RENOLD | Tooth Chain

完美只为玻璃
Perfectly Aligned for Glass

Silent Chain Technology
for the glass industry

Safe, robust, and efficient. The glass industry is demanding. Drive and transport solutions not only need to reliably master operating processes, they also need to be highly resistant to harsh conditions and incredibly efficient. Inverted tooth chains cover all these requirements. They offer precise running characteristics, guarantee a long service life, and enable layouts optimized for specific applications with the utmost efficiency. And they have no qualms when it comes to high temperatures.

安全、稳健、高效。玻璃行业要求严苛。驱动和运输解决方案不仅需要可靠地掌握操作流程，他们也需要应对恶劣环境和令人难以置信的高效率。齿形链满足所有这些要求。他们提供精确的运行，确保长时间使用寿命，为特定应用布局优化以达到最大的效率。他们不会在高温时感到不适。

Experience for the glass industry 玻璃业经验

Automation solutions with inverted tooth chains from Renold ensure cost-effective production

Renold齿形链自动解决方案确保成本效益生产

Tailor-made for your application: drive and transport solutions with inverted tooth chains

为您的应用量身订做：齿形链驱动和运输解决方案

The diverse tasks and working conditions in the glass industry require solutions that are just as varied. Based on a comprehensive product program and specific configurations, we have geared our spectrum of services toward our users to consistently offer solutions that are specifically tailored to their applications.

在玻璃行业不同的任务和工作条件要求多种多样的解决方案。基于全面的产品计划和具体配置，我们专门的服务始终向我们的用户提供解决方案特别适合他们的应用程序。

With unparalleled product quality and expert service. Automation solutions with inverted tooth chains from Renold help you to significantly increase the service life of your systems, minimize downtimes, and ensure cost-effective production in the long term. Our inverted tooth chains master these goals – every day, around the world.

无与伦比的产品质量和专业的服务。Renold齿形链自动化解决方案帮你大大增加系统的使用寿命，减少宕机，确保长期成本效益的生产。我们齿形链精通这些目标—每一天，世界各地。

- Technology leader for inverted tooth chain applications
  齿形链应用的技术领先者
- Unparalleled variety – the right inverted tooth chain for every application
  无与伦比的多样性——为每个应用提供正确的齿形链
- Over 100 years of experience, active worldwide
  全球畅销100多年

Together with our customers, we have developed a broad product portfolio that is precisely tailored to meet the needs of the industry. The result? Products, systems, and solutions that are best in class in all respects and exactly fit your purpose. Talk to one of our industry experts available throughout the world.

我们已经与客户一起开发出广泛产品组合来精确地定制产品以满足行业需求。结果就是在各方面用最好的产品、系统和解决方案来满足你的目的。与我们全世界的行业专家交流。

Content 目录

Quintessential clarity 典型的清晰度

The very essence of clear-cut. Bottles, windshields, aquariums – without glass, we'd see far less, whether from the inside or out. This is only one facet of this fascinating material that enriches our lives in so many areas that we often take it for granted.

清晰的本质。瓶子, 挡风玻璃, 水族馆——没有玻璃, 不论从内或外我们可以看到地更少。这有趣的材料一方面丰富了我们的生活中很多习以为常的领域。

Glass – a natural part of all
玻璃 – 自然的一部分

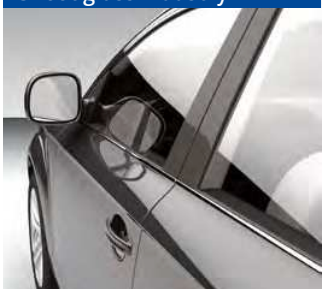
The industry sectors: production and finishing as diverse as the products themselves
工业部分：生产和完成的与产品本身一样多样

The glass industry has become highly diversified. Specialized production processed have developed, with the emergence of completely new work processes. We have been instrumental in shaping these developments and can provide the right solutions for nearly all drive and transport tasks in the individual sectors with inverted tooth chains. All solutions were created with practical situations in mind, in close cooperation with end-users.
玻璃行业已成为高度多样化。专业生产加工的发展出现全新的工作流程。我们一直在帮助塑造这些发展和可以提供正确的几乎所有驱动的解决方案和运输任务的齿形链单独部分。创建的所有解决方案考虑到实际情况，密切合作终端用户。

Hollow glass industry 中空玻璃业

Glass containers, glass packaging for beverages, food, cosmetics, pharmaceuticals, gastronomy
饮料、食品、化妆品、制药、美食的玻璃容器和玻璃包装

Sheet glass industry 平板玻璃业



Vehicles, sheet glass for the construction industry, interiors
汽车，建筑业内部的玻璃片

Specialty glass industry 特种玻璃业

Solar industry, medical technology, optics, illumination, precision mechanics, glass for electronic devices, fiber optics
太阳能产业，医疗技术，光学、照明、精密仪器、玻璃电子设备，纤维光学

The markets: glass products are an integral part of our daily lives
市场：玻璃制品是我们日常生活一个完整部分

Glass is a highly versatile and malleable material. It also offers unique characteristics which make it indispensable in numerous products. Today, glass not only plays an important role as an object of everyday use but can be increasingly found in new areas – in research, science, and numerous cutting-edge industries.
玻璃是一种高度通用的和可塑的材料。它还提供了独特的特点使其成为众多不可或缺的产品。今天，玻璃作为一个日常使用的对象不仅起着重要的作用，同时可以在越来越多的新领域中发现——研究，科学，和众多尖端工业。

- Food and beverage packaging 食品和饮料包装
- Household, gastronomy, furnishings 家居，烹饪，家居
- Motor vehicles, electrical devices 机动车辆，电子设备
- Windows, facades, construction industry 窗户，门面，建筑业
- Optics, solar, research, science 光学，太阳能，研究，科技
- Medicine, pharmaceuticals, cosmetics 医学，制药，化妆品
- Chemical and general industrial applications 化学和一般工业应用

Requirements for the efficient production of glass products are constantly increasing 玻璃制品高效生产的要求不断增加

The glass industry needs to ward off a growing number of competitors and confidently counteract efforts to replace glass with other materials. These two main trends demand future-proof solutions and maximum efforts in the areas of innovation and efficiency.
玻璃工业需要避免越来越多的竞争对手和自信地抵消用其他材料代替玻璃的努力。这两个主要趋势领域的需求不会过时的技术解决方案和该领域最大程度地创造创新和提高效率。

- Improved functionality 功能改进
- Increased cost-effectiveness 提高成本效益
- Absolute quality assurance 绝对的质量保证
- Greater energy efficiency 提高能源效率
- Optimum machine safety 最优机器安全
- Total cost of ownership 所有权总成本

Cost-effectiveness throughout the entire lifecycle (TCO) of a machine or system is the key decision-making factor. Drive and transport solutions with inverted tooth chains ultimately provide the best results due to their extremely low-wear and reliable functioning.
贯穿整个生命周期的成本效益（TCO）的机器或系统是决策的关键因素。与齿形链驱动和运输解决方案最终因其极低磨耗和可靠的功能提供最好的结果。

The fascination of glass – a retrospective
玻璃的魅力 – 追溯历史

Unceasing radiance and charisma 不断的光辉和魅力

We will never know how the discoverers of this unique material felt thousands of years ago as they first created this extraordinary composition. Although the first glass-like objects are only distant relatives to the optical brilliance and radiance of modern glass products, these inventors gave life to a new fascination. And, with that, a history of success: from its earliest beginnings to its emergence as a skilled trade, up to contemporary industrial production, the manufacture of glass has developed into an important industry.

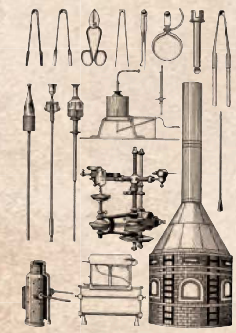
我们永远不会知道几千年前发现者如何发现这个独特的材料，他们首先创造了这个非凡的成分。虽然第一个像玻璃的对象只是光学才华和光辉的现代玻璃制品的远亲，这些发明家给生活赋予了一个新的魅力。正是有了他们才开始谱写了一个成功的历史：从最早开始到成为一个熟练的贸易，现代工业生产，玻璃制造已经发展成为一个重要的行业。

Glass is an ideal combination of **beauty and function**. 玻璃是美丽和功能的理想组合

Glass conveys **lightness and transparency**. It features a wide variety of shapes, delicate structures, and brilliant colors. 玻璃承载着光亮和透明。它有各种各样的形状，精致的结构和鲜亮的色彩

Glass is fascinating and lends a special radiance to many contexts. 玻璃是令人着迷的同时为历史提供了特殊光辉

Glass has fascinated for millennia and continues to do so today
玻璃已经着迷了几千年，而如今也是如此做



3000 B.C.
Glass melting begins in Egypt. First organized production of glass
玻璃融化开始于埃及。第一次组织玻璃的生产

1500 B. C.
Independent trade with pressing and melting in molds
压模和融化形成独立贸易

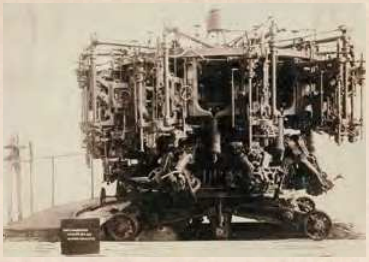
500 B. C.
Invention of the blowpipe in Phoenicia (first glasses)
在腓尼基第一个发明吹管的（第一个玻璃）

16. th c.
Glassmaking reaches Venice (Murano) and Germany.
玻璃制造术到达威尼斯（穆拉诺）和德国。

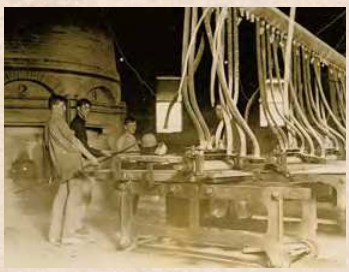
From its first hour 从第一个小时开始

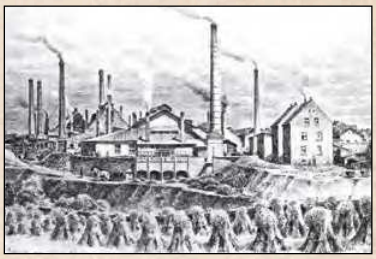
Part of industrial production from its first hour: inverted tooth chains as drives and conveyor elements for hot glass transport

工业生产的部分从它第一个小时开始：齿形链作为热玻璃运输的驱动和输送元素



Start of industrial production
工业生产的开端





1886
The first glass blowing machine from Ashley and Arzwell (approx. 100 bottles/h)
第一个玻璃吹制机诞生在Ashley和Arzwell（约100瓶/小时）

1905
Owens + Bock invent the first fully automatic bottle blowing machine
Owens + Bock发明第一个全自动吹瓶机

1908
Beginning of inverted tooth chain production in Germany
在德国开始齿形链生产

1923
Pilkington + Ford: continuous rolled plate glass for automobiles
Pilkington + Ford:为汽车制作连续轧制玻璃板

1927
First use of an IS-machine
首先开始使用IS机器

1930
Drives with inverted tooth chains enable higher speeds
齿形链驱动支持更快速度

1955
Inverted tooth chain conveyors are used to transport bottles in IS-machines
齿形链输送机在IS机器用于运输瓶子

1970
Float glass production becomes a general standard
浮法玻璃生产成为一个通用的标准

2000
Drive systems with inverted tooth chains in cleanroom conditions (semiconductor industry) and in vacuum coating systems (solar collector production)
驱动系统与齿形链在洁净室条件（半导体行业）和在真空镀膜系统（太阳能集热器生产）

从原材料到单个产品
From the raw material to the individual product

The basic processes in glass production remain the same: mix, melt, shape, anneal, cool.

玻璃生产的基本流程是一样的：混合，融化，塑形，退火，冷却。

Nevertheless, the heat is on: speed, reliability, and accuracy are of the essence. It's precisely these qualities that make our inverted tooth chains ideally equipped to handle all production processes.

然而，热是速度、可靠性和准确性的本质。正是这些品质，让我们齿形链作为处理所有生产流程的理想装备。

Glass production: consistently throughout the millennia

玻璃生产：持续了几千年

Sophisticated products increasingly rely on certain "extras" and small, yet critical details. However, the basic process stages in glass production remain the same, whether in hollow glass, sheet glass, or the wide variety of segments in the specialty glass industry. A specific mixture is melted, transferred to an individual shape in various processes, and finally undergoes finishing to create the final product. Our inverted tooth chains work as drives in forming machines and ensure safe transport of products in all segments of the glass industry.

复杂产品日益依赖特定的"附加条件"，小然而关键细节。然而，玻璃生产的基本过程阶段保持不变，无论是在中空玻璃、平板玻璃或者各种各样的部分专业玻璃行业。特定混合物熔化，转移到一个单独的形状在不同的流程，最后进行完成创建最终的产品。我们齿形链作为成型机驱动，确保在所有的玻璃行业安全运输产品。

- Glass melting, followed by individual process steps
  玻璃融化，随后单独流程步骤
- Initial processing in specific forming machines:
  blow molding, float, bending, drawing, pressing, casting
  特定成型机的初步流程：吹塑、浮法、弯曲、绘制，压片，铸造
- Annealing, quality control, and cooling
  退火，质量控制和冷却

What is the composition of glass? 玻璃包含什么成分？

Basic material composition
基本的材料组成

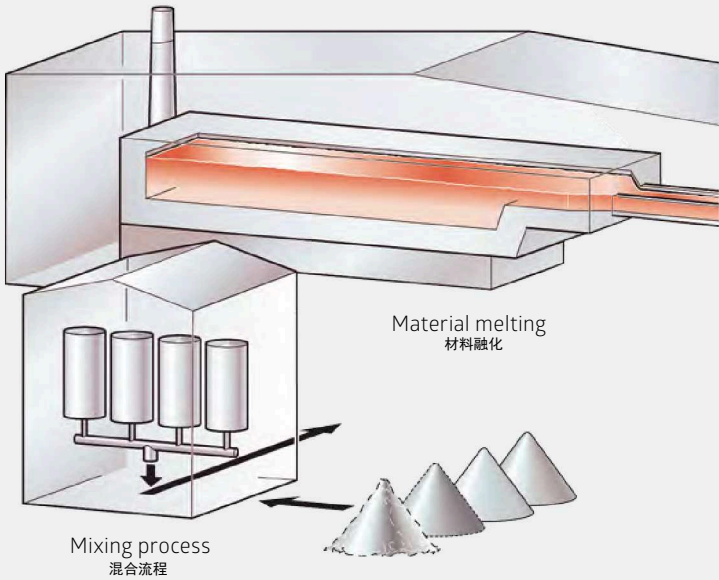
Glass consists exclusively of natural and nature-identical anorganic substances and is fully recyclable.

玻璃成分除自然物质以外还包括自然性的无机物质而且完全可回收利用。

The actual selection andproportions of basic materials and additives determine its quality. The main raw materials are quartz sand (70%), sodium carbonate (13%), and lime (10%), as well as feldspar, dolomite and potash. Quartz sand is increasingly replaced by recycled glass in some areas.

实际基本材料的选择和添加剂的比例决定了其质量。主要原材料是石英砂（70%）、碳酸钠（13%），和石灰（10%）、长石、白云石和碳酸钾。在某些领域石英砂越来越被回收玻璃所取代。

Example: hollow glass production process
范例：中空玻璃生产流程



Inverted tooth chains: ideal for hot materials
齿形链：热材料的理想伴侣

安全、可靠驱动和平缓运输
Safe, reliable driving and gentle transport

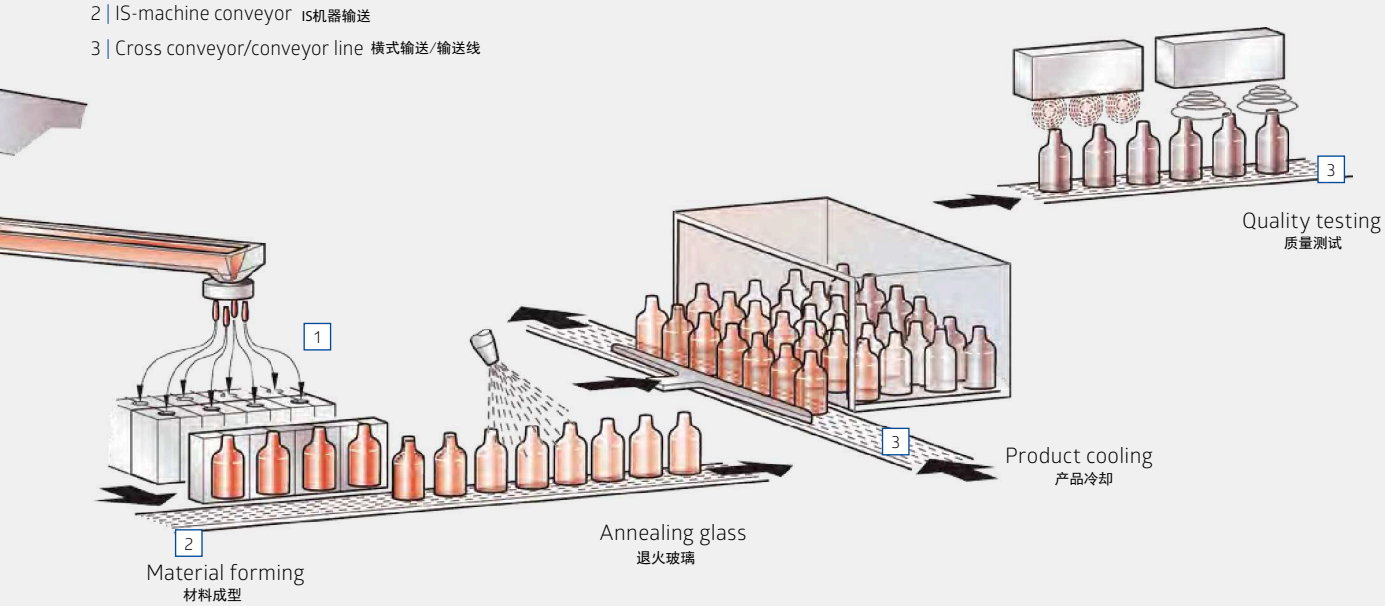
Whatever the tasks our inverted tooth chains take on in your production processes, they guarantee trouble-free continuous operation. All inverted tooth chains are temperature-resistant up to 450°C and the drive chains operate at speeds up to 50 m/s. Our drive chains feature smooth, precise operation with minimal chain link impact and extremely low, even wear.

不管在生产过程中我们齿形链承担什么任务，他们确保无故障地连续操作。所有齿形链都能承受450°C温度和传动链运行速度高达50 m/s。我们驱动链特性平稳，精确操作对链条的最小影响和极低甚至没有磨损。

The interlocking power transmission eliminates slippage. Inverted tooth conveyor chains are among the lowest-wear transport systems on the market. The Renold rolling pivot joint minimizes elongation, which has a positive impact on the service life of the chain. Optimized link plate forms provide even larger sliding areas.

联锁动力传输消除滑移。
齿形输送链是市场上属于最低磨损的运输系统。Renold滚动枢轴关节伸长率最小化，对链条的使用寿命产生积极的影响。优化连接板形式提供更大的滑动区域。

1 | Chain drive/take-out gear 链条驱动/外置齿轮
2 | IS-machine conveyor IS机器输送
3 | Cross conveyor/conveyor line 横式输送/输送线



Automated glass production 自动化玻璃生产

Drive and transport solutions in automatic glass production must meet special requirements

自动化玻璃生产的驱动和运输解决方案必须符合特殊要求

Demanding working environments and materials
要求的工作环境和材料

- Adequately assess temperature characteristics
  充分评估温度特性
- Minimize sliding friction, abrasion, and wear
  滑动摩擦、磨砺和磨损最小化
- Reliably control the cooling process
  可靠地控制冷却过程
- Eliminate complications during “flame polishing”
  “火焰抛光”间消除混合物
- Account for various factors during hot-end coating
  考虑在高电位端涂层各种因素
- Optimize problematic transport conditions through a specific inverted tooth chain layout
  通过特定的齿形链布局优化问题的运输条件
- Implement energy-efficient solutions
  实现节能解决方案

Drive technology – hot products demand speed 驱动技术 – 热制品需要速度

Hot liquid: when it comes to this medium, every second counts. A firm grip, precise movement, repeatability, and speed are essential. For our drives, rapid motion is no unusual feat, but rather common practice – whenever it’s needed, around the clock.

热液体：当谈到这个媒介，每一秒都至关重要。牢固控制，精确移动、可重复性和速度是至关重要的。对于我们的驱动，快速运动是不寻常的功绩，但是惯例就是——只要有需要就必须夜以继日运作。

Conveyor lines for products above 500°C 500°C以上产品输送线

For conveyor lines in the immediate vicinity of the forming machine, two factors are essential. First, they need to easily withstand the high temperatures of hot glass and, second, they must support the cooling process. Renold inverted tooth chains are specifically designed to meet these challenges.

成型机附件的输送线，两个因素是必不可少的。首先，他们需要很容易承受热玻璃的高温，其次，它们必须支持冷却过程。Renold齿形链设计是专门来满足这些挑战。

Function, quality, efficiency 功能，质量，效率

可靠的处理高度敏感的媒介

Reliable handling of a highly sensitive medium

The tasks required of drive and transport solutions in glass processing are highly demanding. The machines operate under extreme conditions and liquid glass is highly sensitive during processing. To achieve consistent quality and avoid waste, numerous factors must be taken into account – from the installation situation to temperature behavior.

在玻璃加工中对驱动和运输解决方案有极高要求。机器在极端条件下运行，液态玻璃在流程中属于高度敏感。达到一致的质量，避免浪费，必须考虑许多因素——从安装情况到温度特性。

- Ensuring consistent glass quality 确保一致的玻璃质量
- Reducing reject rates 减少次品率
- Guaranteeing process reliability 保证过程的可靠性

With our expertise and the individual configuration of inverted tooth chains, we can find the right solution for every application – whether your focus is on driving or transport. With specific inverted tooth chain types, pitches, link plate forms, materials, and optional extras.

用我们的专业知识和单独齿形链配置，我们可以为每个应用找到正确的解决方案——不管你的重点是驱动或运输。特定的齿形链类型、节距、链板形式，材料，和任选附件。

Important questions from practical applications and our product-specific answers

从实际应用和特定产品找到重要的问题答案

Elongation behavior 伸长表现

The elongation behavior of an inverted tooth chain refers to the operation-related elongation of the chain under tensile stress. After a certain amount of elongation, the chain ceases to run smoothly and must be replaced.

一个齿形链的伸长表现指链条在操作相关的拉力压力下伸长。
当一定的伸长后，链条不再运行顺畅时就必须更换

Cooling 冷却

In glass production, especially during transport, properly regulated cooling is important for the gradual stabilization of hot products.

在玻璃生产中，特别是在运输、正确调节冷却对热制品逐渐稳定起到重要的作用。

Installation situation 安装情况

Every machine, system, and application requires an individually configured solution that is ideal for the specific installation situation, including spatial conditions.

每台机器、系统和应用需要一个非常适合安装情况包括空间环境的单独特定解决方案。

Temperature behavior 温度特性

In terms of temperature behavior, both the product throughout the production process as well as the operating characteristics of the inverted tooth chain must be taken into account.

就温度特性而言，必须考虑整个生产过程中的产品以及齿形链的操作特征这两个方面。

Choice of materials 材料的选择

The properties of the inverted tooth chain materials must be optimized for the specific application conditions.

齿形链材料的属性必须针对具体应用条件进行优化。

Variety 多样性

A comprehensive range of individually configurable products, components, and optional extras is required to cater to the wide variety of applications in the glass industry.

全方位的单独可配置产品、零件和可选配件需要迎合玻璃工业中的各种应用。

(See the quality guidelines starting on page 18 for more on these topics)
（质量方针和关于更多关于该主题的信息请从18页开始查阅）

中空玻璃业的输送链
Conveyor chains in the hollow glass industry

Whether as an IS-machine conveyor or a cross conveyor in front of the furnace – inverted tooth conveyor chains offer ideal guiding characteristics

在炉前不论IS机器输送机还是横式输送机——齿形输送链提供理想导向特点

Long service life, reliable transport 寿命长、可靠的运输

Rolling pivot joint with low sliding friction, link plates with FE-optimized contours made of high-strength heat-treated steel or stainless steel, laser-welded outer links, sprockets with hardened involute toothing for smooth, impact-free meshing – there are plenty of reasons why inverted tooth conveyor chains offer consistently precise and reliable operation. Factor in the virtually unlimited options to tailor the inverted tooth chains to the specific requirements of equipment and overall applications. Renold inverted tooth chains – the polished solution for glass.

较低的滚动枢轴关节滑动摩擦、连接链板FE优化链板轮廓由高强度热处理钢或不锈钢制成，激光焊接外链节，链齿轮渐开线硬啮合平稳，无冲击啮合——有充足的理由相信齿形输送链能够提供一贯精确而且可靠运行。几乎无限的因素选项来定制齿形链

来满足特定设备的需求和总体应用。Renold齿形链–玻璃的抛光解决方案。

- Low-vibration, smooth operation
  低振动，运行平稳
- High production speeds
  生产速度快
- Low reject rate for increased efficiency
  次品率低从而提高效率
- Minimal sliding resistance
  滑动阻力最小化

Machine conveyor on IS-machines IS–机器输送机

Machine conveyors take the hot bottles and transport them to the ware transfer. Their features: stable standing surface, high resistance to abrasion, minimal spacing at the machine bed, low sliding friction, air permeability for conveyor cooling, minimal heat withdrawal by the chain, heat resistance even during preheating, chemical resistance against annealing agents.

机器输送机运输热瓶到达制品转移站。他们的特点：稳定站立表面，高耐磨损，机床上最小间距，低滑动摩擦，输送冷却的空气渗透性，最小散热性，即使在预热时耐热性，对退火剂的耐化学性。

Cross conveyor at the cooling furnace 冷却炉的横式输送机

Cross conveyors take over the previously stabilized glass containers and transport them to the cooling furnace. Their features: a stable standing surface, high abrasion resistance, minimal spacing at the cooling furnace, low sliding friction for easy shifting, resistance against thermal stress caused by radiant heat, and chemical resistance against annealing agents.

横式输送机接过前道稳定住的玻璃容器然后把他们运输到冷却炉。其特点：稳定表面站立，高耐磨性，冷却炉最小间距，容易转移的低滑动摩擦，抵抗热辐射引起的热应力，和对退火剂的耐化学性

中空玻璃业的驱动链
Drive chains in the hollow glass industry

20% faster, durable, consistently accurate – the take-out gear with inverted tooth chain drive is the superior solution

20%更快, 耐用, 始终一贯准确 – 带齿形链的外置齿轮传动是卓越的解决方案

Higher productivity, lower costs 更高生产率，更低成本

Whether for shaping on a blowing machine or precisely coordinating the movements of a rotary table system – inverted tooth drive chains are always the right choice when smooth running and accuracy count. On IS-machines, our inverted tooth drive chains in the take-out gear ensure power with precision.

无论是吹塑机还是精确的转盘系统协调运动—— 当需要平稳运行和精确度时齿形驱动链总会是您正确的选择。IS-机器上, 我们齿形驱动链在外置齿轮确保动力和精确。

- Reduced downtimes 停机时间降低
- Improved dynamics 改进的动力
- Increased temperature resistance 提高耐热性
- Considerably longer service life compared to belt drives
  皮带传动相比大大延长使用寿命

Using a Renold inverted tooth chain in a take-out gear helps hollow glass manufacturers to reduce costs by increasing productivity. The longer service life means less downtime for maintenance and repair work on the IS-machine. With optimum dynamics, the installation of an HPC type inverted tooth chain from Renold can reduce the installation width and weight of the drive components.

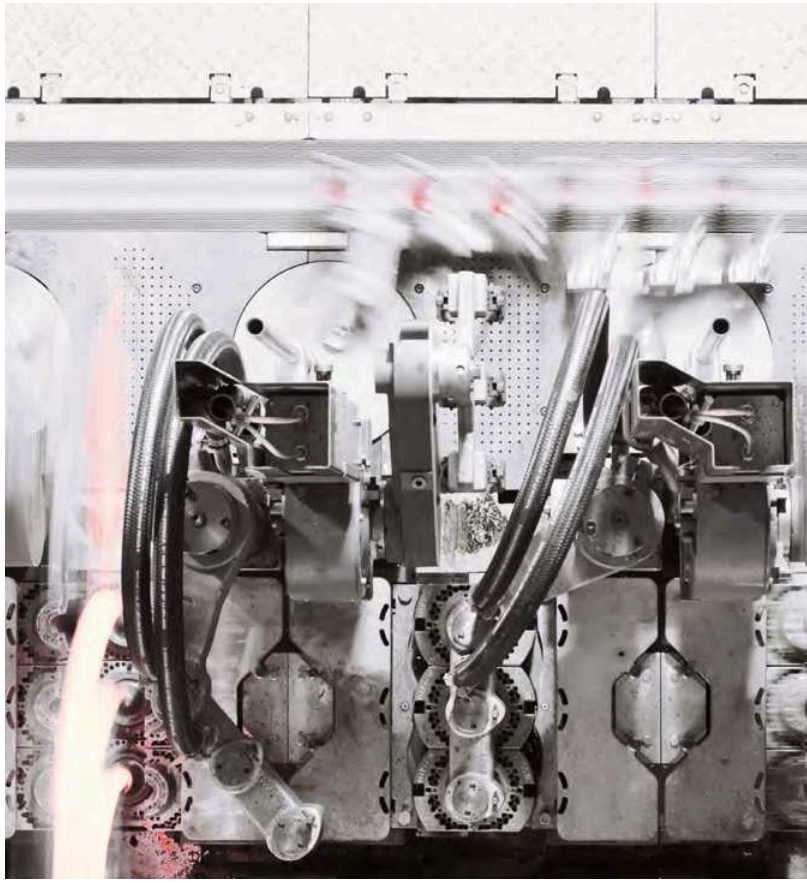
使用外置齿轮的Renold齿形链帮助中空玻璃制造商通过提高生产力来降低成本。寿命越长意味着因机器的维护和维修工作更少的停机时间。最优动力, 安装Renold HPC齿形链可以减少安装驱动零件的尺寸和重量。

In the take-out gear, wear of the drive element must be reduced to a minimum to ensure exact positioning in the long term. Inverted tooth chains with a two-pin rolling pivot joint with hardened axle and rolling pivots maintain smooth operation and thus ensure repeatability of the swivel motion, even over a long period.

外置齿轮, 驱动元件的磨损必须减少到最低以确保长期精确定位。齿形链双旋转枢轴关节硬轴和滚动枢轴保持运行平稳, 从而保证可重复性的旋转运动, 甚至经历很长一段时间仍然保持。

The HPC type inverted tooth chain used in the take-out gear generates almost exclusively low-wear rolling friction and is suitable for speeds up to 50 m/s.

HPC齿形链中使用外置齿轮产生几乎完全低磨耗滚动摩擦和适用于速度到50 m / s为止。



IS机器的外置齿轮
Take-out gears for IS-machines
Inverted tooth chains achieve a significantly longer service life compared to toothed belts.
齿形链与皮带相比大大延长了使用寿命

平板玻璃业的应用
Applications in the sheet glass industry

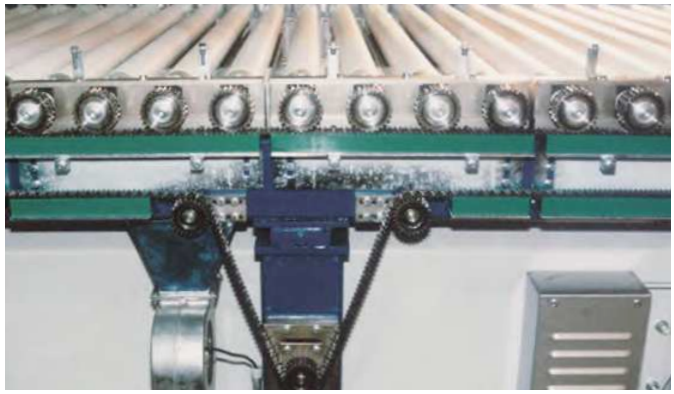
High-precision drives with inverted tooth chains ensure smooth processes in sheet glass production
高精度齿形链驱动保证光滑平板玻璃生产过程

Roller drives in the furnace for bending and annealing sheet glass 滚柱用于驱动折弯和退火平板玻璃炉

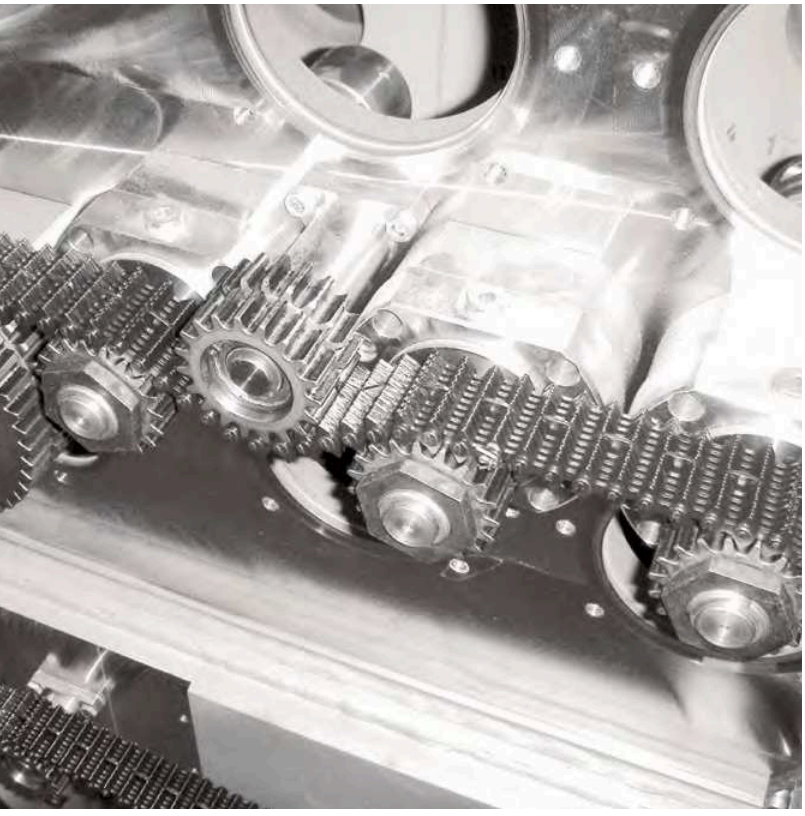
While inverted tooth chains are primarily required for transport during hollow glass production, in the sheet glass industry, they are mainly used for high-precision drives. The variable construction of inverted tooth chains and custom configuration of inverted tooth chain drives permit a wide range of applications.
齿形链主要用于中空玻璃的生产运输所需，在平板玻璃行业，主要用于高精度的驱动。齿形链结构和齿形链的定制配置传动适用于范围广泛的应用。

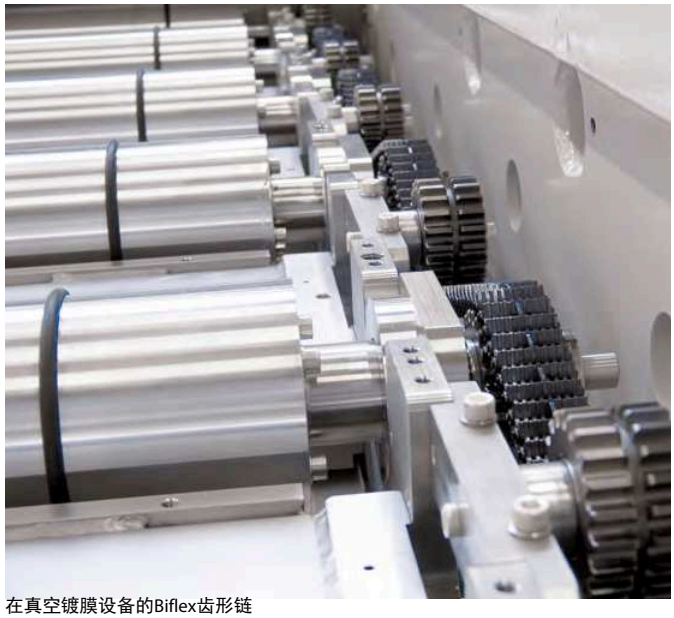
- High temperature resistance, robust operation 耐高温、稳健操作
- Low-vibration, smooth operation 低震动，平稳操作
- Utmost precision and play-free reverse operation
  最大精度和自由反向操作

A widespread field of application is the production of glass panes and automotive glass. Biflex inverted tooth chains are used to drive long roller tables, where raw glass components are heated in a controlled manner for subsequent bending or annealing.
广泛应用于窗格玻璃和汽车玻璃的生产。Biflex齿形链是用来驱动输送辊道，在毛坯玻璃组件加热对后续折弯或退火进行控制。



Driving long roller tables with Biflex Biflex齿形链用来驱动输送辊道
During the annealing process for glass sheets in the roller hearth furnace, uniform synchronous running is critical. Slip-free drive system with Biflex inverted tooth chains. No backlash during reversing with two motors based on the master-slave principle.
在滚柱灶台炉制作玻璃片的退火流程中，统一同步运行非常重要，带Biflex齿形链的滑动自由驱动系统．基于主从原则上反转带两个电机以防止反冲。





在真空镀膜设备的Biflex齿形链
Biflex inverted tooth chains in vacuum coating equipment
Roller drives with specially coated inverted tooth chains for use in vacuum applications, both inside and outside the system (above: inside, at left: outside).
滚柱驱动带特殊涂层驱动齿形链用于真空应用，内部和外部的系统（上图：内部，左图：外部）。

特种玻璃工业中的应用
Applications in specialty glass industry

Extremely hot or sensitive, small or large?
Our inverted tooth chains have seen it all
极热或敏感，小或大?
我们齿形链可以适应一切

Drive and transport solutions for a wide variety of products
动力和运输各种各样产品的解决方案

In addition to their attractive technical properties, the absolute flexibility of individually manufactured inverted tooth chains makes them ideal for nearly every application. Regardless of whether the product is large and heavy or small, lightweight, and prone to tipping, our inverted tooth chains are well-equipped for all situations, from transport to drive applications. They can implement strong forces, torques, and high speeds as reliably as unerring precision – for both fast and slow-moving applications.

除了有吸引力的技术属性，绝对的灵活性单独制造齿形链使他们成为几乎每一个应用的理想选择。无论产品是大型和重型或小型，轻型，易爆，我们齿形链适用于所有情况，从运输到驱动的应用。他们可以实现强作用力，扭矩，高速可靠无失的精度 – 适用于快速和缓慢移动的应用。

- Suitable for vacuum applications
  适用于真空应用
- Also for glass articles without a standing surface
  也适合于无站立面的玻璃制品
- For crystal glass and small glass products
  用于水晶玻璃和小型玻璃产品
- For robust and heavy glass products
  用于坚固和沉重玻璃制品

小型玻璃产品的特殊版本
Special version for small glass products
Individually adapted inverted tooth conveyor chains for a flask production line.
单独适应齿形输送链用于烧瓶生产线

医药玻璃器皿
Medical glassware
A single Biflex inverted tooth chain is used for the synchronous rotation of all 32 forms in a forming glass lathe for processing glass vials.
单个Biflex齿形链用于玻璃车床加工玻璃小瓶的所有同步旋转32道成型流程。

滚动驱动用于真空镀层
Roller drive for vacuum coatings
Complete drive system suitable for special requirements in vacuum coating applications.
完整驱动系统适合于特殊要求的真空镀层应用

齿形链万无一失
Inverted tooth chains are spot on

Toothed chains work fast, precise, and quiet – best arguments for efficient automation
齿形链运行快速，精确，安静, 高效自动化的最佳参数

Skill through and through. Professional equipment, talent and experience, a secure position and a focus on the essentials. The perfect mix provides the basis for optimal results. We've made sure all our pieces are strategically aligned for the glass industry.

高手就是高手．专业装备、人才和经验、稳固的立足点和对本质的专注性。各方面完美协作，最终获得最佳产品。我们的战略定位是服务与玻璃工业的各个环节。

Over 100 years of inverted tooth chain experience in every detail 将100多年的齿形链生产经验融入每个细节

Quality has a tradition. We have worked in close cooperation with the glass industry for decades to consistently optimize our products and systems. All this helps our customers to meet rising demands for higher production speeds, a larger PTM net yield, and longer service lives. Renold inverted tooth chains not only fulfill today's requirements, but are also a future-oriented technology with unique advantages.

追求品质是我们的光荣传统．自数十年前开始，我们就与客户紧密合作，共同致力于产品和系统的进一步优化。这有助于我们有效应对提高生产速度和延长使用寿命的高要求。Renold齿形链不仅能够满足当今的要求，同时也是面对未来具有独特优势的技术决策。

A multitude of strengths by design 设计结构暗含众多优势

The inverted tooth chain is a cohesive network of sturdy links. It is made of numerous link plates and profile pins. The result: a powerful and flexible chain drive that can be perfectly adapted to the task at hand.

齿形链是一个有凝聚力的坚固的网络链接。
它是由无数的连接链板和型销。结果是：一个强大且灵活的链条传动，可根据各项特殊任务进行精确调整。

Arguments for automation solutions with inverted tooth chains from Renold Renold齿形链自动化解决方案论证

We have perfected our inverted tooth chain technology and maintain the world's largest delivery program.

我们完善齿形链技术，并且提供目前世界上最广泛的产品范围。

- Pivot joint with 2-pin system, laser-welded outer links, unique rounded edges 枢轴关节带双销系统，激光焊接外链节，独特的圆形边缘
- Continuous optimization and product variety 持续优化和产品种类
- Application-specific versions 应用性特有的规格
- Inverted tooth chains and sprockets from a single source 齿形链和链轮一站式服务
- Individual configurations based on modular concept 符合模块方案的个性化配置
- Wide range of materials, constructions, guide types, pitches 广泛种类的材料，结构，导片类型，节距

Continuous optimization of link plate forms 对压板形状进行不断优化

Improvement through experience. Renold consistently translates practical knowledge into new product solutions. One example is the enlarged contact surface for inverted tooth chains with an extended pitch. Compared to multiguides, the problem of vertical wear caused by abrasion on the teeth is reduced across the entire chain width.

总结经验，更上一层楼。Renold不断将实践知识转化为新产品的解决方案。例如增加节距齿形链的支撑面。与multiguides相比，减少整个齿形链宽度上摩擦齿尖造成的高度磨损问题。

Special versions and optional extras 特殊规格和辅助装备

Each day is different from the next. With special link plates and specific contact surfaces, the wide range of applications for inverted tooth conveyor chains can be broadened even further. Ceramic supports are one example for especially gentle transport with minimal temperature loss.

我们的产品无处不在，全天候运转。输送齿形链的应用范围通过特殊压板和特有支撑面得以扩展。例如陶瓷支持面是一个特别平缓运输以最少降低温度。

Laser-welded outer links 激光焊接外链节

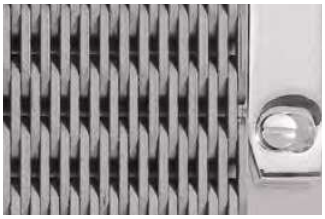
Laser-welded inverted tooth chains have a smooth contact surface on both sides and can be routed directly alongside the dead plates in the IS-machine or the side rails. Minimum side gaps ensure reliable transfer on the machine conveyor and to the cross conveyor as well as easy sliding of the products into the cooling furnace.

激光焊接齿形链两面都有光滑表面，可以直接跟随IS机器或边栏的固定板移动。最小间隙能保证在输送机上的可靠传输和在横式输送机上轻松滑动产品进入冷却炉。

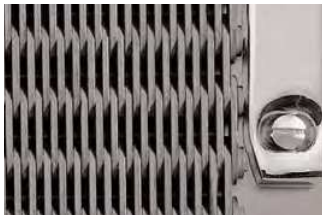
- Connecting links with uniform plate width 统一链板宽度的连接链节
- No lateral movement of joint pivots 连接枢轴不会侧向移动
- Larger side surface prevents lateral wear 增大的侧面避免侧向磨损

Ceramic elements at the hot end
在热端的陶瓷元素

Ground longitudinal profiles
打磨后的纵向外形



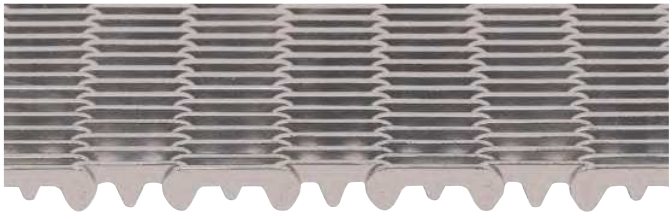
Laser-welded 激光焊接



Riveted 铆接

Workpiece support for bulb components 灯泡零件的工件支持

Precise table top version based on tooth chain 齿形链基链精密顶板



TRILEG: link plate form with extended pitch
TRILEG:加长节距的连接链板

Why are inverted tooth chains with rolling pivot joints the right choice? 为什么滚动枢轴关节的齿形链是正确的选择

One of the main reasons that account for the superiority of Renold inverted tooth chain solutions is the unique two-pin rolling pivot joint. An axle pivot rolls against a rolling pivot. The pivots are pressed into the link plates under tensile force, preventing any further movement. Because the pins maintain permanent contact, the layout of the inverted tooth chain has no impact. Inverted tooth chains with rolling pivot joints therefore permit a variety of design options and can be tailored to individual production processes and requirements. Because the link plates are static in relation to the pins, any loss of strength due to thermal strain is insignificant. With their low friction coefficient, inverted tooth conveyor chains can also be operated without any lubrication.

Renold齿轮解决方案如此卓越的重要一点是具有独一无二由两部分组成的档销关节。旋转销轴在轴颈上滚动。在牵引力的作用下，将栓销压入压板并停止移动。销钉始终彼此相互接触，齿形链的布局图不起任何作用。因此，可自由设计带档销关节的齿形链外形，并根据各个生产过程或要求进行调整。压板不朝销钉反方向移动，因此热负载造成的强度损害显著。输送齿形链摩擦系数很低，仅需进行最低限度的润滑。

Conversely, on the one-pin joint the link plates slide onto an oval pin as they mesh with the sprocket. This results in wear on both the pin and the link plates. Because the holes punched in the link plates are usually not cylindrical, the surface pressure between the pin and link plates is increased, creating additional wear.

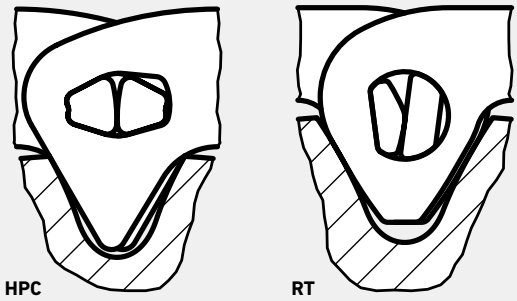
相反，在单销关节连接链板滑到一个椭圆销轴作为他们与链轮啮合。这导致销轴和连接链板的磨损。因为在链接上扎孔板通常不是圆柱形，销和链接板块之间的表面压力增加从而引起额外的磨损。

One-pin joint: increased wear, lower strength, lubrication required 单销关节：增加磨损，降低强度，需要润滑

The number of link plates is also critical. A greater number of link plates on the pin reduces surface pressure and elongation. This is why manufacturers of these chains usually prefer a tighter construction. However, this can be detrimental to effective belt cooling. Because inverted tooth chains in the glass industry are subject to high thermal loads, the material loses its strength. The service life can only be extended by reducing the friction coefficient μ, for example with lubricants – highly problematic in glass production, since high temperatures can result in charring. Lubricants can also have a counterproductive effect in combination with annealing agents. Instead of reducing the friction coefficient, an increase occurs.

连接链板的数量也很重要。越多销轴上的链板越会减少表面压力和伸长。这就是为什么这些链条制造商通常更喜欢更紧凑的结构。然而，这不利于传送带有效冷却。因为在玻璃行业齿形链受到高热负荷，材料会因此失去强度。只能通过减少摩擦系数 μ 延长使用寿命，例如润滑——玻璃生产中很大的问题，因为高温会导致烧焦。润滑油结合退火剂也可以有适得其反的效果，不会降低了摩擦系数，反而增加发生的几率。

Optimal joint kinematics 最佳的关节运动学



Two-pin rolling pivot joint 由两部分组成的滚动枢轴关节

With the 2-pin joint, only rolling friction occurs as the chain meshes with the sprocket. Sliding friction is virtually eliminated; less force is used and natural wear minimized. The drives consume significantly less energy.

双销关节的作用是在出现链轮角度偏差时仅产生滚动摩擦。几乎完全消除滑动摩擦，由此利用较小的作用力工作，可将受自然条件限制的磨损降至最小。显著降低传动的能量消耗。

齿形链和链轮形成刚性连接

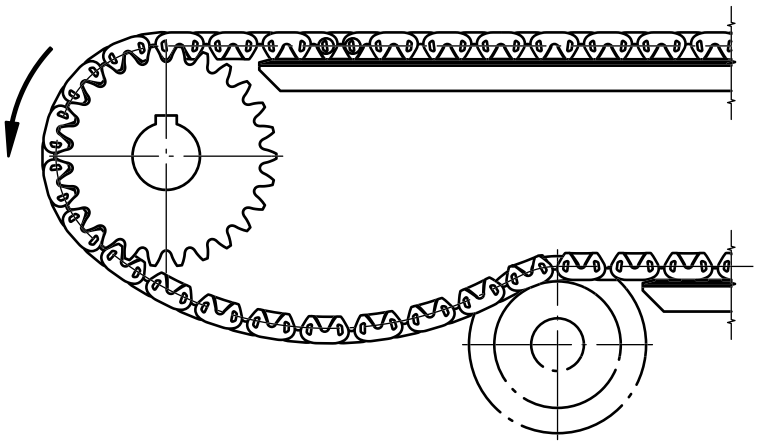
Interlocking connection: inverted tooth chain and sprocket

The correct meshing of chain and sprocket is a prerequisite for trouble-free, continuous operation. All relevant dimensions and profiles are optimally aligned to achieve slip-free movement.

链条和链轮正确啮合是无故障持续运行的前提条件。为了实现无滑动移动，所有相关尺寸和型材须完全协调一致。

Whenever technically feasible, sprockets are manufactured according to the specific needs of the customer. The design of the toothing is adapted to the guide type of the selected inverted tooth chain. Of course, all special versions are also available with guide slots for various chain widths and can be prepared for center and side guides. C45 steel sprockets with hardened tooth flanks are used as a standard with proven resistance to wear. For an even longer service life for cross conveyors subject to extreme thermal loads, without compromising on strength, we also use vacuum-hardened tool steel.

只要技术允许，就会根据客户的特殊期望生产链轮。同时根据所选的齿形链引导方式调整啮合结构。当然也可为不同的链条宽度和内部及外部导向供应带导向槽的特殊规格。带硬化齿面的C45材质钢材具有良好的耐磨性，将其作为标准材料使用。我们也使用真空淬火工具钢，可显著延长极致热负载条件下的使用寿命，且硬度不会降低。



Elongation 延长特性主题

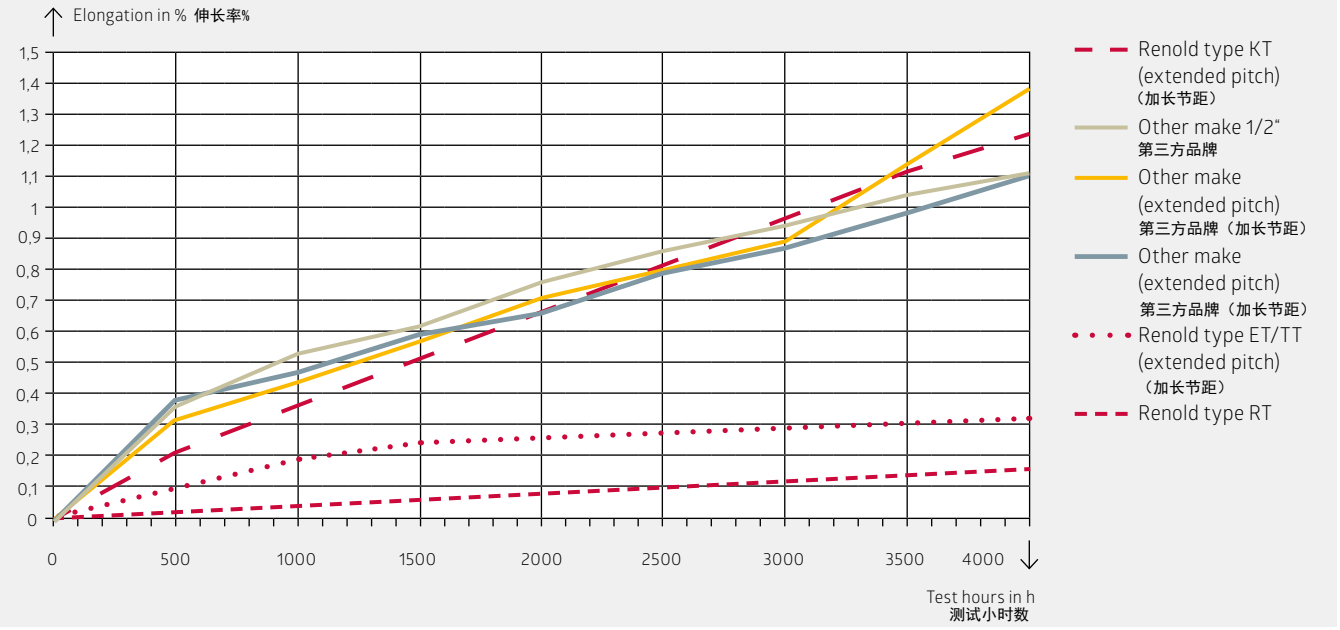
Due to sliding friction and increased wear of the joint, elongation in 1-pin chains can be up to three times higher than in 2-pin systems. Renold 2-pin rolling pivot joint with hardened axle and rolling pivots only creates rolling friction. Over time wear also occurs at the contact line of the pins; however, this wear is evenly distributed on both pins as well as the inner and outer links. The meshing conditions remain constant over the entire period of use. These characteristics are the basic prerequisite for precise angle synchronization in applications for the hollow glass industry.

As shown in the diagram, studies have demonstrated that the elongation of inverted tooth chains is up to three times less with rolling pivot joints instead of single pin joints. Single pins generate constant sliding friction which accelerates wear. Renold rolling pivot joints only generate rolling friction. For an RT type inverted tooth chain, this means a minimal elongation of 0.17% after approximately 4000 test hours, i.e. about 1.7 mm elongation per meter of the chain. This horizontal wear is negligible when it comes to the performance and reliability of inverted tooth chain applications. Inverted tooth chains with a one-pin system, in contrast, exhibit an elongation of approximately 11 to 14 mm per meter, based on a comparison with Renold KT type chains as an example for single pins.

所有单柱销系统的长度均会因滑动摩擦最大增加3倍，活节内的摩擦也随之增加。Renold双销系统的档销关节带有硬化的旋转轴销和轴颈，仅产生滚动摩擦。虽然随着时间的推移，销钉接触线上会出现磨损，但是磨损均匀地分布在两个销钉和内外链节上。在整个使用期间，啮合系统始终保持一致。此特性是中空玻璃应用中准确角度同步应用的基本前提条件。

如图所示，通过实验证明，与单销枢链的齿形链相比，带档销关节的齿形链长度最多增加3倍．在单枢链中，滑动摩擦持续存在，这加速了磨损。相反，档销关节仅存在滚动摩擦。对RT型的齿形链来说，约4000实验小时后，几乎测量不到长度增加，仅仅为0.17%，即每米链条长度增加约1.7mm。此幅度的长度增加对运输链条应用的整个功能来说无足轻重。相比之下, Renold KT型链为齿形链单销系统的一个例子, 呈现的每米伸长大约11至14毫米, 。

Chain elongation in inverted tooth conveyor chains, dry running, no load, 1/2“ and 1/2“ extended pitch Test speed v = 1 m/s 输送齿形链的链条伸长，干运转，无负载，1/2"和1/2"加长节距实验速度v=1m/s



Rolling friction/sliding friction 滚动摩擦/滑动摩擦

With a simple comparison of friction coefficient μ for rolling and sliding friction, it’s easy to see that rolling friction requires far less force.

单从滚动摩擦相对于滑动摩擦的摩擦系数μ观察来说，存在滚动摩擦时，只需利用明显较小的作用力工作。

Friction coefficient: steel on steel 钢对钢的摩擦系数：

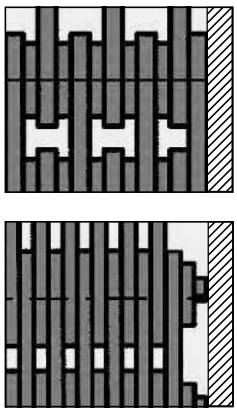
Sliding friction μ = 0.1, rolling friction μ = 0.01

滑动摩擦μ=0.1,滚动摩擦μ=0.0 1

Picture a tricycle and a sled: the tricycle uses rolling friction and has a greater ease of motion than a sled with sliding friction. Sliding friction also depends on the sliding quality of the material. This is negligible with rolling friction.

对比三轮车和滑车：与产生滑动摩擦的滑车相比，产生滚动摩擦的三轮车可轻松移动．此外，产生滑动摩擦时，还会出现材料滑移．在滚动摩擦中，这种情况并不严重。

Laser-welded outer links 激光焊接的外压板



Rolling pivots are laser-welded in the outer plates of Renold inverted tooth conveyor chains. The rivet heads no longer protrude and the belts can be placed flush to the sides without any gaps.

This increases the operational reliability of the chain and the chain width remains constant throughout its service life.

Renold输送齿形链外压板内的轴颈采用激光焊接。从而去除了铆接头的突出部分，并且输送齿形链可齐平放置，因此两侧的缝隙极小。这提高了链条的运行安全性。此外，在整个使用期间，链条的宽度保持不变。

中空玻璃行业的齿形链

Inverted tooth drive chains in the hollow glass industry

Glass is a special product. It places highly specific demands on production equipment and tools for production and processing. The main requirements include: 玻璃是一种特殊的产品。这就对生产加工生产设备和工具有非常具体的要求。主要要求包括:

High temperature resistance, since glass is often processed at temperatures above 500°C. 耐高温, 因为玻璃通常在温度高达500°C进行处理。

High requirements for drive synchronization and accuracy, since even minor deviations can leave marks or scratches on the product, and glass is fragile after cooling.

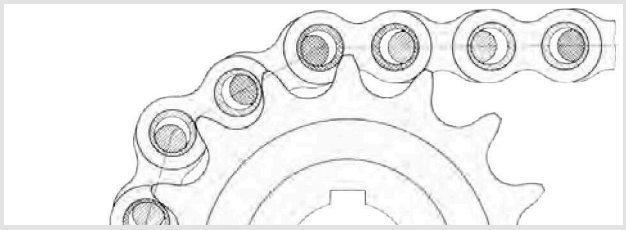
驱动同步和精度要求高, 因为即使是很小的偏差都可以对产品造成印记或划痕，玻璃冷却后是脆弱的。

Wrap drives are drives that enable the cost-effective implementation of larger center distances. Various drive elements, such as belts, roller chains, and inverted tooth chains are available. Belts, regardless of whether toothed, flat, or wedge-shaped, can usually be ruled out, since the temperatures are too high. Roller chains often lack the required accuracy due to sliding friction and wear. Inverted tooth chains with rolling pivot joints are the only viable option ideally equipped to meet all requirements and should always be the first choice.

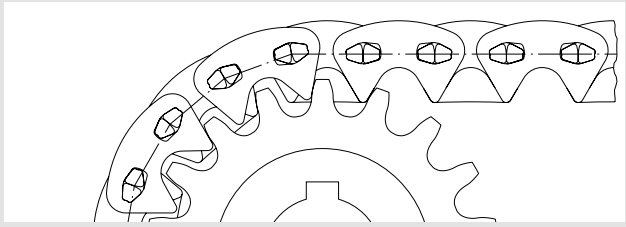
曲率驱动能使成本效益实现更大的中心距离。各种驱动元素可选, 如皮带、滚子链条和齿形链。皮带, 无论齿型、平坦或楔形, 因为温度太高通常可以排除。滚子链条往往由于滑动摩擦和磨损缺乏所需的精度。齿形链与滚动枢轴关节是理想的唯一可行选择来满足所有的需求, 应该是第一选择。

滚子链和齿形链的对比

Comparison roller chain and inverted tooth chain



Roller chain 滚子链



Inverted tooth chain 齿形链

The graphic shows a roller chain shortly before failure due to elongation. Friction and wear is visible between the pins and bushings. Because the pitch of the outer links now varies from that of the inner links, the chain is also prone to running on different swing diameters. The result is jerking in the sprocket and a jolting, uneven drive.

On the inverted tooth chain, it is clear that there is no friction between the pins and bushings; instead the two pins roll against each other. If wear does occur, the inverted tooth chain readjusts its swing diameter and can continue to run without jerking.

图形显示因链条延长导致故障前的滚子链。我们可以观察到销轴和衬套相互摩擦和磨损。因为外链节与内链节的节距不同，所以链条可在不同的回转直径上运行。结果是链轮内出现缺陷，造成突然和不规则传动。从齿形链中我们认识到，销钉与衬套相互之间不产生摩擦，而是两个销钉相互滚动。在可能出现磨损的情况，齿形链寻找新的回转直径，并继续运行，不会出现突然传动。

案例：链条用于吹瓶机成型

Example: Chain drive for shaping on a blowing machine

Inverted tooth drive chain for shaping on a blowing machine for the production of high-quality drinking glasses (goblets/wine glasses). An inverted tooth chain at each of the 18 stations drives the mold for the bowl, an additional inverted tooth chain rotates the stem to weld it to the bowl. Both parts must be rotated with equal precision in order to join the elements. The application uses an HPC inverted tooth chain. A special feature: both drives are positioned laterally, i.e. with vertical axes.

齿形驱动链为吹瓶机生产高质量的酒杯(高脚杯/葡萄酒杯)。齿形链在18站驱动每个模具碗，一个额外的齿形链旋转阀杆焊接到碗里。两个部分必须以平等的旋转精度才能相互连接。此应用使用一个HPC齿形链。特殊特性:驱动器都是横向定位, 即垂直轴。

案例：外置齿轮用于生产容器玻璃

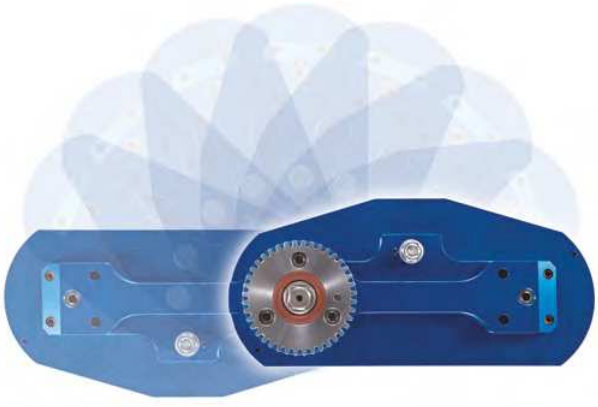
Example: Take-out gears in container glass production

These gears are used to lift glass while it is still glowing out of the IS-machine and onto sheets from which the glass items are shifted onto an inverted tooth conveyor chain. The rotation usually does not exceed 180° by much; the entire gear housing is rotated. The gear rotates around the drive shaft, enabling a swivel motion.

A difficult factor in this process is repeated reversing with relatively high accelerations. Inverted tooth chains meet these demands over a long period. They are unaffected by radiant heat and continuous directional changes with rapid accelerations. In addition, the drives demonstrate exceptional precision and robustness.

这些齿轮用于提升从机器出来的玻璃和然后使用齿形输送链让玻璃物品转移到平板上。旋转不超过180°, 整个齿轮外壳是旋转。在驱动轴齿轮旋转, 促成旋转运动。

在这一过程中困难的因素是重复扭转与相对较高的加速度。齿形链长期满足这些要求。他们不受热辐射和持续加速度方向变化的影响。此外, 驱动表现出卓越的精度和稳健性。



平板玻璃业的齿形传动链

Inverted tooth drive chains for the sheet glass industry

The variable construction of inverted tooth chains allows chain drives to be precisely configured to meet customers' needs. Renold manufactures inverted tooth chains with pitches from 5/16" to 2 ½" and in 4 different performance classes for drives, enabling an optimum configuration of individual drives.

齿形链不同结构允许精确链传动装置配置来满足客户的需求。Renold制造齿形链节距从5/16"到2½"和用于驱动的4个不同性能类别，使他对个别驱动形成最优配置。

案例：真空玻璃成品和太阳能玻璃生产

Example: Vacuum glass finishing and solar glass production

Vacuum applications demand special provisions for a chain drive. To prevent contamination of the vacuum, all parts must be grease-free. Moreover, the friction coefficient μ for sliding friction with steel on steel in the vacuum increases up to 1.0. Outside the vacuum, this coefficient is just 0.1.

真空应用对链传动有特别规定。为了防止真空污染，所有部件必须是不上油。此外，钢对钢滑动摩擦的摩擦系数μ的真空增加到1.0。真空外，这个系数是0.1。

The conveyor roller drives are equipped with wrap drives to reduce friction losses. To achieve the same rotational direction of the conveyor rollers, an additional sprocket must be installed between every other roller, which ensures wrapping on the conveyor rollers and thus enables a uniform direction of rotation. The requirement of absolutely no oil or grease on the inverted tooth chain drives is achieved through a special procedure: a coating is applied to every individual component of the inverted tooth chain. An additional side benefit: this coating prevents direct steel-on-steel contact. The higher friction coefficients in the vacuum are counteracted and energy is saved.

输送辊驱动器配有曲率驱动以减少摩擦损失。实现输送辊的转动方向相同，在其他辊之间必须安装一个额外的链轮，确保输送机滚柱缠绕，从而使旋转方向能够统一。齿形链为了达到绝对没有油或润滑脂的要求需要进行一个特殊应用于每一个单个零件的工艺 。一个额外的好处：这涂层防止钢铁对钢铁的直接接触。可以抵消在真空中较高的摩擦系数和和能源保存。

特殊案例：真空玻璃成品和太阳能玻璃生产

Special case: large-scale automotive glass production

Mass production of automotive glass usually employs roller drives. However, they are not used for reversing; instead, the pre-heating zones are configured as conveyor belt furnaces. These furnaces can measure, for example, 40 m in length and contain hundreds of rollers. The drive for these rollers is not interlocking, but operates exclusively based on friction. Renold manufactures special chains for these furnaces that are highly precise to ensure that all conveyor rollers are at exactly the same height. These drives also use a motor control based on the master/slave principle. This should not reduce backlash, but prevents stick-slip effects that can occur over large conveying lengths.

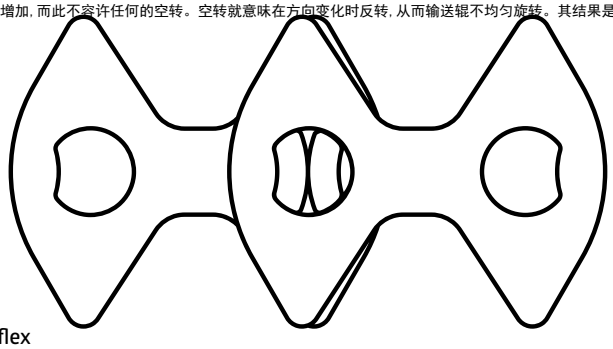
大规模生产的汽车玻璃通常使用滚轮驱动。然而，他们不是用于反转；相反，预热区被配置为网带炉。这些熔炉可以测量，例如，40米的长度包含数百个滚轮。这些滚轮的驱动不是联锁，但运作完全基于摩擦。Renold为这种炉制造非常精确的专用链条，以确保所有输送滚轮都在完全相同的高度。这些驱动还使用一个基于主/从电动机控制原理。这不应该减少抵消，但防止在大型输送长度可能发生的粘滑效应。

案例：Biflex齿形链用于长滚柱台的空转驱动

Example: Biflex inverted tooth chains for play-free driving of long roller tables

Biflex inverted tooth chains are widely used in the sheet glass industry in the production and finishing of automotive glass. They are used to drive long roller tables. Raw glass components are often heated on roller tables for subsequent bending or annealing. To save space and maximize energy efficiency in the furnace, the sheets are moved back and forth on the rollers. Because the plasticity of glass increases at higher temperatures, this movement must occur without any play. Play means backlash during directional changes and thus the uneven rotation of conveyor rollers. The result is scratches in the finished product.

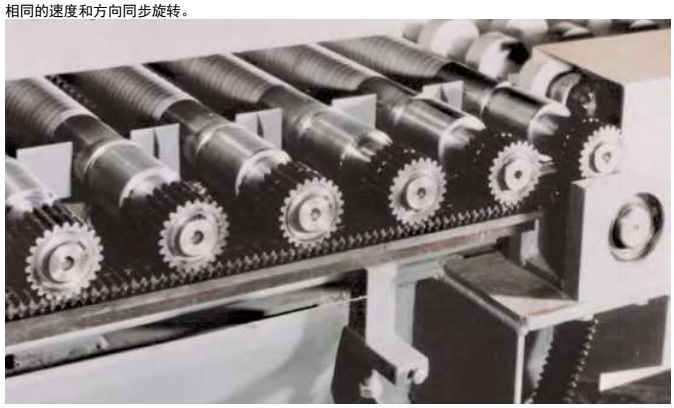
Biflex齿形链广泛应用于汽车玻璃平板玻璃行业的生产和加工。他们是用于驱动长滚柱台。毛坯玻璃组件通常在滚柱台上为后续的弯曲或退火进行加热。炉内为了节省空间和能源效率最大化、玻璃平板在滚珠台上来回移动。温度升高时玻璃的塑性增加，而此不容许任何的空转。空转就意味在方向变化时反转，从而输送辊不均匀旋转。其结果是在成品划痕。



Biflex

The inverted tooth chain acts as a lantern gear underneath the conveyor rollers. It is continuously tensioned by two motors in a master/slave configuration. The chain slack is tensioned via an omega with a simple weight or a pneumatic cylinder. Sprockets with corrected toothing engage with the lantern gear. By engaging the slide rail below the lantern gear, and in some cases through the weight of the conveyor rollers, the toothing also enmeshes tightly with the lantern gear. This makes the entire system free of play and the rotation of all conveyor rollers is synchronized with the exact same speed and in the same direction.

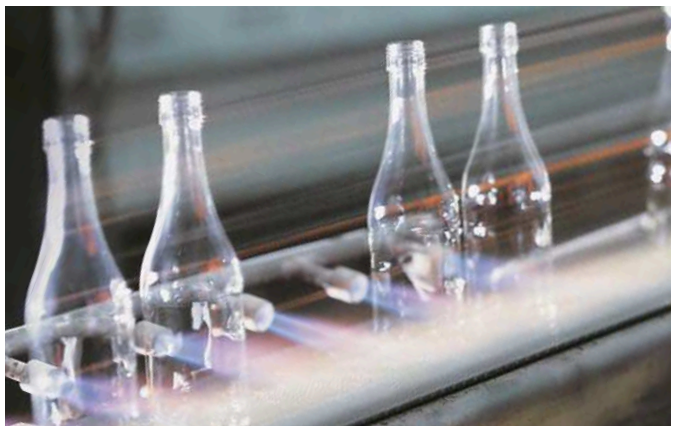
齿形链位于灯笼齿轮输送滚柱下面。它是由两个主/从配置电机不断张拉。链松弛通过用一个简单的重量或气缸 ω 张拉。链轮和齿轮与灯笼齿轮接触进行啮合。通过灯笼齿轮下面的滑轨装置，以及在某些情况下通过输送辊的重量，灯笼齿轮的啮合也会被拉紧。这使得整个系统运行自由而且所有输送滚柱的以相同的速度和方向同步旋转。



为什么在中空玻璃生产中运输如此关键
Why is transport so critical in hollow glass production?

DThe glass product comes out of the IS-machine with a temperature of over 500°C and must be gently and reliably transported to the individual processing stages. However, the product is not yet fully stabilized and is highly delicate. Additional production steps are required along the path from the IS-machine to the cooling furnace. First, belt cooling stabilizes the product. The next step is hot-end coating. Transport must be accomplished without any slippage to ensure that the product stays properly positioned. The spacing between the products is reduced in the ware transfer for optimum space utilization in the cooling furnace. Contact between the products must be avoided at all costs.

玻璃产品是从温度超过500°机器中出来的，必须平稳而且可靠地运送到各个处理阶段。然而，产品还没有完全稳定而且非常精致。沿着机器到冷却炉需要额外的生产步骤。首先，冷却皮带稳定产品。下一步是热端涂层。运输必须完成没有任何滑动以确保产品保持正确的位置。在制品转移时产品之间的间距减少使得冷却炉达到最佳空间利用率，必须不惜一切代价避免接触。



Flame polishing 火焰抛光

During flame polishing, burners on the conveyor belt partially melt the product surfaces. Inverted tooth chains can sustain damage from exposure to high temperatures. Stainless steel can provide an adequate solution for these applications.

在火焰抛光，在传送的燃烧器使产品部分表面融化。齿形链可以暴露造成高温损伤。不锈钢可以为这些应用提供一个适当的解决方案。

Hot-end coating 热端涂层

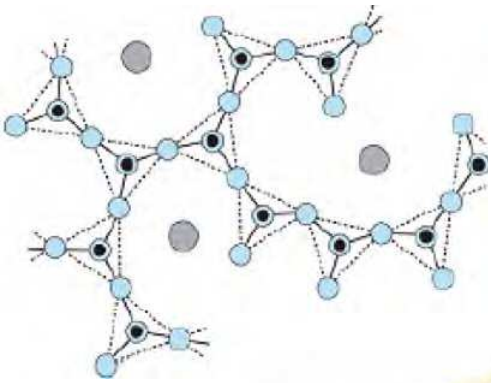
Hot-end coating smoothens surfaces and creates an excellent surface for subsequent cold-end coating. Coating agents in combination with lubricants can damage the inverted tooth chain. However, there are steps you can take to protect the quality of inverted tooth chains. Don't hesitate to ask!

热端涂层平滑表面，对后续的冷端工序提供一个优秀的表面涂层。涂层剂结合润滑油会损害齿形链。不过，您可以采取一些措施来保护齿形链的质量。不要犹豫，咨询我们！

Base cracks 基本裂缝

To withstand harsh operating conditions, inverted tooth chains are usually made of high-strength heat-treated steel. Like all metals, steel is an excellent heat conductor, which presents a problem: the glass needs to cool down during transport in order to stabilize, but at the right rate. If the hot product makes contact with the inverted tooth chain, heat flows from the glass to the chain. The inverted tooth chain dissipates warmth from the glass more quickly than it can be resupplied by the surrounding glass. This results in areas with different temperatures at the contact points with the glass, creating tension that can become visible through micro-cracks (base cracks). When the product is cooled with air on the belt, this effect does not occur. Air acts as an insulator so the glass can continue to supply adequate warmth and cool down slowly and evenly.

承受苛刻的操作条件，齿形链通常由高强度热处理钢材制造。像所有金属，钢铁是一个优秀的热导体，它提出了一个问题：为了稳定玻璃在运输中需要在适当的利率下冷却。如果热产品接触齿形链，热量从玻璃流动到链条上，齿形链能够能快速消散热度而不扩散到周围其他玻璃。这会造成玻璃的接触点上有不同的温度，从而制造张力造成微裂纹（基础裂缝）。当产品在皮带上通过空气冷却时，这种效应不会发生。空气作为绝缘体使玻璃可以继续供应足够的热量和缓慢而均匀地冷却。



调节冷却过程的方法
Ways to regulate the cooling process

First, the melt itself is a decisive factor. A high alkaline content (Arabic: "al qalya" = potassium carbonate) reduces the tendency towards base crack formation.Potassium carbonate or potash is a network modifier and fluxing agent.
Network modifiers alter the properties of glass by depositing atoms in the quartz network and therefore disrupting the even network structure. As a fluxing agent, potash lowers the melting temperature and thus the processing temperature. A lower processing temperature means a smaller temperature difference between the glass and the inverted tooth chain, and thus a reduced heat transfer from the glass into the chain.
An additional factor in preventing base cracks is the design and shape of products. The base of a bottle is curved inward and the remaining circular ring equipped with additional fluting. This reduces the contact surface with the inverted tooth chain considerably.

Finally, the construction of the inverted tooth chain has a significant impact on cooling processes. Tightly constructed chains have a larger closed surface than those with spacers or an openly configured extended pitch.

首先，融化本身是一个决定性因素。碱含量高（阿拉伯语："al qalya" =碳酸钾）减少基础裂纹的形成。碳酸钾或钾化合物是一个网络改性剂和助熔剂。网络改性剂通过沉积原子石英网络改变玻璃的性质，甚至因此扰乱网络结构。钾化合物作为助熔剂，降低了熔化温度，因此处理温度。较低的加工温度意味着玻璃和齿形链之间更小的温差，从而降低从玻璃到链条的热传递。一个额外预防基础裂缝的因素是产品的设计和形状。瓶子的底部向内弯曲，剩下的圆环需要额外的开槽。这减少了齿形链的接触表面。
最后，齿形链的结构对冷却过程产生重大影响。紧链构造带垫片或一个开放配置加长节距会有一个更大的封闭表面

The right material 正确的材料

Should a combination of all measures not eliminate base cracks, stainless steel inverted tooth chains could help to solve the problem. Steel with a high nickel content reduces the withdrawal of heat from glass, which is determined by thermal conductivity, measured in W/m K (watt per meter kelvin). Compared to heat-treated steels, the use of stainless steel reduces the withdrawal of heat by an approximate factor of 3. This also reduces energy consumption and cuts down on melt quantities.

所有措施结合也不能完全消除基础裂缝，不锈钢齿形链可以帮助解决这个问题。高含量镍钢材可以减少玻璃的热扩散性，取决于导热系数，以W / m K（瓦特每米开氏度）计算。相比于热处理钢、不锈钢的使用减少热扩散性近似3倍。这也减少了能源消耗和减少了融化数量。

Thermal conductivity of steel grades 钢材的导热性

Steel grade 钢材	W/m K 瓦特每米开氏度
Carbon steel 碳钢	Approx. 50 大约50
Heat-treated steel 热处理钢	Approx. 50 to 45 大约50-45
High nickel alloy steel Stainless steel 高含量镀镍合金不锈钢	Approx. 27 to 10 大约27-10

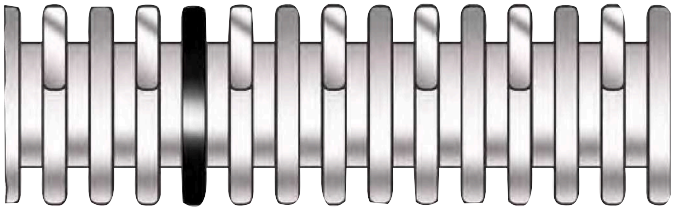
Improved sliding characteristics 改善滑动性能

Some glass bases have minimal contact with the inverted tooth chain. This disrupts the sliding quality when shifting the products on and off the chain. The same applies to angled fluting in the glass base. Renold has developed a solution for these challenges: toothed plate edges are rounded off in an extra work step. This keeps the contact area to a minimum while reducing sliding forces. In addition, the risk of toppling during lateral shifting is minimized, which is especially important for tall, top-heavy products. As shown in the figure, rounded edges can cut the forces required for lateral shifting (both static and sliding friction forces) by roughly one half.

一些玻璃胚与齿形链有最小接触。当产品在链条上下移动时会影响滑动质量。这同样适用于玻璃胚的角度开槽。Renold开发了解决这些挑战的方法：齿形链需要额外步骤进行磨圆。

这使接触面积在减少滑力同时达到最小化。此外，横向转移的倾倒风险最小化，这对于高，头重脚轻的产品特别重要。如图，圆形的边缘可以减少横向转移所需的力（静态和滑动摩擦力）大约一半。

- Reduces the risk of base cracks 减少基本裂缝的风险
- Reduces toppling in topple-prone bottles 减少倾倒性
- Reduces the sliding resistance of glassware 降低了玻璃器皿的滑动阻力
- Improves sliding properties 改善滑动特性

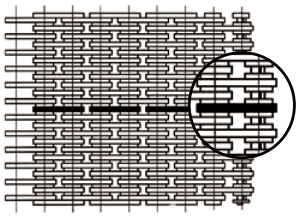


RS inverted tooth chain with rounded link edge
*RS*齿形链带圆形链节边缘

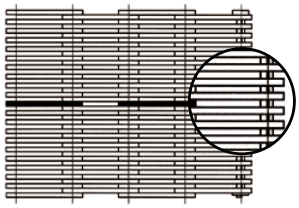
The right layout 正确的布局

Inverted tooth chains have a lamellar design, which always results in a gap between the individual link plates. The additional integration of spacers and/or the use of extended pitches increase this gap, which promotes cooling.Here are just a few examples:

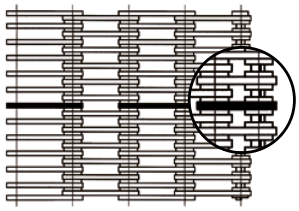
齿形链层状设计，总是导致单个链接板块之间的差距。额外的间隔集成和/或加长节距的使用增加这种差距，促进冷却。这里只是几个例子：



Layout 1 布局1
Standard layout with a surface air permeability of 22%. This inverted tooth chain is the basis for comparison with other versions, i.e. 100%, Type RS-200-CL.
标准布局的表面空气磁导率为22%。
较其他版本而言这个齿形链是基础，即100%，RS - 200-CL类型。

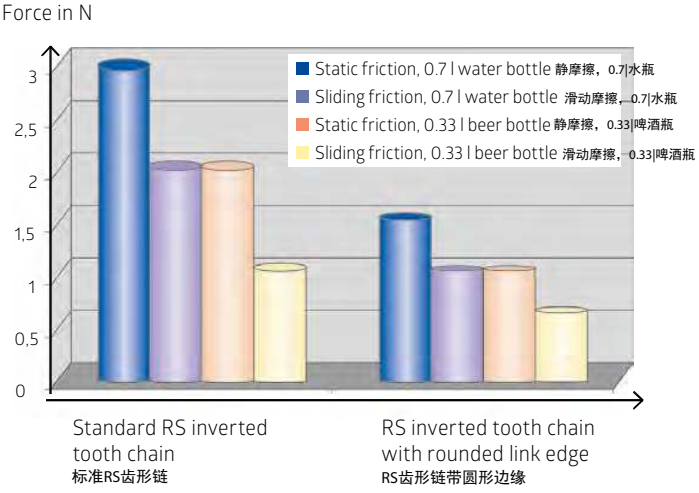


Layout 2 布局2
Extended pitch. Air permeability = 31%, type TT-200-CL.
加长节距
空气磁导率= 31%，
TT-200-CL类型。



Layout 3 布局3
Extremely open extended pitch. Air permeability = 53%, type TS-200-CL.
开放式加长节距
空气磁导率= 53%，
TS-200-CL类型。

Forces for shifting bottles 玻璃瓶移动力



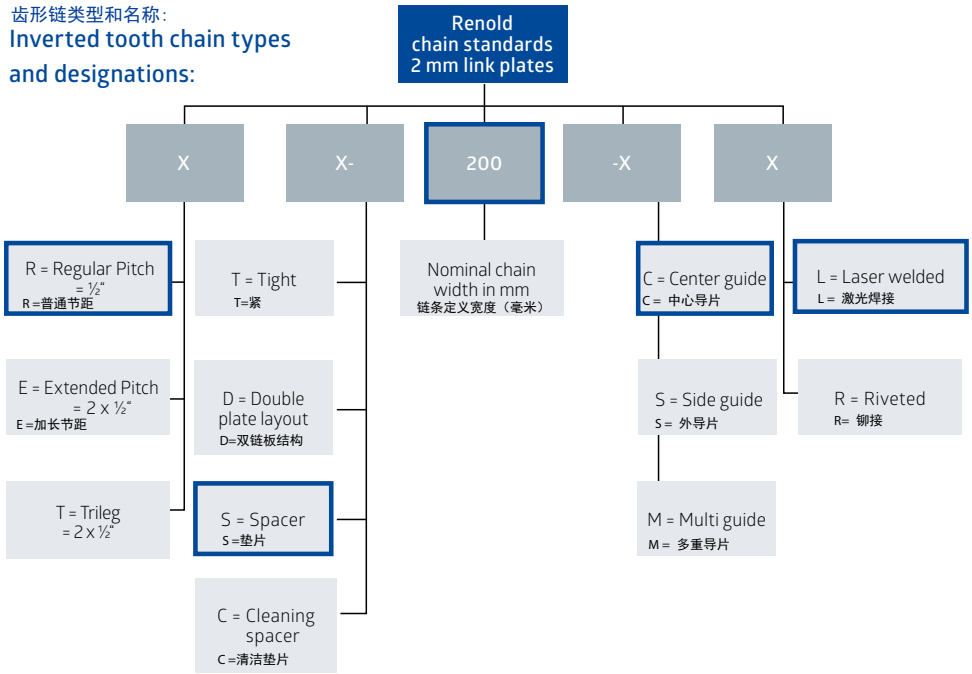
Advantage: variety of chain types 优势：产品类型多样性

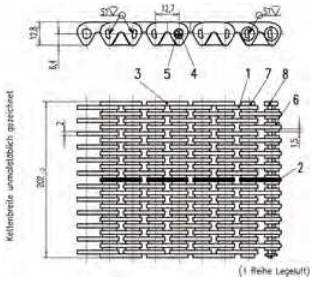
The correct selection of the inverted tooth chain type, construction, and specific version enables an ideal combination for the specific requirements of an application and the product to be manufactured. Once all aspects are considered, the result is economical production costs combined with error-free transport. In short: utmost efficiency. Despite this customizing, it is a fact that few production facilities manufacture the same product day in and day out. Instead, products tend to change frequently: bottles are followed by foodstuff jars, top-heavy products by broad-based, stable bottles. The main objective is therefore to find the best possible compromise, for example, between cooling and standing surface properties.
This requires ample experience from practical applications and extensive configuration options. We can offer you both. Our range of inverted tooth chains provides unparalleled options worldwide. We have also been catering to the specific needs of the glass industry for over 50 years.

正确的选择齿形链的类型、结构和特定版本作为理想的组合来满足应用的特定需求和产品制造。一旦考虑所有方面，结果是经济生产成本加上无误运输。简而言之：效率最大化。尽管定制化，但也有一些工厂天天做同样的产品，相反，产品往往经常变化：瓶子是紧随其后的是食品罐、产品广泛的头重脚轻产品、稳定的瓶子。

因此，主要目标是找到最好的妥协方法，例如，冷却和站立之间的表面性质。
这需要足够实际应用的经验和广泛的配置选项。我们两项都可以为您提供。我们的全球范围的齿形链提供了无与伦比的选项。我们50多年一直在迎合和超过玻璃行业的特定需求。

齿形链类型和名称：
Inverted tooth chain types and designations:





系统的类型名称
Systematic type designation

As we developed our product range, we introduced a systematic structure to reflect the variety and individuality of inverted tooth chain versions. This makes it easy for users to identify specific inverted tooth chain types. The example at the right shows our standard inverted tooth chain type RS-200-CL: 2 mm link plates with standard ½“ pitch, configured with spacers and center guide, laser-welded over a nominal width of 200 mm.

当我们开发我们的产品范围，我们介绍了一个系统的结构，以反映的多样性和单个齿形链版本。这使得用户更容易识别特定的齿形链类型。在正确的例子展示了我们的标准齿形链类型RS-200 CL:2毫米连接板与标准½"节距，配置垫片和中心导片，激光焊接的定义宽度200毫米。

玻璃工业输送齿形链。
比较不同的结构（例子：200毫米宽度）。百分比适应于所有的宽度标准
Inverted tooth conveyor chains for the glass industry.

Comparison of different constructions (example here: 200 mm width). Percentages apply for all widths.

	Standard 标准						
Inverted tooth chain type 齿形链类型	RS-200-CL	RT-200-CL	RD-200-CL	TT-200-CL	TS-200-CL	ET-200-CL	ES-200-CL
Chain weight comparison 链条重量比较 Chain weight in kg/m 链条重量kg / m RS chain weight = 100% RS链条重要=100%	8.8 kg/m 100 %	11.3 kg/m 128 %	11.3 kg/m 128 %	8.9 kg/m 101 %	6.5 kg/m 74 %	7.9 kg/m 90 %	5.8 kg/m 66 %
Air permeability comparison 空气磁导率比较 Air-permeable surface 空气磁导表面 RS open surface = 100% RS开曲面= 100%	22 % 100 %	12 % 53 %	12 % 53 %	31 % 142 %	53 % 246 %	31 % 142 %	53 % 246 %
Tensile force comparison 拉伸力比较 Link plates transferring tensile forces 链接板块转移拉力 RS tensile force = 100% RS张力= 100%	28 % 100 %	48 % 171 %	48 % 171 %	48 % 171 %	28 % 100 %	48 % 171 %	28 % 100 %
Surface pressure comparison on guide bed, bearing surface per m RS bearing surface = 100% Surface pressure w. 10 kg glass/m	6910 mm² 100 % 0.03 N/mm²	12030 mm² 174 % 0.018 N/mm²	12030 mm² 174 % 0.018 N/mm²	7797 mm² 113 % 0.024 N/mm²	4479 mm² 65 % 0.036 N/mm²	5848 mm² 85 % 0.03 N/mm²	3359 mm² 49 % 0.046 N/mm²

导床上表面压力比较，每米承载表面
RS表面轴承=100%
表面压力w.10kg玻璃/米

Advantage: individual construction 优势：单件结构

Compared to other providers, Renold not only offers 1.5 mm link plates in several different constructions, but also 2 mm link plates with six additional construction combinations. This is the largest range of inverted tooth chain versions worldwide. The possibilities are virtually endless.

This wide range of configuration options only provides an advantage in combination with knowledge about critical factors. The main objective is usually to implement a suitable compromise for systems and the products to be manufactured. In addition to the specific functionality of the inverted tooth chain, existing installation situations, and belt cooling requirements, the type and properties of the product itself play a key role. Often, individual testing, combined with specific experience, is required to find the best solution. Rely on advice from our experts: deciding on the perfect system is their daily business.

与其他供应商相比，Renold不仅提供了1.5毫米几个不同的结构链接板块，而且还有2毫米链接板块带六种额外的结构组合。这是全球最大的齿形链版本范围。可能性几乎是无止境的。
结合知识得到大范围的配置选项对至关重要因素提供了优质的保障。主要目标通常是对系统和产品制造实现一个合适的妥协。除了齿形链的特定功能，现有的安装情况，和冷却带需求，产品的类型和属性本身起着关键的作用。通常，单独测试，需要结合具体的经验找到最好的解决方案。依靠我们的专家的建议：决定完美的系统是他们日常业务。

Individual construction/Toothed chain types单独结构/齿形链类型

RS = Standard for universal use. Suitable for medium-sized and large products. Air permeability approx. 22%.
普遍使用的标准。适合中型和大型产品。空气渗透率约22%。

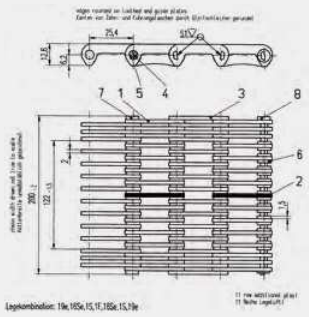
RT/RD = For small glassware and products prone to tipping. Air permeability approx. 12%. Limited belt cooling.
对于小玻璃器皿和容易引爆的产品。空气渗透率约12%。皮带冷却有限。

TT/ET = Suitable for universal use, also for small glassware and products prone to tipping thanks to a level surface. Air permeability approx. 31%. Good belt cooling.
适用于普遍使用，也为小玻璃器皿和由于水平表面容易引爆的产品。空气渗透率约31%。皮带冷却良好。

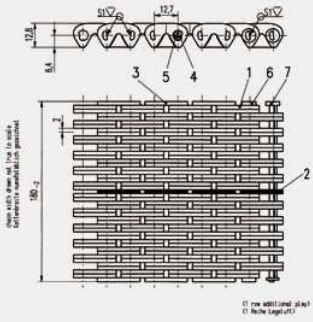
TS/ES = For medium-sized to large products. Air permeability approx. 53%. Excellent belt cooling. Highly suitable for glasses with a solid base or large volume.
中型到大型的产品。空气渗透率约53%。皮带冷却优秀。高度适合坚固底座玻璃或大批量。

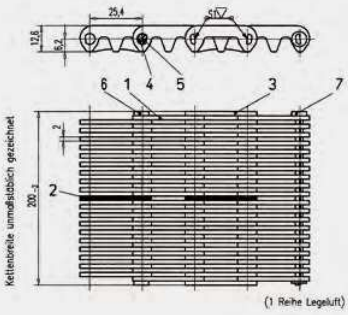
Inverted tooth chain layout 齿形链布局

These design examples illustrate the wide variety of customization options for inverted tooth conveyor chains to implement highly specific functions.
这些设计实例说明了各种各样齿形输送链的定制选项来实现高度特定功能。

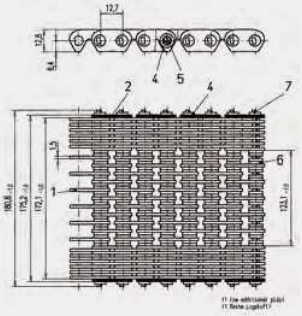


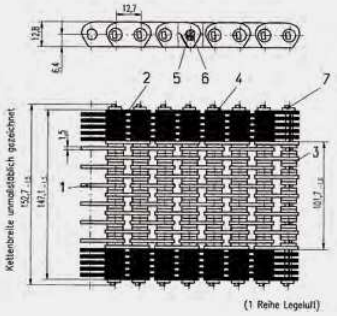
Design example 设计例子
Special layout combining high tensile force and an air-permeable surface.
特殊的布局结合高张力和透气表面。





Design example 设计例子
Special layout for tightly configured chains with a homogenous surface; improved cooling with extended pitches.
特殊的布局与同质表面紧密连锁配置；改善冷却，加长节距。





Design example 设计例子
Special layout combining tensile force and an open surface with areas for decreased surface pressure.
特殊的布局结合表面张力和开放的表面压力下降区域

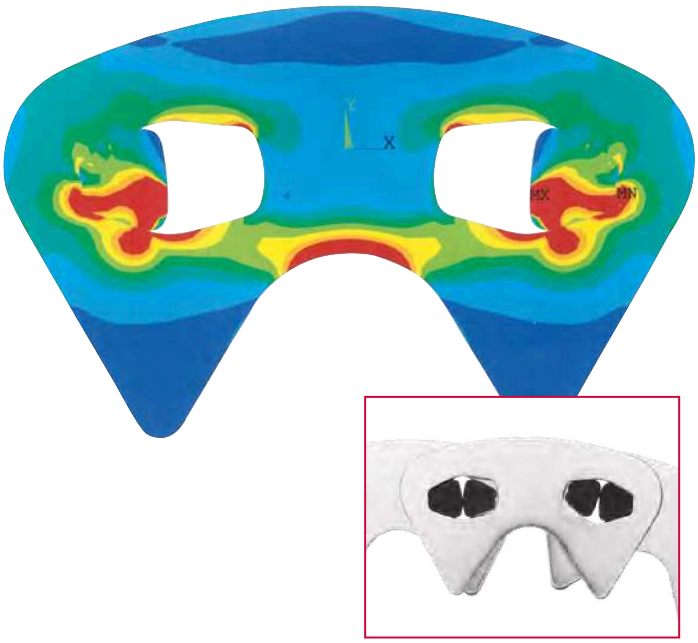
始终最适用于您的应用
Always the best for your applications

Targeted innovations and dedicated service guarantee the best for your applications

目标明晰的创新和热情周到的服务，始终保证达到最佳的应用成果

Our internationally active expert teams for product development and industry solutions help you reach your goals
我们拥有致力于产品开发和行业解决方案、充满活力的国际专家团队，其丰富专业的经验定能助您一臂之力

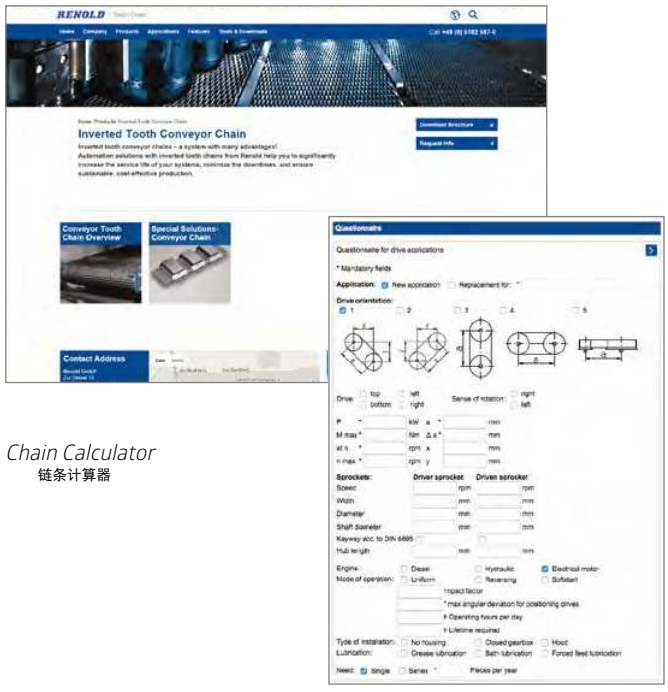
Because requirements change, improvements are always possible, and a technological edge can mean the world, we strive to create even better solutions, day in and day out. Our customers should rest assured that they are receiving the best support and that their inverted tooth chain technology is nothing less than state of the art. We focus on continuous improvements in power transmission, perfecting synchronization, and cutting wear to a bare minimum.
需求会时刻发生变化，所以必须始终抢先一步，技术上的领先优势是未来的保障，我们每天致力于解决方案的改进。我们的客户需要始终获得最好的服务和“最先进”的齿形链技术。同时，我们专注于最高的功率传输和最好的同步性，并力争将磨损降至零。



Optimization of link plates
齿板优化

- Industry-specific product innovations 行业特有的产品创新
- Components with needs-based add-ons 可个性化调整的标准组件
- Customer-specific overall solutions 根据客户自定义设计的整体解决方案

Using the latest technical methods and field-specific knowledge needed for the customers' tasks, we calculate and develop the most suitable configuration. Inverted tooth chains and sprockets are perfectly matched throughout our planning. Consult our online Chain Calculator as a first step toward the perfect inverted tooth chain solution. Take advantage of this online tool for your query or drive layout!
我们利用最现代化的技术方案和特定行业知识用于客户任务，我们计算和开发最合适的配置。在整个设计中，使齿形链和链轮完美协调。我们网站提供的链条计算器是您选择正确齿形链解决方案的第一步。此在线工具用于查询或进行传动器设计！



Chain Calculator
链条计算器

In dialog with our customers
与我们的客户保持沟通

经过实践证明的专业知识和一流的产品组合是基础
Based on proven expertise and a first-class product portfolio

Our understanding of cooperation goes well beyond the boundaries of individual projects. We are constantly in dialog with our customers and are always a competent contact for both technical and economic questions. Our cross-technology expertise creates the solid foundation for our work.
我们对合作的理解远远超过单个项目范围．我们不断与客户保持沟通，在技术和经济上，我们始终保持密切的行动，并与我们的客户确保技术领先优势。

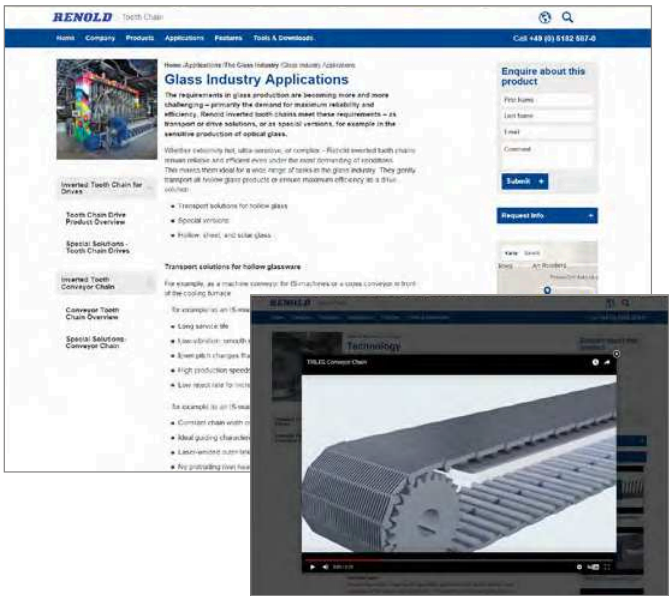
- Inverted tooth conveyor chains 齿形输送链
- Inverted tooth drive chains 齿形驱动链

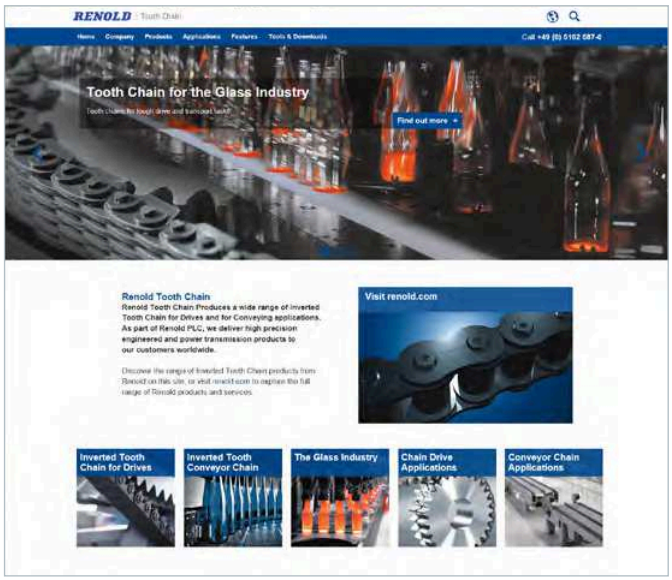
Understanding our customers allows us to respond more quickly and gives us a head start in achieving tailor-made solutions. Thus, we always remain close to the action and ensure the technological lead for our customers.
通过相互推动，我们比他人先一步接近符合需求的解决方案．因此，我们始终保持密切的行动，并为我们的客户确保技术领先优势。

全天候的信息服务
Around-the-clock information

The Renold Internet Portal never sleeps. Our Internet pages contain a wide variety of technical details for our product spectrum.
Renold门户网站全天候为您服务。在我们的网站上，可获取产品范围信息和大量详细的技术信息

- Product highlights 产品亮点
- Internet platform with online tools 拥有在线工具的互联网平台





RENOLD | Tooth Chain

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Your Contact:

The data specified only serve to describe the product. No statements concerning a certain condition or suitability for a certain application can be derived from our information. The information given does not re-lease the user from the obligation of own judgment and verification. It must be remembered that our products are subject to a natural process of wear and aging.

For local support contact your local Renold sales team, visit www.renold.com or call +44 161 498 4600

RTC/R418016399/2016-07/EN Subject to change. Printed in Germany.
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