

EBNER

HEAT TREATMENT FOR
THE **NON-FERROUS**
METALS INDUSTRY

DECUSTOMERSATISFACTIONCOREVALUES
REDESIGNCONSTRUCTIONONGOING
ITIESAUTOMATION
NGUNDERSTANDING
STOMER-SPECIFIC
GHICON/H₂[®]TECHNOLOGICALLEADERSHIP
CREASEEFFICIENCY
GINALSPAREPARTS
ECHNOLOGICALLEAD
DOUSGROWTHCHALLENGESOLUTIONS
GLOBALROLLER-HEARTH FURNACES
CYENERGY-SAVINGDEVELOPMENTFINANCE
UMPTION
SAFEHIGHESTDEGREEOFAUTOMATION
NEFFICIENCYFLOATER FURNACES
ERYEXPERTISEEFFICIENTCOST-EFFECTIVE
EHICON/H₂[®]DELIVERYMARKET-READYLIN
PERFORMANCERATIOREPRODUCIBILITY
AVINGMONEYTEMPERATUREACCURACY
ONMENTALBELL ANNEALERSCOMPATIBILITY
RELIABILITYMUFFLE-TYPE FURNACESCOM
CUSTOMERSATISFACTIONCOREVALUES
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IORITYFUTURECORECOMPETENCEDESIGN
TTREATMENTBELL ANNEALER FACILITIESECO
PERATIONLISTENINGUNDERSTANDING
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HICON/H₂[®]MODERNIZATIONENGINEERING
REASEEFFICIENCYGLOBALPROFESSIONAL
IDENCEPRESS HARDENING FURNACESDES
LOGICALLEADERSHIPCHALLENGE
GROWTHCHALLENGESOLUTIONSINNOVATIVE
RVICESTURNKEY
RECOTEB[®]AUTOMATION
ENERGY-SAVINGDEVELOPMENTFINANCE
SHOTPHASE[®]LOWESTCONSUMPTIODES
ALITYHIGHESTDEGREEOFAUTOMATION
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ERYEXPERTISEEFFICIENTCOST-EFFECTIVE
ELIVERYROLLER-HEARTH FURNACESMARKET
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ECOBURNRECOTEB®HOTPHASE®INCREASE
EFFICIENCYGLOBALPROFESSIONALSERVICES
ORIGINALSPAREPARTSINDEPENDENCEGLOBAL
PLAYEREXPERTISETECHNOLOGICALLEADERSHIP
CHALLENGEPRICE/PERFORMANCERATIO
GROWTH**EBNER MILESTONES IN TECHNOLOGY**SER
SAFECHALLENGESOLUTIONSINNOVATIVE
TECHNOLOGIESSAFEOPERATIONGLOBAL

HEAT TRANSFER **1949**

The first furnace with recirculation fans is built to anneal aluminum mill products.

VACUUM LOCK **1950**

First use of a vacuum lock in a roller-hearth furnace facility to bright anneal copper tubing.

PROCESS ATMOSPHERE GENERATORS AND BURNER SYSTEMS **1965**

These systems are developed and tested in our in-house research and development lab.

BRIGHT ANNEALING TECHNOLOGY **1972**

This process for semi-finished products was developed and patented for bell annealers and has become well-known worldwide as HICON/H₂®.

HICON® PUSHER-TYPE FURNACE **1982**

The first pusher-type furnace with HICON® technology is built to homogenize and reheat aluminum ingots.

SKID BARS **1983**

Special skid bars are patented for the HICON® pusher-type furnaces, eliminating the need for a conventional lubrication of the ingot shoes.

HIGH-CAPACITANCE ALUMINUM FOIL **1984**

The annealing process for a HICON® bell annealer was developed in our in-house lab and installed for the first time in Japan.

COPPER TUBE COILS **1985**

Heavy level wound tube coils are annealed for the first time with HICON/H₂® technology in a roller-hearth furnace.

HICON® ROLLER-HEARTH FURNACE **1988**

The first HICON® roller-hearth furnace to solution treat and quench aluminum plates is built.

HICON® FLOATER FURNACE

1998

Using HICON® technology, an air cushion is generated for the first time to carry an aluminum strip through the furnace and quench contact-free.

VERTICAL STRAND ANNEALERS FOR COPPER STRIP

2001

The world's first HICON/H₂® vertical strand annealer is developed to continuously bright anneal thinnest copper-alloy strip.

HICON® ROLLER-HEARTH FURNACE

2008

The first HICON® roller-hearth furnace to solution treat and quench aluminum profiled sections is commissioned.

TREATperfect

2009

Further development of the BOS computer model to optimize the annealing time of plates and ingots.

HICON® PUSHER-TYPE FURNACE

2010

Development of a process to pre-heat aluminum ingots by using stack gas.

HICON® FLOATER FURNACE

2012

Development of a real-time computer model to optimize process parameters.

HICON® is a registered trademark and stands for "high convection".

02 | 03



XIAMEN XIASHUN Aluminium Foil, P.R. China
max. net charge 442 t (24 ingots), direct gas-fired, view of exit end

ALUMINUM

PUSHER-
TYPE
FURNACES

1

ROLLER-
HEARTH
FURNACES

2

FLOATER
FURNACES

3

BATCH-TYPE
FURNACES

4

BELL
ANNEALERS

5

08 | 13

14 | 19

20 | 25

26 | 35

36 | 37

COPPER AND COPPER ALLOYS

VERTICAL STRAND ANNEALERS

6

BELL ANNEALERS AND MUFFLE FURNACES

7

ROLLER-HEARTH FURNACES

8

MODERNIZATION

9

BURNER SYSTEMS

10

MODERNIZATION AND BURNER SYSTEMS

46 | 53

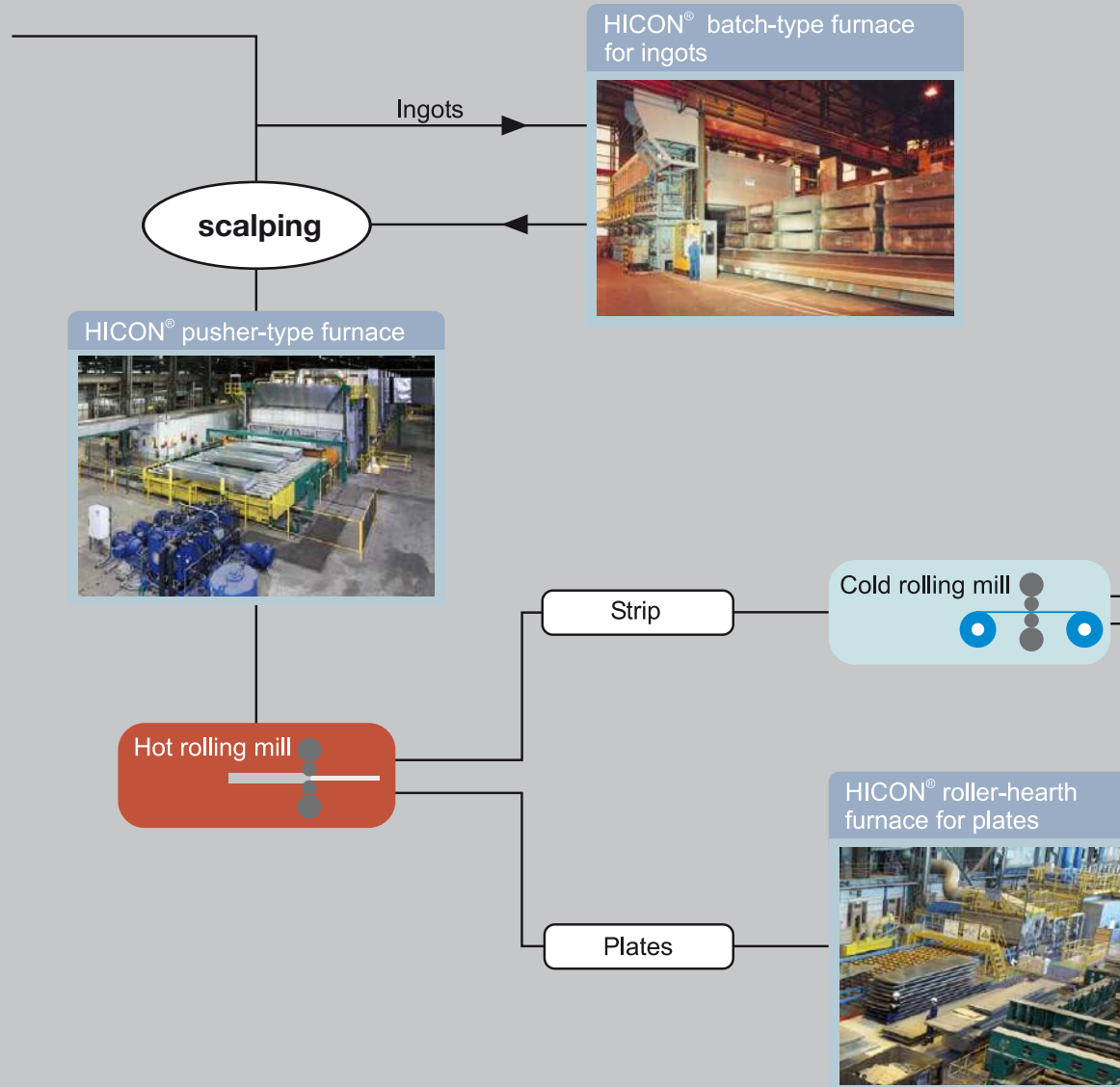
54 | 59

64 | 71

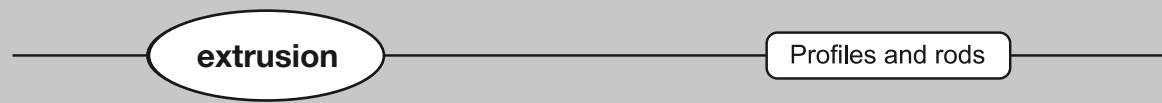
60 | 63

40 | 45

INGOTS



BILLETS



INNOVATIVE TECHNOLOGIES ENERGY EFFICIENCY ENERGY-SAVING DEVELOPMENT FINANCE OPTIONS LOW EMISSIONS CONSTRUCTION MATERIALS AND HEAT TREATMENT LOWEST CONSUMPTION

Cold rolling mill

HICON® batch-type furnace for foil coils



HICON® batch-type furnace for coils



Process anneal

Final anneal

HICON® batch-type aging furnace



HICON® floater furnace



HICON® roller-hearth furnace for profiles and rods



HICON® overhead furnace



HICON[®] PUSHER-TYPE FURNACE

BEST TEMPERATURE UNIFORMITY, HIGHEST COST-EFFECTIVENESS AND MAXIMUM PRODUCTIVITY IN A PUSHER-TYPE FURNACE FOR ALUMINUM INGOTS.

These are the conditions for producing the highest quality in modern hot rolling mills.

1



ALCOA Aluminium Company of America,
Knoxville, Tennessee/USA
max. net charge: 1200 t (48 ingots), direct gas-fired
view of entry end

NOVELIS KOREA, Yeongju, Korea
max. net charge 660 t (30 ingots), direct gas-
fired, view of entry end



SHANDONG NANSHAN, Longkou, P.R. China
max. net charge 750 t (25 ingots), direct gas-
fired, view of entry end

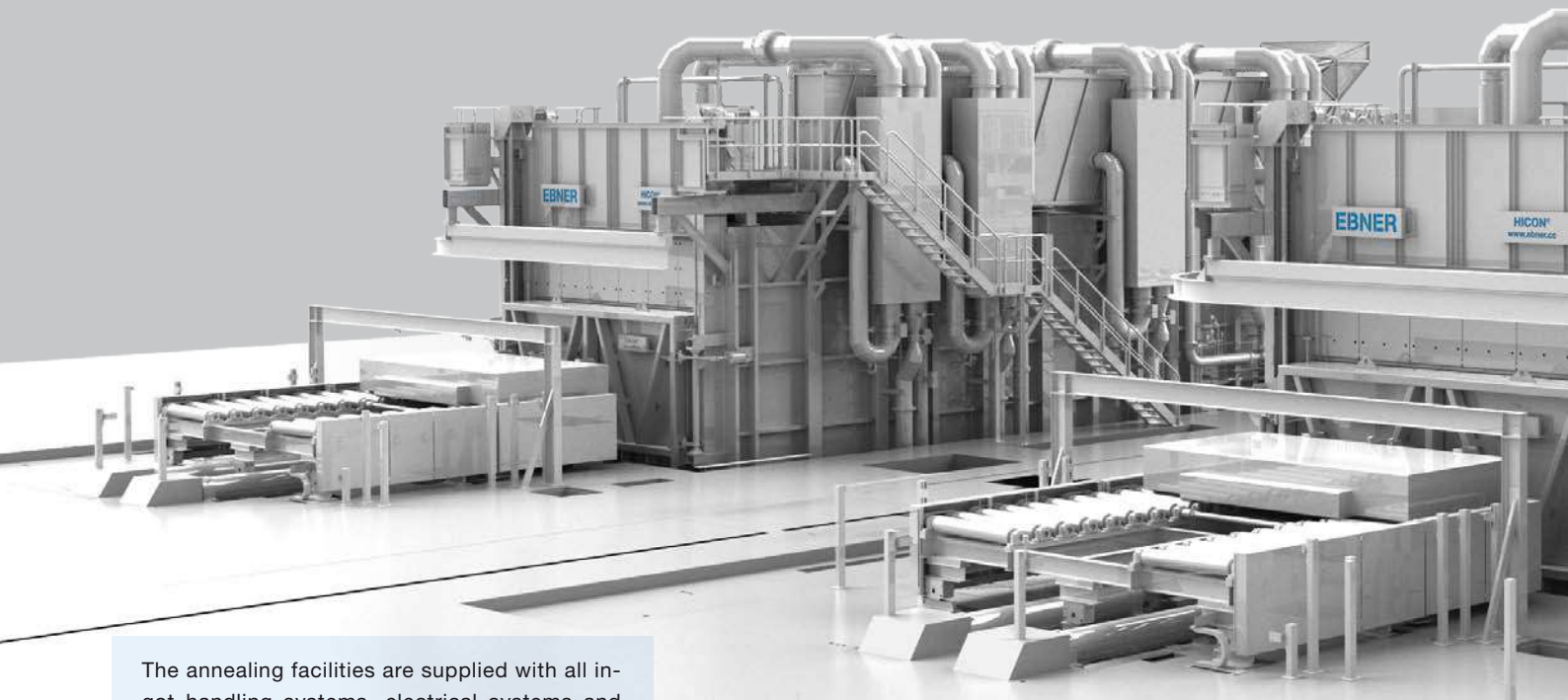
HICON® PUSHER-TYPE FURNACES FOR ALUMINUM INGOTS

The HICON® pusher-type furnace is the most modern design available for reheating and homogenizing cast aluminum ingots for hot rolling. In contrast to conventional annealing facilities (such as batch-type furnaces), the HICON® pusher-type furnace is a semi-continuous facility in which the ingots are heat treated while vertical. Its many advantages make the pusher-type furnace facility the go-to technology for high yearly throughputs.

EBNER also supplies the associated ingot handling systems. Many different styles of ingot handling system have been designed and installed at our facilities, depending on our customers' requirements and existing production facilities. Our design ensures that the carefully scalped surface of the ingots is never damaged.

From the entry end roller table, to being pushed into the furnace to finally being laid down on the hot rolling mill roller table, the ingots are transported fully-automatically and without damage to the rolling surface. Unique solutions are developed with our customers.

1



The annealing facilities are supplied with all ingot handling systems, electrical systems and software.

Features of the HICON® pusher-type furnace

- 1 Shortest heating-up times and best temperature uniformity of $\leq \pm 3^{\circ}\text{C}$ throughout the entire charge by using the TREATperfect computer model
- 2 Use of a special jet floor for fast and even heat transfer to the ingots without overheating
- 3 HICON® high-capacity recirculation fans for each furnace zone with optimized low-loss flow of the convected furnace atmosphere.
- 4 ECOBURN® all-metal burners
- 5 Lowest energy consumption
- 6 Division of the furnace into individually-controlled heating zones
- 7 Penetration thermocouples to read the actual temperature of the material in each furnace zone for better temperature control
- 8 VISUAL FURNACES® process control system

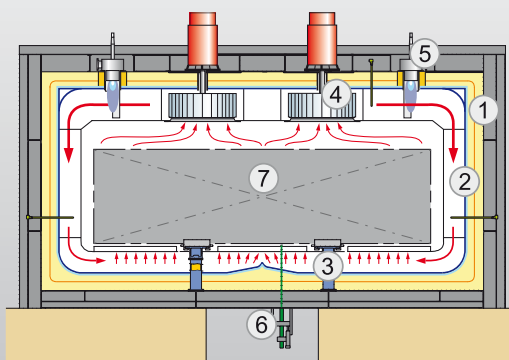


TRADITION QUALITY STANDARD ADDED VALUE
 CUSTOMER SATISFACTION CORE VALUES
 PRIORITY FUTURE CORE COMPETENCE
 CONSTRUCTION ONGOING DEVELOPMENT
 DESIGN HEAT TREATMENT FACILITIES
 AUTOMATION ANNEAL LOGISTICS
 COOPERATION LISTENING UNDERSTANDING

EBNER tailors the size of HICON® pusher-type furnaces to the customer's requirements: Ingot dimensions, number of ingots, required throughput and alloy affect the size and number of furnaces.

The following are a few examples of furnace dimensions:

number of ingots	max. ingot dimensions L x W x D [mm]	max. net charge [t]
48	7900 x 2050 x 560	1200
30	9000 x 2100 x 635	975
30	7000 x 2000 x 660	750
25	6000 x 2200 x 630	565
24	5000 x 2200 x 620	442



- 1 furnace shell and thermal insulation
- 2 inner casing
- 3 ingot shoes and skid rail
- 4 HICON® recirculation fan
- 5 ECOBURN burner
- 6 penetration thermocouple
- 7 ingot



To achieve the best temperature scatter in longer ingots, 2 HICON® high-capacity recirculation fans are installed in each furnace zone roof. In specially-designed furnaces, shorter ingots can also be pushed through two abreast in dual ingot mode.

The facilities are manufactured in our own workshops and at selected contracted companies under supervision of EBNER technicians.

In-house fabrication of an impeller for max. 80 m³/sec

ASIA Aluminium, Zhaoqing, P.R. China
max. net charge 660 t (30 ingots), direct gas-fired,
view of ingot being positioned on the entry end cross-travel car



NOVELIS do BRASIL, Pindamonhangaba, Brazil
max. net charge 650 t (30 ingots), direct gas-fired,
view of entry end

HICON® ROLLER-HEARTH FURNACES FOR PLATE AND PROFILED SECTIONS

HIGH, UNIFORM, REPRODUCIBLE STRENGTH VALUES FOR EVERY COMPONENT ARE EXTREMELY IMPORTANT IN THE AEROSPACE INDUSTRY AND INCREASINGLY SO IN THE AUTOMOTIVE INDUSTRY AS WELL.

Our roller-hearth furnace meets these requirements with innovative solutions, especially the quench and cooling systems.

2



Aleris Aluminum, Duffel / Belgium
max. throughput: 1.5 t/h rods and profiled sections

OAO ALCOA Metallurg Rus, Belaya Kalitva / Russia
max. throughput: 3.7 t/h
max. plate width: 3,600 mm
max. thickness: 200 mm



HICON® ROLLER-HEARTH FURNACES FOR SOLUTION HEAT TREATING AND ANNEALING

HICON® roller-hearth furnaces are designed to heat treat plates, sheet, profiled sections and rods. Depending on the requirements, the material is solution heat treated, recrystallized or tempered.

Suitable aluminum alloys are solution heat treated and then quenched with water. The goal is to achieve especially high and uniform strength values.

The annealed material is generally destined for aerospace applications, which is why the furnace and quench meet the rigorous AMS 2750 D and AMS 2772 aerospace standards. The HICON® high convection system ensures a small temperature scatter.

To prevent damage to the surface, the roller-hearth furnace for hot and cold rolled plates and sheet is fitted with stainless steel brush rollers and can be used to recrystallize or anneal to temper. The material is cooled to below 55°C by means of a multi-zone cooling system.

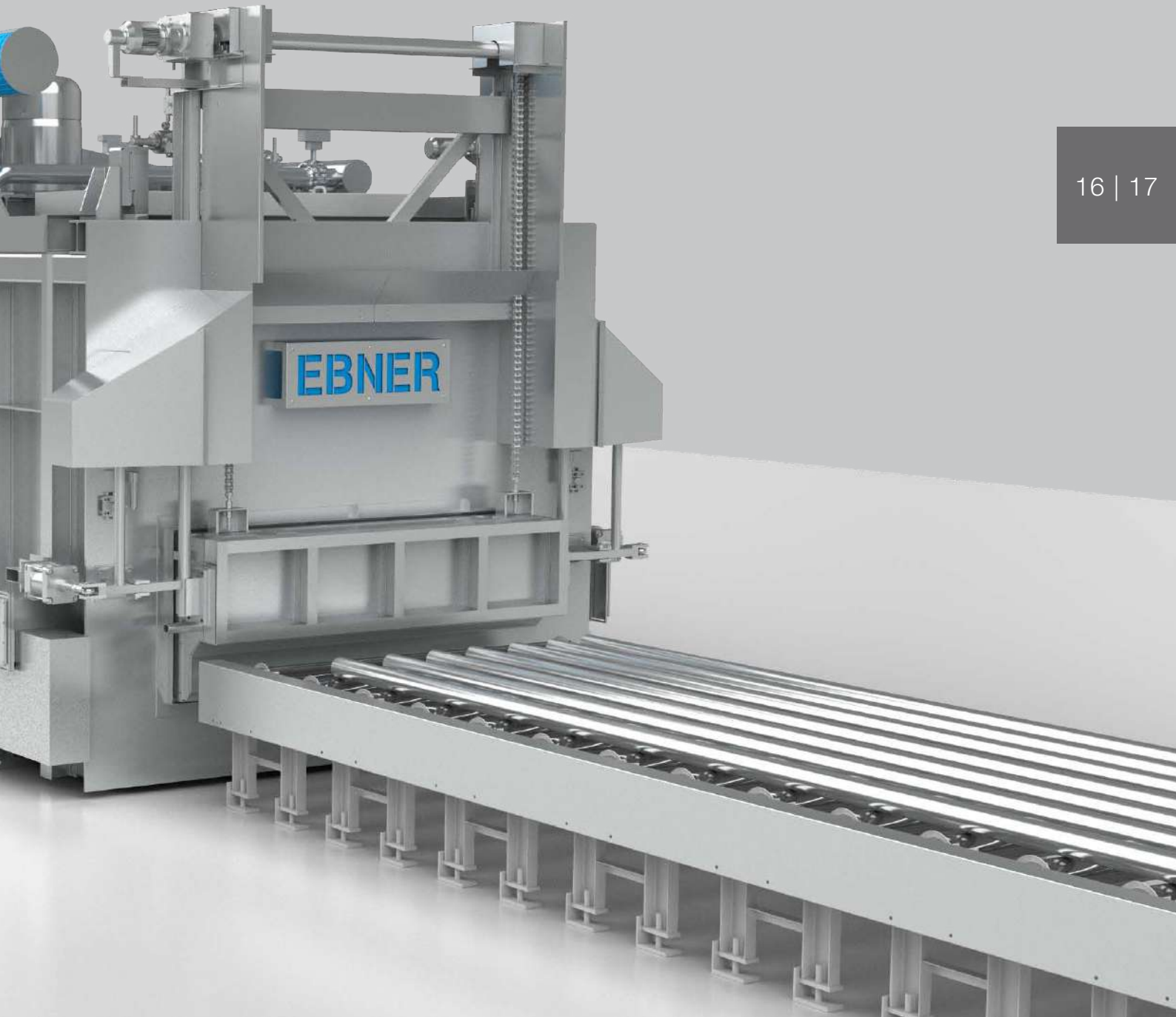
2



All annealing facilities are supplied complete with electrical equipment.

Features of HICON® roller-hearth furnace facilities

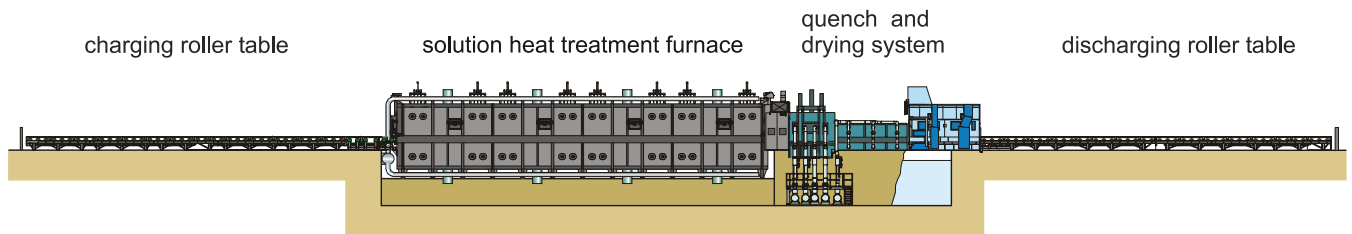
- 1 Temperature scatter in the furnace $\leq \pm 3^{\circ}\text{C}$ during soaking
- 2 Use of brush rollers in the furnace to prevent damage to the material surface
- 3 Recirculation fans located above and below the material for uniform air flow distribution
- 4 Water quench adjustable depending on material height
- 5 Heating systems: gas-fired radiant tubes or electrical resistance heating
- 6 VISUAL FURNACES® process control system



HICON/H₂® HICON® ECOBURN RECOTE®
HOTPHASE® INCREASE EFFICIENCY GLOBAL
PROFESSIONAL SERVICES ORIGINAL SPARE
PARTS INDEPENDENCE RAPID DECISION
MAKING GLOBAL PLAYER TECHNOLOGICAL
LEADERSHIP PRICE/PERFORMANCE RATIO

HICON® ROLLER-HEARTH FURNACES FOR SOLUTION HEAT TREATING

Designed especially for alloys used in the aerospace industry. Plates and sheet can be solution heat treated, and a special system ensures that no imprints are made on the surface of rods and profiled sections as they are heat treated.



Examples of installed facilities:

plate width:	max. 4370 mm
plate and sheet thickness:	2 – 255 mm
heating system:	gas-fired radiant tubes or electrical resistance heating
temperature range:	400°C – 620°C
quenchant:	water

2



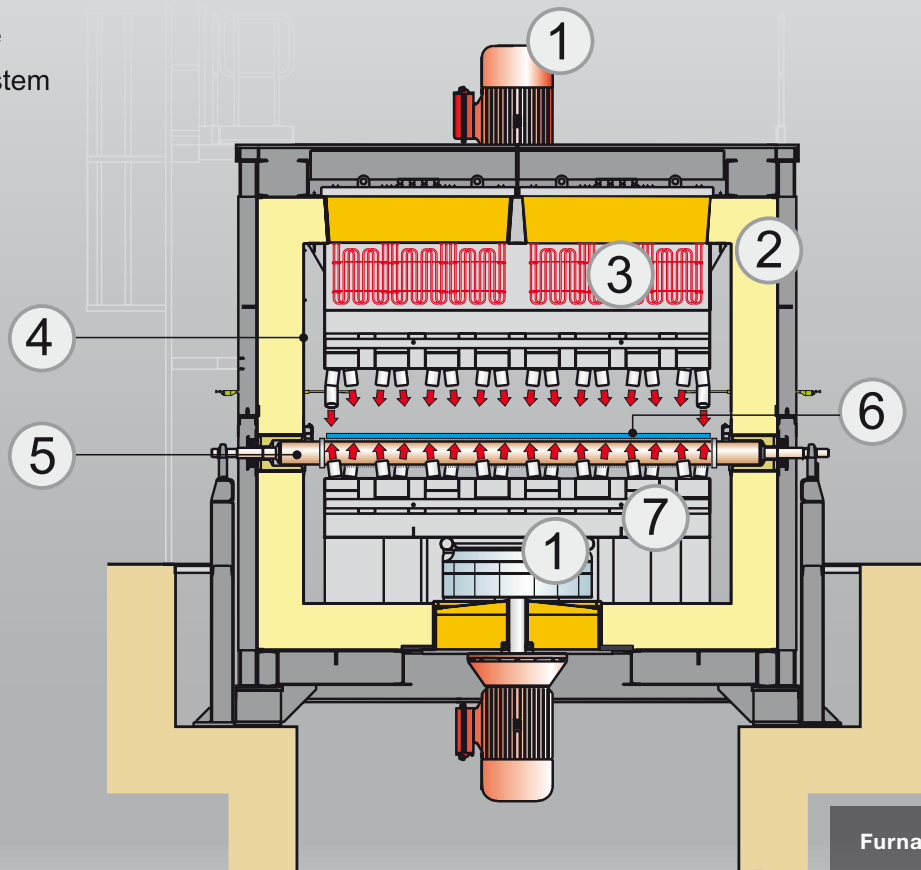
Low pressure quench zone

HIGHEST QUALITY HIGHEST DEGREE OF
AUTOMATION HIGHEST THROUGHPUT
HIGHEST COMBUSTION EFFICIENCY
EFFICIENT INSULATION INNOVATION
ANNEAL LOGISTICS DELIVERY EXPERTISE
COST EFFECTIVENESS CUSTOMER

HICON® ROLLER-HEARTH FURNACES TO RECRYSTALLIZE AND ANNEAL TO TEMPER

Recrystallizing and/or temper annealing is carried out similar to the previous description. The water quench is replaced by an air cooling system.

- 1 HICON® recirculation fans
- 2 furnace shell and thermal insulation
- 3 electric heating system
- 4 inner casing
- 5 hearth rollers
- 6 aluminum plate
- 7 HICON® jet system



FLOATER FURNACE FACILITIES

HIGHEST THROUGHPUT AND BEST QUALITY FOR ALUMINUM STRIP.

Our facilities produce top quality aluminum strip for the automotive and aerospace industries.

3



AMAG rolling, Ranshofen / Austria
throughput: 4.4 t/h
strip width: 900 – 1700 mm
strip thickness: 0.3 – 6.35 mm



Aleris Aluminum, Duffel / Belgium
throughput: 31.5 t/h
strip width: 800 – 2300 mm
strip thickness: 0.5 – 3.5 mm

HICON® FLOATER FURNACE FACILITIES FOR ALUMINUM STRIP

The HICON® design has massively improved the throughput and quality of the continuous heat treatment of cold rolled aluminum strip.

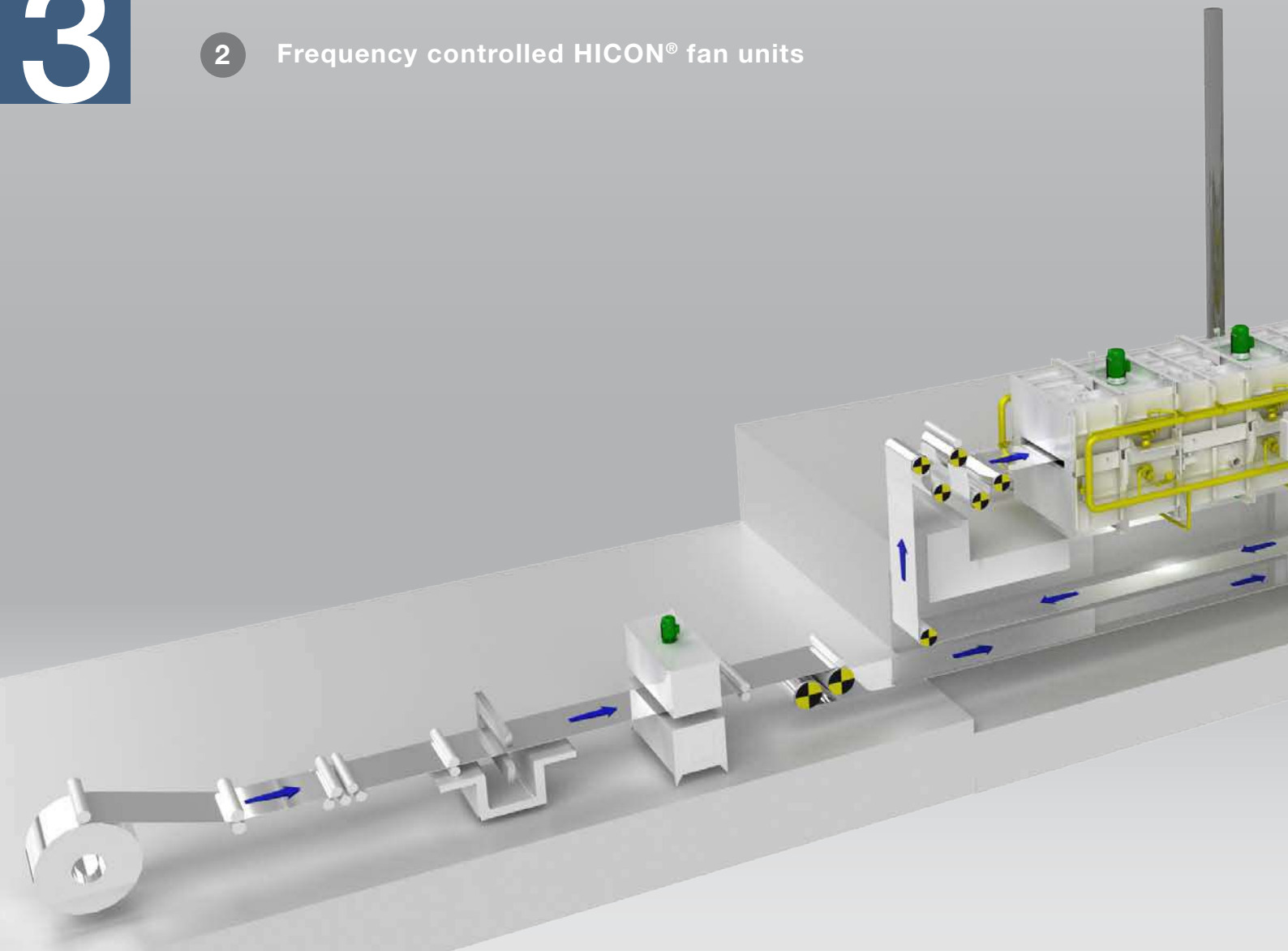
With a newly-developed jet nozzle array, the load capacity and heat transfer to the strip have been significantly increased.

A state-of-the-art air/water quench was developed in order to give the strip the required strength values by means of precise cooling gradients, and also allow the strip to be dried before leaving the facility.

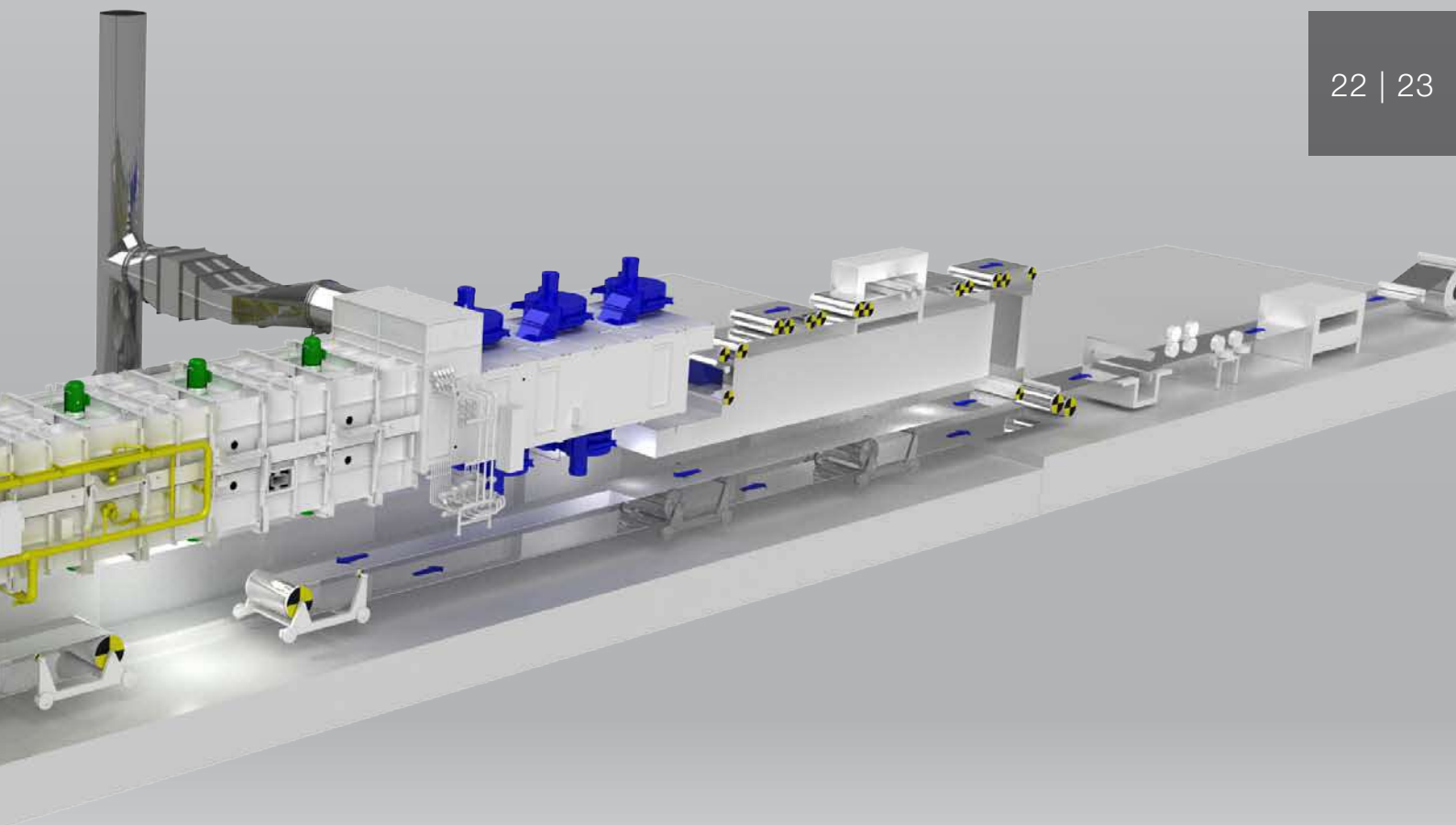
Features of HICON® floater furnace facilities

- 1 Heat treatment of aluminum strip for the aerospace industry as per AMS 2750, 2770, 2772
- 2 Frequency controlled HICON® fan units

3



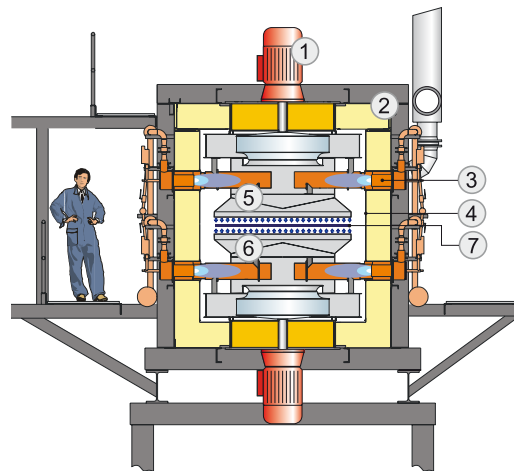
- 3 Temperature scatter $\leq \pm 3^{\circ}\text{C}$ on the strip during soaking
- 4 ECOBURN® burners for low NOx combustion
- 5 Removable furnace roof
- 6 Minimal strip distortion during cooling
- 7 Water does not flow back from the quench into the furnace



All facilities are supplied complete with strip handling gear, electrical equipment and software.

HICON® FLOATER FURNACE FACILITIES

The continuous strip movement during heat treatment results in uniform time/temperature influence on the entire length of the strip coil as well as a flawless surface thanks to the HICON® floater system.



- 1 HICON® recirculation fans
- 2 furnace shell and thermal insulation
- 3 ECOBURN burner
- 4 inner casing
- 5 upper nozzle box
- 6 lower nozzle box
- 7 aluminum strip

3

HICON® floater furnace facilities are designed especially for the automotive and aerospace industries. In order to meet these strict requirements, the temperature scatter during soaking at full throughput is limited to $\leq \pm 3^{\circ}\text{C}$.

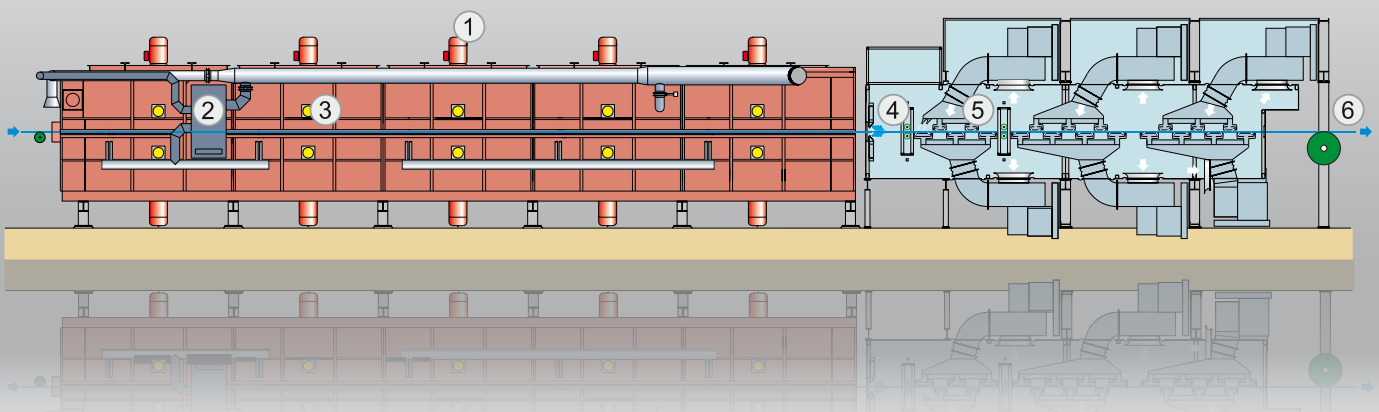
Examples of installed facilities:

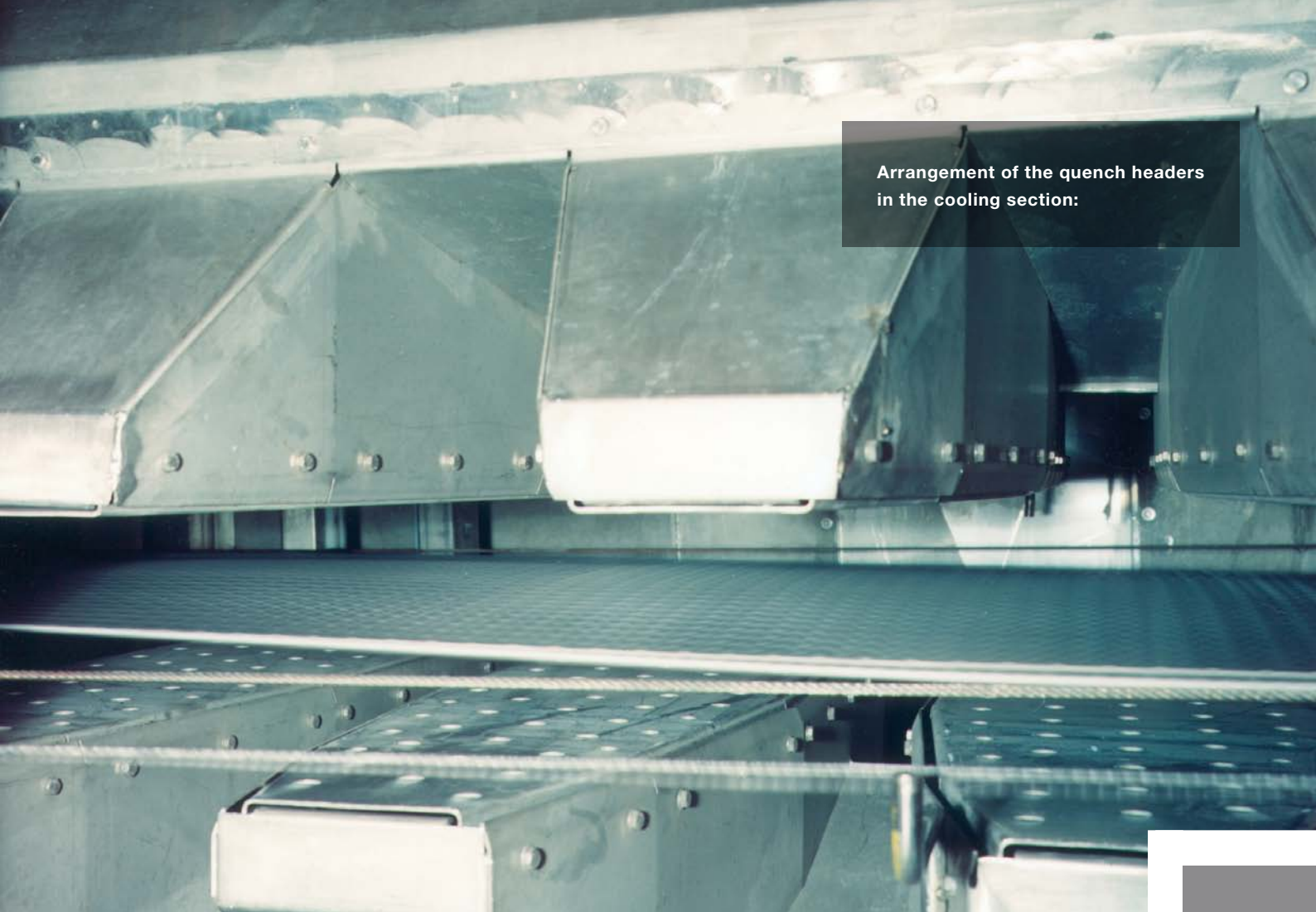
strip width:	up to 2400 mm
strip thickness:	0.3 – 6.35 mm
throughput:	up to 31.5 t/h

The cooling section comprises a water/air cooling zone and a downstream air cooling zone, which also dries the strip.

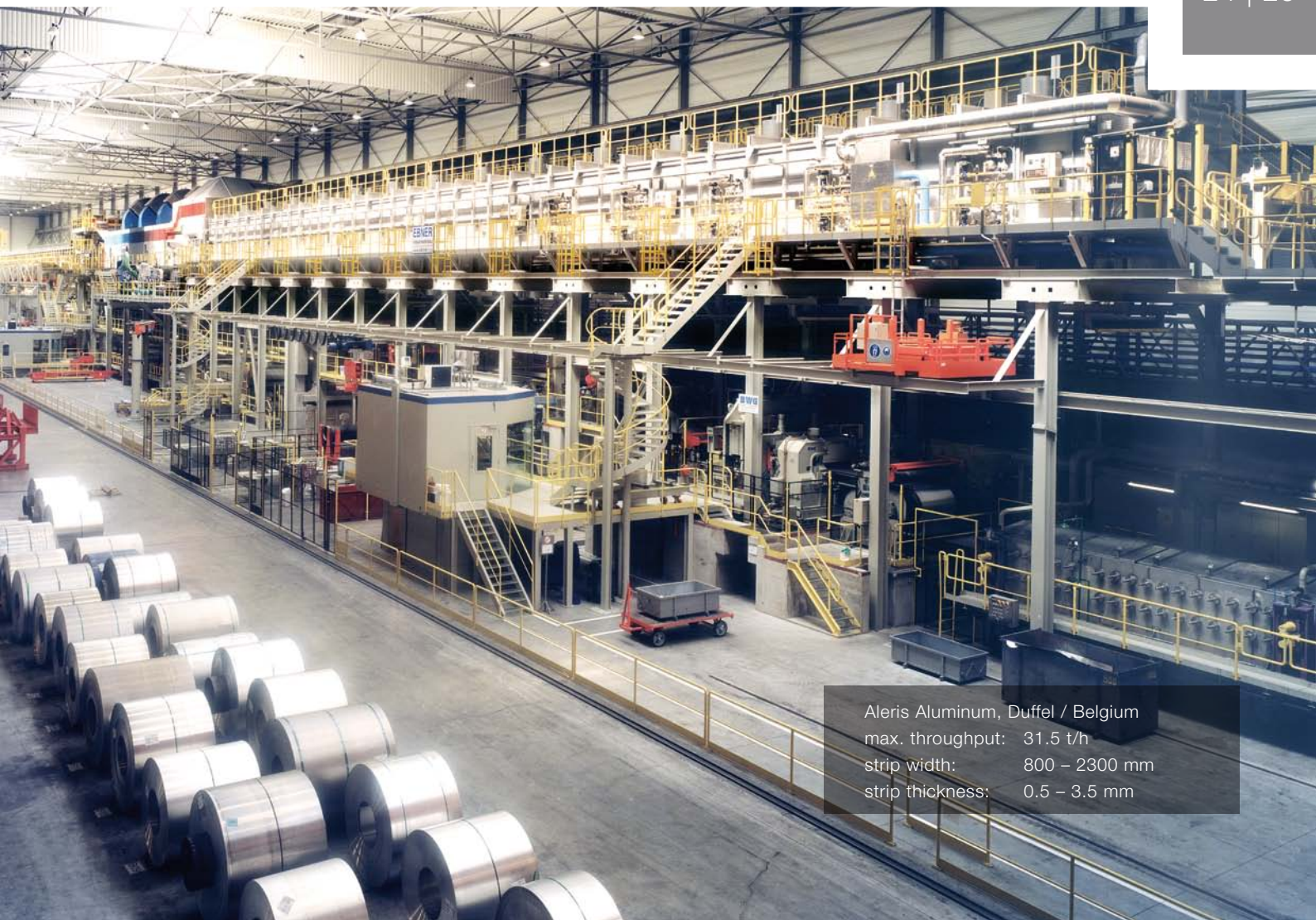
Air knives are located in the floor and roof of the inlet and outlet ends of the quench/cooling section. They prevent water from flowing backward into the furnace or forward into the air cooling zones.

- 1 HICON® recirculation fans
- 2 recuperator
- 3 ECOBURN burner
- 4 water quench
- 5 HICON® air cooling and drying
- 6 aluminum strip





Arrangement of the quench headers
in the cooling section:



Aleris Aluminum, Duffel / Belgium
max. throughput: 31.5 t/h
strip width: 800 – 2300 mm
strip thickness: 0.5 – 3.5 mm

HICON® BATCH-TYPE FURNACES

THE MANY TYPES OF HEAT TREATMENT AS WELL AS THE VARIETY OF MATERIAL GRADES AND FORMATS CALL FOR UNIQUE PROCESS AND DESIGN SOLUTIONS.

Whether homogenizing, recrystallizing, aging or temper annealing, the batch-type furnace with flexible design is an ideal annealing facility.

4



Aleris Aluminium Koblenz / Germany
homogenization of ingots
max. net charge: 320 t
view of furnace inlet and charger
heating system: direct gas-fired

Constantia Teich AG, Mühlhofen / Austria
annealing foil coils in air
max. net charge: 35 t
gas-fired radiant tube heating



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HICON®
www.ebner.at

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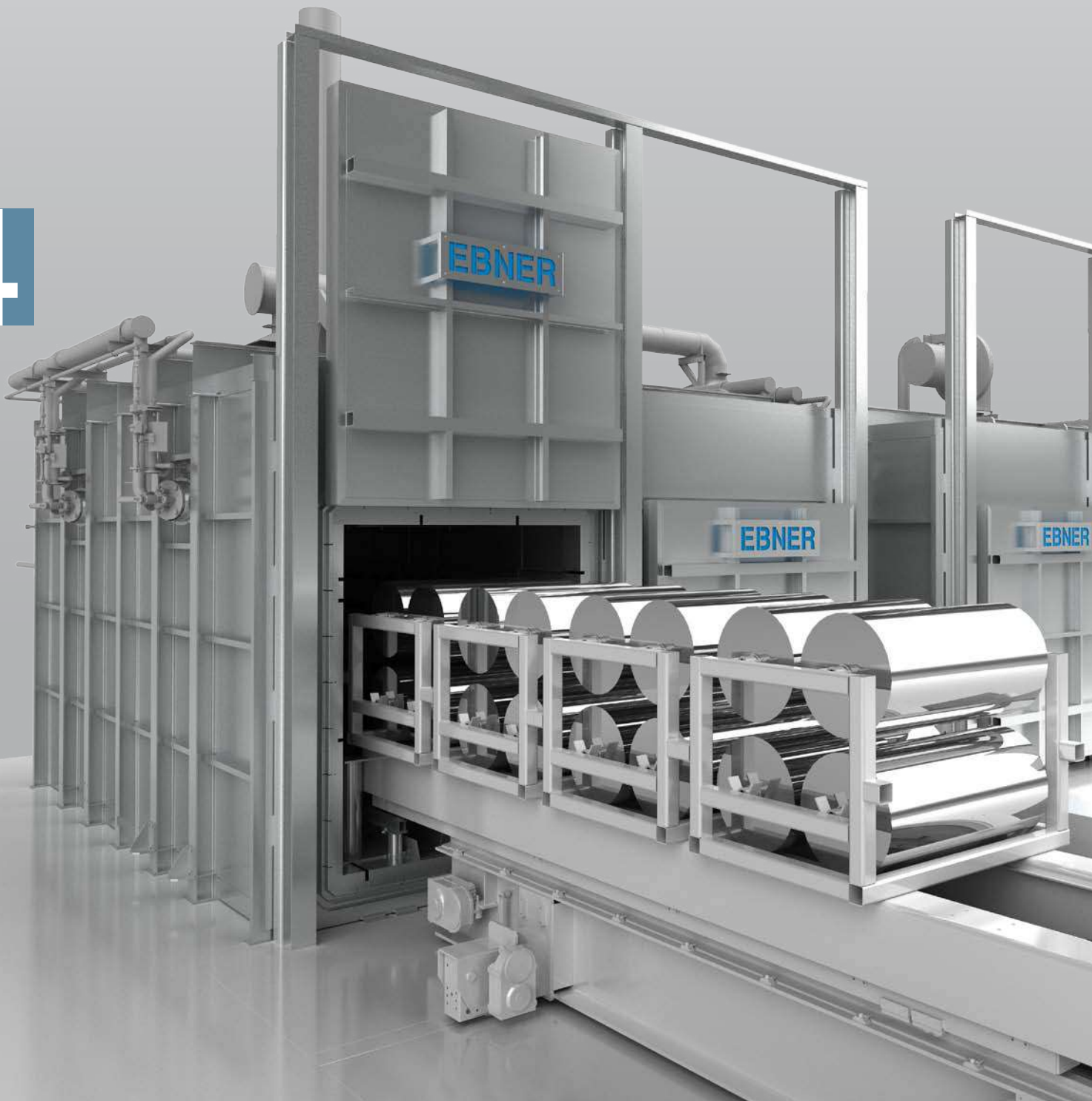
Mitführen
verboten

HICON® BATCH-TYPE FURNACES

HICON® technology ensures best temperature uniformity throughout the charge at the same time as short annealing times. The recirculated flow is precisely directed by high-capacity recirculation fans through a baffle system to the heating system and the material to be annealed.

Process atmosphere - usually nitrogen or air - is used as a heat transfer medium. The furnace design is variable. An oxygen content of below 0.05% is required to minimize the unavoidable oxide layer that forms on the surface of special aluminum alloys.

4



Features of HICON® batch-type furnace facilities

- 1 The design depends on the material to be annealed
- 2 With HICON® technology, temperature scatter of $\leq \pm 1.5^\circ\text{C}$ can be achieved
- 3 No overheating despite short annealing times
- 4 Frequency-controlled recirculation fans
- 5 Choice of electric, direct gas-fired or indirect gas-fired heating systems
- 6 VISUAL FURNACES® process control system for centralized facility operation expandable with modules such as "TREATperfect" for real-time process optimization
- 7 Optional atmosphere coolers
- 8 Depending on the type of charge, jet nozzle or mass flow system for efficient heating / cooling



All facilities are supplied complete with charging systems, electrical equipment and software.

HICON® BATCH-TYPE FURNACES FOR STRIP AND FOIL COILS

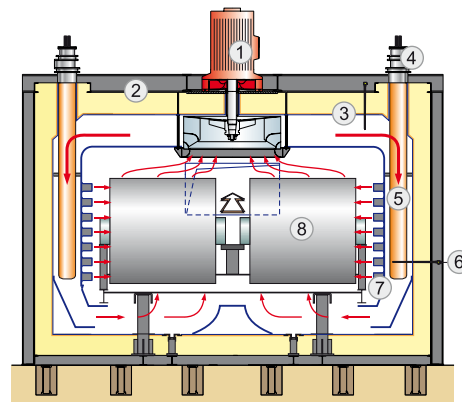
Depending on the requirements of the alloy, the facility is equipped with or without process atmosphere capability.

The circulated process atmosphere or air - up to 40 m³/sec - ensures a temperature scatter of $\leq \pm 3^{\circ}\text{C}$ throughout the charge (all core and surface temperatures) at the end of heating-up time, a short annealing time and that the rolling lubricant evaporates without residue.

Food-grade foil is usually annealed just in air. A special time/temperature track ensures that the residual rolling lubricant evaporates without staining or sticking.

High-capacity recirculation fans are installed in the roof. They conduct the process atmosphere or air to a suitable nozzle system via a baffle system. The nozzle system consists of

- round jet nozzles arranged concentrically facing the coil face
- adjustable vanes arranged horizontally



- 1 HICON® recirculation fan
- 2 furnace shell and thermal insulation
- 3 inner casing
- 4 recuperative burner
- 5 radiant tube
- 6 thermocouple
- 7 HICON® jet system
- 8 coils

Examples of installed facilities with electrical or gas-fired radiant tube heating:

	workload space dimensions strip coils	workload space dimensions foil coils
length:	8000 – 12600 mm	4000 – 7600 mm
width:	2000 – 4200 mm	2400 – 3400 mm
height:	1000 – 2700 mm	1500 – 3900 mm
net charge:	up to 80 t	up to 40 t

The strip coils are usually charged on coil cradles since supporting the sleeves would interfere with the flow directed by the jet nozzles onto the coil face during annealing and cooling. Foil coils are heated using the mass flow system across the surface, allowing the use of charging racks which support the sleeves of the coils. The VISUAL FURNACES® process control system for central operation and the "TREATperfect" module are used for every batch-type furnace to generate ideal annealing conditions.



Aluminium Konin Impexmetal, Konin / Poland
net charge: max. 63 t strip coils
annealing in process atmosphere
heating system: gas-fired radiant tubes



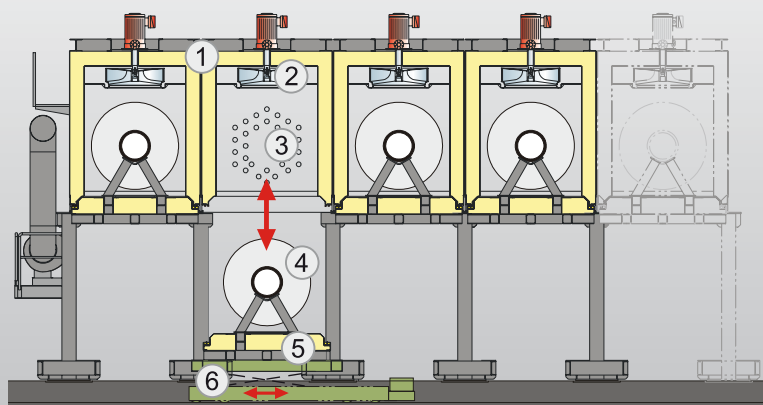
Teich AG, Mühlhofen / Austria
net charge: max. 35 t foil coils per chamber
12 furnace chambers to anneal foil coils in air
heating system: gas-fired radiant tubes

HICON® SINGLE COIL BATCH-TYPE FURNACES FOR STRIP COILS

To each coil its own annealing program. Combining best material quality and the highest degree of flexibility and reliable delivery for the final customer. In this case, the chambers are arranged overhead so that the coils are charged through the furnace floor.

- Choice of gas-fired radiant tube or electrical heating system
- Use of high-convection jet system for a temperature scatter of $\leq \pm 3^\circ\text{C}$ in the entire coil in shortest annealing time
- "TREATperfect" real time model to optimize mechanical properties, utilization factors and energy consumption during the annealing and cooling cycles
- Special safety and purge design to prevent explosive mixtures
- Trace oxygen content $< 0.05\%$ throughout processing
- Simple expansion by adding chambers
- VISUAL FURNACES® process control system for centralized facility operation

4



- 1 furnace shell and thermal insulation
- 2 HICON® recirculation fan
- 3 HICON® jet system
- 4 coil
- 5 furnace floor
- 6 charging car and lifting device



ALCAN Rhénal, Neuf Brisach / France
 single-coil overhead furnace facility
 consisting of 4 individual furnaces
 to anneal strip coils (max. 15 t)
 in process atmosphere
 heating system: gas-fired radiant tubes

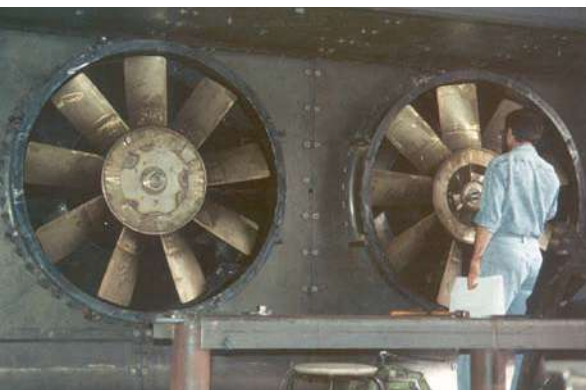
HICON® BATCH-TYPE FURNACES FOR PLATES AND SHEET

Aging and temper annealing with best temperature uniformity in the entire charge. Charges can be aged at about 200°C to a temperature scatter of $\pm 3^\circ\text{C}$. AMS standards 2750, 2770, and 2772 are fulfilled, allowing materials annealed in these furnaces to be used in aerospace components.

Plates up to 36 m long are aged with identical time/temperature profiles without overheating.

Design features:

- Electrical heating system
- Specially designed baffle system
- Frequency controlled high-convection axial-flow fans
- Sensitive temperature control system
- VISUAL FURNACES® process control system for centralized facility operation



Aleris Aluminium, Koblenz / Germany
plate length: max. 25,000 mm
net charge: max. 60 t



HICON® BATCH-TYPE FURNACES FOR INGOTS

Sensitive alloys have to be homogenized after casting to reduce the stress within the ingots. Homogenizing temperature is just below the melting point. The more precisely the temperature can be controlled, the shorter annealing time can be without risking the ingot starting to melt. This and possible strict standards such as for the aerospace industry are met by using HICON® technology with sensitive heating control.

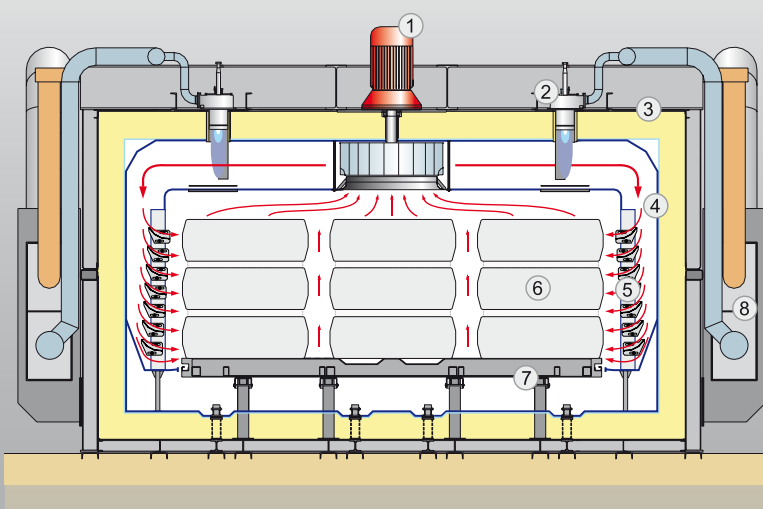
This furnace makes use of the same tried and true high-convection system and components as our pusher-type furnaces.

In addition to ingots, cast strip coils and extruded billets can also be homogenized in this furnace.

Examples of installed facilities:

	clear dimensions
width:	2700 – 6500 mm
height:	1000 – 2700 mm
depth:	6000 – 16000 mm
net charge:	up to 180 t

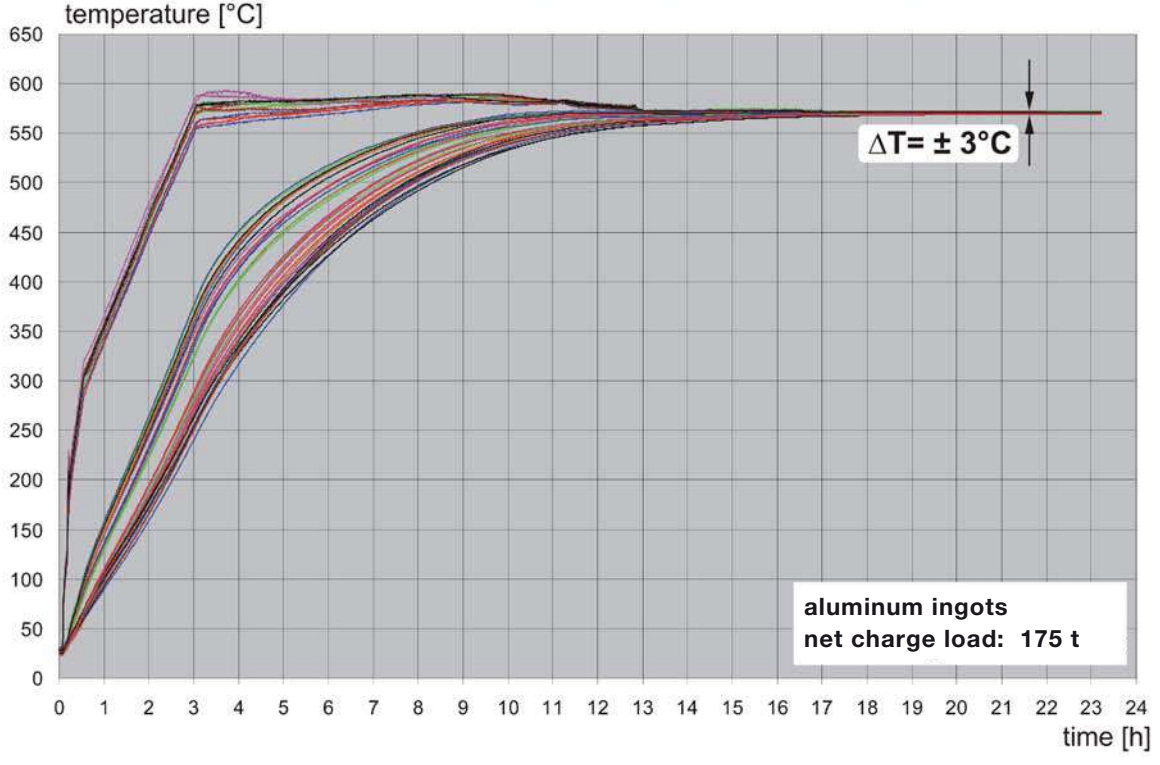
A single central charger charges ingots into each furnace.



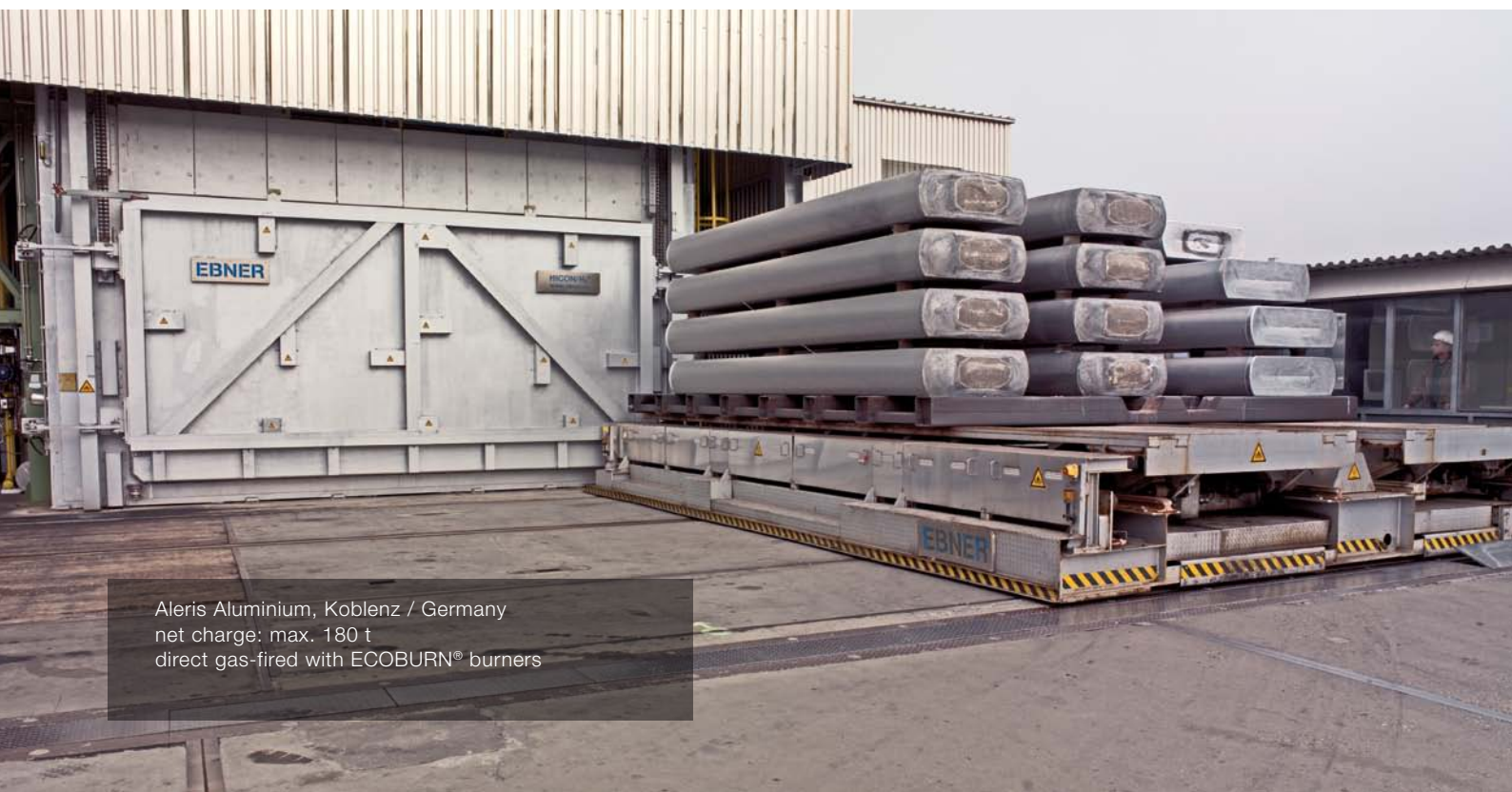
- 1 HICON® recirculation fan
- 2 ECOBURN burner
- 3 furnace shell and thermal insulation
- 4 inner casing
- 5 diffuser assembly
- 6 ingot
- 7 rails and charging frame
- 8 recuperator

HIGHEST COMBUSTION EFFICIENCY
EFFICIENT INSULATION INNOVATION
SOUND PROOFING DELIVERY EXPERTISE
LISTENING COST-EFFECTIVE CUSTOMER
SPECIFIC LOW NOISE RELIABLE DELIVERY

time/temperature plot homogenizing aluminum ingots



34 | 35



Aleris Aluminium, Koblenz / Germany
net charge: max. 180 t
direct gas-fired with ECOBURN® burners

HICON® BELL ANNEALER FURNACES

HICON® BELL ANNEALERS FOR HIGH-CAPACITANCE ALUMINUM FOIL COILS

The absolutely gas-tight, vacuum-tight, metal encapsulated workload space provides very clean prerequisites for annealing. High-capacitance foil spools are annealed in process atmosphere to generate an even layer of Al_2O_3 on the surface, facilitating the downstream tunnel etching process.

5



HICON® bell annealer facility
net charge: max. 14 high-capacitance foil coils
to be annealed in N₂/Ar

36 | 37

Design features:

- Metallic surfaces designed for medium vacuum
- Flexible heating up and cooling gradients in vacuum or process atmosphere
- Gas and vacuum tight workload space
- VISUAL FURNACES® process control system for centralized operation

Workload space dimensions of installed facilities:

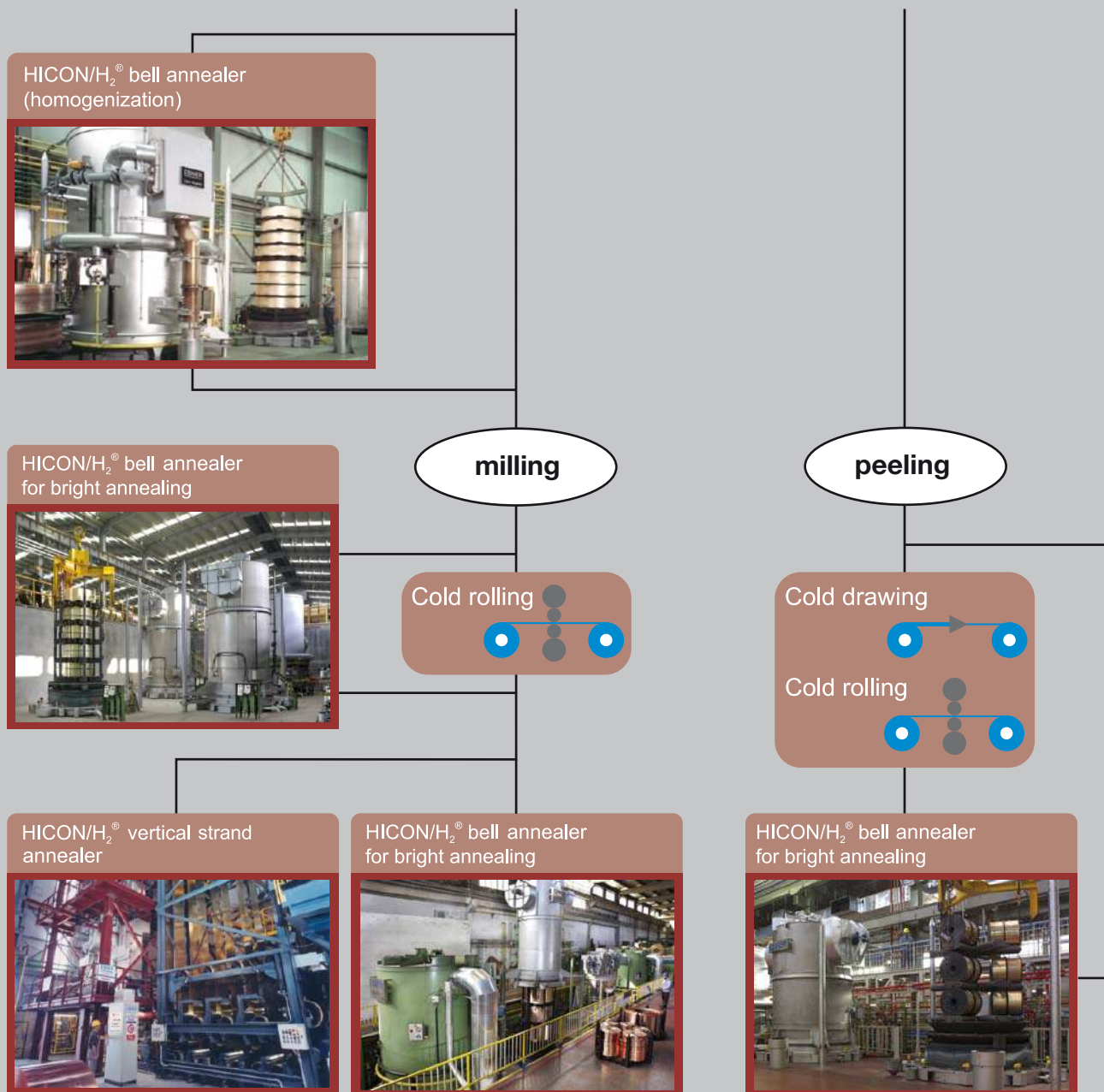
charging diameter:	1800 – 2600 mm
charging height:	2000 – 3000 mm

STRIP

BILLETS

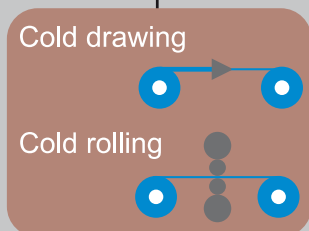
Continuous casting

Continuous casting



TUBES

**Extrusion,
Continuous casting,
Welded cold strip**



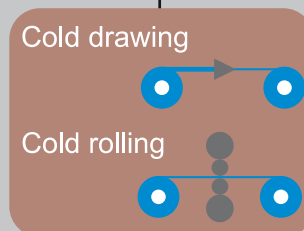
straightening

HICON/H₂® roller-hearth furnace
for bright annealing tube coils



RODS

**Extrusion,
Continuous casting**



straightening

HICON/H₂® roller-hearth furnace
for straight tube/rod



VERTICAL STRAND ANNEALERS

Highest quality, greatest efficiency and best throughput for alloyed and unalloyed copper strip.

These factors define our bright annealing lines and are the basis for our worldwide success in Europe and Asia.

6



ILNOR S.p.A. / Italy

ILNOR S.p.A. / Italy
max. throughput: 8.5 t/h brass and bronze strip
strip width: up to 650 mm
strip thickness: 0.05 – 1.2 mm



VERTICAL STRAND ANNEALERS FOR COPPER AND COPPER ALLOY STRIP

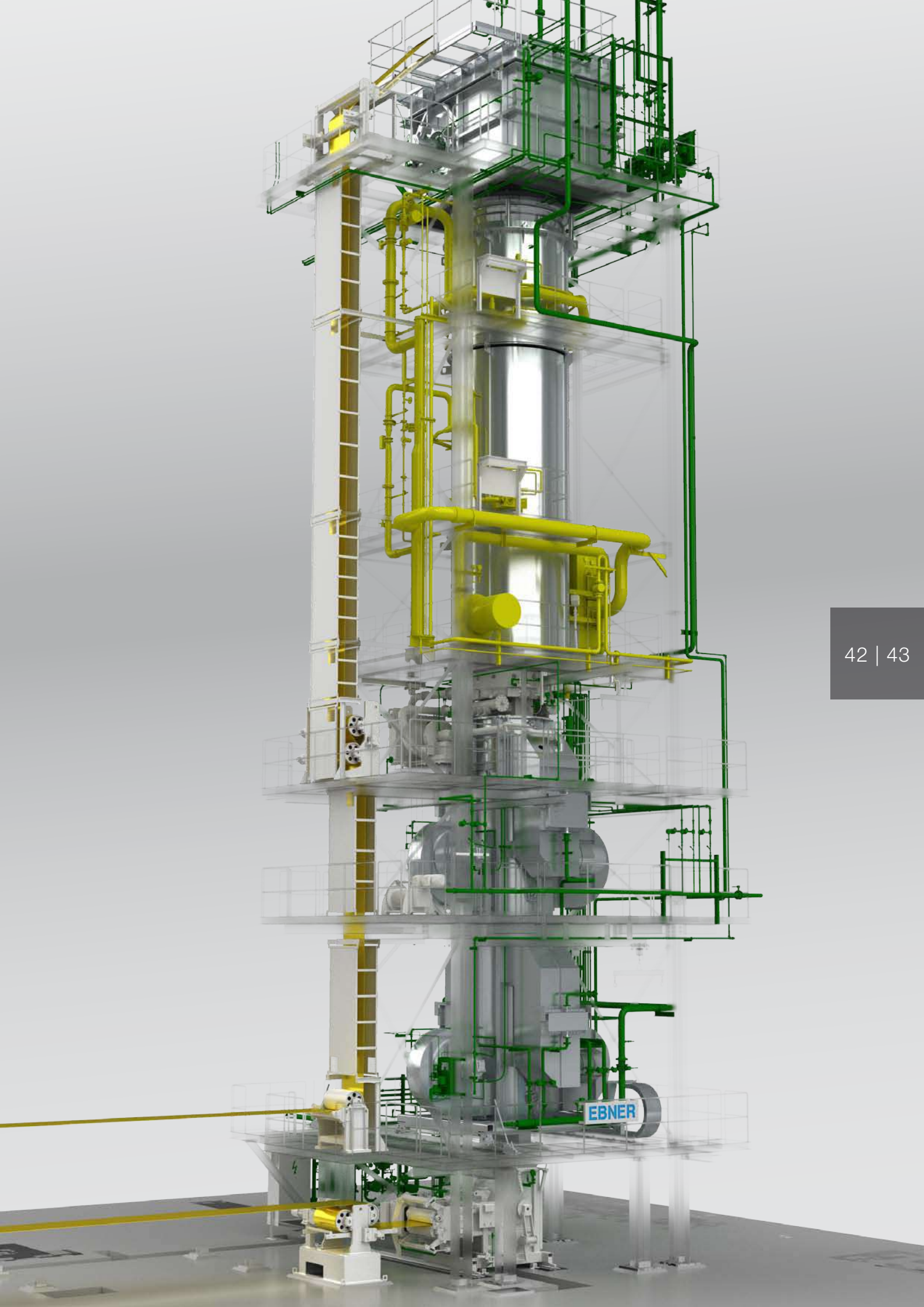
These vertical furnaces are designed using the trusted muffle concept in order to utilize the advantages of up to 100% hydrogen and lowest dewpoint when bright annealing alloys highly sensitive to oxidation. This ensures best strip surface. An efficient gas-fired heating system is another advantage.

Features of the EBNER muffle design

- 1 70% hydrogen and -60 °C dewpoint for best oxide-free and bright strip surface thanks to gas-tight design
- 2 The strip degreased with hot water only, no solvents, before passing into the furnace section
- 3 Lowest strip tension thanks to catenary control or integrated dancer roll in hydrogen beyond the sealing rolls
- 4 HICON/H₂[®] jet tunnel with adjustable flowrate in the heating up section
- 5 Strip temperature up to 950°C
- 6 Lowest fuel gas and electrical consumption
- 7 Use of efficient gas heating with ECOBURN[®] burners

6

All processing lines are supplied complete with strip handling gear and electrical equipment.



INCREASE EFFICIENCY SAFE OPERATION
AUTOMATION DURABILITY INNOVATIVE
ECONOMICAL ENERGY-SAVING ENERGY
EFFICIENCY DEVELOPMENT ADDED VALUE
LOWEST EMISSIONS EXCELLENT SERVICE

HICON/H₂[®] VERTICAL STRAND ANNEALERS

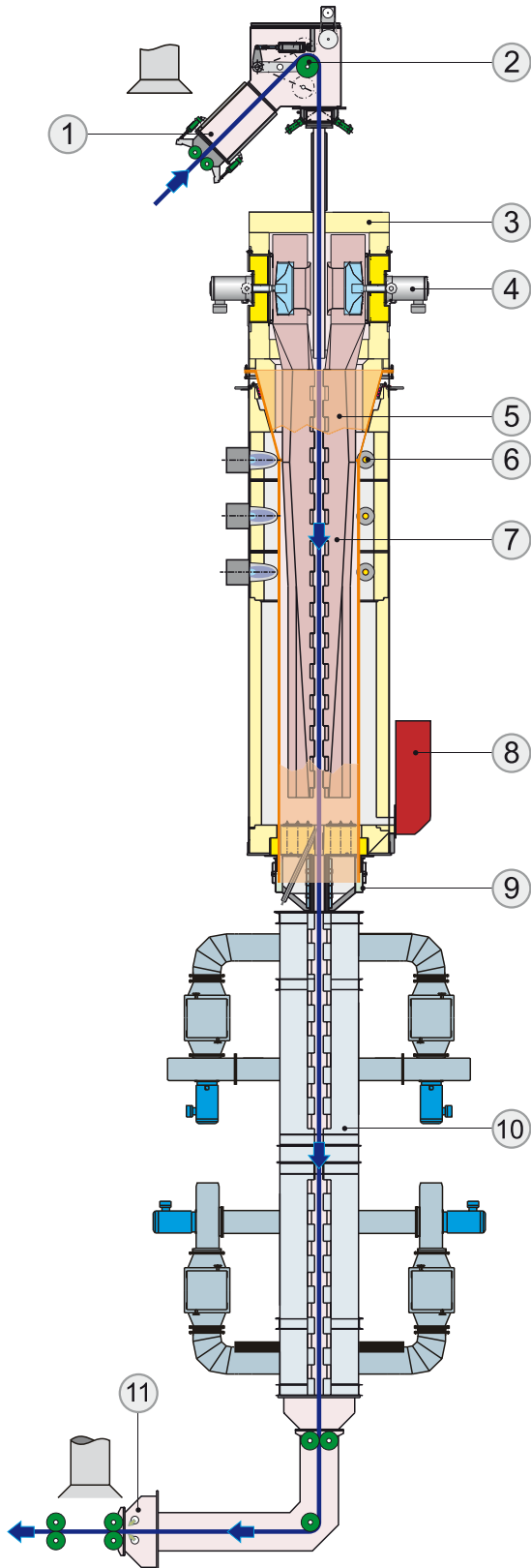
The strip passes through sealing rolls, into an integrated dancer box and into the furnace. The strip is heated to 850°C in the jet tunnel. The strip can be further heated in a radiant section. Two radial-flow fans ensure even distribution of the flow across the strip in the jet tunnel from both sides and keep the strip stable at speeds of over 100 m/min. The strip is cooled in the jet cooler. The plug is located between these two sections with an integrated liquid seal for the muffle.

strip dimensions	
strip width [mm]	300 – 700
strip thickness [mm]	0.05 – 1.5

heating system: gas-fired or electrically heated
temperature range: up to 950°C with a radiant section
process atmosphere: 5 – 75% H₂



6



This diagram shows the strip path inside a HICON/H₂® vertical strand annealer. Strip tension is around 1 N/mm² with catenary control.

Perfectly aligned baffle plates ensure that the zinc-bearing process atmosphere of the furnace and the zinc-free process atmosphere of the cooler do not mix. Zinc-bearing process atmosphere is cleaned and returned to circulation.

By arranging a radiant cooler beyond the jet tunnel and jet cooler, solution heat treatments for copper-iron, corson, beryllium copper, etc can be carried out at up to 950 °C. Another advantage for BeCu is that the small amount of surface oxidation can be eliminated with minimal brushing.

Technical data of installed facilities:

strip width	max. throughput t/h
650 mm	up to 8.5 t/h
450 mm	up to 5.0 t/h

- 1 inlet seal box
- 2 dancer
- 3 thermal insulation
- 4 HICON/H₂® recirculation fans
- 5 muffle
- 6 ECOBURN burner
- 7 HICON/H₂® jet tunnel
- 8 recuperator
- 9 liquid seal for muffle
- 10 HICON/H₂® jet cooler
- 11 exit seal box

HICON/H₂[®] BELL ANNEALERS AND MUFFLE FURNACES

HICON/H₂[®] TECHNOLOGY HAS REVOLUTIONIZED THE HEAT TREATMENT OF COPPER-BASE MATERIAL STRIP AND WIRE COILS.

Today, HICON/H₂[®] is internationally known as a synonym for excellence in quality, productivity and production costs. It is the exceptional quality of material annealed in 100% hydrogen which has provided the cornerstone for the lasting success of HICON/H₂[®] bell annealers.

7



YKK Corporation, Kurobe / Japan
4 workbase facility with heating bells
max. net charge: 12 t per base
throughput: max. 2.6 t/h

ABUS 16t

46 | 47

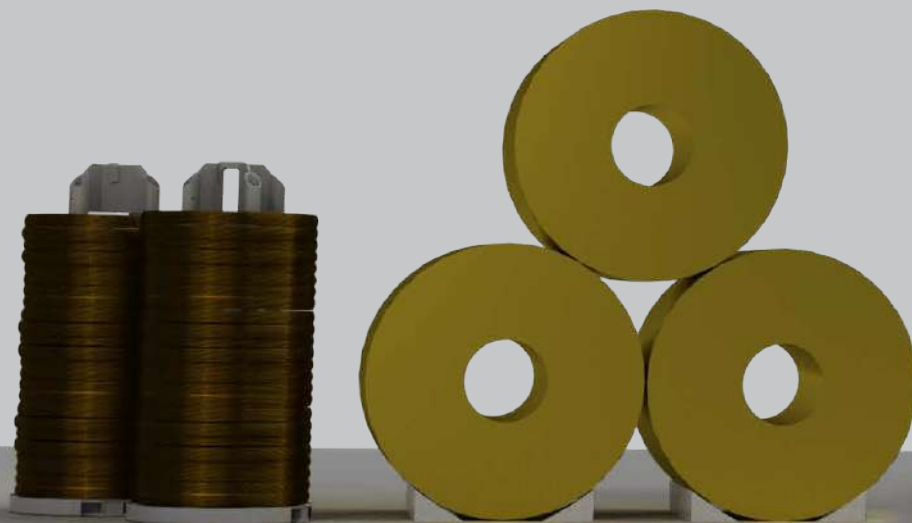
Özer Metal, Cerkezköy / Turkey
10 workbase facility
net charge: max. 50 t per base
throughput: max. 20 t/h

HICON/H₂[®] BELL ANNEALER FACILITIES FOR STRIP AND WIRE COILS

In the 1970s, EBNER developed HICON/H₂[®] technology for the bell annealer. A bright, oxide-free surface is achieved after annealing for cold-rolled brass strip and wire as well as tube coils.

Together with uniform mechanical characteristics, these are ideal conditions for further processing.

- 1 The metallically-tight workload space allows safe use of process gases such as 100% hydrogen.
- 2 After the workload space has been evacuated of air at the beginning of the anneal, it is filled with dry process atmosphere before hydrogen is fed in.
- 3 The low dewpoint and trace oxygen content make bright surfaces possible even for brass.
- 4 Annealing to temper is possible thanks to the high convection, which generates the smallest possible temperature scatter in the charge stack.
- 5 Use of VISUAL FURNACES[®] process control system for centralized operation





All facilities are supplied complete with electrical equipment and software.


HIGHEST COMBUSTION EFFICIENCY
EFFICIENT INSULATION INNOVATION
SOUND PROOFING DELIVERY EXPERTISE
LISTENING COST-EFFECTIVE CUSTOMER
SPECIFIC LOW NOISE RELIABLE DELIVERY
MARKET-READY FEWER OPERATING
PERSONNEL SOUND PROOFING SAFETY

HICON/H₂[®] BELL ANNEALER FACILITIES

The hydrogen annealing technology makes residue-free evaporation of lubricant possible thanks to pyrolysis. This results in a clean, bright material surface for strip, wire and tube.

Suitable for:

- Copper alloys
 - brass
 - copper/iron alloys
 - nickel silver
 - phosphor bronze
 - beryllium copper
- Copper
 - ETP, electrolytic copper (with max. 5% H₂ in the process atmosphere)
 - OFC, oxygen-free copper
- Precious metals such as gold, silver and alloys
- Superconductors



Technical data	
Charging height	1000 – 3500 mm
Charging diameter	1500 – 4500 mm
Heating system	gas-fired, electrically heated, oil-fired
Operating temperature range	up to 850°C

Advantages:

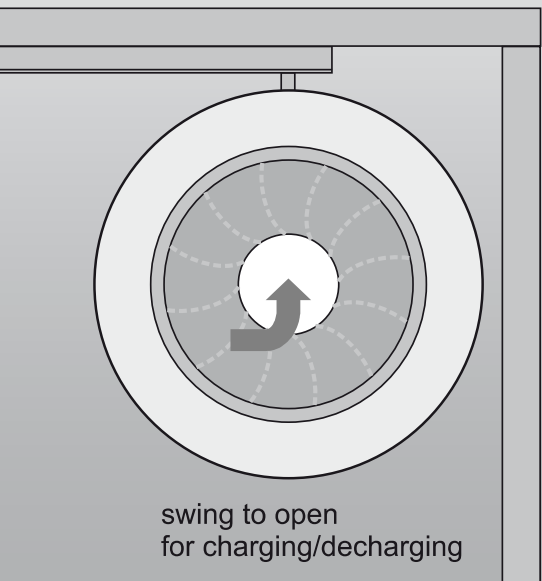
- 100% load-bearing area protects the edges of thin strip.
- An outburner for used hydrogen contaminated with evaporated rolling/drawing lubricants increases both efficiency and environmental friendliness.
- A cylindrical baffle ensures defined process atmosphere flow when annealing wire bunches and coils.
- The HICON[®] system ensures a temperature scatter of $\leq \pm 3^\circ\text{C}$ in the material by the end of soaking.



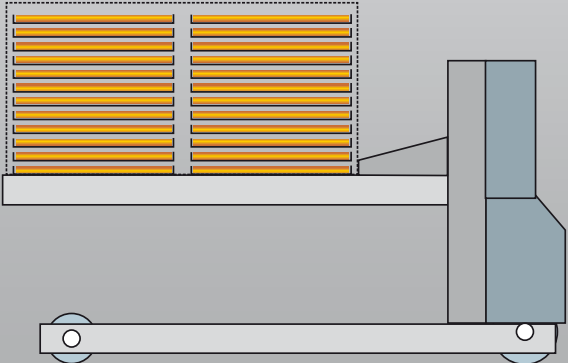
ООО "GZOCM", Gai / Russia
max. net charge: 36 t



Münze Österreich, Vienna / Austria
 max. net charge: 2 t
 electric heated



- 1 furnace shell and thermal insulation
- 2 electric heating
- 3 charge
- 4 HICON/H₂[®] recirculation fan
- 5 cylindrical baffle



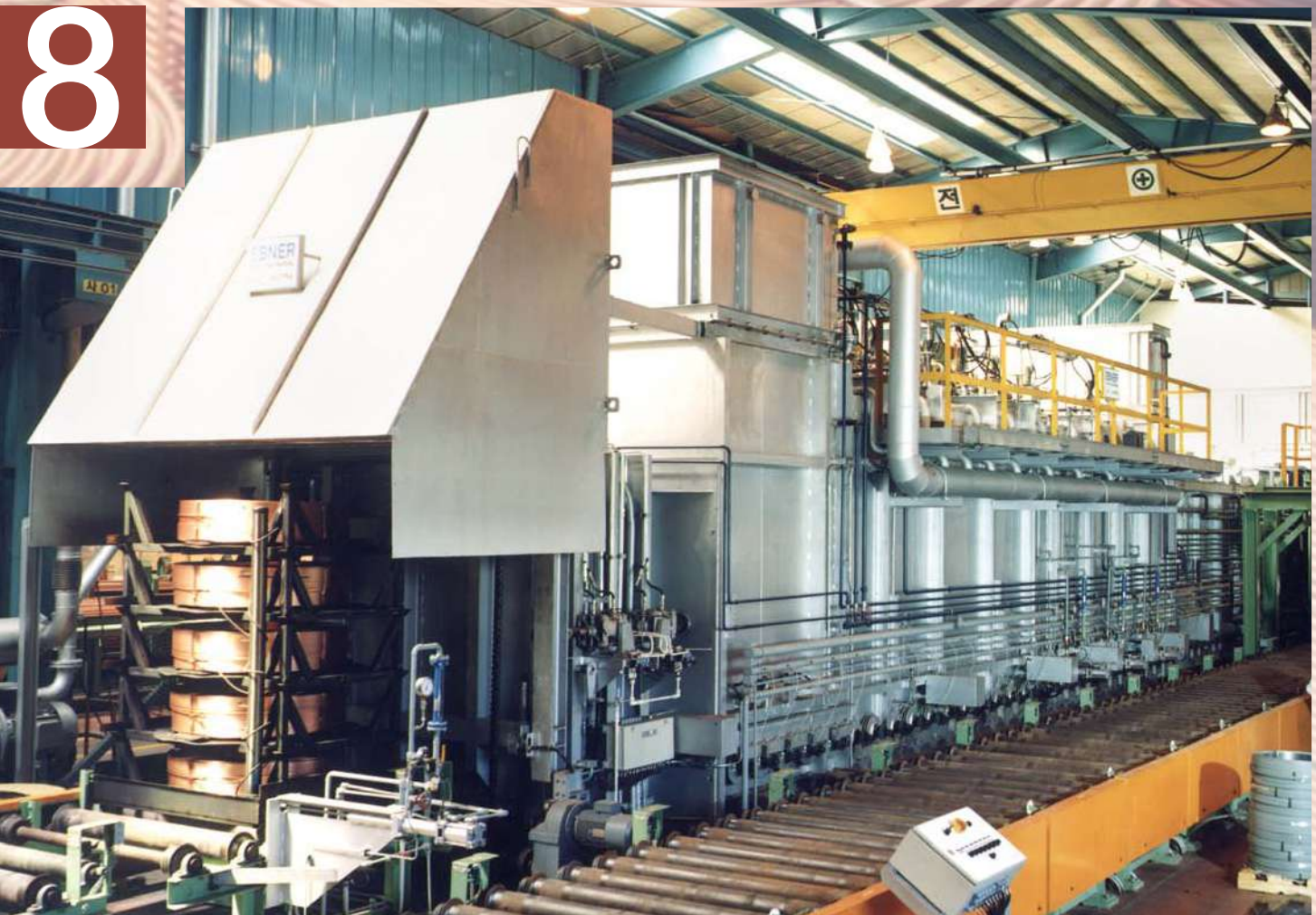
ROLLER-HEARTH FURNACE FACILITIES

In 1960, EBNER built the world's first roller-hearth furnace facility with a vacuum lock. The idea was to save process atmosphere and still achieve a bright finish to copper tubing.

Straight tubes and rods, flat "pancake" tube coils or tall "level wound" tube coils are annealed in different roller-hearth furnaces depending on material shape and required throughput.

The charge is transported through the facility on hearth rollers with a clear width of 1300 - 2300 mm. Throughput ranges from 2.0 to 4.5 t/h.

8



Buntmetall Amstetten, Amstetten / Austria
max. throughput: 3 t/h
suitable for straight tubes and rods as well as tube coils



EBNER

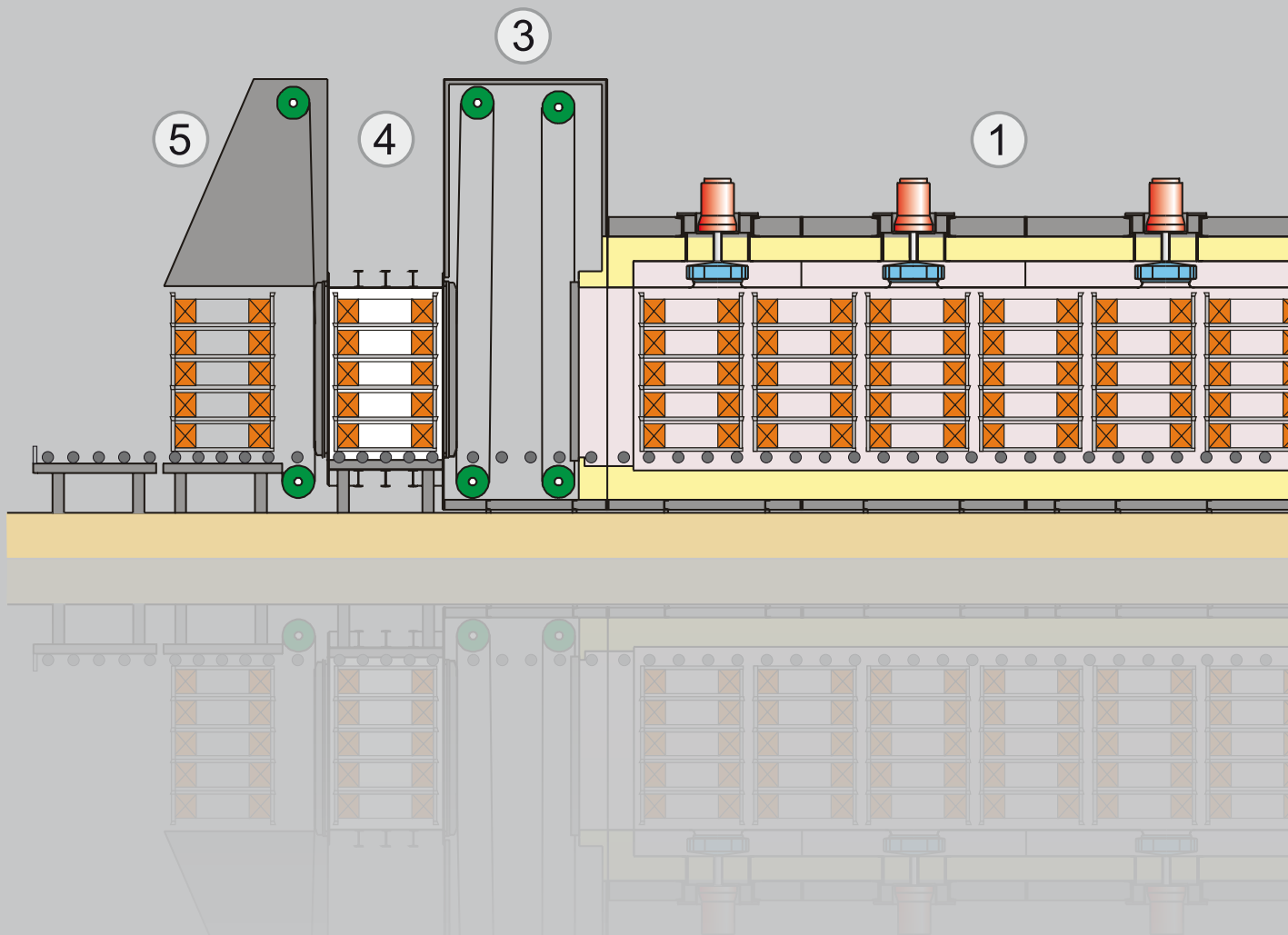
ROLLER-HEARTH FURNACES TO RECRYSTALLIZE COPPER AND COPPER ALLOY COLD-FORMED LONG PRODUCTS OR TUBE COILS

As well as taking care of the as-annealed quality factors (purging air out of the inside of tubes, for example), this design of furnace also minimizes process atmosphere consumption to increase the cost-effectiveness of a state-of-the-art furnace facility. Vacuum locks are located at the furnace inlet and outlet for this purpose.

The facilities are designed for a processing temperature range of up to 900 °C.

For certain alloys, a HICON® jet cooler can be installed beyond the furnace to achieve specific material characteristics. Generally, a cheaper water-cooled radiant cooler is used to achieve the required mechanical values and surface characteristics.

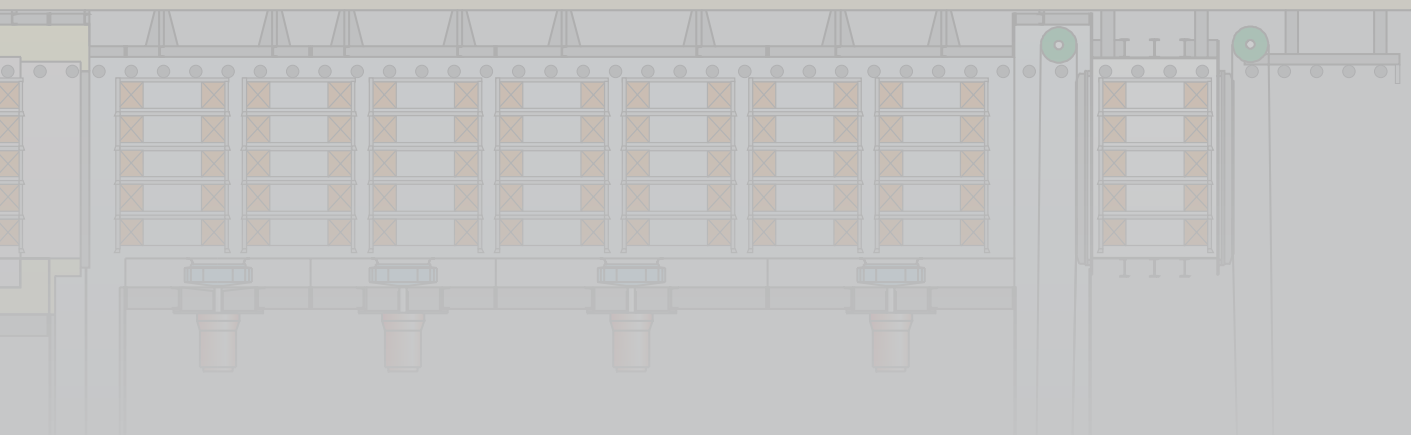
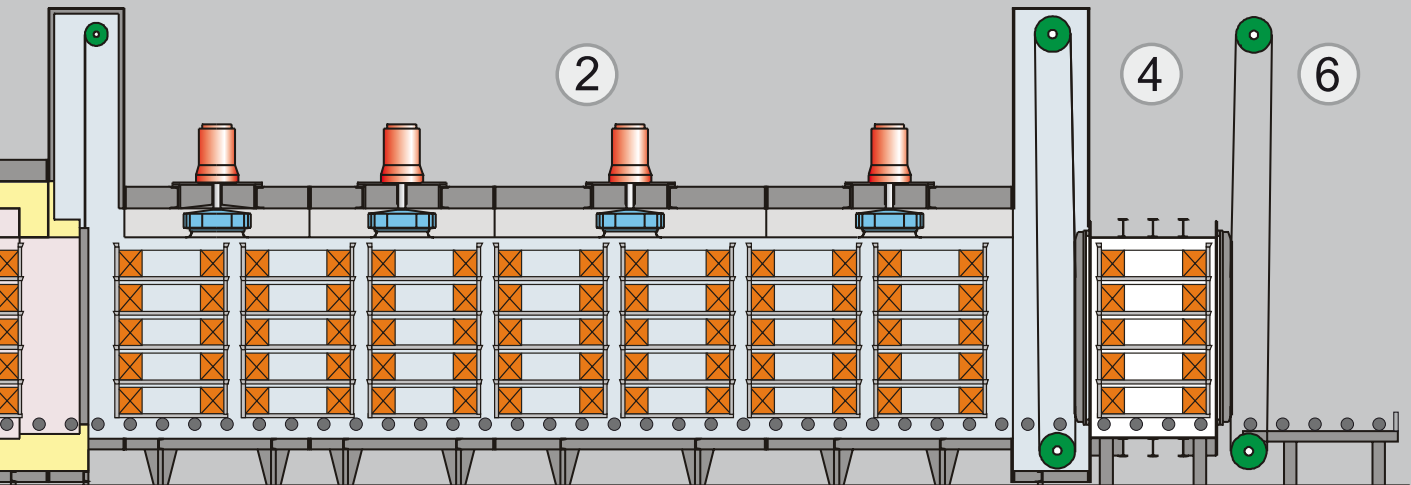
8



The EBNER design and its advantages

- 1 Gas-tight furnace and cooler, enabling best bright surface finish for copper and most alloys
- 2 Vacuum lock at inlet and outlet, resulting in high process atmosphere savings
- 3 Uniform microstructure providing best conditions for further processing of the annealed material
- 4 Automated processes and charge tracking
- 5 The HICON® system is required for high throughputs of heavy level wound coils, achieving a temperature scatter of $\leq \pm 2^{\circ}\text{C}$.

- | | |
|-----------------|---------------------------|
| 1 furnace | 4 vacuum lock |
| 2 HICON® cooler | 5 charging roller rable |
| 3 vestibule | 6 decharging roller rable |



Straight tubes and rods and light tube coils (pancake coils)

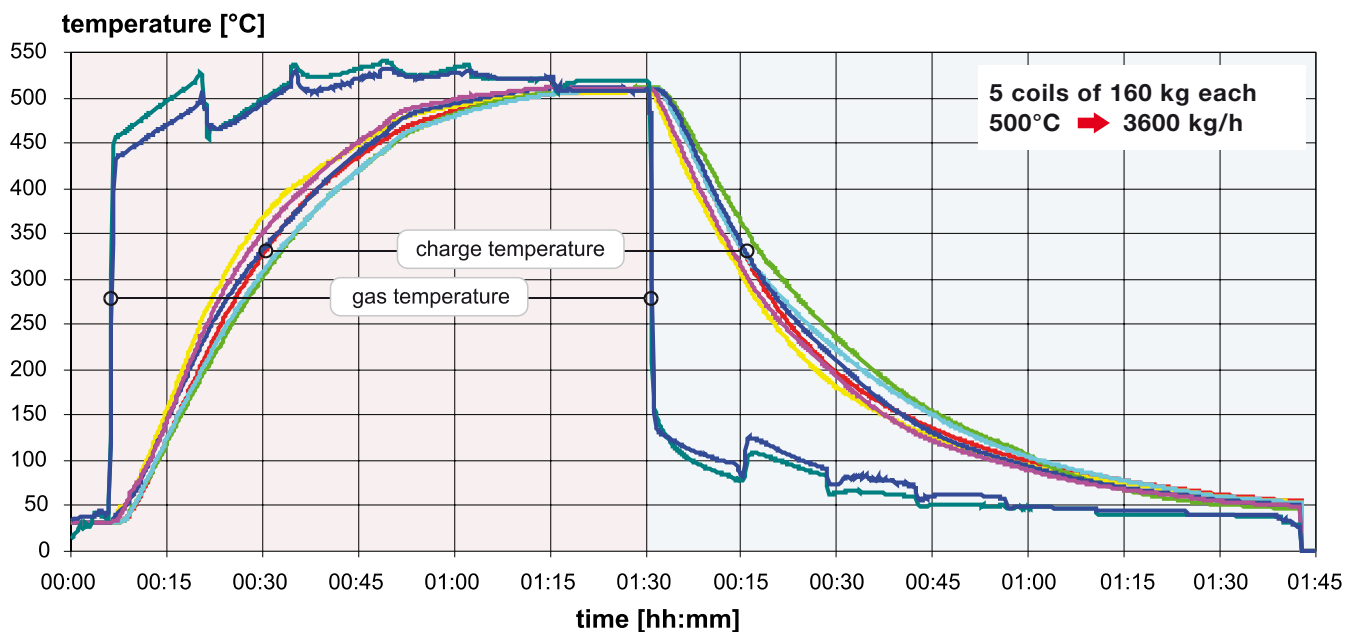
A basic prerequisite for a bright post-anneal finish is the use of lubricants which evaporate without residue. 3% hydrogen in the process atmosphere makes this process easier. In the vacuum lock, both the surrounding air and the air inside the tubes are purged with process atmosphere, ensuring that the lubricant evaporates from all surfaces. This technology is used for tubes and rods up to about 12 m in length.

8

Heavy tube coils (level wound coils)

Coil weight of 350 kg and up. Tube length rises to several kilometers. In addition to evacuating the ambient air, the inside of the tubes must be carefully purged with process atmosphere.

This purge continues while the coils are being heated in order to blow out the lubricant. Heavy, tightly-wound tube coils require the HICON[®] system in the furnace and cooler.



LOWEST EMISSIONS LOWEST CONSUMPTION
 CONSTRUCTION EXCELLENT SERVICE
 DESIGN CONSTRUCTION ONGOING
 DEVELOPMENT HEAT TREATMENT FACILITIES
 DESIGN AUTOMATION ANALOGISTICS
 COOPERATION LISTENING DEVELOPMENT
 UNDERSTANDING TRUST RESEARCH

Technical data of installed facilities:

clear hearth roller width (mm)	single layer charging (low furnaces) for tubes, rods and pancake coils max. throughput t/h	multi-layer charging (tall furnaces) for level wound coils max. throughput t/h
1300 – 1500		2 – 4.0 t/h
1500 – 2300	2 – 4.5 t/h	



WIELAND WERKE, Ulm / Germany
 max. net throughput: 3.6 t/h
 coil charging at the inlet end

MODERNIZATION

KEEPING PRODUCTION STANDARDS AT THE HIGHEST LEVEL.

There are many situations where it is worth modernizing a heat treatment facility before considering investment in new equipment. The main objective is usually to increase production capacity using the space available. That said, modernization is just as often used to increase the quality of the as-annealed material. EBNER can often achieve both objectives and at the same time provide a new control center and comply with current safety regulations. The facility components are pre-assembled as far as possible prior to installation and work is performed in shifts to reduce installation time.

9





Move and modernization of a HICON/H₂® bell annealer facility

MODERNIZING EXISTING FURNACE FACILITIES INCLUDING NON-EBNER FURNACES

Apart from quality and production capacity, other reasons for modernization include outdated heating systems and worn rotating parts. Electrical equipment also wear out due to short product cycles - and spare parts are not always available. Upgrading or modification to future-safe systems is a prerequisite for operational reliability.

Why MODERNIZATION?

- 1 Increasing throughput
- 2 Applying the latest safety standards
- 3 Reducing emissions of CO₂, NO_x
- 4 Simplifying operation such as with the VISUAL FURNACES® process control system
- 5 Reducing process atmosphere consumption by using the TREATperfect real-time module
- 6 Reduction of operating costs e.g. for CH₄, electricity, etc.

Examples of successful modernization projects include

- 1 Fitting a jet cooler into a roller-hearth furnace facility for tubes to increase strength
- 2 Increased throughput by upgrading the gas-fired heating system from proportional pressure control to transmitter control
- 3 Modernizing the entire control system and implementing the latest software for a HICON/H₂® bell annealer facility e.g. with VISUAL FURNACES®
- 4 Intelligent computer models for shortest possible heat treatment times and lowest possible energy consumption (TREATperfect module)
- 5 HICON/H₂® convection in a bell annealer workbase increased from 85Hz to 100Hz (3000 rpm) for greater throughput



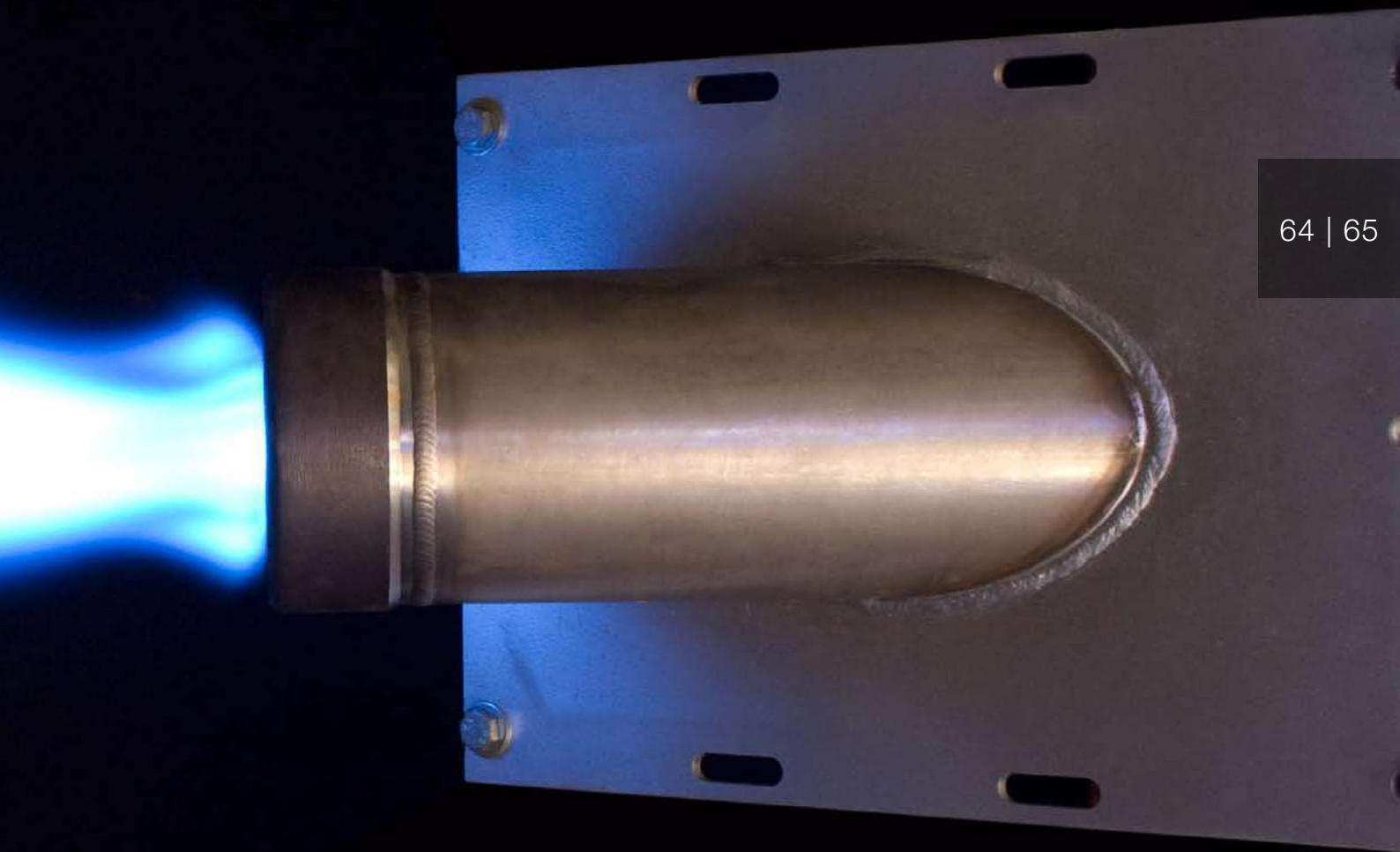
BURNER SYSTEMS

CONVINCING TECHNOLOGY DEVELOPS FROM A PASSION FOR PERFECTION.

Striving for perfected functionality and quality is one of the most important elements of EBNER's lasting success and a major factor in ensuring the higher productivity and more economical operation of EBNER's heat treatment facilities.

10



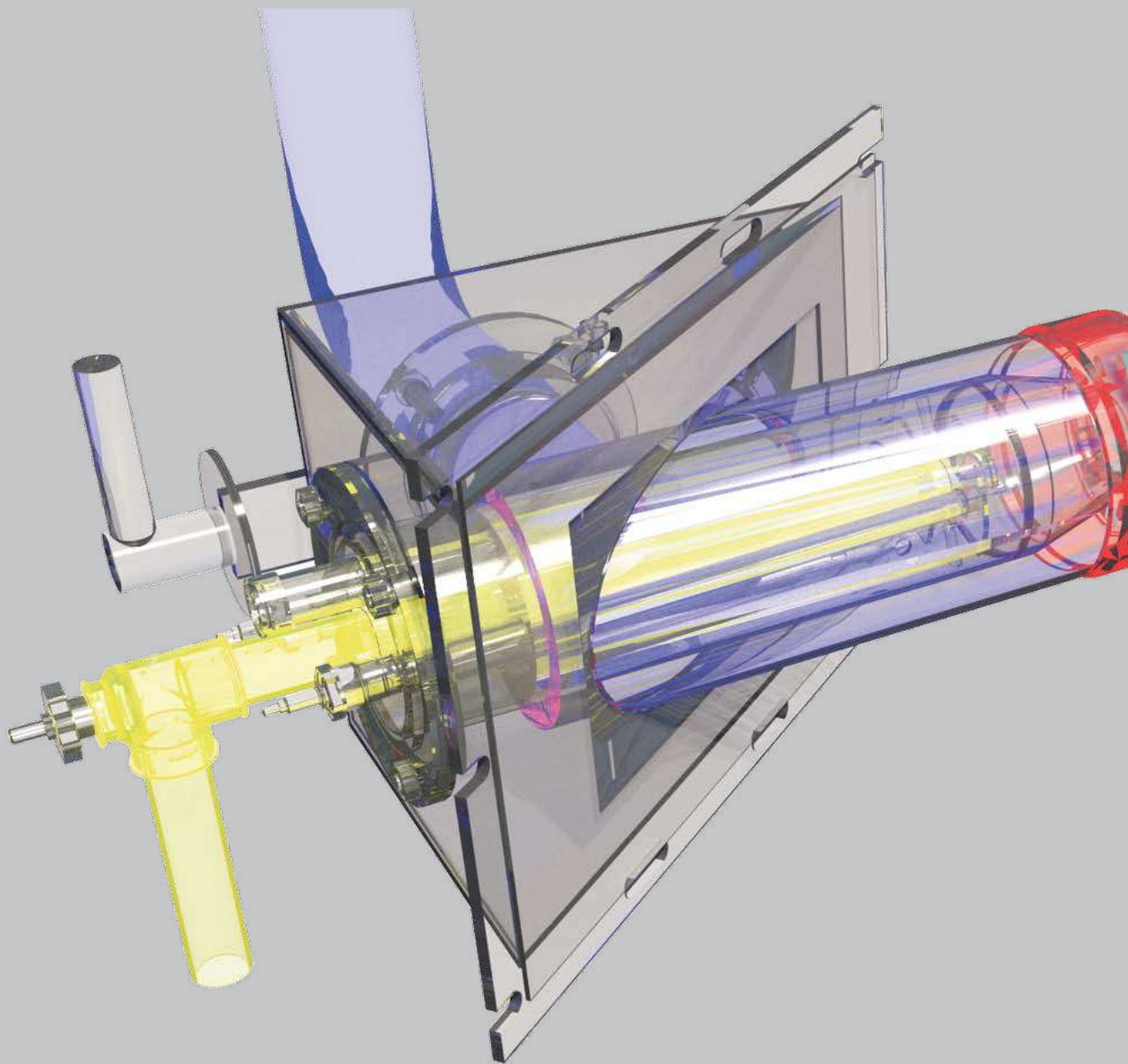


BURNER SYSTEMS

The development of direct-fired or indirect-heated systems contributes greatly to the economy and durability of individual components and furnace facilities as a whole.

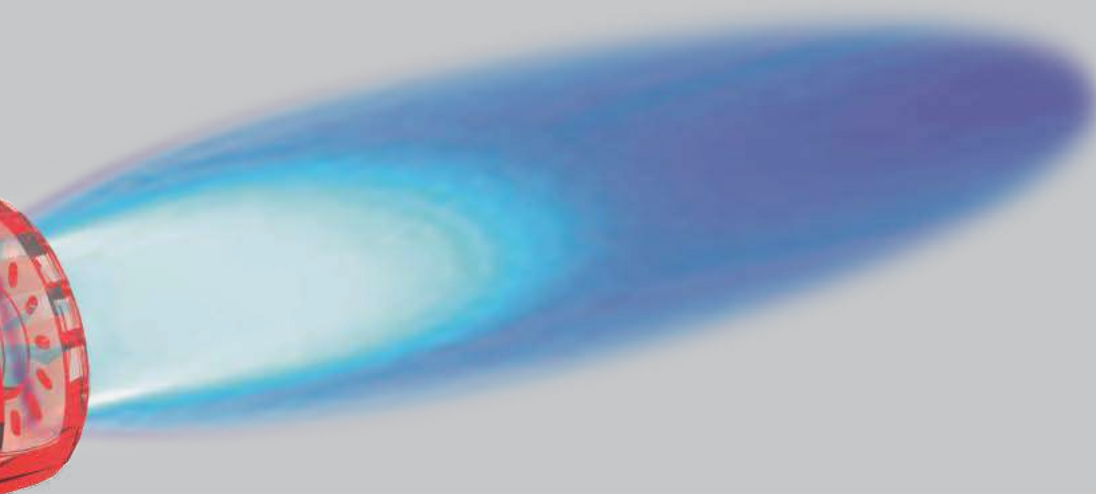
EBNER is in the enviable position of being able to develop burner systems for industrial furnaces or process-specific applications in its own research and development laboratory.

10



HIGHLIGHTS

- 1 All-metal 2-stage burner
- 2 Suited for all common fuel gases
- 3 Direct ignition
- 4 Variable power output range
- 5 Combustion air pre-heating up to 500 °C and lowest exhaust temperatures



66 | 67

- 6 Best combustion efficiency
- 7 Lowest NOx levels
- 8 Variety of installation options

INDEPENDENCE COMPLIANCE WITH REGULATIONS
INCREASED THROUGHPUT GLOBAL PLAYER
TECHNOLOGICAL LEADERSHIP PERFORMANCE
RATIO CONTINUOUS GROWTH DEVELOPMENT
TECHNICALLY ADVANCED CHALLENGES SOLUTIONS
INNOVATIVE TECHNOLOGIES REPRODUCIBILITY
QUALITY SAFE OPERATION AUTOMATION
DURABILITY ENERGY EFFICIENCY ENERGY-SAVING
HORIZONTAL FURNACE DEVELOPMENT COMPLIANT

ECOBURN - ADVANTAGES at a glance

All-metal – long service life

The entire burner casing is an all-metal design. The burner head is insulated by a vacuum-formed insulating component. The outer burner tube (1st combustion phase) is also cooled by the secondary combustion air supply, which contributes to exceptional durability.

Two-stage combustion - guaranteed low NO_x values

10

This burner is designed for two-stage combustion with air staging. In the primary combustion zone, sub-stoichiometric combustion lowers flame temperature and suppresses formation of NO_x as a result. Complete combustion takes place in the secondary combustion zone.

Identical electrodes - simple spares management

Ignition and supervision electrodes are identical and interchangeable - which is advantageous for stock-keeping and servicing.

fuel gas		net calorific value (Hu) in kW/Nm ³ (kJ/Nm ³)
CH ₄	natural gas	about 9.7 (about 35 000)
LPG	LPG (mixed with air to obtain the Wobbe index of natural gas)	about 27.8 (about 100 000)

The burner is also used for mixed gas and coke-oven gas.

ECOBURN® burners being manufactured in the EBNER workshop



68 | 69



ECOBURN® burners installed in a pusher-type furnace facility for aluminum ingots

RADIANT TUBES AND BURNERS

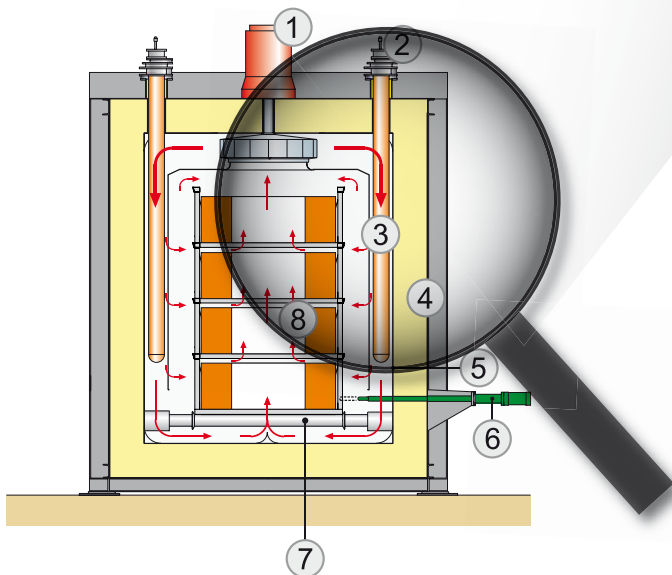
THE SERVICE LIFE OF THE RADIANT TUBE DEPENDS ON THE BURNER

A perfectly matched system increases the service life of the radiant tube. In our research and development department, we can observe and optimize developments in long-term tests.

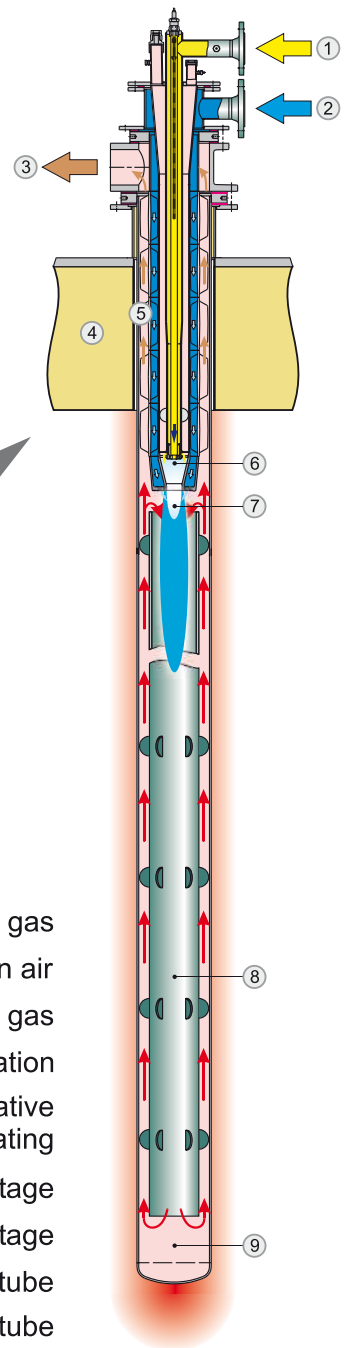
EBNER supplies vertical or horizontal radiant tube systems depending on the requirements.

10

- 1 water cooled motor with HICON® impeller
- 2 recuperative burner
- 3 radiant tube
- 4 furnace shell and thermal insulation
- 5 inner casing
- 6 tube purging system
- 7 hearth rollers
- 8 charging racks and coils



- 1 fuel gas
- 2 combustion air
- 3 stack gas
- 4 furnace insulation
- 5 recuperative combustion air preheating
- 6 first stage
- 7 second stage
- 8 flame tube
- 9 outer tube





EBNER

70 | 71

Radiant tube heating of a roller-hearth furnace facility to anneal straight copper alloy tubes.

HEAT TREATMENT FURNACE FACILITIES FOR THE STEEL INDUSTRY

Annealing facilities to normalize and recrystallize unalloyed and low-alloyed grades

- **HICON/H₂**® bell annealers for steel strip and wire coils
- Roller-hearth furnaces for tube and bar stock

Annealing facilities for stainless Cr and CrNi alloys and NiFe special alloys

- **HICON/H₂**® vertical and horizontal bright annealing lines for strip
- **HICON/H₂**® bell annealers for steel strip and wire coils

Hardening and tempering lines for unalloyed and high-alloyed grades

- Horizontal hardening and tempering lines for carbon steel strip (martensite, bainite, sorbite) and martensitic chromium steel strip
- Vertical hardening and tempering lines for carbon steel strip and martensitic chromium steel strip
- Hardening and tempering lines for strapping band

Annealing facilities for press hardening for the automotive industry

- Single and double-decker roller-hearth furnaces
- Multi-chamber batch-type furnaces

ATMOSPHERE SYSTEMS

Generators

- Exothermic generators
- Nitrogen and hydrogen generators
- Ammonia cracker with molecular sieve adsorber
- Cracked ammonia and nitrogen mixer and adsorber facilities
- Hydrogen and nitrogen mixers

Hydrogen purification systems

Nitrogen purification systems

AUTOMATION

Basic automation systems

- Power panel enclosures
- Field-mounted units
- PLC control panels

VISUAL FURNACES® central operating and process control systems

- Visualization and archiving
- Expansions and retrofits
- Programming of function-specific add-ons

Annealing facilities to spheroidize and recrystallize higher-alloyed grades

- **HICON/H₂**® bell annealers for steel strip and wire coils
- Roller-hearth furnaces for tube and bar stock

Annealing facilities for coated and uncoated strip

- **HICON**® vertical radiant tube heated facilities for CGLs and CALs
- **HICON**® vertical lines with muffle

Annealing facilities for electrical strip

- **HITT/H₂** bell annealers to anneal RGO and HGO at high temperatures
- Continuous lines for recrystallizing GO strip
- Continuous lines for decarburizing GO strip
- Continuous lines for stress-relief annealing GO strip
- Continuous lines for final annealing NGO (with optional decarburization)

Process atmosphere pressure vessels

- Process atmosphere pressure vessel and tank filling units

Process atmosphere analyzers

- Hydrogen analyzers
- CO₂, CO and CH₄ analyzers
- Dewpoint analyzers
- Oxygen analyzers
- Trace oxygen analyzers
- NOx analyzers

Ammonia storage facilities

- Storage tanks for road and rail supply

BURNER SYSTEMS

- RECOTEB® burner / radiant tube system
- ECOBURN burner

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Leonding | Austria

Subject to change to due to
technical upgrades

1



EBNER Industrieofenbau GmbH

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phone: (+43) 732 6868, fax: (+43) 732 6868 1000
email: sales@ebner.cc, www.ebner.cc

2



EBNER India Pvt. Ltd.

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Andheri East / Mumbai - 400059 / INDIA
phone: (+91) 22 6139 3333, fax: (+91) 22 6139 3311
email: bti@ebner.cc, www.ebner.cc

EBNER SERVICE - WORLDWIDE - AROUND THE CLOCK



3



EBNER Furnaces, Inc.

224 Quadral Drive, Wadsworth / Ohio 44281 / USA
phone: (+1) 330 335 1600, fax: (+1) 330 335 1605
email: sales@ebnerfurnaces.com, www.ebner.cc

4



EBNER Industrial Furnaces (Taicang) Co., Ltd.

Beijing East Road 82, 215400 Taicang / Jiangsu / CHINA
phone: (+86) 512 5357 6868, fax: (+86) 512 5357 6867
email: sales@ebner.cn, www.ebner.cc

5 EBNER

Service Center Brazil
Uberlandia , MG
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EED-Services
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Service Center Taiwan
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TAIWAN

8 EBNER

Service Center Japan
Chuo-ku, Tokyo 104
JAPAN

TRADITION QUALITY STANDARD ADDED VALUE
PRIORITY 162808 B 2012-05 ENFUTUR
DEVELOPMENT HEAT TREATMENT FACILI
ANNEAL LOGISTICSCOOPERATION LISTENIN
TRUST RESEARCH AND DEVELOPMENT CUS
ECONOMICAL RELIABLE SAFE ENGINEERING
HICON® ECO BURN RECOTE B® HOT PHASE® INC
GLOBAL PROFESSIONAL SERVICES ORIGI
INDEPENDENCE GLOBAL PLAYER EXPERTISE TE
PRICE/PERFORMANCE RATIO CONTINU
INNOVATIVE TECHNOLOGIES SAFE OPERATION G
AUTOMATION DURABILITY ENERGY EFFICIEN
OPTIONS LOWEST EMISSIONS LOWEST CONSU
EXCELLENT SERVICE HIGHEST QUALITY
HIGHEST THROUGHPUT HIGHEST COMBUSTIO
EFFICIENT INSULATION INNOVATION DELIVE
CUSTOMER-SPECIFIC LOW NOISE RELIABL
FEWER OPERATING PERSONNEL PRICE/P
QUALITY SOUND PROTECTION SAFETY SA
TEMPERATURE UNIFORMITY TURNKEY ENVIR
TRADITION COMPLIANCE WITH REGULATIONS
CONSTRUCTION QUALITY ADDED VALUE EC
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