

Nordic
Copper



Architectural

 **Aurubis**

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Copper in the architecture



100% of architectural copper products are manufactured by recycled raw-material.

1995 first post-patinated copper product was delivered from Pori mill.

13th century and before, historians believe that copper is used as roofing material.

Copper was one of the first metals used by man and is one of our oldest building materials, with unique properties and characteristics. With the 20th century and the international modernist movement came a transformation from copper's historic role as a durable roofing material to a flexible architectural skin over any surface, including walls. The malleability of copper sheet allows it to be used as a covering for architectural elements of all shapes with minimal constraints. Surfaces can be flat, curved or faceted and used at any inclination or pitch, and in any environment. As a result, modern architects have focused on copper as a layer covering entire surfaces in order to enhance buildings' form and maintain material continuity.

Architects continue to exploit this capability today, driven by the complex shapes made possible by computer aided design techniques. But with the move to postmodernism and beyond, many designers have also been keen to explore new manifestations of copper – very much as part of the dynamics of contemporary architecture and with a real sense of freedom.

Realizing designs in copper

This brochure provides an introduction to the architectural opportunities and unrivaled freedom that architects can enjoy by working in partnership with us to realize their designs in copper, no matter how innovative. It explores how Nordic Copper redefines copper for contemporary

design with the ongoing development of surfaces, forms and systems – not as a prescribed range of products to select from, but rather a source of inspiration for architects and the starting point for a creative partnership with us.

Our expertise and personal service are essential to developing your architectural visions in copper and we welcome early involvement with your projects. Our website **NordicCopper.com** provides contacts, more detailed information and interactive tools to help you at each stage in the design and specification process.

Characteristics of copper

Nordic Copper products for architectural applications such as facades and roofs use phosphorus deoxidized copper, designated Cu-DHP and complying with EN 1172:2011 – “Copper and Copper Alloys: Sheet and Strip for Building Purposes”. This pure and natural material exhibits a unique range of characteristics and performance benefits, including:

- » Protection by its patina against corrosion in any atmospheric conditions, durable and problem-free with no maintenance.

- » Exceptional, indefinite lifespan demonstrated over hundreds of years, and without underside corrosion issues.
- » Cost-efficient substrates and low ‘whole-life’ costs.
- » Easy malleability at any temperature and no brittleness in cold weather.
- » Low thermal movement and high melting point, which prevents stretching in hot weather.
- » Non-toxic and safe to work with.



The impressive sustainability and environmental credentials of copper have been clearly demonstrated in the past. Although the copper industry is well-known for recycling, the Nordic Copper range is exceptional, with 100% of copper produced for roofing and cladding applications over the last few years coming from recycled material. This material includes internal processing scrap (around 50-60% of the recycled material). Embodied energy and global warming potential figures are therefore less than half those for copper generally – already significantly lower than stainless steel and aluminum.

Copper can provide a complete external skin, wrapping around complex building forms with material continuity. Alternatively, it can give distinctive character to individual facade or roofing elements, particularly when used in conjunction with other high quality materials. Besides, there is growing interest in the use of copper for interior design.



Opportunities with copper

In addition to standard copper sheet, Nordic Copper explores new forms of copper architecture with designers, including textured, pressed, grinded and embossed surfaces as well as profiled sheets. Also, perforated or expanded copper sheets add new possibilities for transparency. Installation techniques and systems also help to define architectural character with texture and scale – ranging from traditional standing seam sheet installation techniques to panels, cassettes and other factory-made systems.

But the natural color changes leading to the development of copper’s distinctive blue/green patina continues to fascinate architects and inform the development of Nordic Copper, discussed next.

Copper surfaces

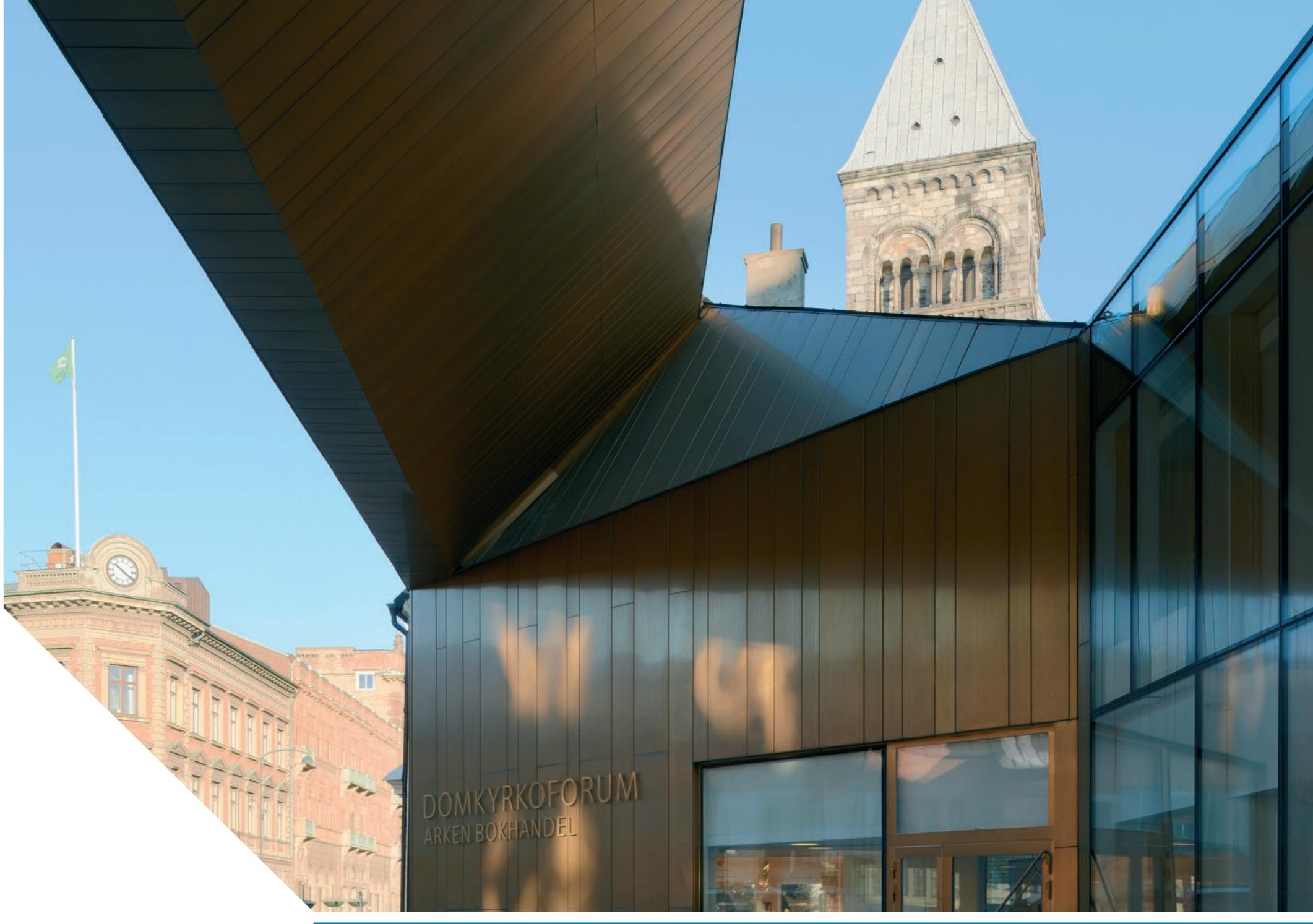
The natural development of copper patina is one of copper’s unique characteristics. Within a few days of exposure to the atmosphere, the surface of Nordic Standard copper begins to oxidize, changing its color from the “bright” mill finish to a chestnut brown which gradually darkens over several years to a chocolate brown. Continued weathering can then result in development of the distinctive green patina – or blue in coastal locations. This process is an expression of the metal’s propensity to revert to mineral compounds that resembles the ore from which it originally came. The patina film provides impressive protection against corrosion and can repair itself if damaged, defining the exceptional longevity of copper cladding.

Some rainwater is needed for the patina to form and its rate of development will depend on the water “dwell time” on a surface. As a result, vertical cladding and sheltered surfaces will take much longer to patinate naturally than exposed roofs. Airborne pollution also increases the rate of patination, which therefore takes longer in more remote, cleaner environments than in cities or industrial areas. The complex combination of factors determines the nature and speed of development of patination, giving copper unique, living visual characteristics developing over time in response to local conditions.

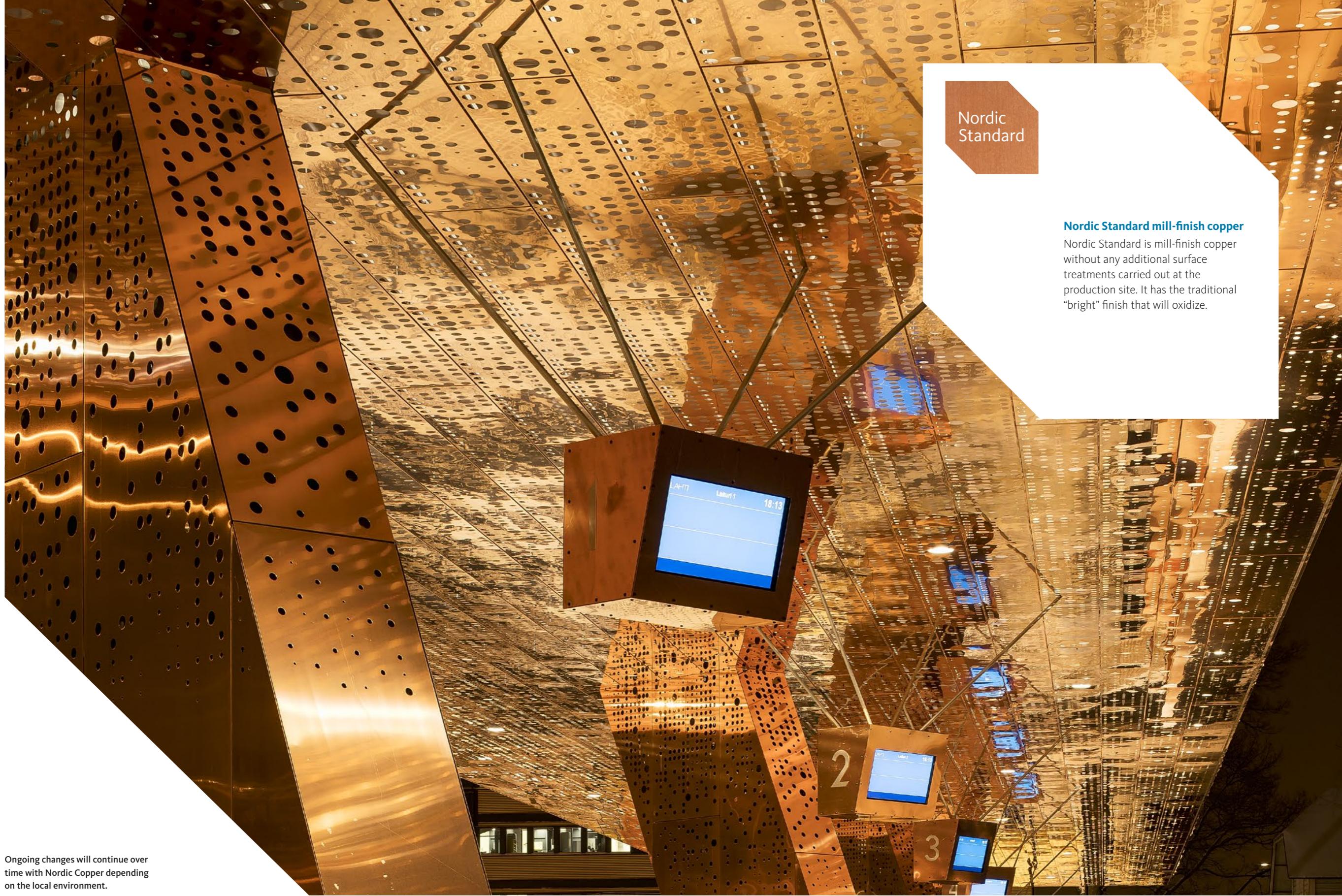
Products

For decades Aurubis has been developing an unrivaled range of factory-applied surface treatments to provide various stages of oxidation and patination of copper for facades and roofs. The processes involved are very similar to those taking place over time in the environment and utilize copper mineral compounds, not invasive chemical treatments. Essentially, they bring forward the environmental changes without taking away the integrity of Nordic Copper as a natural, living material.

Nordic Copper includes variable intensities of green or blue pre-patination and brown pre-oxidation. Copper alloys Nordic Brass, Nordic Bronze and Nordic Royal – a golden alloy – are also available, adding to a rich palette of colours and surface textures. Nordic Copper forms an integral part of the copper without coatings or paint. Ongoing changes will continue over time with Nordic Copper depending on the local environment, ranging from quite rapid with Nordic Brass to minimal for Nordic Royal. Nordic surfaces are supplied with a protective sheet to the finished face.



Nordic Copper product range is illustrated on the following pages. Aurubis works closely with architects in developing custom-made surfaces and other techniques, in addition to the ranges shown here. The early involvement with the architectural design process is essential.



Nordic Standard

Nordic Standard mill-finish copper

Nordic Standard is mill-finish copper without any additional surface treatments carried out at the production site. It has the traditional "bright" finish that will oxidize.

Ongoing changes will continue over time with Nordic Copper depending on the local environment.



Nordic Brown pre-oxidized copper

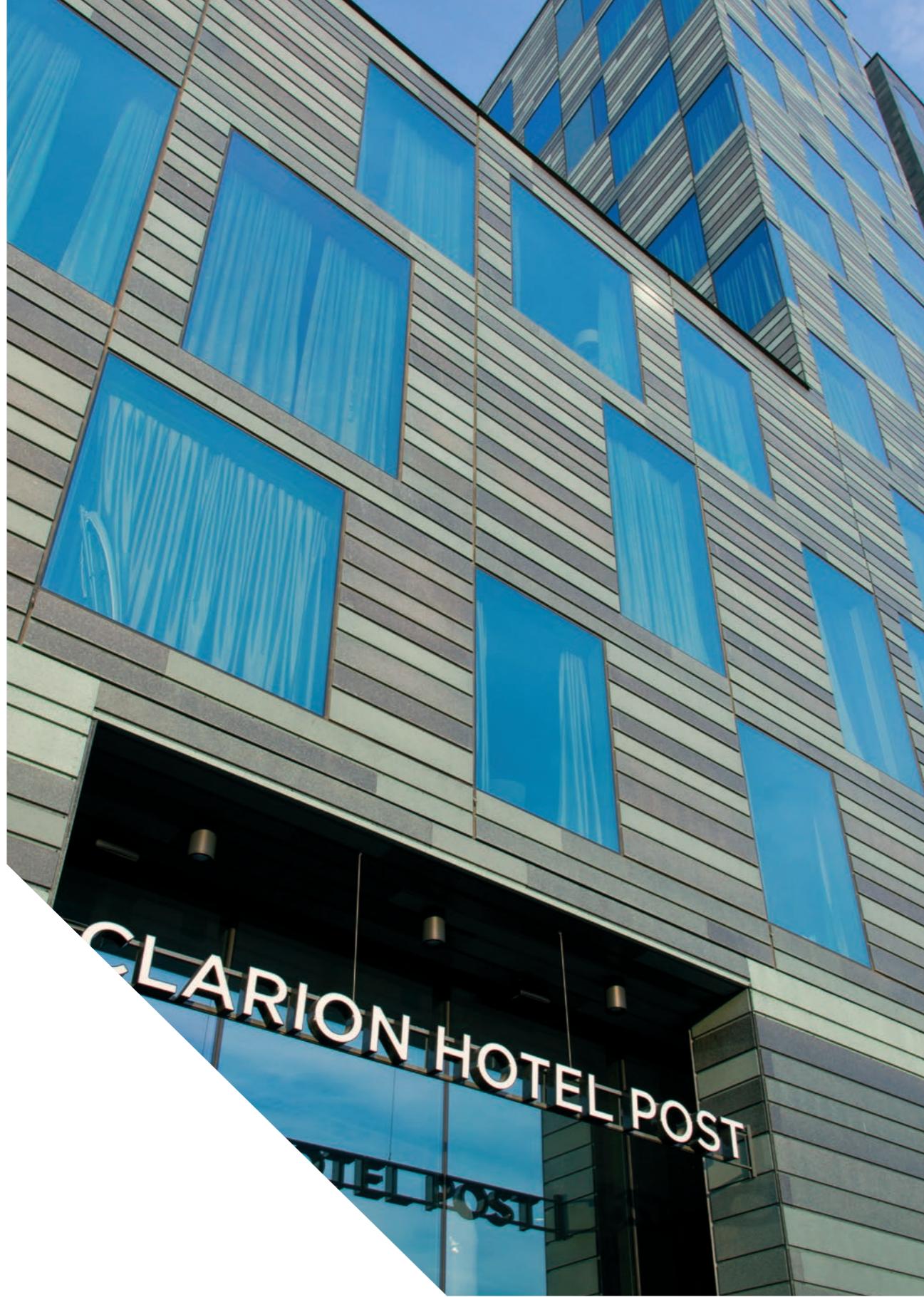
Nordic Brown products are burnished at the Aurubis mill to immediately provide the same oxidized brown surface that will otherwise develop over time in the environment. The thickness of the oxide layer determines the color: both Nordic Brown Light and the darker Nordic Brown versions are available.

Both Nordic Brown surface finishes are useful to minimize hand and other construction marks which can occur for a short time after the installation of bright Nordic Standard copper.

Nordic Brown can also be combined with other surface finishes such as Nordic Standard or Nordic Royal to create various visual effects.

Nordic
Brown

Brown
Light



Nordic Green

Nordic Blue

Nordic Turquoise

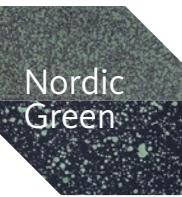
Nordic pre-patinated copper

Nordic Green, Nordic Blue and Nordic Turquoise products offer designers unparalleled design freedom and the ability to determine the type and intensity of green or bluish patina for each project with choices of “living” surfaces. In a carefully controlled factory process, pre-oxidized copper is treated with specifically formulated copper compounds to create the desired patina colors and heat-treated to chemically bind them to the copper.

The factory process can be accurately controlled so that, as well as the solid green patina color, other intensities of patina flecks can be created, revealing some of the dark oxidized background material.

Aurubis' experts can also work in partnership with architects to develop special individual levels of patination to meet their design requirements or to match historically patinated copper on existing buildings.

The material is easily bent and formed, and there are no limitations on the length of pre-patinated copper sheet or strip because whole coils are treated on the production line, not just limited size sheets. Pre-patinated products are available in sheets or coils with one treated surface.



Nordic
Green



Nordic
Blue

Nordic Green, Nordic Blue & Nordic Turquoise

The most common compound found in natural patinas all over the world is the copper sulfate mineral brochantite. Aurubis' factory-applied patinas have been developed with properties and colors based on the same brochantite mineralogy.

Brochantite is a light blue color but in many locations impurities and other components in the air add a yellow tint to give the naturally developed patina a green hue. In the same way, Nordic Green is produced with a hint of iron sulfate yellow component added to the blue copper sulfate, replicating the natural green.

In marine climates, the natural copper patina contains some copper chloride, giving it more of a blue color and this is emulated with Nordic Blue. Brochantite is a light blue color and Nordic Blue patination is 100% brochantite.

By its nature, Nordic Copper's pre-patination process encourages the continuing formation of natural patina by releasing copper sulfate to react with the copper below. As a result, just like natural patina, Nordic Green and Nordic Blue undergo continuous changes through environmental exposure dependent upon local atmospheric and rainfall conditions.



Special surfaces

For example, if you need a new patina resembling the existing naturally patinated roof. We are able to help by offering a tailor-made solution. You are able to specify the color by sending a piece of the original copper to us. We can then adjust the brochantite patina to closely match the original sample.



Nordic
Royal

Nordic Royal copper alloy

Nordic Royal is an alloy of copper with aluminum and zinc, giving it a rich golden through-color and making it very stable. It has a thin protective oxide layer containing all three alloy elements when produced. As a result, the surface retains its golden color and simply loses some of its sheen as the oxide layer thickens with exposure to the atmosphere to give a matte finish. It behaves differently from other Aurubis copper products over time and does not develop a blue or green patina.



Nordic Brass copper alloy

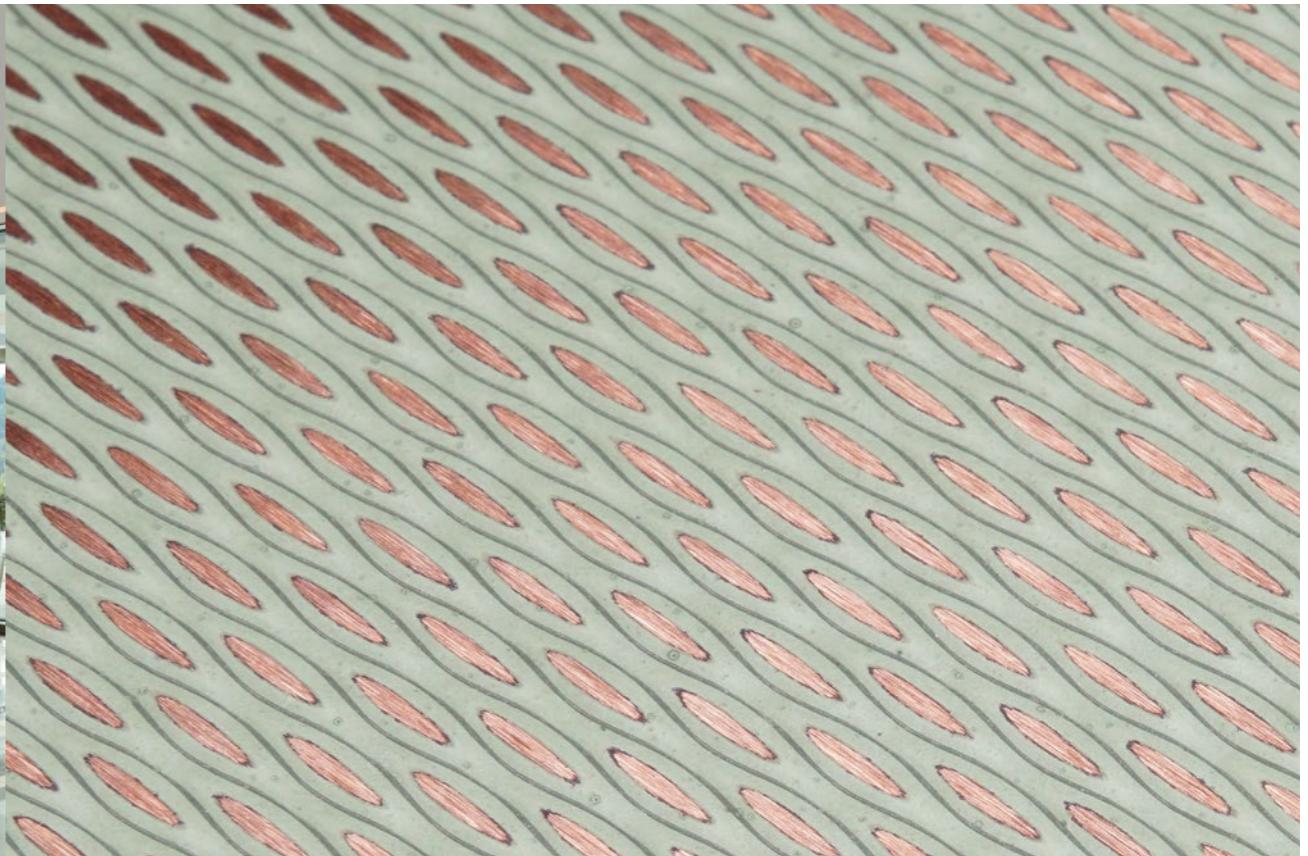
Nordic Brass is an alloy of copper and zinc with a distinctive golden yellow color. When exposed to the atmosphere, the surface begins to darken within weeks and can change to a dark brown in around a year – unlike Nordic Royal alloy, which retains its original color. A weathered brownish surface is also available to provide the same oxidized brown surface that otherwise develops over time in the environment.



Nordic
Bronze

Nordic Bronze copper alloy

Nordic Bronze is an alloy of copper and tin with a similar color to Nordic Standard initially. When exposed to the atmosphere, the surface gradually changes to a stable dark chocolate brown.



Nordic Décor

The extensive Nordic Décor product line combines pre-oxidized, burnished and pre-patinated copper with various mechanical surface treatments, e.g. grindings and pattern embossings.

The various Nordic Décor grindings for Nordic Standard, Nordic Brass, Nordic Bronze and Nordic Brown are applied onto one face of the copper sheet and give the surface a rustic and grainy finish.

The individual grindings and pattern embossings offer new freedom of design and can be used for different

applications – indoors, e.g. in hotels for bars and counters, wall design, elevator cladding and ceilings, and in external design as an eye-catcher and for facades.

As a design element for roofing, it shines as a maintenance-free, storm- and rain-resistant building surface. The material can be shaped, edged, milled, lasered, cut and bent.

In addition to the large number of products, the type and intensity of the grinding and pattern embossing can be adjusted individually.

Nordic
Décor

Systems



Apart from standard copper sheet, Aurubis is constantly exploring new forms of copper with designers, creating extra dimensions of modulation, texture and transparency for architectural surfaces. The final step in designing with copper is the installation technique or system, which adds "grain" and structure to the external skin of the building, helping to define its character.

Aurubis provides an extensive range of factory pre-fabricated systems for facades or roofs, as well as copper sheets or coils and other copper items.

Most of these products are supplied by Aurubis, and others are developed in a close working relationship with our specialist partners.



Traditional Techniques

Traditionally, copper has been used as a lightweight, fully supported covering for roofs, walls and other building elements. Here, sheets of copper are joint using double lock standing seams (or angle seams for vertical cladding) visually defining the copper bays, interrupted by cross-welt joints running longitudinally. A more

modern interpretation of fully-supported, standing seam technology is Long Strip. In this case, copper trays are prefabricated with profiles and installed in long lengths – perhaps 10 m or more – eliminating cross-welts and creating a strong linear appearance. Long Strip is an efficient and cost-effective method where

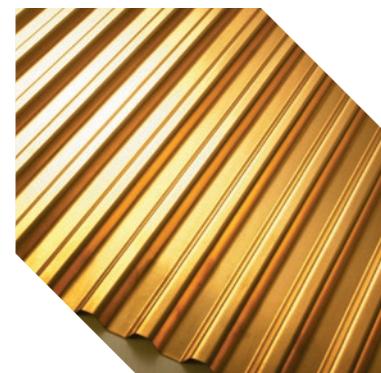
mechanization can be maximized both for pre-fabrication and jointing on site. Aurubis copper can be supplied in cut-to-size sheets or in coils to suit any system. In particular, Aurubis is unique in its ability to supply any of its Nordic Copper in coils for Long Strip.



Facade Systems

Apart from traditional systems, various standard or tailored prefabricated systems are available in Nordic Copper. They offer the benefits of consistency and accuracy, being fabricated under controlled off-site conditions, as well as different visual characteristics helping to define the architecture.

Nordic Copper is available in a variety of ranges and providing a wide choice of visual scale and detail. Just a few examples are shown here. Full technical information is available in the designer's tools sections of each range on the website NordicCopper.com.



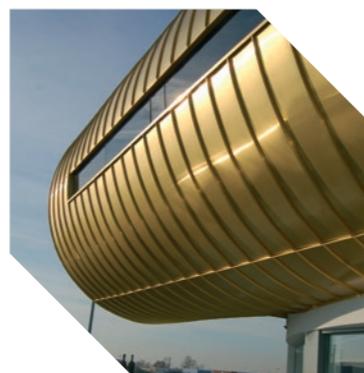
Profiled sheets

Aurubis offers an extensive choice of roll-formed or welded profiled sheets in the full range of Nordic Copper. Full technical details are available on the website. Other custom-made profiles can also be provided to order.



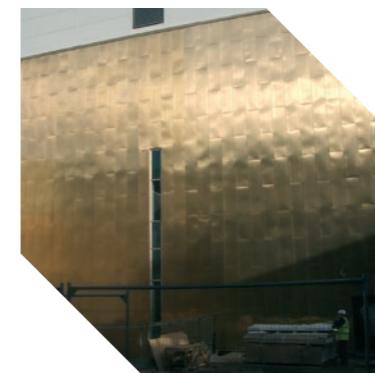
Perforated & expanded mesh

Aurubis offers a range of standard perforation patterns on its copper sheet with any Nordic Copper, as well as special customized patterns. Variable perforation sizes can be used to create subtle patterns, "super graphics" and even text. Our partners can also provide expanded copper sheet with any Nordic Copper to suit particular requirements.



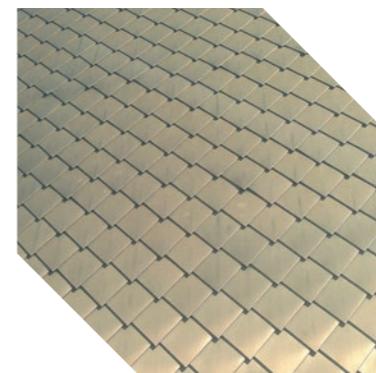
Prefabricated trays

Prefabricated tray is a fully-supported 0.5 – 0.6 mm thick copper tray, pre-formed to be ready for fast, efficient installation.



Panels

For facades, self-supporting copper panels pre-formed on two sides can be used vertically, horizontally or diagonally to give a linear, striated appearance. Various shapes and sizes are available.



Shingles

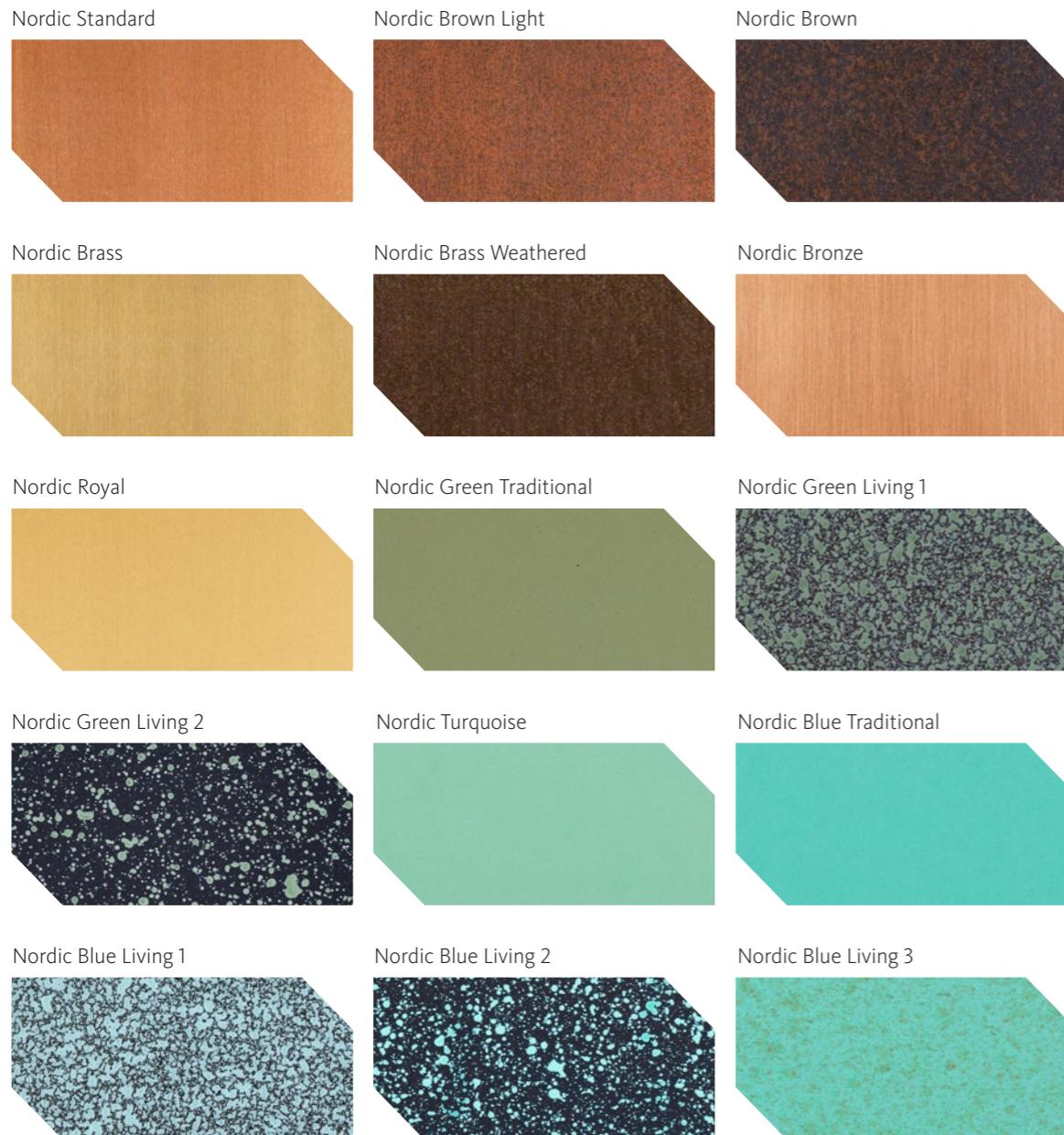
Fully supported copper elements for facades or roofs, shingles offer a distinctive "fish scale" appearance with shapes including squares, diamonds, rhomboids and rectangles in various sizes.



Cassettes

For larger flat areas, cassettes have squarer proportions with folded edges on all four sides. Various types and sizes are available.

Product Range



Product specifications			
Product	Alloy	Thickness range (in mm)	Maximum width (in mm)
Nordic Standard	Cu-DHP	0.3 – 4.0	1,100
Nordic Brown	Cu-DHP	0.5 – 1.5	1,000
Nordic Brown Light	Cu-DHP	0.5 – 1.5	1,000
Nordic Green	Cu-DHP	0.5 – 1.5	1,000
Nordic Blue	Cu-DHP	0.5 – 1.5	1,000
Nordic Turquoise	Cu-DHP	0.5 – 1.5	1,000
Nordic Royal	CUAl5Zn5Sn1	0.5 – 1.5	1,000
Nordic Brass	CuZn15*	0.5 – 2.0	1,000
Nordic Brass Weathered	CuZn15*	0.5 – 1.5	1,000
Nordic Bronze	CuSn4	0.5 – 2.0	800

* Other alloys upon request.



Nordic Décor: Grindings & Embossings

Nordic Brass Weathered Décor 980



Nordic Brown Décor 990



Nordic Brass Weathered Décor 1040



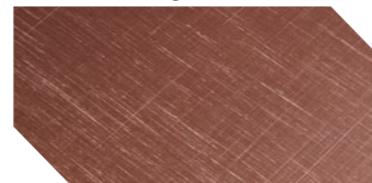
Nordic Brass Weathered Décor 1120



Nordic Brown Light Décor 1130



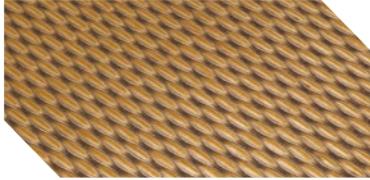
Nordic Brown Light Décor 1140



Nordic Brown Décor 1150



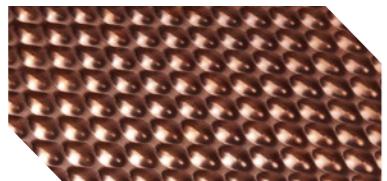
Nordic Brass Décor 5020



Nordic Royal Décor 5030



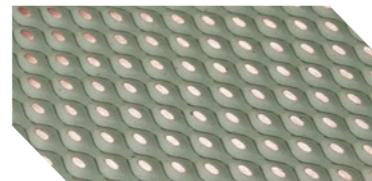
Nordic Brown Light Décor 6000



Nordic Green Décor 6010



Nordic Green Décor 6030



Nordic Brass Weathered 7000



Nordic Brass Weathered Décor 7010



Nordic Brown Light Décor 7040



Sample images of grindings and embossings present one example.

Décor products are available with all Nordic Copper products on page 28.

Nordic Décor specifications			
Décor No.	Max. width (in mm)	Thickness (in mm)	Max. length (in mm)
980	1,000	0.7 – 1.5	3,000
990	1,000	0.7 – 1.5	6,000
1040	1,000	0.7 – 1.5	3,000
1120	1,000	0.7 – 1.5	6,000
1130	1,000	0.7 – 1.5	6,000
1140	1,000	0.7 – 1.5	6,000
1150	1,000	0.7 – 1.5	6,000
5020	1,000	0.7 – 1.5	6,000
5030	1,000	0.7 – 1.5	6,000
6000	1,000	0.7 – 1.5	6,000
6010	1,000	0.7 – 1.5	6,000
6030	1,000	0.7 – 1.5	6,000
7000	1,000	0.7 – 1.5	6,000
7010	1,000	0.7 – 1.5	6,000
7040	1,000	0.7 – 1.5	6,000

Contacts for Aurubis Nordic Copper:

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