

SUPPLIERS' MANUAL

Packaging manual for suppliers

Motion business area

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1. Purpose and basic description



ABB is committed to continuous improvement of its supply chain. Through collaboration with our business partners, we aim to enhance supplier relationships, ensure the highest quality standards in our business, and create a sustainable value chain.

Sustainability and integrity are a key part of ABB's procurement and logistics strategy. Therefore, we have released an update of our global Packaging Manual for suppliers, which are in a current or upcoming business relationship with the Motion (MO) Business Area.

This packaging manual supersedes all other general instructions and guidelines for the Divisions on a global level. The material specific instructions submitted with dedicated orders are excluded from that.

ABB is looking forward to continued cooperation and on the way forward to more agile continuous improvements in procurement and logistics incl. packaging and therefore the optimization of the end-to-end value chain.

The purpose of this manual is to inform our suppliers of our general guidelines required to minimize safety risks, achieve optimum components quality and zero solid waste discharge from our facilities.

With the cooperation of all parties, we can continually reduce injuries, make improvements, increase our competitiveness, and minimize costs.

Suppliers are responsible for packaging and shipping parts that are of an acceptable quality to the point of use, utilizing the transportation method designated by ABB Business Area Motion.

These specifications provide guidelines for printing and applying a shipping/parts identification label.

The label is designed to improve productivity and control at suppliers and at ABB Business Area MO, by allowing effective and efficient capture of data for production counts, warehouse input/output, cycle checking, shipper generation, forwarding, freight transfer control, receiving, and other inventory controls.

Strict adherence to these specifications for the shipping/parts identification label will reduce implementation costs and increase benefits for ABB Business Area MO and its suppliers.

In this document, the word "SHALL or MUST" indicates a requirement and the word "SHOULD" indicates a recommendation.

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These guidelines are to be used during development of packaging, prior to submitting a quotation for production parts.

Specific regulations for each local division / manufacturing location, hereafter called LD e.g., products or country-specific requirements will be respected and are included in contracts with suppliers.

If specific regulations exist these supersede the data in the main document.

A supplier or manufacturer of components for ABB SHOULD have a certified quality management system that satisfies the requirements of the latest version of the standard DIN EN ISO 9001 as a minimum requirement.

Also, the supplier SHOULD work with a certified environmental management system DIN ISO 14001 and Sustainability and Supplier Code of Conduct.

In addition, the requirements of the national laws and the OHSAS 18001 (health & safety) SHOULD be fulfilled.

ABB would like to raise awareness of their suppliers to use ecological type of packaging solutions and systems also to use recyclable materials to reduce CO2 emissions and minimize carbon footprint <https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex%3A31994L0062>.

All necessary information for Suppliers is given at ABB official side: Supplying to ABB <https://global.abb/group/en/about/supplying>.

The packing MUST correspond to the various requirements in respect to quality, production specificity and technology, warehousing conditions, transport, expiry details, environmental, norms, directives, and custom requirements.

The basic information is presented in the Packing Manual and MUST be included in negotiations with suppliers to produce parts in accordance with ABB specifications, instructions, and special demands.

This Manual will be extended and updated according to future needs and requirements.

Every component or part has relevant packing requirements to ensure the best delivery condition including environmental aspects and norms.

Based on this, packing SHOULD fulfill below requirements:

- protection of the products from damage, humidity, temperature, dust, sand, negative environment influence,
- support excellent quality of components during transportation from Supplier to ABB,
- on time delivery with good condition,
- compliance with statutory/regulation/norms,
- uniformity of the workflow in delivery chain,
- expenses avoidance,
- time saving and
- standardization.

Packaging must protect its contents from any damage and make sure they remain unbroken, unscratched, non-rusted etc.

If the package contains something fragile or hazardous, it MUST always have a warning label.

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Packaging **SHOULD** be easy to remove.

All packing materials **SHOULD** be recyclable and **MUST** be non-toxic.

In addition, if the strap is in contact with painted or machined surface, the interface **MUST** be additionally protected to avoid scratches and abrasions. Staples are not preferred.

General regulations upon quotation, all suppliers **MUST** introduce the appropriate purchasing activity via the packaging specifications and materials used.

The actual cost for each item purchased to package the part and costs for the pallet, box or container, dunnage, and containment (e.g., strapping, tapes, or glue), **MUST** be available for review, and **MUST** be included in the price list of the product.

When submitting the quotation, a packaging specification and a packaging costs form **MUST** be submitted to ABB for review including:

- information about package type,
- pieces per packaging,
- weight and
- shipping point and return point for packaging materials for all parts shipped to ABB.

For direct shipments, the supplier **MUST** ask the ABB contact or buyer for the guidelines concerning the packaging and labeling required by final customer.

If any specific ABB approval **MUST** be obtained contact the supplier.

Suppliers **MUST** designate a packaging contact to the ABB category manager for problem resolution related to packaging.

The determination of the type of package design is the supplier's responsibility and the supplier **MUST** ensure that the parts and all packages of all shipments are received in an acceptable (damage-free) condition and are efficiently and economically packaged for the method of transportation, storage and type of handling planned for the final destination and its intended point of use.

To ensure that all packages and shipments will reach their intended point of use, all packages **MUST** be tested under simulated real-life conditions or ABB approves it based on its own experience.

The packaging **SHOULD** be inspected during FAI (First Article Inspection).

Package contents and routing **SHOULD** be easy to see, along with any special handling requirements.

All features/surfaces considered important to the quality or operation of the component (e.g., machined surface, bore, etc.) **MUST** be properly protected from damage, moisture, salt, corrosion, road dust, wood chips, fungus or other debris as required by ABB.

Supplier-initiated packaging or cost improvements are encouraged but **MUST** be initiated and approved through the ABB Category Manager to ensure that our plant productivity is not adversely affected.

All packaging **MUST** conform to all government and transportation rules and regulations (country of origin, travel, and destination).

The packaging of hazardous materials **MUST** follow relevant country-specific regulations, which describe the proper method of classification, packaging, marking, and labeling of each shipment.

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Furthermore, where other federal, state, or local standards and/or regulations are in effect the packaging and labeling **MUST** comply.

Suppliers **MUST** be assured that packaging materials in need of repair, rework, or any of such are not used for shipping purposes.

Pack design and parts count (pieces per container) **SHALL** does not vary, and containers are to be shipped fully filled except when a release is marked, or such fact is agreed with ABB.

Ergonomics **MUST** be considered as part of the packaging design.

All parts delivered to ABB **MUST** conform to all quality specifications, including parameters called out on the drawing/MSDS/SDS data sheets, any agreements made with the supplier upon negotiations.

ABB does not accept any non-conforming materials for re-work or needed additional costs or time to be able to be assembled, caused by improper packing proposed by supplier.

In addition to packaging integrity, and to further ensure the quality and reliability of delivered components, ABB places strong emphasis on the cleanliness of supplied materials. All suppliers **SHALL** ensure that components, whether mechanical or electrical, are delivered free from contaminants such as slag, burrs, dust, oil, splinters, or residues. These cleanliness standards apply even when not explicitly stated in technical drawings or specifications, and are critical to maintaining product quality, safety, and process reliability throughout the value chain.

ABB MUST always be informed in advance about packing change and MUST approve it before first shipment.

1.1. Packaging materials usage regulation overview

The European Union (EU) Registration, Evaluation, Authorization, and Restriction of Chemicals (REACH) Regulation and the Restriction of Hazardous Substances (RoHS) Directive have many things in common; both are required for market access, are commonly managed by product or/and material compliance and restrict the use of potentially dangerous substances in all products and electronics including their packing.

All necessary details are given at <https://global.abb/group/en/about/supplying/material-compliance>.

ABB suppliers **MUST** always confirm that their components comply with the requirements of:

REACH: For products and packing <https://echa.europa.eu/substances-restricted-under-reach>.

RoHS: Restriction of Hazardous Substances Directive 2002/95/EC (RoHS 1), short for Directive on the restriction of the use of certain hazardous substances in electrical and electronic equipment-for relevant products.

SDS: All components, their parts, impregnation, protection, primers and packing **MUST** be checked accordingly with SDS (Safety Data Sheet), which contains information about the hazards of working with a specific material in an occupational setting data sheet for safety aspects.

PFAS: Components **MUST** be also checked for **per-and polyfluoroalkyl substances** presence due to their environmental pollution properties and some of them are linked to negative effects on human health according to REACH announcement.

ABB do not intend to expose their employees to any danger or health loss.

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Figure 1. Hazard symbols.

AISPM 15; IPPC: If wood-packing materials used in international shipping **MUST** be stamped with the approved by IPPC (International Plant Protection Convention) stamp.

ISPM 15 (International Standards for Phytosanitary Measures) Marking with IPPC certification symbol **SHOULD** be clearly marked on all wood used for international shipments.

It is not required for transportation within EU (including Switzerland, excluding Portugal).

MB (methyl bromide) not accepted according to EU regulations since March 19th, 2010, <https://ispm15.com/>.

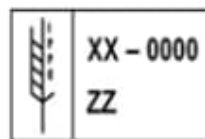


Figure 2. IPPC stamp.

All new components MUST be approved by ABB Authorities first before their purchase.

1.2. Sustainable raw materials in the product packaging

Requirements for plastic packaging material:

- use of single use plastics shall be avoided whenever possible and replaced with alternative materials,
- if plastic material is applied, then only mono material allowed without coating,
- reusable, a packaging product has been designed to be reusable within a reuse system. The system for reuse is established in a way that ensures the possibility of reusing in a closed-loop or open-loop system with multiple rotations (e.g., reusable plastic box that is sent back to Supplier by the ABB) and

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- in case of use of plastics packaging material. Material shall contain at least 80% of material weight recycled plastics or bio-based polymers from sustainable bio-waste feedstock.

Requirements for metal packaging material:

- metals used in packaging shall be low emission materials and shall include at least 70 % of weight originated from recycled material sources and
- alternative Low carbon material inputs from primary sources such as green steel is allowed to be used.

Requirements for packing materials related to wood sources:

- paper/cardboard/paperboard /chipboard, utilized in boxes, crinkle paper, shredded paper, corrugated bubble paper, honeycomb sleeves, molded pulp, etc., and wood (utilized in pallets), shall be FSC, PEFC or equivalent certified and
- If made from paper or cardboard, the remaining primary raw material is to be FSC certified.

All packaging materials are subject to audits and certification schemes, and all packaging material in total shall consist of at least 65 % sustainable based materials.

Formula for sustainable packaging content calculation:

$$\text{Sustainable packaging content} = \frac{\text{weight (kg) of secondary raw packaging material (SRM)}}{\text{weight (kg) of total packaging materials}}$$

2. General order and load information

2.1. Packing based on orders

Each order **MUST** be packaged separately, unless there is a different agreement with ABB.

If a supplier must deliver more than one order on the same delivery date, each order **SHOULD** be delivered in a separately packaged unit.

In case two orders are packed into one pallet it **SHOULD** be clearly marked as shown on the illustration. It is allowed to deliver two differently packaged units on the same unit load carrier (e.g., Euro Pallet).

Combination of two orders in one package unit is forbidden unless supplier agreed differently with ABB for better space use. In such cases it **MUST** be clearly listed and marked in the PO document and on the pallet.

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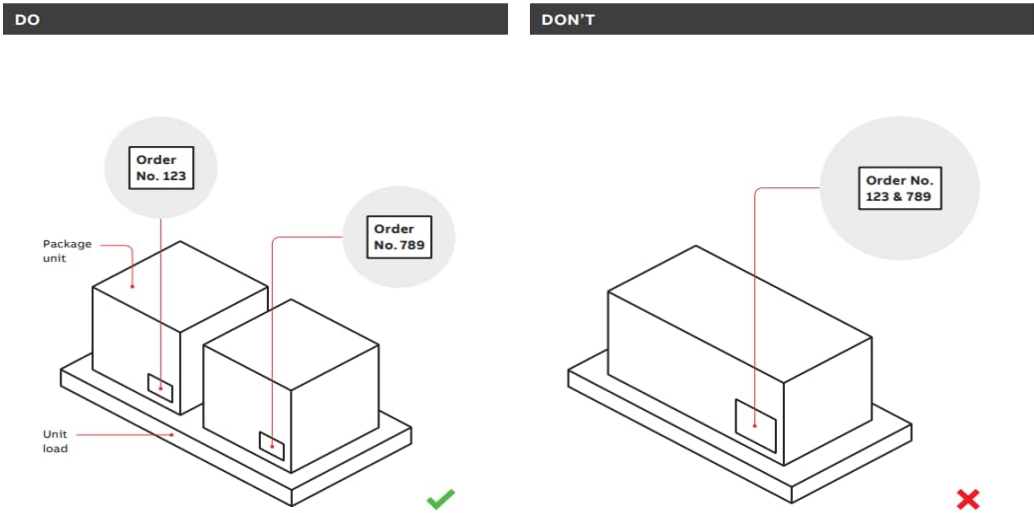


Figure 3. Orders.

When multiple package units are needed to deliver one order, each package unit **MUST** be clearly marked to identify which part of the order it comprises.

A copy of the delivery note which includes information on the partial order **MUST** be attached to each unit.

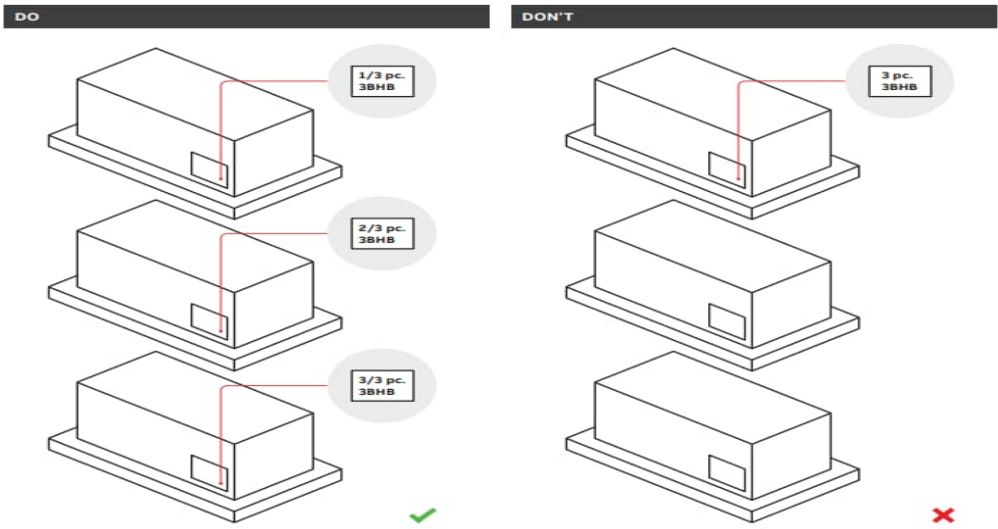


Figure 4. Order marking.

2.2. Kit item load

If kitting packing used, the kit delivery **MUST** be delivered as a complete set (exp. main item + accessories wires, seals, screws etc.).

It is not acceptable to deliver individual components contained within the kits separately unless prior approval has been obtained or ABB has requested this delivery method.

Loose individual components without customer material identity number ID No. (e.g., accessory items) must be fastened or packed together with the corresponding main material.

Material without customer ID No. could not be handled.

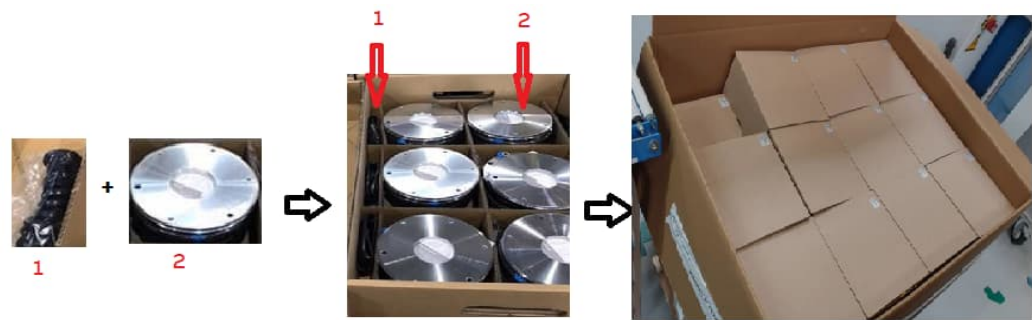


Figure 5. Photos of packed kit items.

Partial shipments **MUST** be clearly indicated on the delivery note.

Additionally, the ABB purchaser who authorized the partial shipment **SHOULD** be noted.

In addition to the material ID label, a kit shall be labeled with a content label that lists the following for each component in the kit:

- component part number,
- quantity in kit and
- component part description.

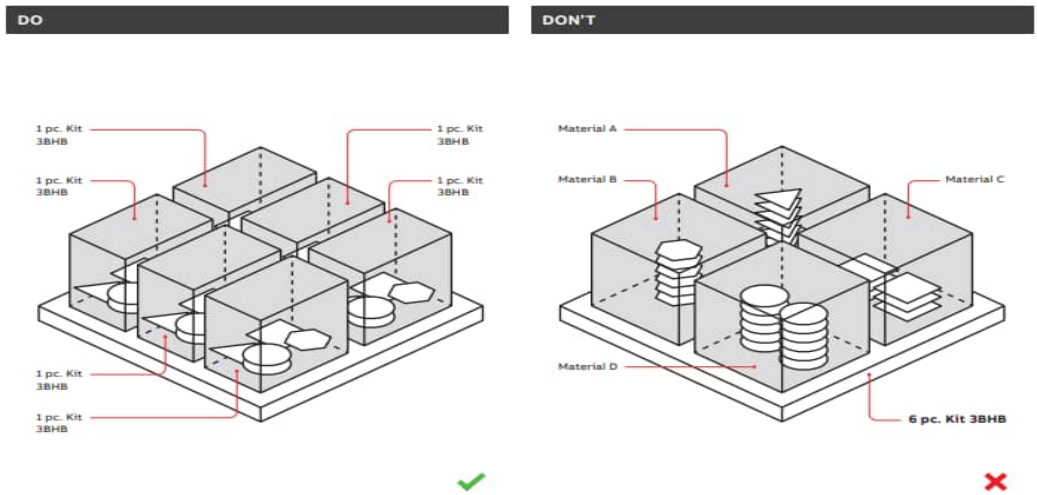


Figure 6. Packing kit items.

2.3. Mixed item loads

Mixed item loads **SHALL** be avoided.

If necessary, a label with the words “mixed parts” must be attached in a noticeable location and following instructions to be followed:

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- each sub-pack or item SHALL be identified with an individual label,
- product SHOULD be stacked vertically onto pallet,
- mixed loads MUST be stacked with the heaviest package at the bottom and the lightest package on the top,
- same part number SHALL not cross pallets unless carton quantity is more than a single pallet and
- multiple purchase order (PO) numbers of the same part number SHALL not cross pallets unless carton quantity is more than single pallet.

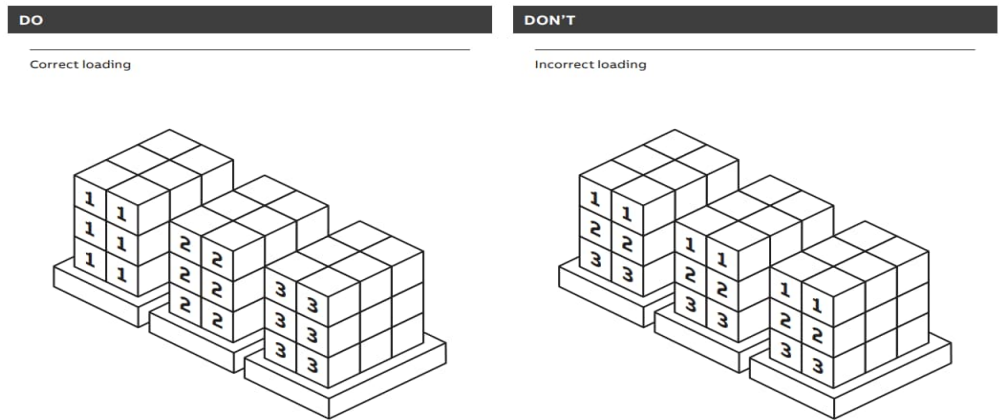


Figure 7. Packing mixed items.

2.4. Positioning of packages and packed goods

The packaged goods SHOULD be arranged within the packaging to allow even weight distribution.

The size of the packaging SHOULD reflect the size of the packed goods.

To ensure that the packed goods do not shift out of position during transport and handling, all empty spaces in the packaging SHOULD be filled.

The package (packaged good + packaging) SHOULD be positioned on the load carrier to allow for even weight distribution.

The basic size of the load carrier MUST not be exceeded by the package.

If the packages do not completely cover the load carrier, they SHOULD be arranged to allow for an even weight distribution and to prevent them from shifting out of position.

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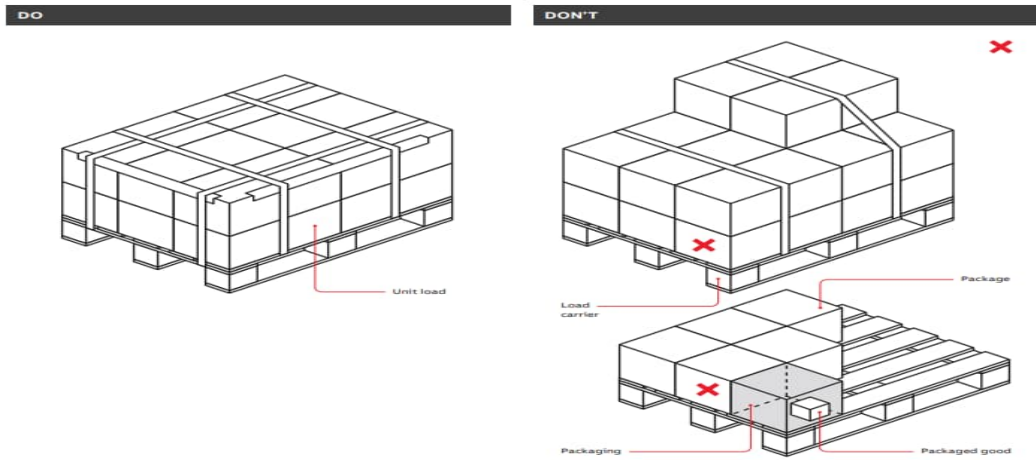


Figure 8. Position of packages.

2.5. Oversized items

If possible, containers SHOULD be adapted to fit unit load shipping sizes.

Packages with a weight above the maximum limit need to be delivered on load carriers which are designed for this purpose.

Loading units MUST be able to be lifted and therefore maneuverable by forklift, for instance with the use of pallets.

In the case of cabinets and housings, it is important that the load carrier exceeds the size of the packaged goods for collision protection.

Parts that exceed the load carrier are only permissible after consultation with the ABB and appropriate Authorities responsible for local product group transport, trade and logistics (LPG TT&L) Manager and clearly marked and labeled.



Figure 9. Size of load carrier.

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2.6. Unit load stacking

One of the most important properties of unit loads is that they are stackable.

Carriers **MUST** guarantee that pallets etc. can be securely stacked on top of each other with or without any stacking support (e.g., no slipping off the stacked goods).

The stacking of packaging **MUSN'T** be done sacrificing the stability and quality of the packaging.

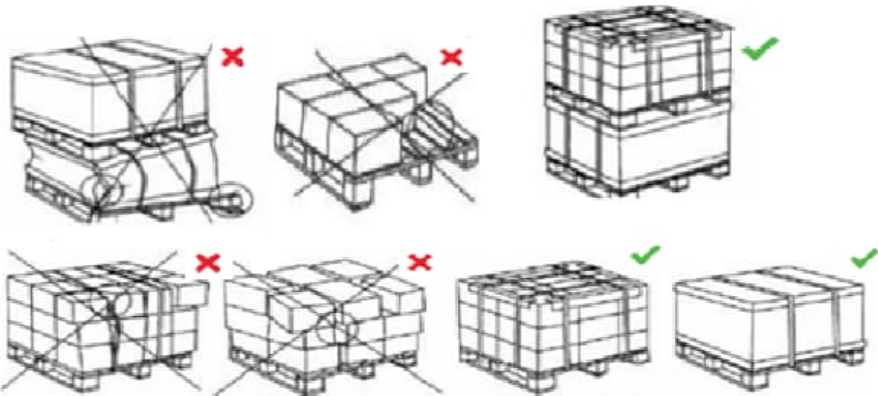


Figure 10. Stacking.

When corner posts are required for stacking strength, the preferred option is corrugated posts glued into place.

Wood corner supports require plant approval and **MUST NOT** be stapled to the boxes; instead, they are to be held in place by use of die cut folds with the flaps stapled over them.

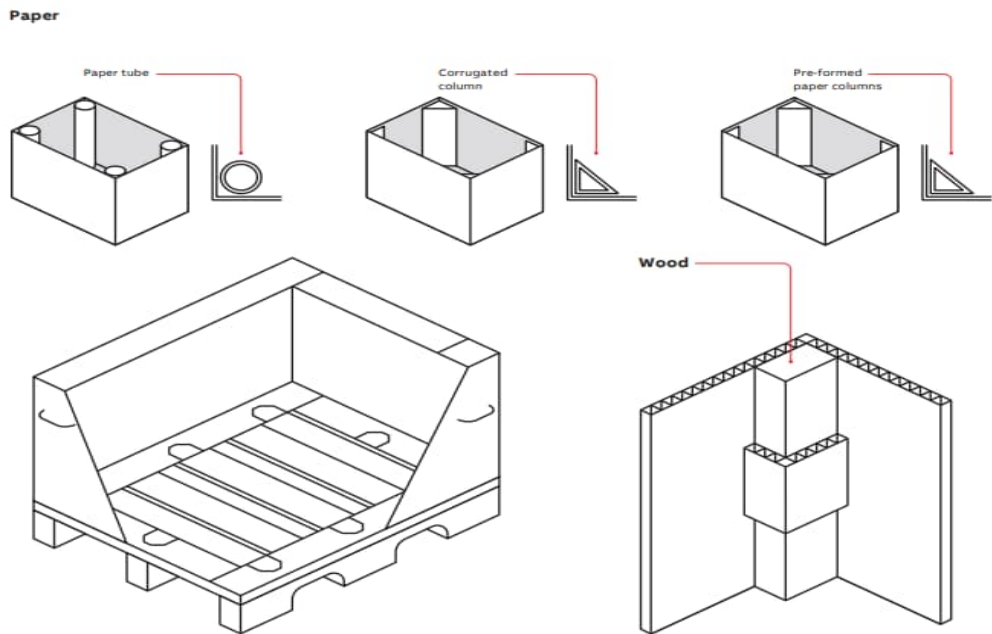


Figure 11. Corner supports.

ABB advice to place tiers, slips, dividers, or partition sheets between products to protect them from bumping into each other during shipping.

They also allow easier, safer stacking by more evenly distributing weight and preventing slip-page when placed between layers of product.

Divider sheets increase stability.

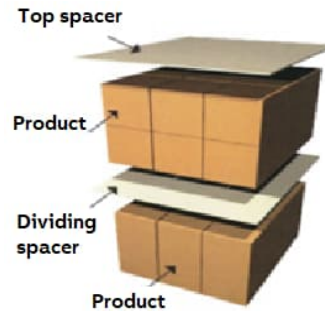


Figure 12. Tier, slip, divider, and partition sheets.

2.7. Packing marking

Packages need to be clearly marked for safe and efficient handling by using common symbols and markings.

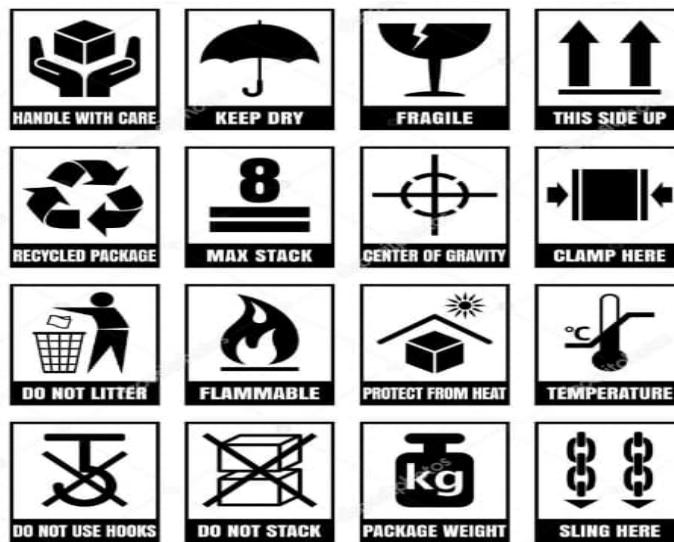


Figure 13. Package markings.

Not stackable items MUST be labeled accordingly.

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Figure 14. Sample of not stackable marking.

If wood-packing materials used in international shipping **MUST** be stamped with the approved by IPPC (International Plant Protection Convention) stamp.

ISPM 15 (International Standards for Phytosanitary Measures) Marking with IPPC certification symbol **SHOULD** be clearly marked on all wood used for international shipments.



Figure 15. IPPC stamp.

3. Packaging solutions

For transport and storage of packaged goods, environmentally compatible products **MUST** be used regarding ECO packing requirements.

For additional details about sustainable raw materials in the product packaging please see chapter **Error! Reference source not found.**

Overloading of pallets is prohibited.

3.1. Pallets

3.1.1. Euro pallet (EUR)

The pallet of the European Pallet Association (EPAL) pallet pool is the preferred load carrier, and it is the only one where multi-way use is acceptable.

The Euro pallet (EUR) is always preferable to an equal one-way pallet <https://www.epal-pallets.org/eu-en/>.

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Specifications of EUR pallet:

- length 800 mm,
- width 1,200 mm,
- height 144 mm,
- weight ~ 25kg and
- safe working load 1,500 kg.



Figure 16. Euro pallet.

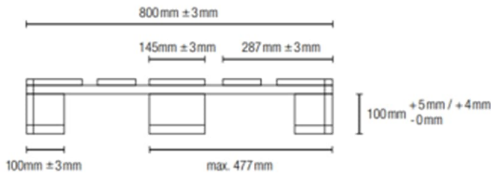
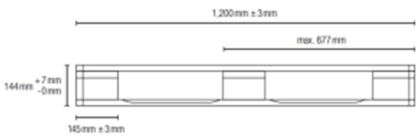


Figure 17. Dimensions of Euro pallet.



Figure 18. “EPAL in oval” on the left and right corner block (since 08/2013) used with Euro pallets.

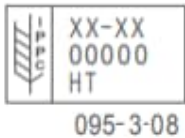


Figure 19. IPPC symbol, country code, registration number of the national plant protection authority, heat treatment, license number-year-month on the central block.



Figure 20. Compliance with the ISPM 15 standard is the most essential condition for the unrestricted use of load carriers in the international movement of goods.

All EPAL Euro pallets are therefore produced according to the stringent specifications of the IPPC and can thus be deployed around the globe.

Production units have a right to approve also other sizes of pallets, but the permission must come from the purchaser of the unit.

3.1.2. Re-used EUR pallet

If EUR pallets show one or more of the following defects, they are not swappable and have to be repaired according to the requirements of the UIC-Leaflet 435-4.

Damaged pallets, which are not swappable anymore, will not be exchanged and the supplier must pay for the repackaging.

Secondhand, EUR pallets are also an option classified as follows:

- pallets that have passed the UIC-Leaflet 435-4 checks and been repaired accordingly,
- technical requirements still meet the EUR standards,
- marked in the right-hand corner so that it is easier to distinguish the secondhand pallet and
- re heat-treated if Heat Treated mark is older than 21 days in China.

In case the supplier uses a non-marked EUR pallet, the following characteristics of the pallet need to be met.

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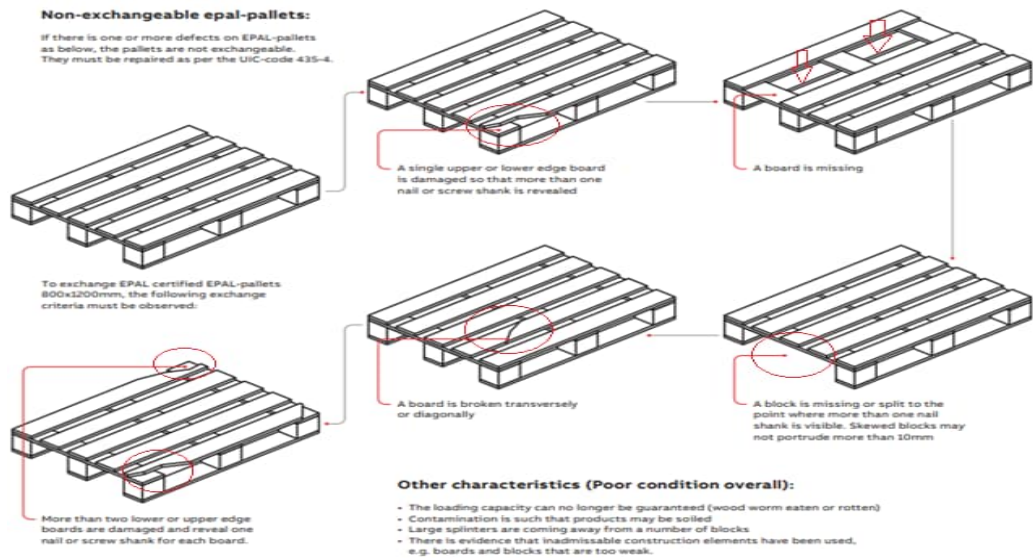


Figure 21. Requirements for EUR pallets.

3.1.3. FIN pallet

FIN pallet is used mostly in Finland, and it is suitable for train system and track width, which allows wider carrying pallet system usage.

This type of pallet is not so widely used by other EU countries because of unusual dimensions.

Specifications of FIN pallet:

- length 1,200 mm,
- width 1,000 mm,
- height 144 mm,
- weight ~ 27kg and
- safe working load 1,800 kg.



Figure 22. FIN pallet.

3.1.4. Spill pallet

Is advised for transportation of dangerous liquid substances or these which are exposed to chemical reaction and overflow effect.



Figure 23. Spill pallet.

3.1.5. Pallets/loads carriers

Demands on non-EUR pallets.

Region		Dimension (W x L)		Max weight per single package	
Measure	mm	in	kg	lb	
Americas	812 x 762	32.00 x 30.00			
	1067 x 1067	42.00 x 42.00	18	40	
	1219 x 1016	48.00 x 40.00			
Asia	1000 x 1200	39.37 x 47.24			
	1067 x 1067	42.00 x 42.00	25	55	
	1100 x 1100	43.30 x 43.30			
	1140 x 1140	44.88 x 44.88			

Region		Dimension (W x L)		Max weight per single package	
Measure	mm	in	kg	lb	
Australia	1165 x 1165	44.88 x 44.88			
	1100 x 1100	43.33 x 43.33	20	45	
Europe	800 x 1200	31.50 x 47.24			
	1000 x 1200	39.37 x 47.24	20	45	

Figure 24. Table of pallet dimensions.



Figure 25. Map.

The pallet dimensions used per market needs always to be confirmed by ABB buyer.

3.2. Corrugated packing

Selection of a corrugated container will depend upon the specificity of components, their materials, the method of transportation, transport destination and the method of handling required by the fabricator and the receiver.

Supplier MUST take into consideration proper paper type, flute, bursting strength, edgewise crush resistance etc.

It MUST be suitable for solid packing with protection against dust, dirt, moisture, and damage. However, certain basic factors deserve consideration.

Package size, strength and type MUST be selected to fit:

- the size, shape, and weight of component,
- the method of transportation and applicable carrier regulations, sufficient protection from the elements, number of transfer points, distance of travel, and roughness of the route,
- customer handling abilities (wracks dimensions, carrying capacity of forklifts etc.),
- carton MUST be moisture sealed to protect parts,
- triple wall corrugated is preferred to ensure parts arrive safely,
- the use of corners, divider sheets, separators inside to support the load is advised,
- **overloading is prohibited,**
- boxes SHOULD be stabilized by the corners if needed and protected by straps to the pallet and finally whole packing SHOULD be wrapped by foil to secure packing against dust and moisture,
- cardboard materials SHOULD be store properly (temperature, humidity etc.) before packing to assure the best packing properties like strength and

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- wrapping foils MUST not be luminous and reflective since it would cause a problem for codes scanning.

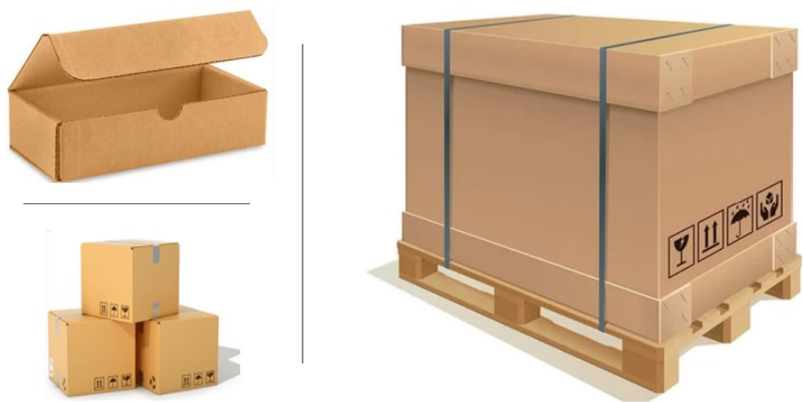


Figure 26. Boxes.



Figure 27. Dividers.

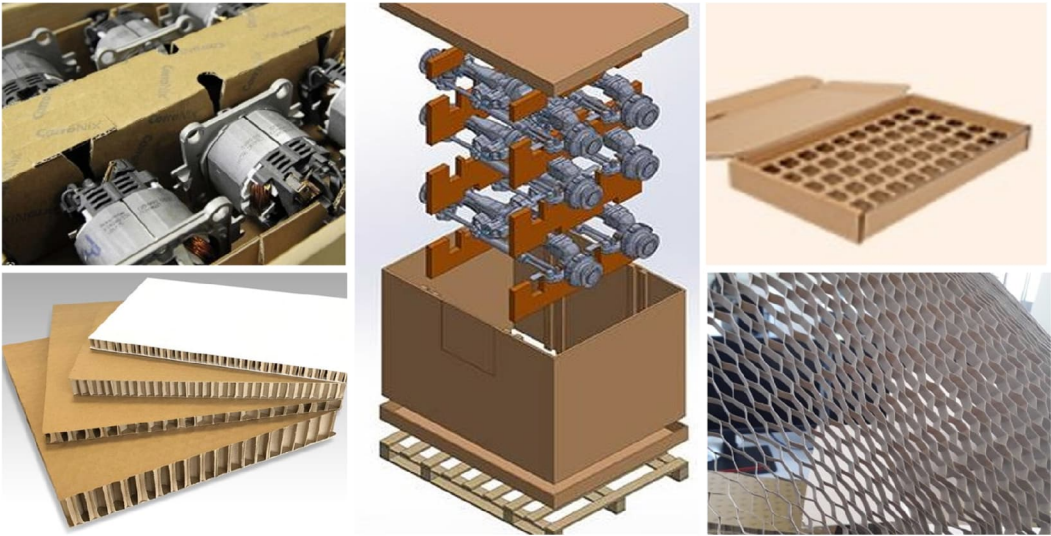


Figure 28. Dividers and spacers.

In case of not fully packed pallets it is highly required to fill the empty spaces with bubble wrap or corrugated board not to let them move and get damaged during transportation process.



Figure 29. Wrapping foil and packed cardboard boxes.

3.3. Wooden packing

Selection of a wooden container will depend upon the specificity of components, their materials, the method of transportation, transport destination and the method of handling required by the fabricator and the receiver.

Supplier **MUST** take into consideration proper factors ensuring bursting strength, edgewise crush resistance etc.

It **MUST** be suitable for solid packing with protection against dust, dirt, moisture, and damage.

Package size, strength and type **MUST** be selected to fit:

- collars component **MUST** be treated according to international standards (ISPM 15),
- the size, shape, and weight of component,
- the method of transportation and applicable carrier regulations, sufficient protection from the elements, number of transfer points, distance of travel, and roughness of the route,
- customer handling abilities (wracks dimensions, carrying capacity of forklifts etc.),
- wooden box **MUST** be protected by lid to protect parts from moisture, dust, humidity,
- separators are advised when multiple components are inside to prevent parts from damage and restrain movement,
- max. 4 collars can be overlaid and
- **overloading is prohibited.**

Pallet collars/SBB-CFF-FFS

- 1200 x 800 x 200mm,
- 4 or 6 hinges and

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- HT (IPPC Marked) MB (methyl bromide) not accepted according to EU regulations since March 19th, 2010.



Figure 30. Wooden boxes.

Use the appropriate fasteners and wood material sizes for corners and as fasteners to resist splitting or fracturing the wood components during assembly.

Good	Better	The Best
Helically Threaded Nail	Annularly Nail	Wood Screws
		

Figure 31. Recommended fasteners.



Figure 32. Dividers for EUR pallet.



Figure 33. Dividers and spacers.

Foldable one-way plywood packaging.

Standard plywood packaging made from:

- birch/pine/eucalyptus or oriented strand board (OSB),
- sizes 1200 x 800 x 200/ 400/ 600/ 800/ 1000 mm and
- thickness 5,5–9 mm.

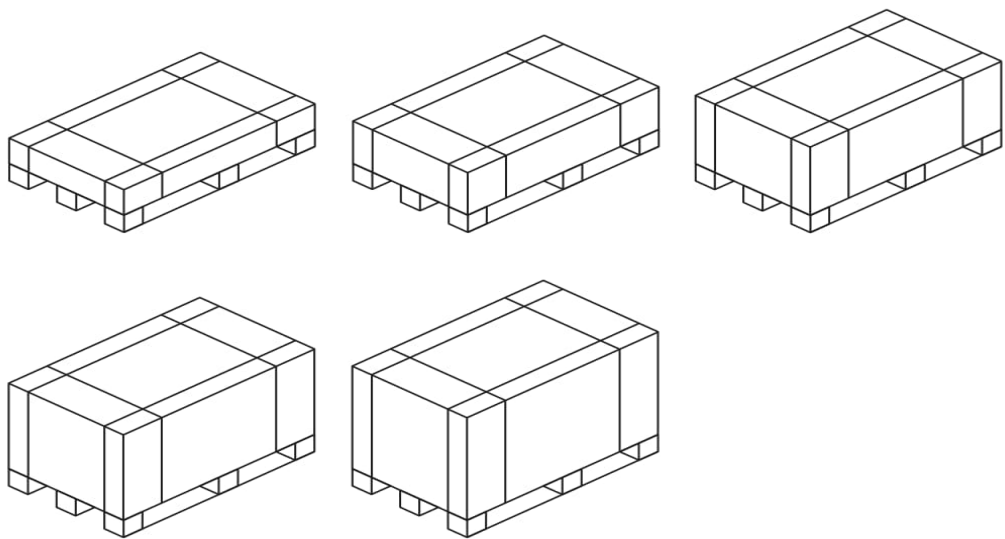


Figure 34. Plywood packages.

3.4. Plastic boxes and containers

Requirements for plastic boxes and crates:

- recyclable plastic material preferred,
- supplier is responsible for managing the recycling process and
- physical requirements:
 - strong, lightweight, cleanable, stackable.

3.5. Preservation alternatives for casting and machining

Preservation is used to protect products from corrosion and damage throughout the value chain.

Purchased still, iron, chrome, copper, brass, and zinc type of products like machined components, stator frames, shafts, bearings may be exposed to many factors like humidity, temperature, water vapors, dirt during shipping process with the result that they undergo corrosion, and this may influence product damage or causing defects that may lead to additional re-works and providing additional cost and time consuming to the customer.

3.5.1. PE bag plus desiccant

PE bags protect the goods from dust and moisture.

Desiccants are used inside the packaging to protect goods from moisture, and they absorb the moisture inside the packaging, stopping any condensation that may happen during transport or storage.

It is important to seal or close the bag properly since desiccant can absorb only a limited amount of moisture and when they are saturated with moisture, they lose protective ability.

Wood, regular paper, and cardboard already contain moisture in their mass, so if something is wrapped in such material it **SHOULD** always be taken into consideration that these materials will emit humidity.

3.5.2. VCI (volatile corrosion inhibitor)

To ensure that products reach the purchaser in good condition without corrosion, the right packing **MUST** be used like VCI for proper effects. It is crucial to make sure that the right VCI will be used under given conditions e.g.:

- correct VCI for protected material (ferrous, nonferrous), it is recommended to contact VCI supplier to choose the most appropriate version and
- correct VCI for transportation conditions: time, humidity, temperature.

It is the supplier's responsibility to choose correct packaging standard and process (VCI, separators, absorbers, and other materials used for packaging/protection).

VCI films actively protect against corrosion during all stages like production, storage, shipping, and the advantage of using them is also that usage of oil, wax or any other protective substances can be skipped, and parts can be stored for longer time in warehouse.

Corrosion can be caused by:

- air: industrial emissions, nitrogen oxide, sulfur dioxide, oxygen, and humidity,
- water: chlorinated water, seawater,
- acids: stains, grease, cleaning reagents, caustic materials, toxic environments placed nearby packing places,
- alkali: in certain pH range,
- dust: dirt, dust, hardened oil, and grease and
- perspiration and grease from hands that contain chlorines, sulfates, moisture, and grease. That is while packing gloves **SHOULD** be worn to avoid fingerprints on the parts' surface.

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VCI bags and films contain volatile corrosion inhibitors forming a thin protective layer, which prevents electrochemical reactions of water and air with the metal.

VCI bags advantages:

- provides a better moisture barrier compared to VCI paper by reducing the rate of penetration of external conditions into the packaging, which could cause corrosion,
- the foil is easy to use and if semi-transparent, and the elements can be seen through the packaging, thanks to which we have an easier opportunity to inspect the shipment at any time of storage or transport,
- the foil protects metal details from dust and dirt and
- the advantage of VCI foil is its long operating time.



Figure 35. VCI bags and foils.

ZERUST® EXCOR® VALENO® tubing and half-tubing are available in four types:

- E – yellow film – protection against corrosion damage for ferrous metals, such as iron, steel or cast iron,
- NE(c) – blue film – protection against corrosion damage for non-ferrous metals, such as aluminum, copper, brass, and bronze,
- MM – green film – protection against corrosion damage for parts that contain combinations of ferrous and non-ferrous metals and
- A – contains special corrosion inhibiting technology for all metals – use after consultation.

VCI wrapping paper is often used as a packaging substrate. Such paper can be impregnated or coated with an inhibitor solution, which usually contains two components: a volatile corrosion inhibitor and a special substance that binds it.

VCI paper advantages:

- faster emission of VCI molecules in the package,
- VCI paper is cheaper than VCI bags,
- it can be easily wrapped around metal parts and
- provides full amortization, which provides mechanical protection of parts during transport.

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Figure 36. VCI wrapping papers.

A different product will be suitable for different applications. The film is most often used in the form of a VCI bag matched with the packaging, e.g., a box or a cardboard box. VCI anti-corrosion paper is most often used as a spacer between details. VCI paper with VCI anti-corrosion bag can be combined for different purposes.

For example, the container may be lined with a bag and the individual parts wrapped in anti-corrosion paper e.g., shafts to stabilize them during transport. Combining these materials also increases the amount of VCI and provides better corrosion protection for all the details in the package.

Modern anti-corrosion packaging is easy to use, cost effective, environmentally friendly, non-toxic, and recyclable.

Best packing practices with VCI usage still, iron, chrome, copper, brass, and zinc type of products like machined components, stator frames, shafts, and bearings:

- all components **MUST** be clean and dry. **Drying process SHOULD guarantee that,**
- the temperature of packed part and environment **MUST be RH <20 and 23°C,**
- parts **SHOULD** be packed as soon as possible to avoid moisture in suitable, dry space,
- all parts at the pallets **MUST** be packed into VCI bag. VCI surface area **MUST** be properly calculated accordingly to parts surface size (accordingly to the Supplier recommendation),

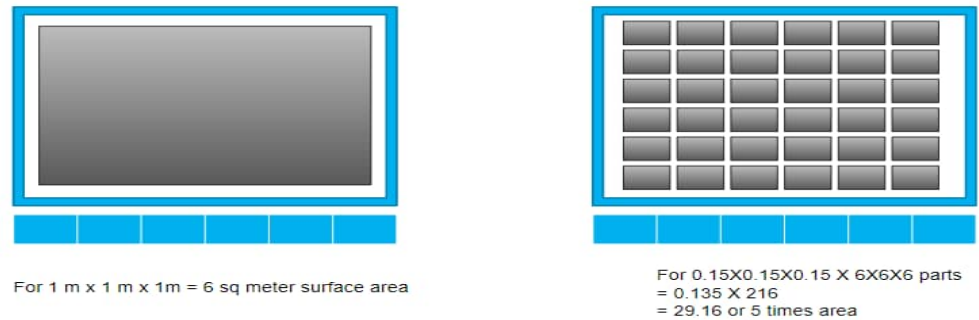


Figure 37. VCI bags vs. content.



Figure 38. VCI bags.

- VCI bags **MUST** sealed and be additional protected in standard bag,
- while packing it is mandatory to wear gloves to avoid leaving fingerprints, grease, and moisture,



Figure 39. Packing.

- components **SHOULD** be separated by spacers. **If absorbing moisture materials like corrugated boards, paper or wood, each element **MUST** be separately wrapped in VCI bag, film, or paper. If any regular paper used **SHOULD** be dried out to value 20% of moisture,**



Figure 40. Spacers and dividers.

- it is advised to add few desiccators per layer,



Figure 41. Desiccators and emitter diffusers

- VCI bags and external covering bags **MUST** be airtight sealed with a waterproof tape or heat seal, covered with wooden lid, and closed with plastic straps and
- **it is forbidden to use any type of lubricants (machined parts), that may stain the coated surface of the components.**

Things which must be avoided in packaging “RUST-X”:

- wood and corrugation contact or presence with VCI enclosure,



Figure 42. VCI packaging proposals.

- water washing and water remnants in parts,



Figure 43. Humidity influences parts' rusting.

- dirt/dust/improper oiling of parts,
- unsealed packaging,
- inadequate VCI and
- high moisture content of air while packaging, fingerprints.

Using VCI products you need always to take into consideration not to protect outer surface with oil or grease substances since they will leave greasy marks on the neighboring surface, causing contamination of entire element!

3.5.3. Aluminum barrier bag plus desiccant

It creates a barrier between the products and the outside environment, while desiccants are placed inside the bag to keep the moisture level low:

- an aluminum barrier bag is suitable for long term storage as it can withstand remarkably hot temperatures and conditions of high relative humidity,
- when closed with vacuum and sealed it extends time of storage for and
- high quality demand and is not reusable.

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Type of bag	Description	Benefits	Drawback	
Plastic bag		Shields from dust and provides corrosion protection for up to 6 months when emitters are applied.	Fast and easy to apply.	Suitable only for local transportation and limited period of time.
Vapor phase corrosion inhibitor (VpCI) bag		Provides corrosion protection up to 12 months, is used together with clay bags (as a type of desiccant) and is see-through.	Faster and easier to apply compared to aluminium bag, closed only with a small tape and can be re-opened.	Quantity of clay bags important because they can cause corrosion after saturation.
Aluminium bag		Aluminium bags have a humidity barrier where air is kept out by vacuum sealing, so a thermo sealer is needed. Silica gel bags are used against corrosion and should not be in direct contact with metal parts; instead hang them in net bags which provide protection up to 24 months.	Good protection for long storage.	More time consuming to apply, has to be 100 percent air tight as tearing and small holes reduce functionality. Cannot be opened during transport and storage.

Figure 44. Barrier bags.

3.6. Shock and temperature indicators

Shock indicators are used to record the impact on the transported goods.
See Figure 45 for applicable indicators.

Selection guide

Metric	Volume						
Weight	0.14 - 0.42m³	0.42 - 1.42m³	1.42 - 2.83m³	2.83 - 7.08m³	7.08 - 14.16m³	14.16 - 304.8m³	304.8+ m³
0 - 5kq	75q	75q	50q	37q	N/A	N/A	N/A
5 -11kq	75q	50q	50q	37q	25q	N/A	N/A
11 - 23kg	50g	50g	37g	25g	25g	15g	N/A
23 - 45kg	50g	37g	37g	25g	15g	15g	10g
45 - 113kg	37g	37g	25g	25g	15g	15g	10g
113 - 454kg	37g	25g	25g	15g	15g	10g	10g
454 - 907kg	25g	25g	25g	15g	15g	10g	5g
907 - 2,268kg	25g	25g	15g	15g	10g	10g	5g
2,268 - 4,536kg	25g	15g	15g	15g	10g	10g	5g
4,536 - 6,804kg	N/A	15g	15g	10g	10g	5g	5g
6,804 - 9,072kg	N/A	N/A	10g	10g	5g	5g	5g
9,072 - 13,608kg	N/A	N/A	N/A	5g	5g	5g	5g
13,608+ kg	N/A	N/A	N/A	N/A	5g	5g	5g

Figure 45. Applicable shock indicators.

3.6.1. Impact indicators

ABB reserves the right to request the use of such shock indicators. An example of an indicator used at a MO site in Turgi.



Figure 46. An example of a shock indicator used at a MO site in Turgi.

3.6.2. Tilt indicators

Various products should not be tilted, turned upside down or laid on one side.



Figure 47. Examples of tilt indicators.

3.6.3. Temperature indicators

Especially used for resins and paints barrels assignment, which MUST be stored and transported under special conditions not to decompose.



Figure 48. Examples of different temperature indicators.

3.7. Preservation alternatives for painted components

It is possible to stack Metal fan covers and other such types, but to do this, paper spacers, foil bags or other (preferred eco solutions or recyclable materials) MUST be used.

This type of packaging protects against scratches, dents and other visual defects and it is important these parts are not covered by grease or any oily substance.



Figure 49. Examples of packing painted components.

3.8. Labeling

To standardize incoming identification of materials product and package identification **MUST** be able to remain intact throughout all transit, storage, and handling, right up to the point of use.

Inbound shipments **SHALL** be randomly verified at ABB for compliance with these specifications and in the event of non-compliance, ABB reserves the right to:

- reject and return (at the supplier’s expense) any shipment(s) received that are improperly identified,
- the supplier may be removed as an approved source if, after being notified, the supplier repeatedly fails to comply with these requirements and
- only relevant labels to the shipment **SHALL** be attached.

The information included on the label **SHOULD** be consistent with the data transmitted in the advance shipping notice.

Mixing of part numbers on a pallet is strongly discouraged; when unavoidable, due to handling/shipping expense, pallets **MUST** have the proper “Mixed Load” label per ABB labeling instructions, and each box needs to have individual labeling.

To facilitate receiving activities, every order **MUST** be identified with its own delivery note through a well-defined link between the delivery note and the articles and the labeling information **MUST** be consistent across the delivery note and the articles (e.g., with respect to units).

Within the order, each loading unit (e.g., pallet, cardboard box, wooden box etc.) **MUST** be explicitly identified with a label containing the following information:

- ABB ID-number (according to delivery note),
- article description (according to delivery note),

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- quantity and unit (e.g., ten pieces) and
- risks and handling instructions.

Additionally, each packing unit within the order **MUST** be labelled in a manner that makes it easily identifiable to the receiving staff and therefore, each article, or the smallest packing unit, **SHOULD** be labelled with supplier part number and ABB ID number.

Certificates, as well as hazardous material and safety data sheets, are to be enclosed with the relevant materials.

Non-identifiable or incomplete deliveries will be rejected.

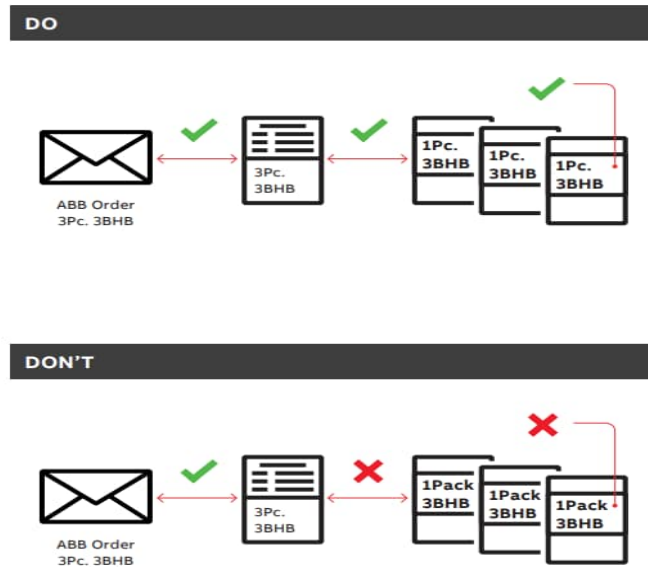


Figure 50. Labeling instructions.

3.9. Packing list

The packing list **SHOULD** be attached to goods during transportation and is not to be sent via e-mail unless agreed otherwise.

The packing list **SHOULD** be attached in a plastic pocket to the outside of the packaging.

If the packing list is placed inside the package the package **MUST** be marked with text “CONTAINS PACKING LIST”.

A packing list **SHOULD** contain following information:

- packing list number,
- delivery date,
- ABB’s reference (purchase number and line number),
- ABB’s part number,
- parts description,
- net weight, gross weight, and quantity delivered,
- incoterms with place,

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- terms of payment,
- invoice number,
- unit of measure,
- net value and
- measurement or quality protocols attached to every pallet where it is necessary (when agreed).

3.10. Quality certificates

The supplier **MUST** be familiar with the preventive tools of quality assurance that allow early recognition of weaknesses in the design, production, and manufacturing of the purchased parts like FMEA.

To each delivery or each production batch, as requested by ABB, Quality Conformation Certificate **MUST** be attached.

The form of which **SHOULD** be agreed with ABB (Quality Control and Incoming Inspection departments) during negotiations with future supplier and it **SHOULD** include:

- description of the tested element (ABB's part number),
- measurement values of certain points according to technical drawing, specification, certificate or other,
- test method and equipment used,
- sample size and
- sampling frequency.

If necessary, the supplier **MUST** independently take other measures beyond agreed to ensure the quality.

4. Special packaging and conditions

If no standard packaging exists for a certain item, the supplier **SHOULD** determine a way of packing with ABB and when a packaging method has been agreed, it **SHOULD** be included in contract as well.

If needed drawings and pictures **MUST** be included.

Please pay extra attention to products which demand special care or packing to be able to fulfill production requirements.

4.1. Impregnation resins, paints, solvents, greases

Some impregnation resins, paints, solvents, and sprays demand special treatment in transportation, handling, and storage due to their content specification.

This **MUST** always be done with respect to MSDS and SDS data sheet of the product introduced by the producer.

If such a product has a separate or mixed activator or catalyst it **MUST** always be stored and transported with respect to temperature standards, especially in summer and winter.

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When shipment in a particular demanding season takes place and when the temperature outside is remarkably high or low, barrels and cans **MUST** be protected respectively to the conditions.

Barrels and cans **MUST** be secured, wrapped in silver foil which reflect sun rays during summer and blankets in the winter or temperature indicators **MUST** be used – refer to the chapter 3.6.

In both cases barrels **MUST** be transported with temperature control truck, otherwise expiry date of such product decreases rapidly because of small scale chemical reaction, which will initiate and influence negatively further storage of such product in ABB warehouse.

Too high or low temperatures may cause precipitation of some ingredients or decomposition of some products may occur.



Figure 51. Examples of transport and packing of barrels and cans.

4.2. Electrical steel

The steel coil packaging **SHOULD** ensure that the product will not be loose and damaged upon arrival to ABB, and It **MUST** protect the coil's surface from moisture contamination caused by humidity or condensation effect that will cause rust of material during transportation and storage.

Packaging materials **MUST** always comply with relevant laws and regulations:

- top metal cover,
- bottom metal cover,
- side cover metal sheet, watertight plastic bag and rust VCI paper and
- corner protection metal sheet.

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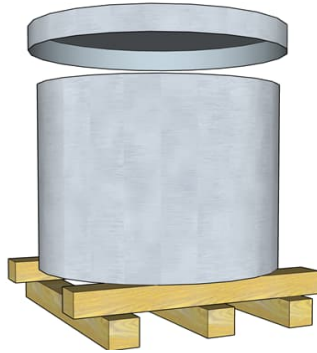


Figure 52. Steel coil packaging.

4.3. Electric wires and equipment

Packaging electric wires requires the same level of attention as the product itself, as it is necessary to protect the performance, safety, and security of the product.

Shipping electrical and electronic products in safe, high-quality, and sustainable packaging requires an understanding of many critical aspects.

RoHS directive needs to be taken into consideration.

Packing **MUST** protect wires against:

- mechanical damage,
- moisture and
- dirt.

Depending on specific material, plastic bags, bubble wrap, foam or corrugated paper could be used for extra protection.

Sockets and connections **MUST** be protected with plastic bags or plastic wraps and fixed with e.g., rubber bands or twist-ties.

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Figure 53. Electric wires and equipment.

4.3.1. ESD packing methods

When ESD protective packing is necessary, suitable items include metalized protective bags, cardboard boxes or other antistatic materials with a conductive coating, boxes made from volume conductive plastics etc.

The maximum earth leakage resistance of ESD protective packaging and containers is regulated by standards IEC 61340-5-1 and ANSI/ESD S541-2008.

The best method for packaging ESD sensitive parts is to use a static dissipative material closest to the ESD sensitive part and a conductive material is then used to surround the ESD sensitive item, outside of the dissipative layer, to provide an electrostatic shield (Faraday cage).

Cushioning and outer packaging **SHOULD** also be static dissipative if there is potential for the ESD sensitive part to touch it as the bag is unpacked.

In general, plain cardboard is not considered a major ESD threat when combined with the use of a proper shielding bag.

However, all materials and containers used within an ESD controlled manufacturing environment **SHOULD** be static dissipative and packed accordingly using suitable packing material:

- **static shielding bags:** a multi-layered bag which consists of a static dissipative material next to the ESD sensitive item along with a thin outer metallic layer,
- **static dissipative cartons:** an ordinary kraft corrugated container with static dissipative foam may be used to contain the ESD sensitive item provided the part is first placed in a static shielding bag. If a static shielding bag is not used, the outer box **SHOULD** be manufactured from conductive corrugated board and have static dissipative cushioning,
- **thermoformed blister-style packages:** this style of packaging is acceptable if the material which contacts the ESD sensitive part is manufactured from an appropriate static dissipative material and is inside a conductive outer container. If supporting parts are required to provide physical strength, these **SHOULD** be made of appropriate conductive material too, unless the part is placed in an appropriate ESD shielding bag and

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- **reusable tote-style box for bulk handling:** reusable tote boxes manufactured from conductive corrugated or plastic materials may be used for inter-plant, supplier, or intra-plant shipments to manufacturing sites. Tote-style boxes **SHOULD** not be used for parts in-bound for support or field service use.

Material categories

ESD protective materials are categorized as follows:

Category	Standard specification	Note
Static dissipative	$10^5 < RS < 10^{11} \Omega$	If $RS > 10^9 \Omega$, 90% of the initial value must disappear during a measurement of the static field in < 2 s
Insulator	$RS \geq 10^{11} \Omega$	Examples: plastics, glass, wood, ceramics.
Conductive	$\geq 10^5 \Omega < 10^{11} \Omega$	Examples: metals – aluminium, copper.
Conductive	$10^2 < RS < 10^5 \Omega$	
Discharge shielding (bags)	< 50 nJ	ANSI/ESD STM 11.31

Figure 54. ESD protective materials.



Figure 55. Example of ESD protective packaging.

Note that in addition to ESD protection, cleanliness is critical. Contaminants such as dust or residue can compromise the functionality of sensitive components and **SHALL** be avoided.

4.3.2. Identification

General warnings (e.g., stickers) **MUST** be affixed in the presence of ESD, e.g., for printed board assemblies.

This also applies to packaging, storage containers, work surfaces, transport trolleys etc.

The ESD symbol (black on yellow background) according to IEC 60417, symbol no. 5134.

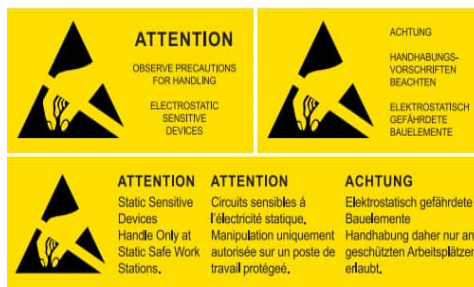


Figure 56. ESD markings.

4.4. Bearings

Bearing packaging can be divided into inner packaging and outer packaging.

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The bearing **MUST** be cleaned and rust-proofed after it has been manufactured and qualified for conformity and it **SHOULD** be placed in the package to achieve the requisite waterproof, moisture-proof, dust-proof, and shock-proof features.

Unless otherwise specified, the inner and outer components of separable tapered roller bearings **SHALL** be individually wrapped in film before shipping, or the inner and outer components **SHOULD** be packed separately.

To prevent rust, do not handle it with your bare hands.

The surface **SHOULD** be coated with rust preventative and stored in a package with max relative humidity of 60%.

Bearings **MUST** be stored flat to prevent grease floating.



Figure 57. Bearings.

4.5. Copper wire

For packaging and transportation of copper wires special types of pallets and containers are used which ensures that there are minimal shock impact and wire damage risks during the transportation, and the delivery can be completed in a safe, hassle-free manner.



Figure 58. Reel 315/500 – 7 pcs per pallet.

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Figure 59. Reel 400/630 – 3 reels with a bell per pallet.

4.6. Aluminum bars

Aluminum bars **SHOULD** be packed alternately to ensure the stability of the structure.

For safety precautions they **MUST** be additionally secured by plastic straps and wrapped with foil.



Figure 60. Aluminum bars.

4.7. Sheet metals

Cut and lasered sheet metal components **MUST** be packaged in a way that prevents scratching, bending, corrosion, and contamination during transportation and storage.

All sharp edges **SHOULD** be protected using edge guards or foam padding, and sheets **MUST** be stacked with interleaving layers of corrosion-inhibiting paper or plastic film.

If the material is prone to oxidation, VCI paper or foil **MUST** be used. The entire stack **MUST** be secured with non-abrasive straps and wrapped in moisture-resistant foil.

Pallets or crates used for transport **MUST** be stable and allow for even weight distribution.

Handling personnel **MUST** avoid direct contact with the metal surfaces to prevent fingerprints or grease contamination.

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4.7.1. Cleanliness and packaging requirements of laser-cut and trimmed sheet metals

Laser-cut and trimmed sheet metal components require special attention to cleanliness and surface condition to ensure proper function, corrosion resistance, and compatibility with downstream processes such as painting, welding, or assembly.



Figure 47. Sheet metals

Therefore, these components **MUST** be free from splinters, grease, oil, and surface defects such as dents, scratches, or blistering.

- Surface quality **SHALL** be visually inspected for soiling, stains, and irregularities
- Packaging **SHALL** prevent ingress of contaminants
- Protective wrapping (e.g., bubble bags) **SHOULD** be used where needed to avoid scratches or abrasion
- Packaging **MUST** be sealed to prevent exposure to external elements
- Cleaned parts **MUST** be packed using appropriate corrosion methods (e.g., VCI bags, desiccants)
- Parts must be dry before packaging

The supplier is responsible for selecting and implementing a packaging method (see chapter 3) that ensures parts remain clean and protected throughout transport and storage.

ABB reserves the right to reject or return parts that do not meet cleanliness standards.

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5. Additional information

5.1. Listing of related documents

Ref #	Document Kind, Title	Document No.

6. Revisions

Rev.	Page (P) Chapt. (C)	Description	Date Dept./Init.
A	All	Initial version	29.3.1013/JW
B	All	Document template updated and content finalized	19.5.2023/JI
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