments, e.g. in atmospheres with a high saline concentration such as in coastal areas (near saltwater), corrosive fumes, smoke, rainwater containing carbon, and condensation. Water retention must be avoided.

Transport, storage and handling

The coils or sheets must be transported, stored and handled in such a way as to prevent the formation of moisture – due to condensation, for instance – as well as permanent deformation or surface damage such as scratches.

Solar energy generation system components must be manufactured, handled and installed with care to avoid any damage such as scratches or the presence of fragments of iron or iron-containing particles on the surface.

Maintenance and cleaning

Once the system is properly installed on the roof, effective maintenance starts with regular inspection to identify any action required and to avoid, amongst other things:

- Contact with incompatible materials (see above)
- Any water stagnation due to dust, leaves, grasses
- Areas that are continuously wet
- Corrosion at the edge of the elements
- Corrosion where there is an overlap (connection with other elements of the system)
- Paint issues
- Connections between the different elements and fasteners

The system has to be thoroughly cleaned (at least once a year) to ensure optimum product performance and to be in compliance with the automatic guarantee rules. Cleaning can be done with a soft brush, followed by a wash with soapy water to remove any waste and to prevent premature deterioration of the parts.

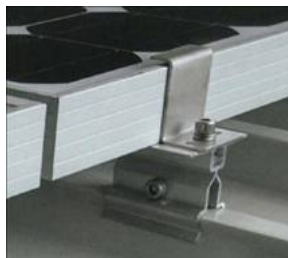
JOINING THE SYSTEM TO THE STRUCTURE

As described in the Annex to IEC 61215 and IEC 61646, both the solar panel and its substructure must be able to withstand climatic loads i.e. wind, snow, static or ice loads. According to the standards, the module and its connectors to the structure must withstand a positive or negative pressure of 2400 Pa. Some recent systems can withstand 5400 Pa, or 540 daN/m², which is equivalent to a 360 km/hour wind.

Mechanical assembly

Mechanical assembly is the most common way to attach solar panels – PV or thermal – to the roof and to connect components of the supporting system together. This involves the use of clips, clamps, screws, bolts and rivets.

Solar panels are fixed directly on the roof or via an intermediate rail system. For basic systems, the panels are simply screwed to the roof by means of a dedicated leg. This system is often used even though it has the drawback of piercing the roof panel, with the subsequent high risk of losing watertightness. Recent systems avoid this threat and comprise a combination of specific fasteners and associated specific roof panels.



As recommended above, contact between different materials must be avoided.

Welding

Welding is less common than mechanical assembly in the design of supporting systems for solar panels. To connect narrow profiles, ArcelorMittal recommends using Magnelis[®] ZM310 due to its high durability. Another advantage is that Magnelis[®] ZM310 is thinner than equivalent galvanised metallic coatings for an expected corrosion resistance, with the direct consequence that the welding process is facilitated.

The fused zone and the heat-affected zone must be re-protected after welding.

Adhesive bonding of PV laminates

A new technique for joining roof panels and laminated PV panels has recently been developed, based on adhesive bonding. One of the advantages of this technique is that it requires no drilling and does not cause any damage to the roof, potentially leading to leaks.

The following working conditions must be observed when applying the adhesive:

- The PV panels are fixed either directly on the roof or using spacers between the roof and the modules.
- The roof must be clean and dry: the surface must be cleaned properly with a brush and soapy water and then with a cleaner recommended by the adhesive supplier.
- The adhesive must be applied to the roof panels when their temperature is in the range 5°C-40°C. It is not rare for roofs to reach up to 80°C, especially in summer. In such cases, it is recommended to carry out installation late in the evening or to shade the area of the roof where work is taking place.
- The adhesive must be carefully selected to suit the materials to be glued.
- The pot life of the glue must also be respected.
- Some adhesives take a long time to cure completely, depending on the weather conditions.

- In service, the joints will compensate for thermal expansion and ensure that the module is securely held on the roof. The number of beads per module and the bead dimensions, as defined by the adhesive and PV module suppliers, must be strictly observed.
- The adhesive joint should not prevent rainwater drainage.



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Adhesion of flexible PV cells

Even though the efficiency of flexible cells is about two to three times lower than that of laminated rigid PV cells, flexible cells can be easily adapted to the building envelope. They are directly glued on the roof and/or cladding of the building, on site or preferably in the workshop. It is possible to assess their shear and peeling resistance to validate their adhesive performance.



Design support

How can ArcelorMittal be of assistance to you?

- Selection of the best coating and the right steel grades based on your specifications.
- Resistance assessment of mechanical assembly or adhesive bonding.
- Tests to prove that the assemblies are reliable in accordance with standards IEC 61215 and/or IEC 61646, whatever the purpose (orientation or accreditation).
- Based on Eurocodes, the structural calculation of your design.
- Based on Eurocodes and in partnership with you, optimisation of the design, e.g. weight reduction of the structure.

Standards and certifications

	Magnelis [®] ZM310	Aluzinc [®] AZ185	Granite [®] HDX	Granite [®] HDS
Certifications	<ul style="list-style-type: none"> • CSTB/ETPM • KIT/KIII (D)* • SITAC(S)* 	<ul style="list-style-type: none"> • KIT VAKA-103352 (D) • SITAC 0161/08 (S) • BBA 07/4493 (UK) • CSTB/ETPM 2/11-1437 (F) 		
Standards	<ul style="list-style-type: none"> • EN 10346* • SEW022 (D)* • DIN 55928-8 	<ul style="list-style-type: none"> • DIN 55928-8 		
* pending				