General information and regulations on the storage and transport of semi-finished aluminium parts

The functional capacity of semi-finished aluminium parts is generally not impaired by transport, storage or handling. Damage incurred during storage, transport or handling may arise in particular following a surface treatment, such as anodic oxidation, stove enamelling or powder coating, and can negatively impact the visual appearance of the semi-finished part. The potential negative impacts include water stains, scratches, kinks, dents, black discolouration, whitish spots, corrosion and abrasion points. For this reason, great care and attention should be paid when storing and transporting semi-finished parts. In particular, 'atmospheric corrosion' and 'condensation' must be considered very closely in order to prevent the issues named above from occurring.

1. Corrosion

Aluminium and aluminium alloys have been used for many years due to their corrosion resistance. The thin oxide layer that forms naturally on the metal surface inherently offers effective protection against external influences. Despite this, the surface may become "tarnished" or suffer punctiform corrosion. This can be caused by the effects of aggressive substances, such as road salt or acid rain. Such "aesthetic defects" generally have no impact on the functional capacity of a part, and can be removed if desired. This removal, however, can only be effected through mechanical removal of the surface layer.

2. Condensation and atmospheric humidity

Alongside atmospheric corrosion, attention must be paid to the formation of condensation during the processing and storage of aluminium. Generally, aluminium has good thermal conductivity, which is why the oxide layer on the surface of the semi-finished aluminium part reacts very quickly to differences in temperature at the storage location. Water vapour in the air condenses on the metal when the surface temperature of the metal is below the dew point of the surrounding atmosphere. The dew point is dependent on the ambient temperature and the relative air humidity. Condensation can result in whitish spots or black discolouration, and only negatively affects the semi-finished aluminium part in terms of its visual appearance. These defects do not affect the part's mechanical characteristics: they only impact on its visual appearance and can be covered by paint or varnish.

The following is a list of possible causes of unwanted condensation:

- If, for instance, a semi-finished part is transported from a cool or cold storage location to a warm room or truck, this can result in water condensation forming on the metal – in particular on wet or humid days. This can occur at any time of year.
- If semi-finished aluminium parts are cooled too quickly in sealed packaging, containers or transport space, this can result in condensation forming on the semi-finished parts.
- In the event of a thunderstorm, air humidity can rise rapidly, even though the temperature may remain constant. If the material is subjected to this raised air humidity, condensation can form.
- If the air is severely contaminated, e.g. by CO_2 or dust, unwanted water condensation can form as the result of even minor changes in temperature.

This condensation not only occurs on the outer surfaces but also in fissures and crevices as a result of capillary action. The capillary penetration by such moisture occurs in particular with coiled belts and stacked sheets. The dew point can be calculated using the table below. This denotes the point from which condensation is more likely to occur.

Dew Point (°C)										
Air Temperature (°C)	Relative Air Humidity (%)									
	100	90	80	70	60	50	40	30	20	10
43	43	41	39	37	34	31	27	22	16	5
41	41	38	36	34	32	28	24	19	13	3
38	38	36	34	32	29	26	22	17	11	0
35	35	33	31	27	26	23	19	15	9	0
32	32	31	28	26	23	20	17	12	6	0
29	29	27	26	23	21	18	14	10	3	
27	27	25	23	21	18	15	12	7	2	
24	24	22	20	18	16	13	9	5	0	
21	21	19	17	15	13	10	7	3		
18	18	17	15	13	10	7	4	0		
16	16	14	12	10	7	5	2			
13	13	11	9	7	4	2	0			
10	10	8	7	4	2	0				
7	7	6	4	2	0					
4	4	3	1	0						
2	2	0								
0	0									

Example 1: From storage into warm open air
The material was stored in dry conditions at 21°C and subsequently moved outside for onward transport or further processing at a temperature of >29°C and a relative air humidity of 60%. Water condensation forms.

Example 2: From cold open air into warm storage
The material was stored in dry conditions under a roof in the yard at a temperature of 7°C and is subsequently moved into a storage facility with a temperature of 18°C and air humidity of 60%. The dew point is 10°C, but the material is at 7°C. Water condensation forms immediately.

3. Information and regulations to prevent damage

Transport information
Condensation on semi-finished aluminium parts or impacts on parts due to aggressive substances can be avoided by transporting the parts in closed and covered vehicles. If it is not possible to transport parts in this manner, the packaging must be covered by tarpaulins. Care should be taken to prevent the bottom packaging unit from being impressed or crushed under the materials on top of it, in particular during transport over uneven surfaces (impact loading makes such damage more likely). To prevent damage of this type, load each packaging type correctly and accordingly. In addition, the whole load should be secured in place with straps in order to create one rigid unit and enable safe transport. In case of internal transport, e.g. into a warm room, the same rules apply as for storage.

Unloading information
Generally, semi-finished aluminium parts should be unloaded under cover. This means that the semi-finished aluminium parts and, above all, the sealed packaging, remain dry. Materials that have become wet or damp must be dried out on the same day. If the intermediate layers are removed and the parts stored in such a manner that they do not touch one another, air drying is permitted. To prevent kinks, long semi-finished parts must be secured and supported in multiple places by lifting devices. Slings used in such processes should be padded. If specific ‘grab points’ are provided or designated on a material, only these points should be used by the forklift or lifting device. If a metal sheet is removed from its packet, this sheet should not be dragged with its surfaces uncovered, as this would result in the underside being scratched and the surface of the sheet directly below it being damaged.
An incoming goods inspection must be conducted immediately on delivery of materials. Any transport damage that has occurred must be declared immediately, such as with the note “Accepted with reservations”. The reason for this is that transport insurance claims must be asserted within a limited period of time.

Warehousing information

As described above, condensation can form when a cold semi-finished part is brought directly to a warm and/or humid environment. First and foremost, this can quickly damage the surfaces of packaged materials. In order to prevent this, and depending on the precise situation, the following measures can be taken:

- The material should be moved immediately to a cool, dry location where no condensation is expected, and stored there temporarily.
- The goods should be covered with tarpaulins until the materials have reached room temperature. Air admission is thereby reduced and the formation of condensation predominantly avoided.
- Packaged material must be unpacked as soon as possible.

Storage instructions

Semi-finished aluminium parts must not be stored in the open air. Instead, as mentioned above, the parts should be stored in heated or unheated rooms but above all in the dry, and not stacked on top of one another. In the case of a coil, a small scratch mark on the outer winding can carry through several layers of the coil as a result of pressure (e.g. from another coil) and cause several metres of damage or rejects. It is therefore recommended that coils are kept in a separate room designated for this purpose and stored on a smooth, clean surface. In addition, coils must not be stacked on top of one another under any circumstances, as this can result in damage, in particular to the underside of the coil. When coils are stacked, not only can scratches and marks occur, but the risk of accidents also increases considerably (as coils may topple and fall).

Façade panels are particularly prone to corrosion and scratches on the building site, and should therefore be stored in a separate room away from the principal transport routes, with lots of space for forklift trucks to manoeuvre. If it is not possible to store them in a different room, a frame should be built from scaffolding and a water-repellent tarpaulin used to cover it. In addition, it must be ensured that the tarpaulin covers all packaging and that sufficient spaces are available for air to circulate.

Rapid temperature variations, draughts and high air humidity levels can all negatively impact on the material. As a result, only goods that are completely dry should be stored in their original packaging. Sheets should be stacked carefully and not too high, to avoid scratches in particular. Attention must be paid to the weight of pallets stacked on top of one another so that materials are not damaged by this stacking. Semi-finished aluminium parts that are not packaged must not be stored in direct contact with other metals, as this can lead to contact corrosion. The frame supports should be covered with a non-moisture-retaining material that is chemically neutral with aluminium and which also does not scratch the surface of the material. Such materials include wood and plastics.

Handling information

Neither scratches nor abrasions should be caused to the material when moving it; therefore, particular care should be taken when handling the material. Non-corrosive materials such as acid-free corrugated cardboard, wooden slats or synthetic specialist products should be placed between parts for internal transport.

When handling coils with cranes or forklift trucks, the contact surfaces must be covered with a soft material such as felt, rubber or cardboard in order to prevent damage to the inner windings. It is crucial that no chains are used.
When lifting façade panels, be careful to avoid damaging the panel edges.
In addition, nylon hangers must be used when lifting with a crane. Suspension chains should not be used under any circumstances. Façade panels must be supported along their entire length to prevent them from being damaged. Ideally, beams produced specifically for the product should be used, which ensure optimal distribution of the weight of the façade panels. If a forklift truck is used for handling, the forks must be adjusted so that the entire length of the panels is supported. Alternatively, other aids may be used to distribute the weight (e.g. boards).
Furthermore, it must be remembered that hand sweat can be transferred to semi-finished parts on contact and quickly damage metal surfaces. This consequently damages the metal's aesthetic qualities, particularly when the parts are subsequently anodised. If fingerprints are present despite precautions, these should be removed with methanol or ethanol as soon as possible. This damage cannot be removed by chemical means at a later stage, and instead have to be remedied by mechanical treatments such as sanding or brushing. For this reason, personnel who work with semi-finished aluminium parts are obligated to wear clean gloves made from soft textiles.