



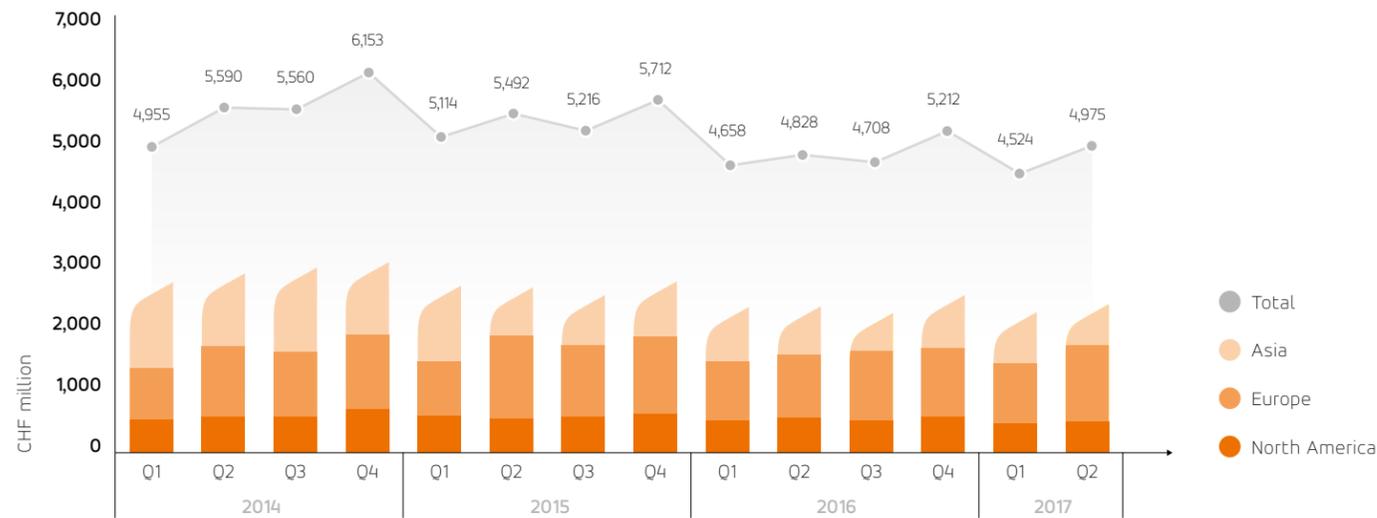
TORNOS

*We ensure
your success,
time after
time, to the
tiniest detail*

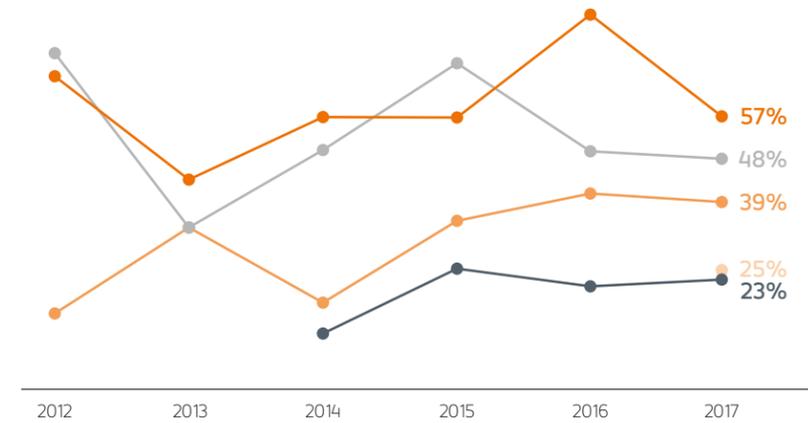
MICROMECHANICS

Swiss watch exports (CHF m)

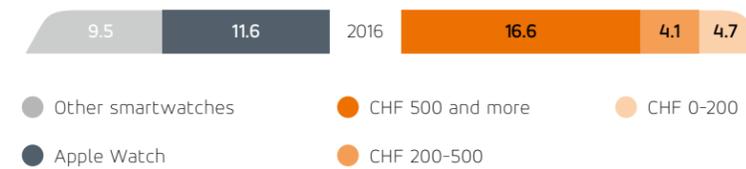
Asian, North American and European markets



Source: The Deloitte Swiss Watch Industry Study 2017 | It's all about digital



Source: The Deloitte Swiss Watch Industry Study 2017 | It's all about digital



Source: The Deloitte Swiss Watch Industry Study 2017 | It's all about digital

Top five external risk factors

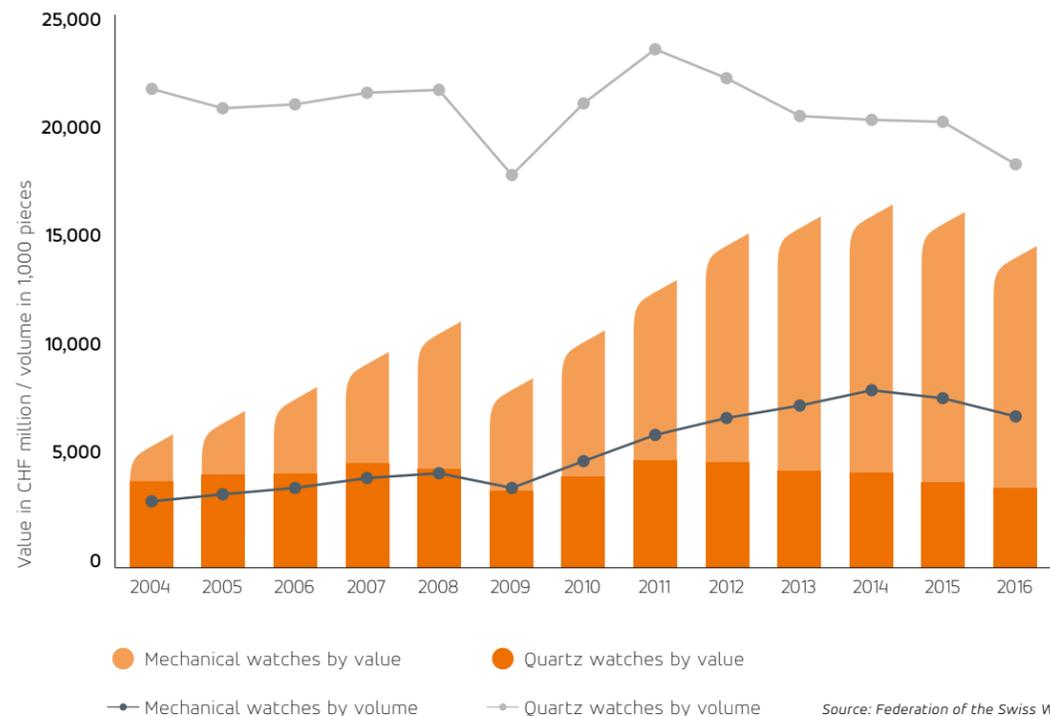
according to the watch executives surveyed

- Strength of the Swiss franc
- Weaker foreign demand
- Weaker domestic demand
- Smartwatches as a competitive threat
- Implementation of the revised Swiss Made legislation (First asked in 2017)

Shipments of smartwatches vs Swiss watches (in m units)

Swiss exports of mechanical and quartz watches

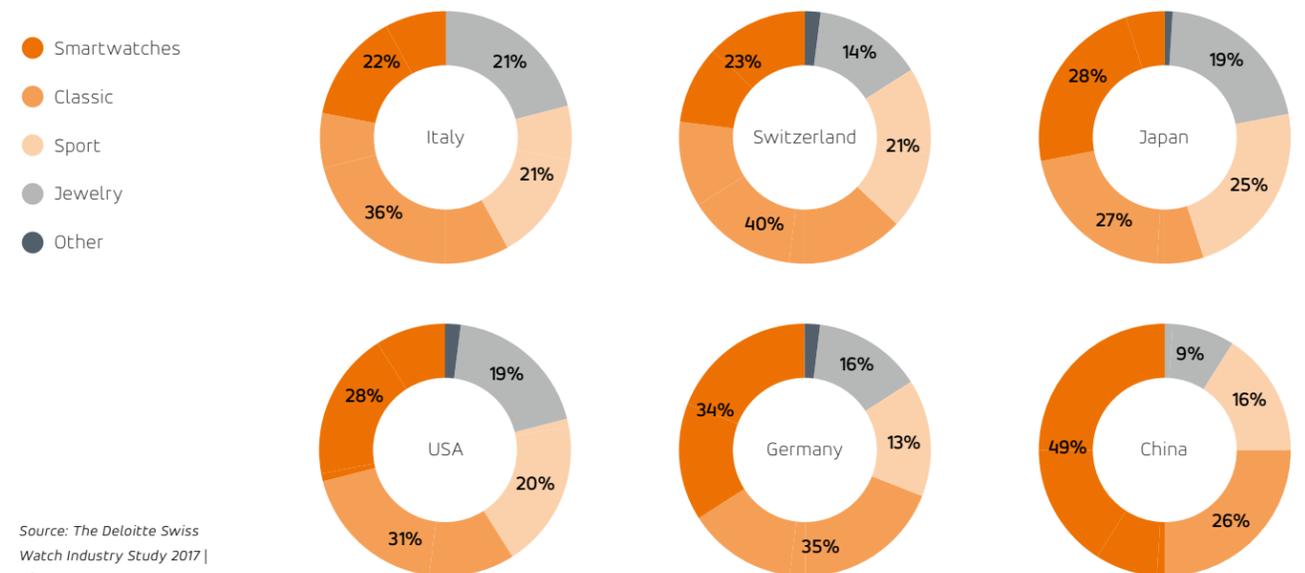
by value (CHF m) and volume (in 1,000 pieces)



Source: Federation of the Swiss Watch Industry FH, Deloitte analysis

Watch buyers' purchase intention

What kind of watch are you most likely to buy in the next 24 months?



Source: The Deloitte Swiss Watch Industry Study 2017 | It's all about digital

Time for transformation

WATCHMAKERS FACE BOTH OPPORTUNITIES AND CHALLENGES DUE TO KEY MEGATRENDS, FROM GLOBALIZATION TO CHANGING DEMOGRAPHICS TO DYNAMIC TECHNOLOGICAL INNOVATION.

Globalization, changing demographics, dynamic technology and innovation.¹ They're all megatrends: transformative global forces that define the future world with their far-reaching impact on businesses, societies, economics, culture and personal lives. They have the potential to disrupt even the most deeply rooted industries and micro-mechanics—which includes the watchmaking industry—is no exception.

Emerging from a slow growth period, the Swiss watchmaking industry today is asserting its relevance in an increasingly digital world. At the same time, the industry is under pressure to cope with the many challenges of globalization while satisfying both its longtime customers and new, empowered and tech-savvy consumers. A handful of megatrends present both opportunities and challenges for watchmakers.

Globalization

Defined as the increasing internationalization of markets for goods and services, the means of production, financial systems, competition, corporations, technology and industries², globalization is no new trend. In fact, globalization, travel and time-keeping have been longtime companions, as evidenced by John Harrison's 18th century

invention of the marine chronometer, making accurate celestial navigation a reality. The early to middle 20th century brought with it the advent of air travel—and globalization as had never been seen before.³ An emerging “jet set” needed to keep track of time across worldwide time zones and the Swiss watchmaker Louis Cottier in the 1930s stepped up with a mechanism to display all of the world's 24 main time zones on a single watch dial.⁴

Today, globalization and the growth of future markets continue: Worldwide exports are expected to triple by 2030, and it is anticipated that exports from emerging and developing economies will quadruple by 2030. While Swiss watchmakers produce only 30 million watches per year—2.5 percent of the world's timepieces—they account for more than half of the luxury watch sector. More than 95 percent of the watches with price tags greater than CHF 1,000 (USD \$1,000) are manufactured in Switzerland⁵. Even with that global dominance, the Swiss watchmaking industry confronts globalization-related challenges. Case in point: After tremendous 2010-2013 growth spurred largely by strong demand from prosperous emerging markets, particularly China, Swiss watch exports began to stumble in 2015, due in great part to a significant fall in sales to Asia⁶.

World population is expected to grow 18 percent (1.2 billion people) by 2030

Additionally, the strength of the Swiss franc,⁷ spurred by the Swiss National Bank's 2015 decision to abandon the exchange rate floor between the Swiss franc and the euro, has pushed up Swiss watchmakers' costs in contrast to their earnings. At the same time, diverging currency movements opened gaps in prices between the same luxury watches in various countries, leaving open the door for watch buyers to arbitrage: simultaneously buy and sell luxury timepieces to profit from those price discrepancies.⁸

The good news is that Chinese demand is rebounding and the industry appears to be on its way to recovery, with the Federation of the Swiss Watch Industry reporting a 9 percent increase in shipments (1.7 billion francs/USD \$1.8 billion) in May 2017. Exports to China soared 34 percent—the third month of growth surpassing 30 percent—and exports to Hong Kong rose 18 percent.⁹ Watch industry executives expect the United States and India to be the next big growth markets, as the US economy appears to be performing well with growth and consumer spending continues to increase. In parallel, India has shown strong economic growth in recent years: GDP grew by 7.2 percent and 7.3 percent in 2014 and 2015 respectively. Others believe the potential for this market could be longer term.¹⁰

Changing demographics

The global population is growing and aging, again presenting both opportunities and challenges for watchmakers. World population is expected to grow 18 percent (1.2 billion people) by 2030, with population in developing nations growing six times faster than that of developed countries¹¹. New affordable luxury watch brands are emerging to challenge the old guard and position themselves to serve consumers in developing countries that are trading up for more luxurious timepieces as well as consumers in developed nations who are trading down from traditional luxury brands.

At the same time, life expectancy is rising. By 2030, half of the world's population will be older than 33.1 years.¹² As life expectancy increases, so will the median age, reaching 43.7 years in developed countries, and the 60-plus age group will gain a stronger foothold as a customer constituency. More of the working population will be older than 60, so it will be important for organizations to adapt structures and processes to exploit their experience to the greatest degree.¹³

Millennials—the generation born between 1980 and 2000 and also known as Generation Y—are moving into their prime spending years and, at the same time, taking their place in the global

¹ Roland Berger Strategy Consultants, *Trend Compendium 2030*

² United Nations, European Commission, International Monetary Fund, Organisation for Economic Co-operation and Development, United Nations Conference on Trade and Development, World Trade Organization, *Manual on Statistics in International Trade in Services* (New York: United Nations, 2002), 182

³ Sotheby's, *In the loupe*, “The Indispensable World Time Wrist Watch,” January 2, 2015, <http://www.sothebys.com/en/news-video/blogs/all-blogs/in-the-loupe/2015/06/indispensable-world-time-wrist-watch.html>

⁴ Forbes, “The World of Worldtimer Watches”, June 17, 2015, <https://www.forbes.com/sites/msolomon/2015/06/17/best-worldtimer-watches-2015-gmt-utc-world-time-watches/#3912054e9ea3>

⁵ swissinfo.ch Baselworld 2017 coverage, “Six things you should know about the Swiss watch industry,” March 22, 2017. https://www.swissinfo.ch/eng/business/baselworld_six-things-you-should-know-about-the-watchmaking-industry/43038180

⁶ Deloitte AG, The Deloitte Swiss Watch Industry Study 2016: Navigating through stormy waters, 4

⁷ F&D, International Monetary Fund, “Double-Edged Sword: A more integrated global economy is affecting workers around the world,” December 2016, 22

⁸ Financial Times, “How watchmakers coped with the rising Swiss franc,” November 14, 2015. <https://www.ft.com/content/ec3a2a92-6da4-11e5-8171-ba1968cf791a?mhq5j=e1>

⁹ Bloomberg, “Swiss Watch Exports Jump Most In Four Years On Asia Recovery,” June 22, 2017. <https://www.bloomberg.com/news/articles/2017-06-22/swiss-watch-exports-jump-most-in-four-years-on-asia-recovery>

¹⁰ Deloitte AG, The Deloitte Swiss Watch Industry Study 2016: Navigating through stormy waters, 4

¹¹ Euromonitor International, “Watches 2016 and Beyond: How Will Asia Move From Here?” January 6, 2017. <http://blog.euromonitor.com/2017/01/watches-2016-and-beyond-how-will-asia-move-from-here.html>

¹² Roland Berger Strategy Consultants, *Trend Compendium 2030*, Demographic dynamics, 12

¹³ Ibid., 24

The digital economy is here

workforce. In general, they are educated and tech savvy, having come of age during a period of technological change, globalization and economic disruption¹⁴—giving them a different set of behaviors than other generations and presenting challenges and opportunities to employers and retailers, including the watchmaking industry.

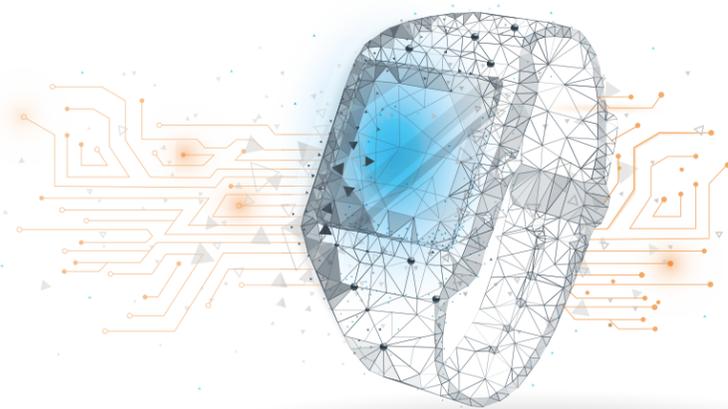
Dynamic technology and innovation

Disruptive and sustaining innovations, most of which are technology-based, are changing the world. It is well established that innovation drives wealth and, increasingly, innovations are being

diffused faster. For example, studies show that it took 45 years for 25 percent of the US population to adopt electricity after it was introduced in 1873 and it took 16 years for the same percentage of the US population to adopt the personal computer after its 1975 introduction. In contrast: 13 years for the mobile phone, seven years for the World Wide Web, and four years for Facebook.¹⁵

The digital economy is here and influencing a wide range of industries—including watchmaking—and their ways of doing business, from production and distribution to marketing and how they serve customers. Bloggers and social media have increasing influence over consumers' buying decisions, particularly the purchasing decisions of young people, and social media is now one of the most important elements of watch companies' marketing strategies.¹⁶

Dynamic technology and innovation are also giving rise to new partnerships between luxury watchmakers and technology companies, as well as virtual reality worlds in which watchmakers showcase their products, and individualized, bespoke products. Global management consulting firm McKinsey predicts that by 2025, online purchases of luxury goods will account for 18 percent of sales across all categories, triple today's figure.¹⁷ Watchmakers clearly are branching out to stake their claims to a share of the digital timekeeping landscape, and transforming the industry.¹⁸



¹⁴ Forbes, "How Millennials Are Changing Retail Patterns," January 23, 2017. <https://www.forbes.com/sites/tommcgee/2017/01/23/the-rise-of-the-millennial/#117048d15f74>

¹⁵ Roland Berger Strategy Consultants, Trend Compendium 2030, Dynamic technology and innovation, 11

¹⁶ Deloitte, "Digitalisation unlocks new opportunities for Swiss watchmakers," March 23, 2017. <https://www2.deloitte.com/ch/en/pages/consumer-industrial-products/articles/swiss-watch-industry-goes-digital.html>

¹⁷ Financial Times, "High-end watch brands finally embrace the digital market," November 14, 2015. <https://www.ft.com/content/7f-fa86f6-6c2d-11e5-8171-ba1968cf791a?mhq5j=e1>

¹⁸ Ibid.

We keep you turning

Tornos has long been part of Switzerland's watchmaking heritage. Indeed, our history began with the industry's first steps into the industrialization of horological components, such as the movement screw in the 19th century. Today, Tornos delivers the same degree of commitment that led the art of watchmaking into the modern industrial world.

Just as Swiss watchmaking is renowned for its precision, quality and reliability, Tornos is known worldwide for its know-how and the quality of its Swiss-type machines.

Our bar turning expertise is evidence of the key role we play in a network of toolmakers, machine manufacturers, subcontractors, factories and watchmaking groups. In recent years, the watchmaking industry's production tool requirements have evolved, and Tornos has responded effectively with success-triggering workflow solutions—machines, software and services.

Production tools for watchmaking must be compact, able to work round the clock, and deliver ease of use while ensuring best value for the investment. These challenges have motivated our development as an ever-stronger partner to the watchmaking sector.

With our deep expertise in both micromechanics and electronics, Tornos has the workflow solutions to support you across a broad range of horological applications, from traditional mechanical watchmaking to hybrids and smartwatches. We are relentless in our drive to advance our technologies, products, software and services so that you experience uncompromising precision, master complexity and deliver highest quality at the best price.

Look to us for:

- more than 125 years of experience in the field of the watchmaking, along with automatic single- and multispindle solutions to satisfy your needs for quality and precision
- feasibility studies and technical expertise to help you judiciously choose the machine best aligned to your particular needs
- best possible machining conditions, thanks to ergonomics and accessibility in the context of your applications
- top-quality parts, thanks to our advanced technology guaranteeing high added value, an important factor in your watchmaking environment
- high-precision results and machine: We achieve ± 0.001 mm precision
- experience with integration of processes such as gear hobbing (up to three gear-hobbing devices can be installed on our machine), in-machine decoration, milling and engraving

We invite you to discover our professional, specialist solutions by contacting us or simply visiting tornos.com.



Smartwatch

Material

Diameter (in mm)

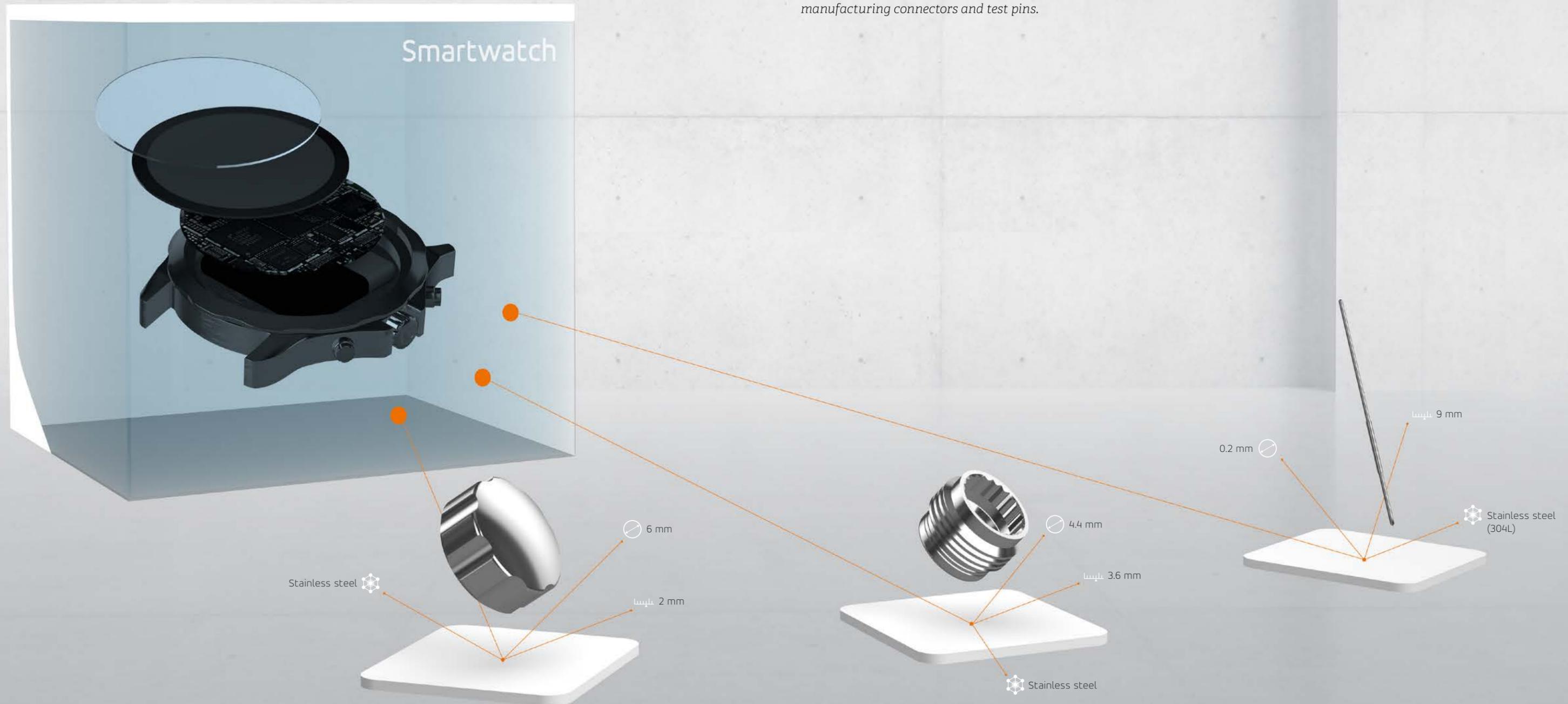
Length (in mm)

SMARTWATCHES ARE TAKING ON EVEN GREATER IMPORTANCE IN TODAY'S FAST-PACED WORLD. FOR SOME USERS, THEY HAVE BECOME A 24/7 COMPANION. SMARTWATCHES PRESENT UNIQUE MANUFACTURING CHALLENGES: THEY REQUIRE IMMACULATE PERFECTION IN THEIR FINISHING.

At the same time, smartwatch buttons, casings and crowns entail the same manufacturing processes as conventional timepieces. Given our experience in micromechanics, we are the perfect partner for smartwatch producers. Our expertise extends beyond decorative parts: Our electronics expertise makes us your champion when comes to manufacturing connectors and test pins.

Whether the load process is made through a small connector or capacitive charging, you can turn to Tornos for your smartwatch production solutions.

Our single- and multispindle technology solutions make it possible for us to support your high-volume production.



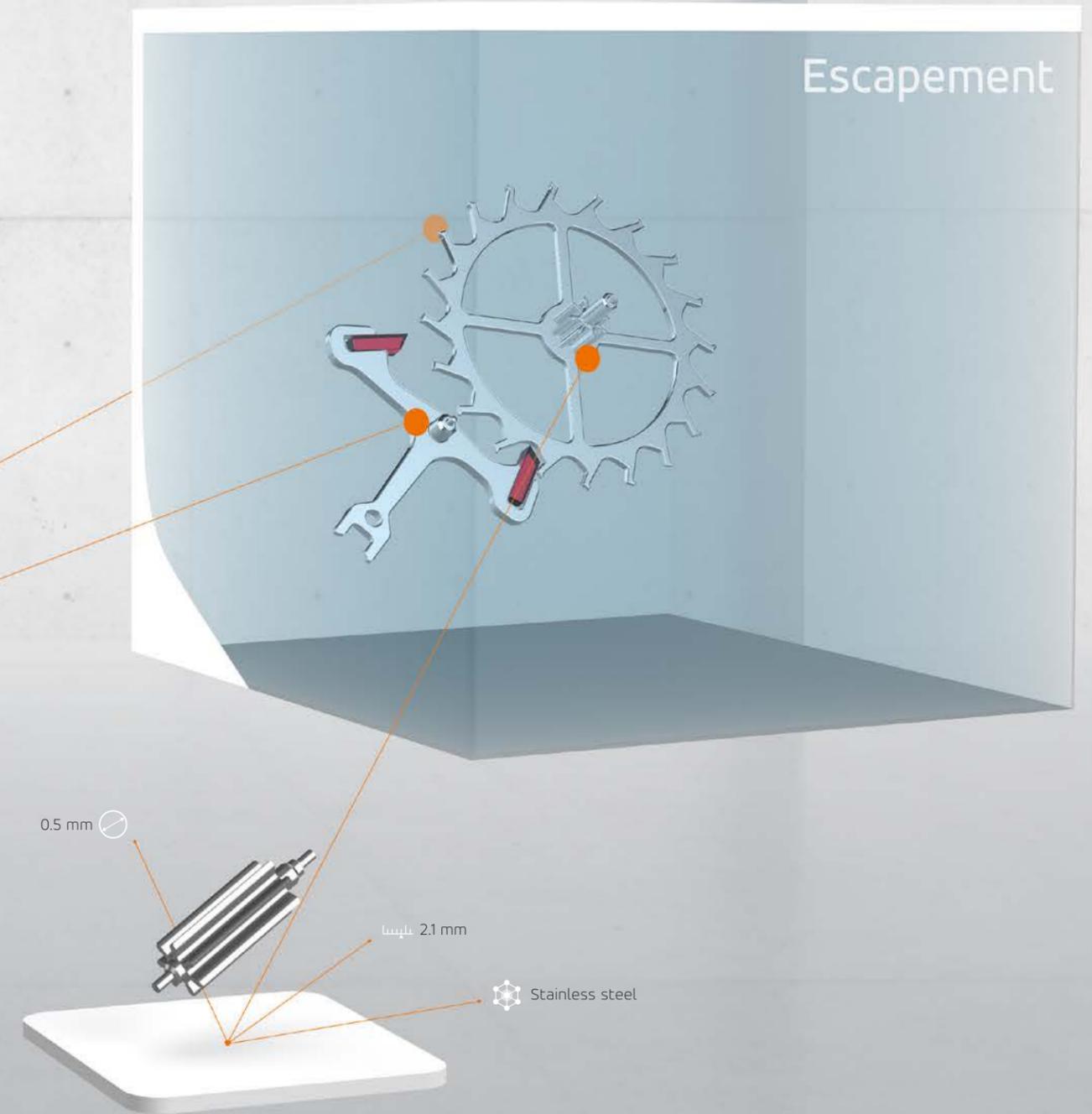
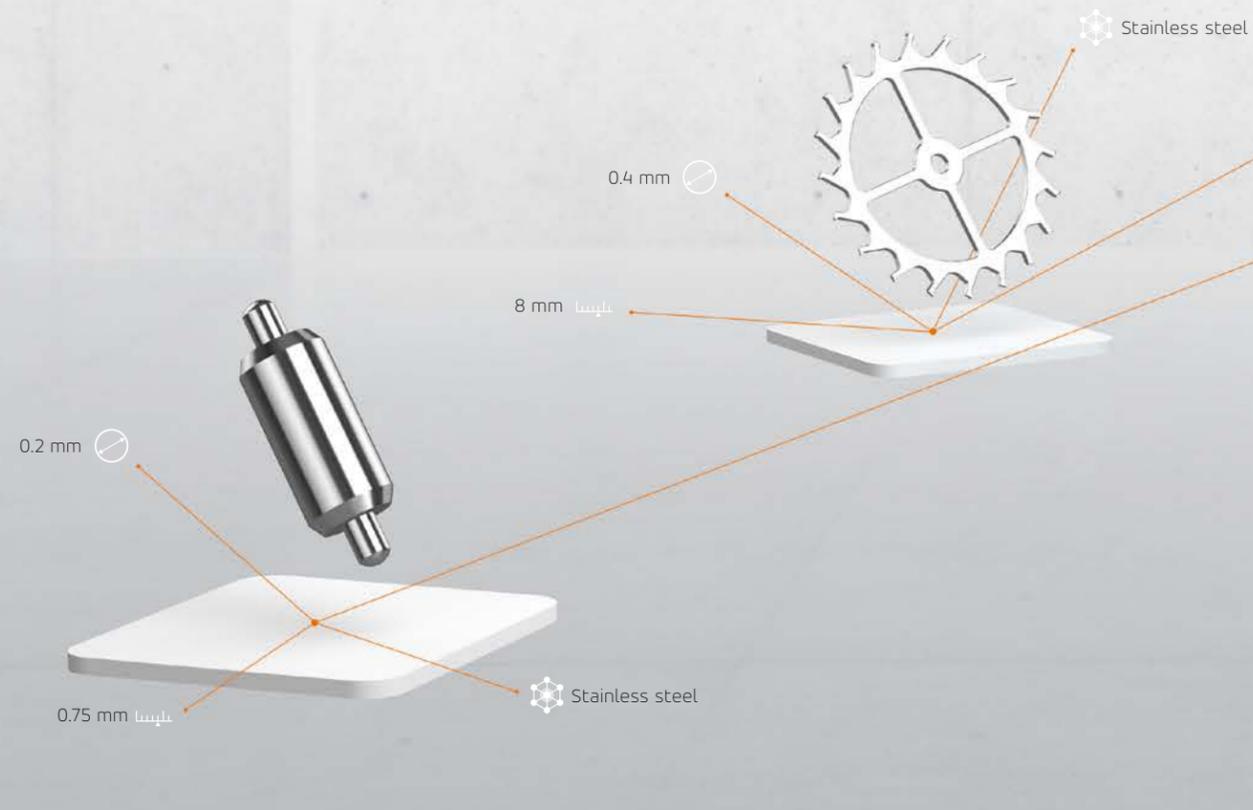
Orchestrate your production to the second

THE ESCAPEMENT CHANNELS THE ACCUMULATED ENERGY INTO THE SPRING AND IS ESSENTIAL TO THE PRECISION OF THE WATCH. THE ENERGY IS TRANSMITTED CONTINUOUSLY BY THE MAINSPRING PORTIONED INTO REGULAR UNITS IN ORDER TO COUNT THE TIME.

The escapement allows transformation of this energy received into pulses. Without this component, the wheels would turn too quickly and the spring would be disarmed in seconds.

The escapement makes the connection with the regulating component and distributes the pulses to the pendulum.

The anchor receives the force of the mainspring thanks to the impulses of the anchor wheel. The role of the anchor is to transform the circular movement of the wheel into an alternative movement to animate the pendulum. It performs a rocking movement and produces the "tick" and "tock" that is heard when a mechanical watch works.



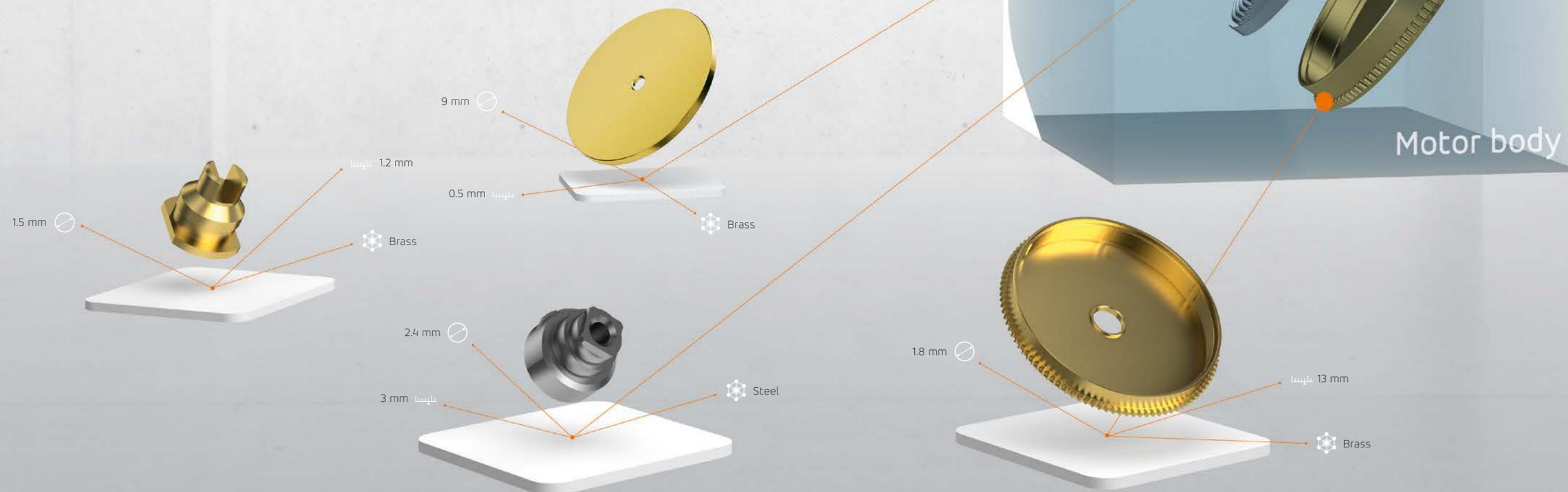
Keep your production moving

TORNOS DELIVERS UNIQUE EXPERTISE—INCLUDING GEAR CUTTING—TO SUPPORT YOUR PRODUCTION OF THE VAST MAJORITY OF WATCH COMPONENTS AND DRIVE THE ENGINE OF YOUR PRODUCTION.

To operate, a mechanical watch needs energy. This is provided to the mechanism by a spring which is tightened during the winding of the watch. This motor spring is housed in the cylinder—the barrel—and its teeth are often made with single- or multispindle technology. The spring under the action of the winder device comes rolling around the barrel shaft, accumulating and storing the necessary force to make the watch work. Once reassembled, the spring will resume its initial shape and relax, producing the energy necessary for the operation of the watch.

The barrel and its drum are in solidarity with a cog wheel meshing with the cogs of the movement.

As the link between a watch's exterior and interior, the winding stem is manipulated by pulling, pushing and turning at the crown in order to set the mechanical movement. Where the crown is attached to the case, the winding stem is precisely threaded—another demonstration of Tornos' micromechanics expertise. In addition to the winding stem, Tornos' know-how helps you machine a variety of watch components:



Perfect oscillation

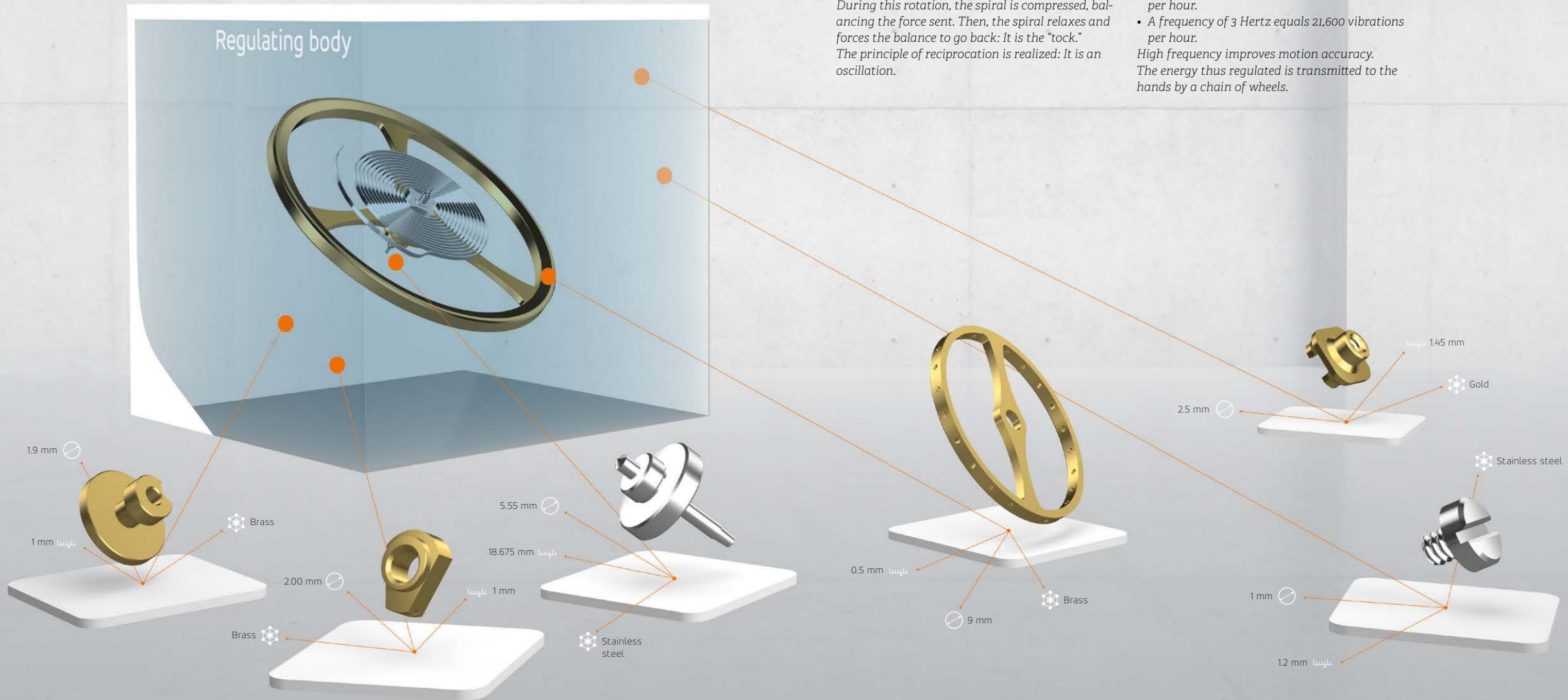
A PERFECT BALANCE STAFF FOR FLAWLESS OSCILLATION: THE BALANCE AND SPRING ASSEMBLY ARE THE TRUE HEART OF THE WATCH. THE BALANCE REGULATES THE PASSAGE OF TIME THANKS TO ITS OSCILLATIONS AND IS RESPONSIBLE FOR THE PRECISION OF THE WATCH.

It consists of a two - or three-arm balanced armature statically balanced coupled with a spiral (steel) spring thinner than a hair. The pendulum performs a circular to and fro movement and divides the time into equal units. The anchor gives the impulse to the escape wheel to make a rotation: It is the "tick." During this rotation, the spiral is compressed, balancing the force sent. Then, the spiral relaxes and forces the balance to go back: It is the "tock." The principle of reciprocation is realized: It is an oscillation.

A new pulse is then given by the anchor. An oscillation is thus made of two alternations. The frequency is the number of oscillations in one second. This term often qualifies the caliber of a watch; it is expressed in hertz or in alternations per hour:

- A frequency of 2.5 hertz equals 18,000 vibrations per hour.
- A frequency of 3 Hertz equals 21,600 vibrations per hour.

High frequency improves motion accuracy. The energy thus regulated is transmitted to the hands by a chain of wheels.

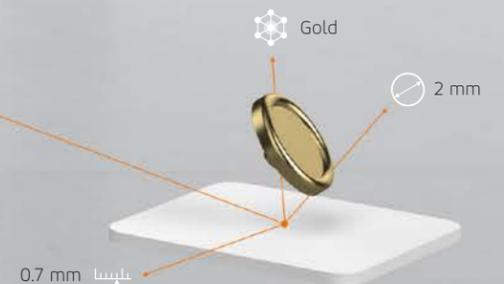
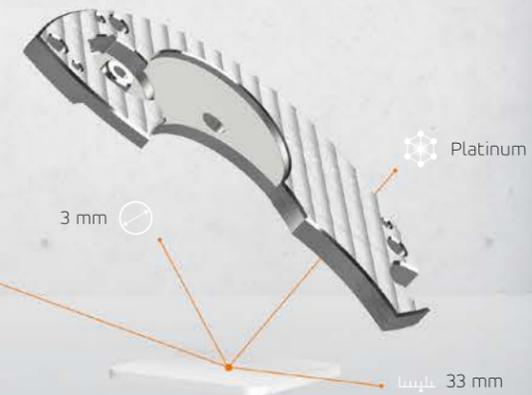
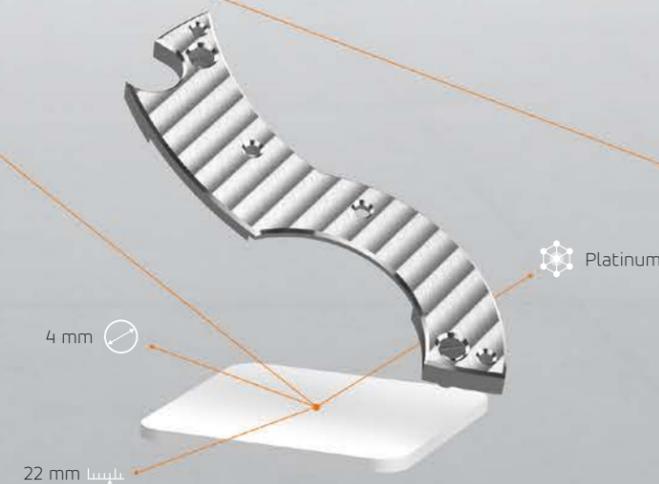
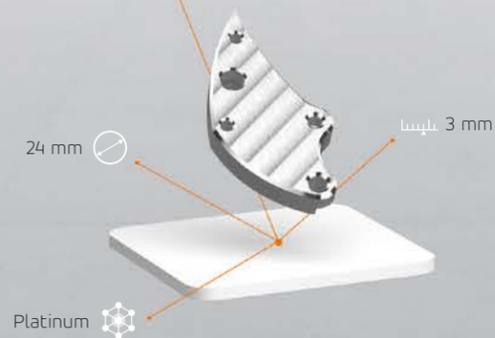
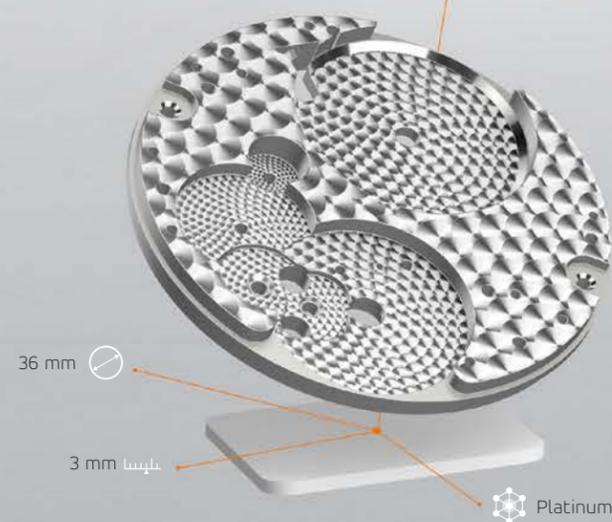
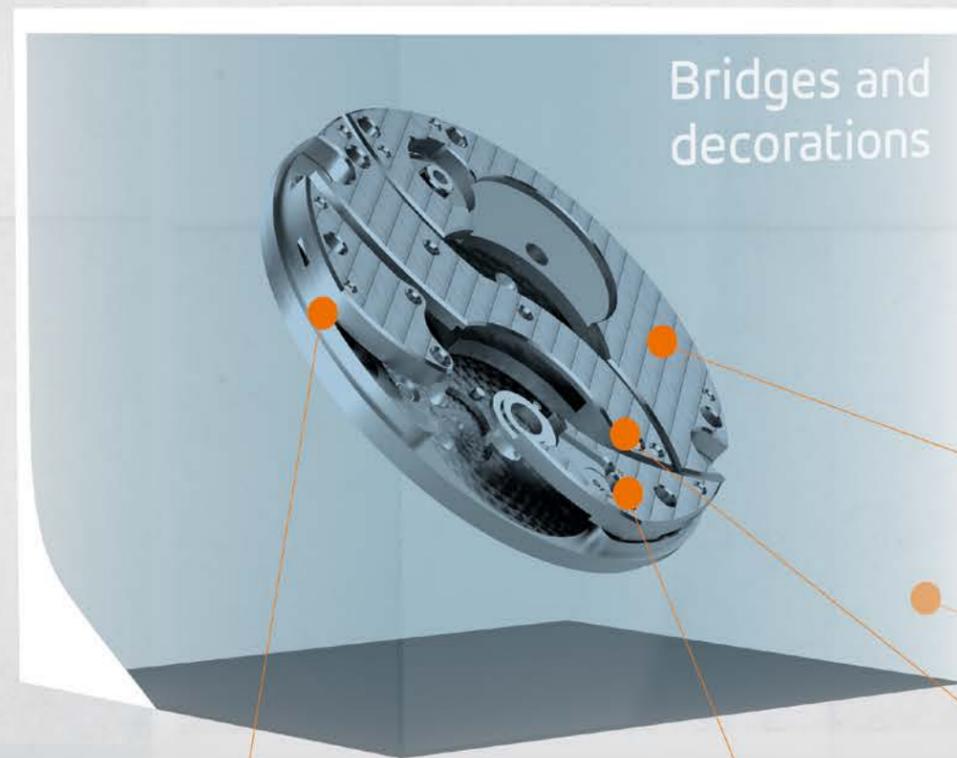


We are the support for your watch production

BRIDGES PLAY THE ROLE OF SKELETON FOR A WATCH.

Bridges have essential roles. They hold the movement all together and are the base of the watch. They are the most visible parts and therefore must be perfect in every angle.

In addition to their functions, they give style to your watch. Tornos specializes in the machining of all types decorations—even the most complex. We can support your beading operations, Guilloché, Geneva coasts, sunshine or even snailing.



We meet our customers' challenges with a legacy of micromechanics expertise.

Your challenges

To reduce its costs and maintain impeccable quality, the micromechanics industry is becoming increasingly insistent that its selected suppliers achieve its performance goals. As a supplier, you are a specialist with advanced knowledge. Your challenges include:

- producing a functional piece of impeccable visual quality
- working with standard deviations below 1 micron
- integrating into your turning process more specific operations like trimming or decoration
- delivering consistently high-quality products in a timely manner
- controlling processes and flows, from raw material to final products; increasingly, your processes include a cascade of many finishing operations under agreement
- managing the versatility of the controls and the evolution of the parts
- reacting quickly, since large batches are divided into small series according to your customers' needs, with very short delivery times
- complying with ever-evolving demands in order to ensure your success

Our experience

Tornos is a leader in this field. Thanks to our developments and know-how in the field of watchmaking, we can recommend machining modes for parts from a millimeter in diameter on our single-spindle lathes and four millimeters for our multispindle lathes.

Our knowledge goes from stamping and trimming through to the decoration as well as all the other operations such as chip removal. The objective is to finish the watch components with no errors.

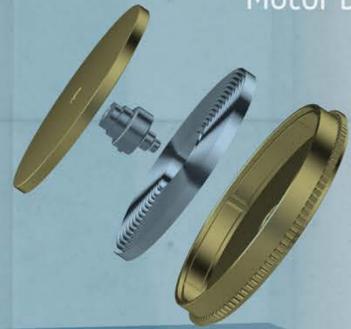
We can advise you on the best solution in terms of machine kinematics and performance as well as equipment and tools.

Thanks to our knowledge, we can offer you the best tools and machining conditions to optimize your cycle times and maximize your productivity.

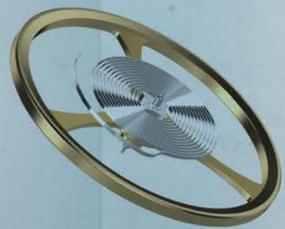
Our experience goes beyond mechanical and quartz watches and extends to support for your production of digital watches (smartwatches).

The bigger your challenge, the bigger your success

Motor body



Regulating body



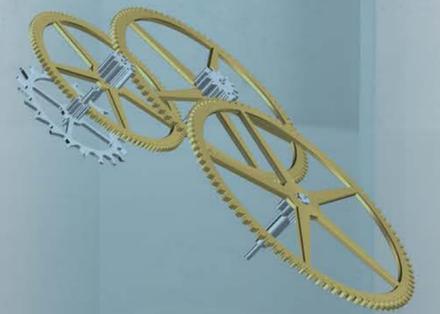
Winding and hand setting mechanism



Bridges and decorations



Gear train



Escapement



Achieving high productivity is a challenge, with many hurdles to overcome, including reducing cost per part, improving process security, shortening cycle times and securing component quality.

With our competitive solutions for reliable, low-cost manufacturing, backed by in-depth application know-how, Tornos is uniquely positioned to drive your success across a broad range of essential micromechanics manufacturing applications.

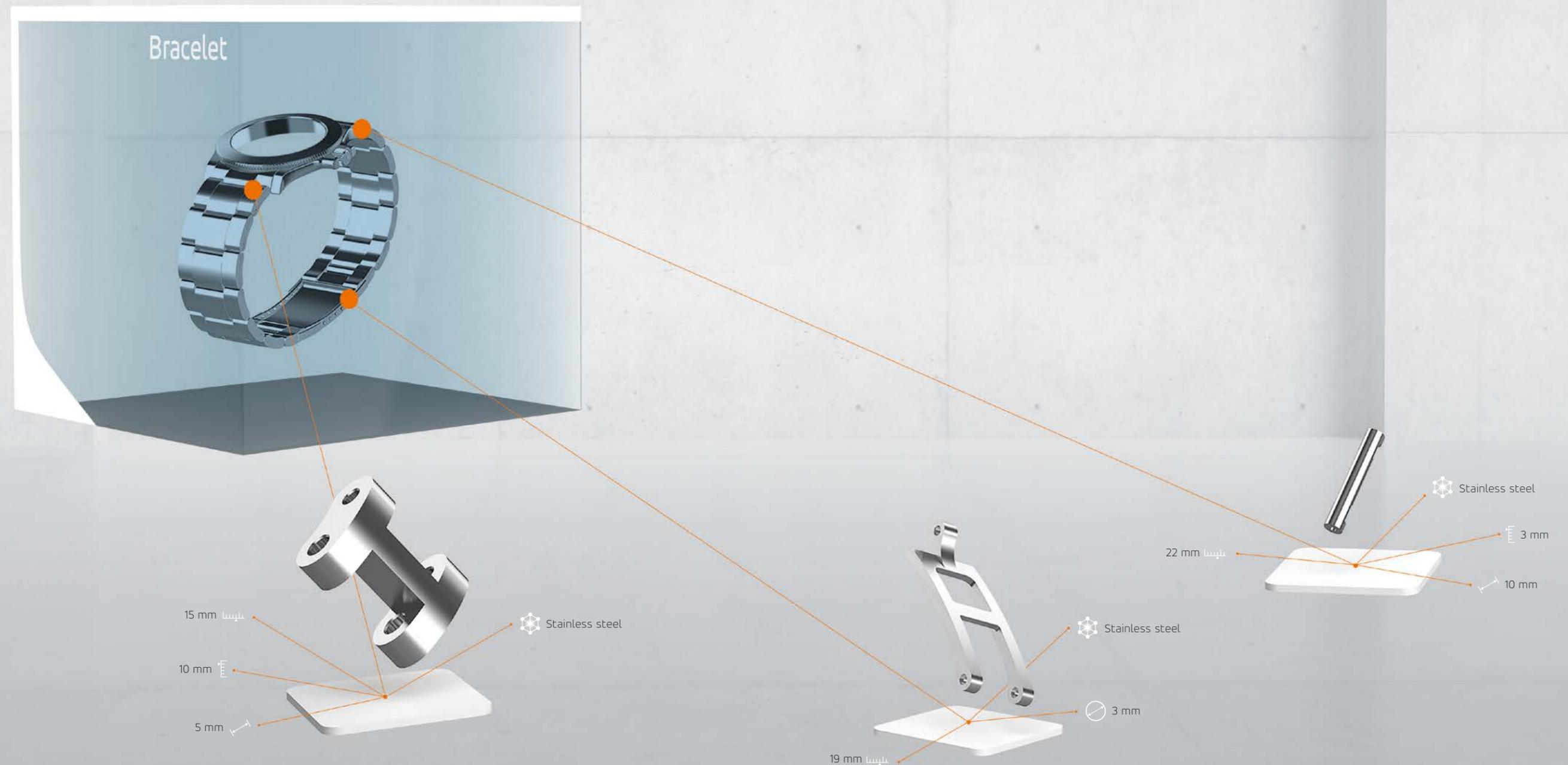


The bracelet and case your watch deserves

WHETHER THE TIMEPIECE IS A LUXURY MECHANICAL WATCH OR A HIGH-END SMARTWATCH, ITS PRECIOUS METAL BRACELET MUST BE VISUALLY PERFECT, ABLE TO SUSTAIN WEAR AND—WITHOUT QUESTION—STAY SECURELY ON THE WRIST.

Machining precious metals for watch bracelets presents all these unique challenges—and more. When machining high-value materials like platinum and gold, manufacturers are faced with the need to maximize recovery of precious metal swarf generated by the machining process.

Tornos' milling machines ensure perfect machining of watch cases, bracelet links, lugs and clasps, and are equally adept at tackling hard materials like stainless steel. Additionally, we offer a solution that can recover 99.7 percent of the precious metal chips in just 20 minutes.



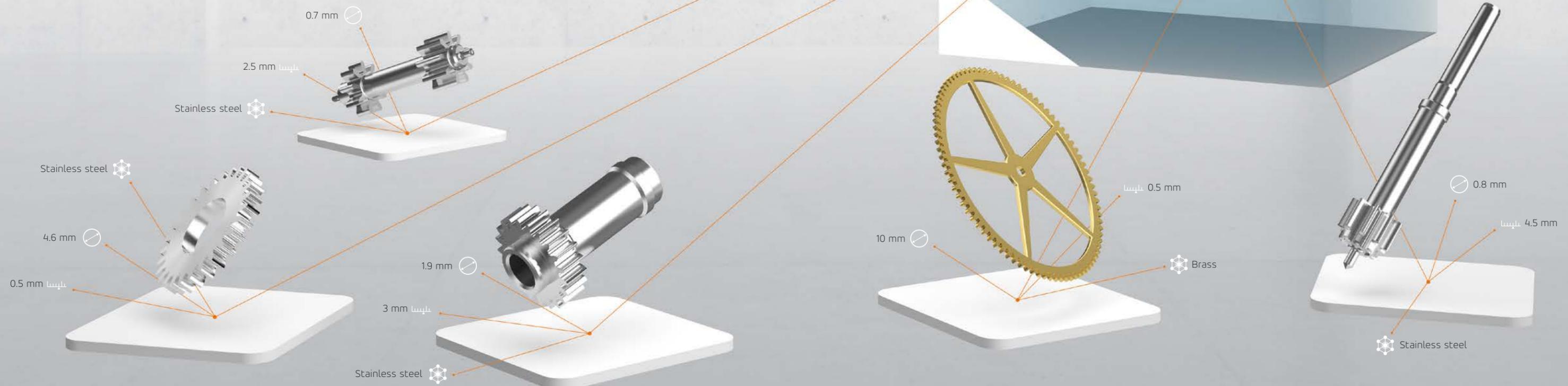
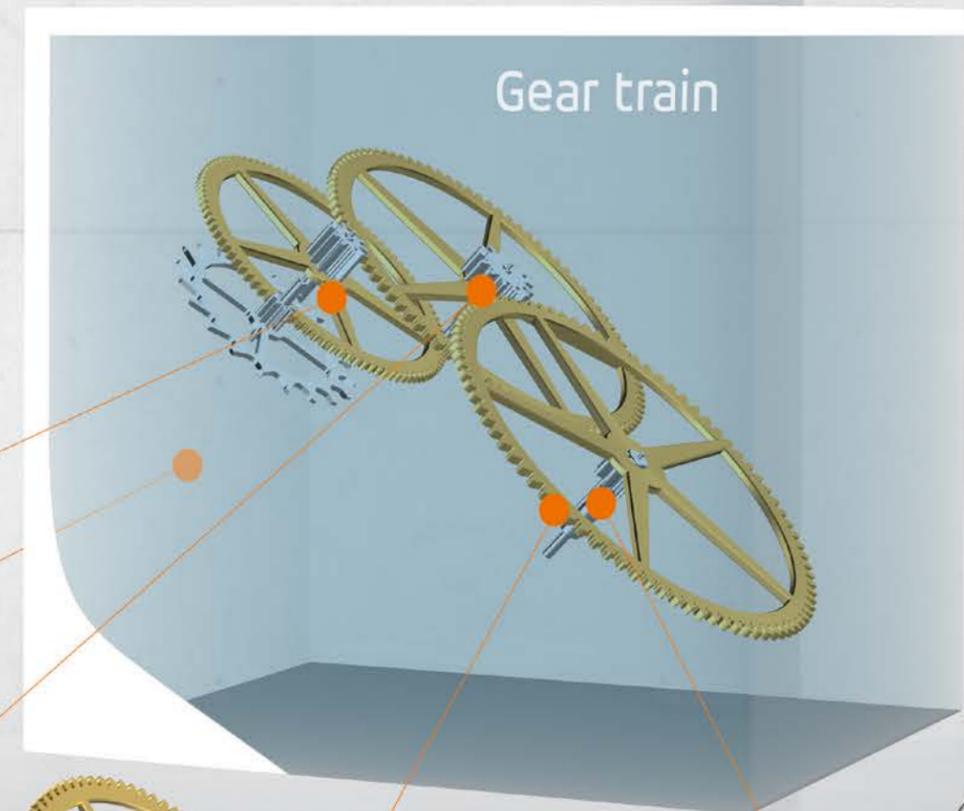
The drive wheel of your production

THE TRANSMISSION SYSTEM OR COG TRANSMITS THE ACCUMULATED ENERGY IN THE BARREL TO THE ESCAPE WHEEL THROUGH THE MOVEMENT FOR PRECISE AND PERFECT TRANSMISSION OF POWER.

Side bridges: Under the action of the spring, the barrel rotates and drives the wheels. The first wheel after the barrel is the center wheel. It is in the center of the movement. This wheel performs one lap in 12 hours, and serves as a support to the hour hand. The second wheel, the middle wheel, is an intermediate wheel. The third wheel indicates seconds on the dial. This wheel can also be found in the center of the movement or at six o'clock on the dial. It performs one turn in 60 seconds and supports the second hand when the watch is equipped with such a hand. These three wheels are brass.

The fourth wheel is the anchor wheel or escape wheel. It lets out the energy conveyed by the wheels to the anchor in an intermittent way. This wheel is very different from the previous three. It is made of stainless steel with an impressive number of shocks in contact with the anchor (on average 21,600 shocks in one hour, more than 518,000 in 24 hours). The shape of the teeth is also very different. This wheel is one of the most difficult and delicate parts of the movement to make—and Tornos has unique experience in this application.

Dial side: The cannon pinion that carries the minute hand is adjusted on the center pinion shaft. It meshes with the timer wheel, which carries the timer sprocket, which meshes with the wheel of the hours.

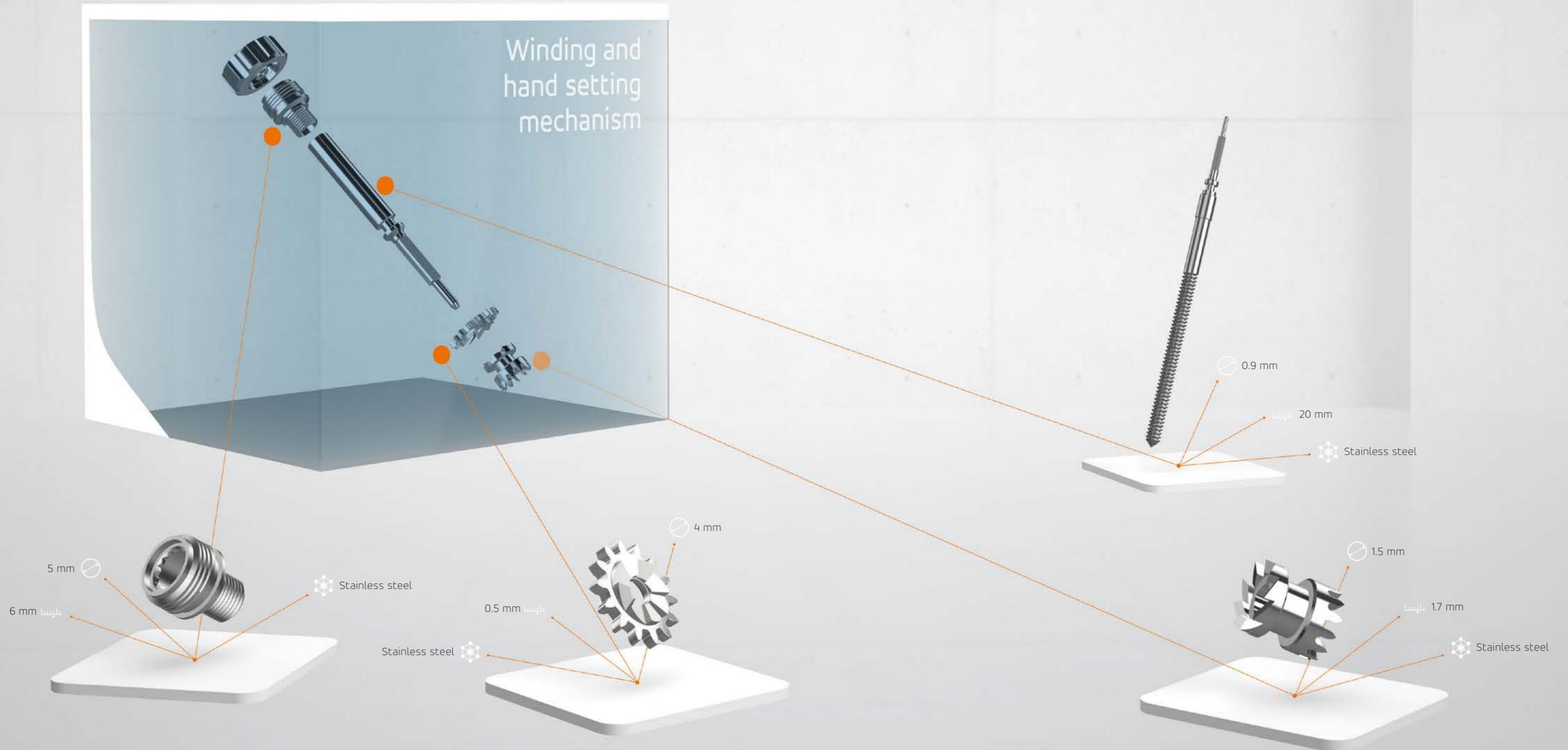


Set your production right on time

THE WINDING AND HAND SETTING MECHANISM ALLOW YOU TO CONTROL THE TIME OF YOUR WATCH AND SET IT UP ACCORDING TO YOUR TIME ZONE.

Setting the time of a watch consists of changing the position of the dial hands in order to reset the mechanism to the correct time. When setting the time of the watch, the user pulls the winding stem, which pushes the rocker and drives the sliding pinion and the return (small gear).

The return also controls the minute wheel as well as the minute hand and the hour wheel. Once the change is made, the user pushes the winding stem to block the setting of the timer and corresponding hands.



With a solution for every challenge, we secure our customers' application success, operational uptime, quality, and efficiency.

Solution: gear hobbing

Cutting toothed wheels is a very high-precision operation and a big asset to your business. The cleanliness and regularity of the cutting are fundamentals that Tornos masters perfectly.

A sliding pinion can be cut in one operation. Production of a pinion in a single operation is practically impossible on a conventional turning machine but our unique technology makes this application easily feasible. Our available gear

hobbing device will prevent you from having to finish the parts on other machines. In addition to the gain of ground surface and considerable time saving, the concentricity between the cutting and the bore is ensured. Our most appropriate kinematics allow you to achieve simultaneous turning and deburring. Our EvoDECO 10 can accommodate up to three gear hobbing devices in order to achieve the most complex operations and shape possible. Our SwissNano machine enables cutting from 1 mm diameter bars.



Solution: machine decoration

Our solutions enable decorating operations, such as:

- snaling, a decoration obtained by means of a rotating wheel, oriented in order to obtain spiral lines on the surface of the workpieces
- le Guilloché, a technique used for the decoration of dials and watch cases. It consists of making an engraving of straight or crossed or interlaced curves.
- diamondage, which provides a black, polished surface condition thanks to the use of a diamond cutter. It is achievable from metals called "coppery" such as brass, nickel, etc.



Solution: micro threading

The realization of nets is a delicate process, because it is one of the last finishing steps on your high-value workpiece. Our application engineers' knowledge and our mastery of the machining process allow us to propose solutions in accordance with NIHS standards to every problem you might encounter.

Fillet milling has distinct advantages compared to other methods of achieving this type of geometry:

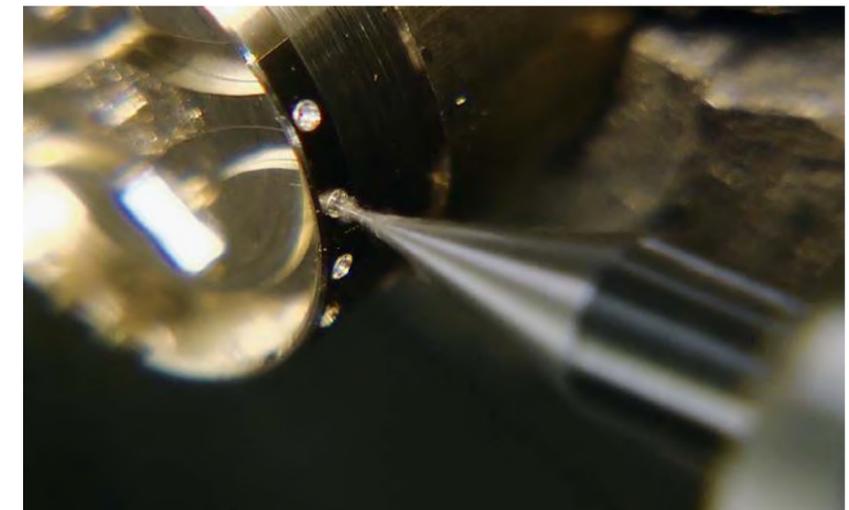
- increased speed
- possibility of milling fillets close to the face of the part
- use of standard market cutters
- no positioning or indexing concerns
- very stiff due to the use of a strip
- perfect synchronization with the main spindle

Solution: internal thread whirling

Our machines can all be equipped with a high-frequency spindle allowing you to perform internal whirling operations, according to NIHS standards. We are familiar with tappings up down S0.3.

Solution: flawless quality

The watches and components you produce must be flawless. Consumers expect nothing less when they invest in a timepiece. To ensure the expected quality, Tornos partners with specialists in controlling and measuring procedures and has developed an interface that is able to communicate with various types of measuring systems. Data from this interface is made available to suppliers of these systems who then adapt them. This partnership guarantees total compatibility between the machine and the measuring system for the operator who, as a result, has one less major issue. This interface is available on our single- and multispindle machines and allows corrective data to be transmitted. If the measuring system detects a gradual drift from input data—due to tool wear, for example—a corrective measure is automatically triggered by the turning machine's control unit. In this way, the operator can monitor both tool wear parameters and any sudden shift from an input dimension resulting from tool failure, because in this case the system automatically actuates an alarm and can stop the machine. We also offer various systems to monitor



the torque of the motor spindle or motor axis for abnormalities such as tool wear or breakage. The system's advantages include:

- reduced tooling costs due to extended tool life-time
- increased machine efficiency due to reduced machine stops for tool changes
- fewer scrapped parts, thanks to fewer tool breakage-related machine stops

Finishing a part on a single machine is a benefit much appreciated by the micromechanics industry. When issues arise, locating the cause is greatly simplified and the quality of the parts increases because machining conditions remain unchanged for the whole batch.

Solution: vacuum

Manufacturing the smallest, most precise parts in the world and removing them from the machine: That is the daily challenge faced by users of our machines, and there are a wide number of solutions available, whether manual or using a vacuum system. Most people generally agree that the vacuum system is the best solution for removing parts, although it is generally the most expensive to implement. Tornos offers a very cost-effective solution.

The vacuum option is delivered with two supports: The first allows the ejection of parts in back operation mode, while the second allows parts to be picked up by the guide bush; the second support is fixed beneath the back spindle and, as



it is mounted at three points, it can be positioned very precisely, and allows each part to be properly and efficiently collected. The vacuum system is very easy to control using the M function on the CNC. The system is equipped with two buckets to recover the parts. The buckets are made from a synthetic material and are designed to maintain a certain level of oil to soften the impact of the part as it arrives in the bucket. These buckets also are equipped to receive parts using a sieve system with two possible levels of filtration (60 microns or 250 microns).

Solution: high-pressure coolant

High-pressure coolant can be used in certain micromechanics machining cases. Increasing the coolant pressure has a positive effect on both chip breaking and tool life. Tornos' high-end machines designed for high productivity have a tool holder with fixed nozzles to enable high precision of the coolant supply at the cutting edge of the insert, a direct route to excellent chip breaking, process security and high productivity. Coolant delivery optimizes the machine's capabilities and further improves tool life and chip formation. Since early 2000, machine builders have increased the pressure and flow on their machines each year, resulting in increased electrical power consumption. With our latest products, Tornos has resolved this dilemma with built-in coolant that increases precision in the oil jet to reduce the flow and, consequently, reduces energy consumption of the machine while achieving the same highly precise results. The coolant jet has four main effects:

- cooling the insert in the contact zone
- quickly forcing the chips away from the insert face, reducing wear on the insert
- helping to break the chips into smaller pieces and evacuate them from the cutting area
- for rough turning, a coolant pressure of 80 bars provides a longer tool life that with regular pressure

Tool life—times seven

By applying a coolant pressure of 80 bars, tool life increases by seven times in the finishing operation. The wear value (VB) is lower after 33 minutes in cut with 80-bar pressure, than after less than five minutes with a conventional coolant

pressure of 15 bar. For roughing operations, tool life is increased by approximately 40 percent when using high-pressure coolant.

Solution: chip management

Chip management is essential, and it becomes even more significant where precious metals are concerned. Our solutions for customers interested in recovering precious material chips in their machine include filtration adapted to the machining of precious metal. An important factor in chip management is the way the oil is filtered. Clean oil is necessary to use a high-pressure pump and increase tool life and machining quality. In addition, the life of the pump's chiller and other peripherals in the loop is increased. We constantly filter our oil; when a filter is dirty, we automatically clean it without interrupting the machining process. On our single-spindle solution, we offer a fluid manager aggregate that concentrates filtering, high-pressure pumps and thermal stabilization in one single unit specifically developed and fine-tuned to serve our customers. On the peripherals and equipment side, Tornos builds partnerships on the basis of its extensive experience.

Solution: programming intelligence

In today's competitive global marketplace, there's not a moment to waste in meeting customers' demands.

Our available TISIS communication and programming software puts you on the fast track to truly effortless programming and real-time process monitoring. TISIS knows your Tornos machine fleet and can help you decide which machine to use for a specific part—but that's not all. It enables you to assess each machine's options, reduces the risk of collisions and resulting stoppages, and improves your productivity and efficiency.

TISIS is a smart and advanced ISO code editor that does the thinking for you. It knows your Tornos machine inventory, can help you write your code, and points out any coding errors. It puts the code in color and can display your program in an attractive, readable Gantt diagram, making it easy for you to see the critical path and react quickly to optimize the process.

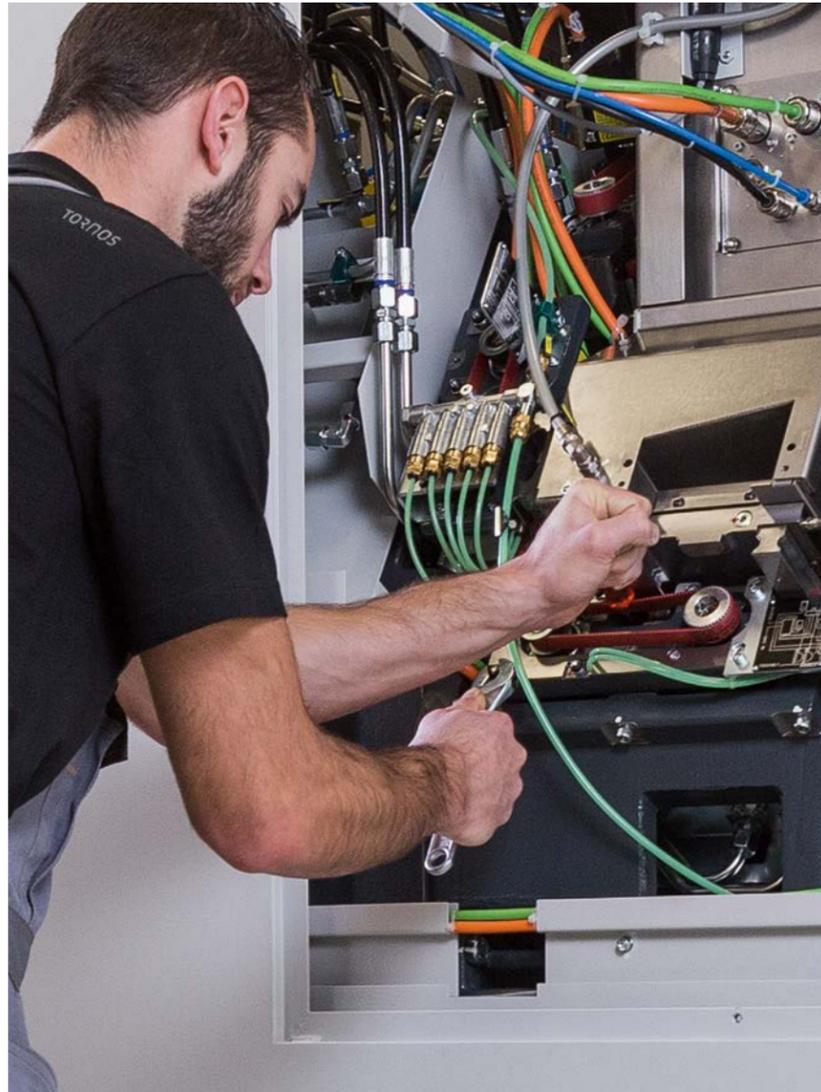


At the same time, TISIS is Industry 4.0 ready and takes the complexity out of process monitoring. Even from a remote location, you can keep an eye on the details of the machining process from your smartphone or tablet. The software also allows you to quickly transfer your programs by USB key or directly onto the machine. Your parts designs in various stages of completion can be stored with your program and your parts are easily retrieved from the database.



Discover the TISIS video

Tornos Service



Buying a Tornos machine is much more than a business transaction. It is your investment in the future. Tornos Service thrives worldwide by guaranteeing the superior production capabilities of products carrying the Tornos name.

Situated close to its customers, as demonstrated by the 14 Tornos Service Centers strategically located across Europe, Asia, and the Americas, Tornos Service offers a comprehensive range of leading support services for Tornos machines, and encompasses the innovation, reliability and attention to detail expected of a premier Swiss brand. And it is all backed by a 125-year legacy of expertise and in-depth understanding of customers' processes, applications and challenges across a wide range of industrial segments, including automotive, medical, electronics and connectivity, and micromechanics.

Start-up assistance

From the first feasibility tests prior to purchase, you are in good hands with Tornos Service. In our state-of-the-art Techno Centers, expert application engineers support you with tests to gauge the feasibility of machining processes and applications. With start-up assistance, you are secure in the knowledge that you will never be left alone to deal with a brand new machine.

Expert training and coaching

Engineered for intuitive and easy use, Tornos machines offer a vast range of options and enable myriad processes. Expert training and coaching help your employees become specialists proficient in programming, handling and maintenance, adding more value to your processes, applications and products.

Free Hotline support

Wherever you are in the world, highly qualified specialists who speak your language and understand your processes are just a phone call away to quickly support you with handling and programming solutions.

On-site support

Fast, efficient on-site operations and preventive maintenance ensure the continuous high performance of your Tornos machines. Regular

scheduled preventive maintenance can help you avoid 70 percent of machine breakdowns and keep you on the path to productivity.

Certified original spare parts

Rapid, reliable, worldwide delivery of certified original spare parts is a speciality of Tornos Service. Regardless of the age of your Tornos machine, we stock the essential certified spare parts to keep the machine running at peak performance.

Machine overhauls

Tornos machines inspire confidence. It's no surprise, therefore, that many customers turn to Tornos for a complete overhaul of their machines. The Tornos overhaul service returns the machines in good-as-new condition, significantly extending their service life.

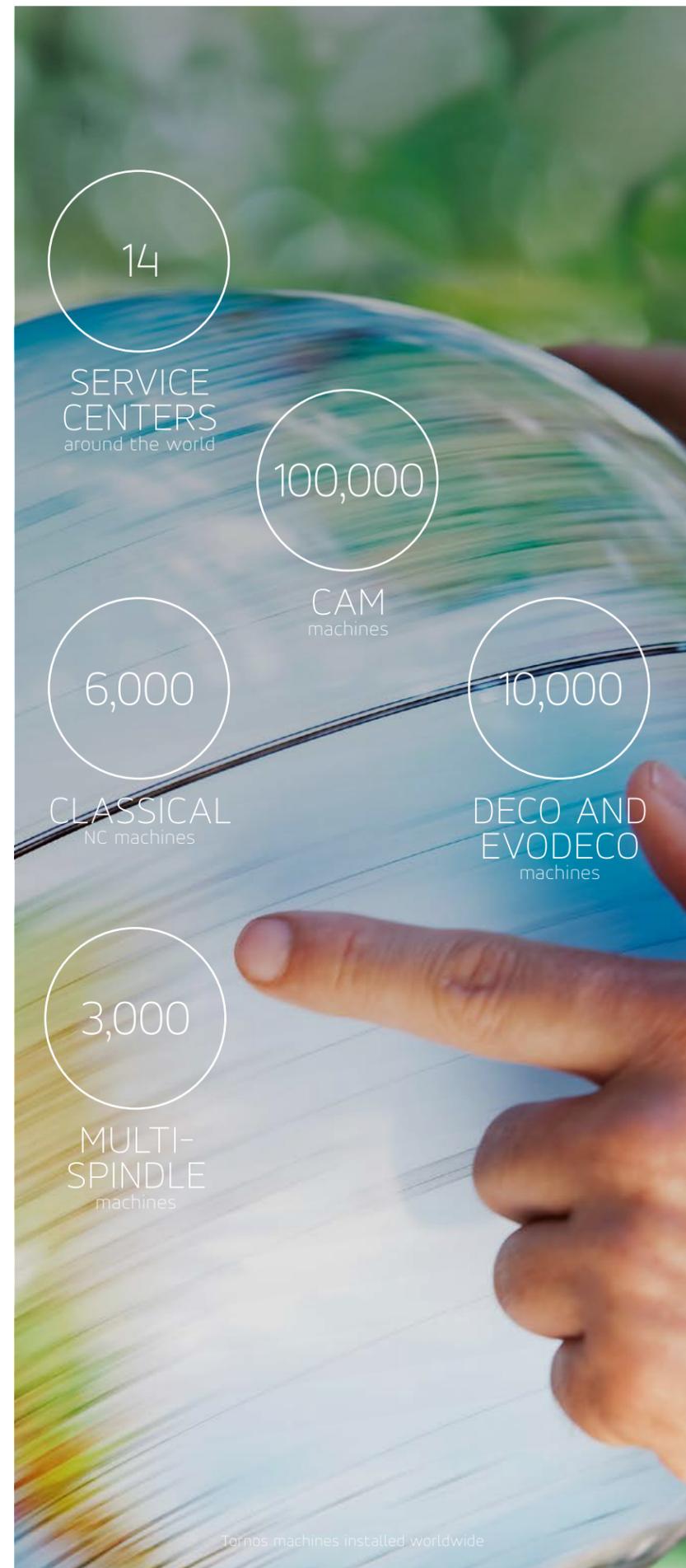
Options, upgrades and X-change modules

To help you achieve your manufacturing, productivity and quality objectives, our experts collaborate with you to manage complex machining processes, develop software features for machining complex shapes, design special equipment, and tailor peripherals to your needs. Tornos' X-change modules expand your application capabilities and profitability.

Backed by both geographical proximity to customers and an in-depth understanding of their processes, applications and market challenges, Tornos Service delivers an unparalleled continuum of support: start-up assistance, expert training and coaching, free hotline, on-site operations support and preventive maintenance, original spare parts seamlessly delivered worldwide, complete overhauls to extend the service life of Tornos machines, and a range of operations and X-change modules to expand customers' application capabilities and profitability.

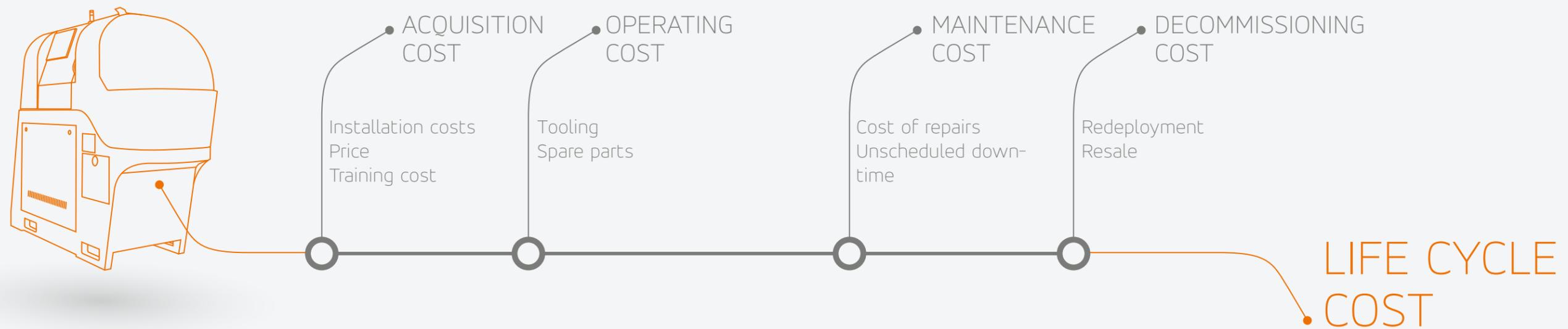


Discover
Tornos Service



Truly best value goes beyond calculations like ROI and total cost of investment to deliver optimal life cycle cost.

IT'S NO WONDER RENOWNED MICROMECHANICAL MANUFACTURERS AND THEIR SUPPLY PARTNERS CHOOSE OUR TECHNOLOGIES, PRODUCTS, EXPERTISE AND SERVICES.



In the face of myriad micromechanical industry opportunities and challenges, **Tornos keeps suppliers turning with solutions that ensure optimal life cycle cost (ROI)**. Manufacturers often focus only on equipment price when calculating return on investment (ROI), not taking into account the total life cycle cost or anticipated performance of the equipment. The price-only philosophy can make you forget the reality: The acquisition, operating, maintenance and decommissioning costs can all affect a machine's true cost.

Tornos solutions continue to serve you well beyond the classical five-year amortization period. Our machines are designed to stand years of heavy-duty production.

A low-cost machine is fully depreciated after three or four years, so it looks inexpensive on the accounting books. This type of thinking leads many manufacturers to keep the machine running in the shop long after it should be retired. A lower-cost machine leads to high maintenance costs, insufficient part quality and increased waste of material and parts. After three years, such a machine has minimal value. In contrast, **a high-performance Tornos machine can extend component life and reliability, reduce maintenance costs and retain 50 percent of its value on the used market at the end of three years**. These benefits should be factored into actual ROI.

Price is only one facet of a machine's cost, as the life cycle cost model illustrates well:

Costs considered

- price
- cycle time

Costs usually ignored

- product performance
- product life cycle
- financing costs/cash flow
- tooling
- unplanned downtime
- repair costs
- labor
- waste
- redeployment costs
- administrative costs
- installation
- utilities (software, etc.)

A global footprint

Rooted in Switzerland, Tornos' global footprint keeps us close to you. Economy, flexibility and efficiency are the most important premises of the Tornos Group's production and assembly network.

Lean assembly and careful use of resources are the guiding principles behind all Tornos production planning and an integral part of the entire production process.

The same consistent quality standards are enforced at all locations around the globe. Intelligent linking of knowledge between our plants, along the commitment and know-how of our employees—enable production to begin right on time.

Wherever you are in the world, we keep you turning.



Xi'an

Our Xi'an, China site's special testing and development center allows it to fit out machines to customer specifications. In Xian, we produce standard products delivering great value for the money on a global scale.

La Chaux-de-Fonds

Tornos La Chaux-de-Fonds is renowned for its high-quality bespoke solutions in the field of micro milling. We create turnkey solutions to your technical specifications. Each machining center has its own characteristics when it leaves the production plant.

Moutier

Our Moutier site—using the latest production technologies and equipment—produces the key components of our world-renowned machines and assembles our high-end automatic turning machines and other multispindle solutions. Key components stamped “made in Switzerland” are produced in Moutier for all of our production sites.

Taichung

In Taichung, Taiwan—a city with a long machine toolmaking tradition and broad network of suppliers—Tornos produces mid-range machines. Our Taichung facility's services include customization, setup, designing models, and on-site testing of machines produced. Key components of our machines produced in Taichung are sourced from our Moutier production site.



We keep you turning



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