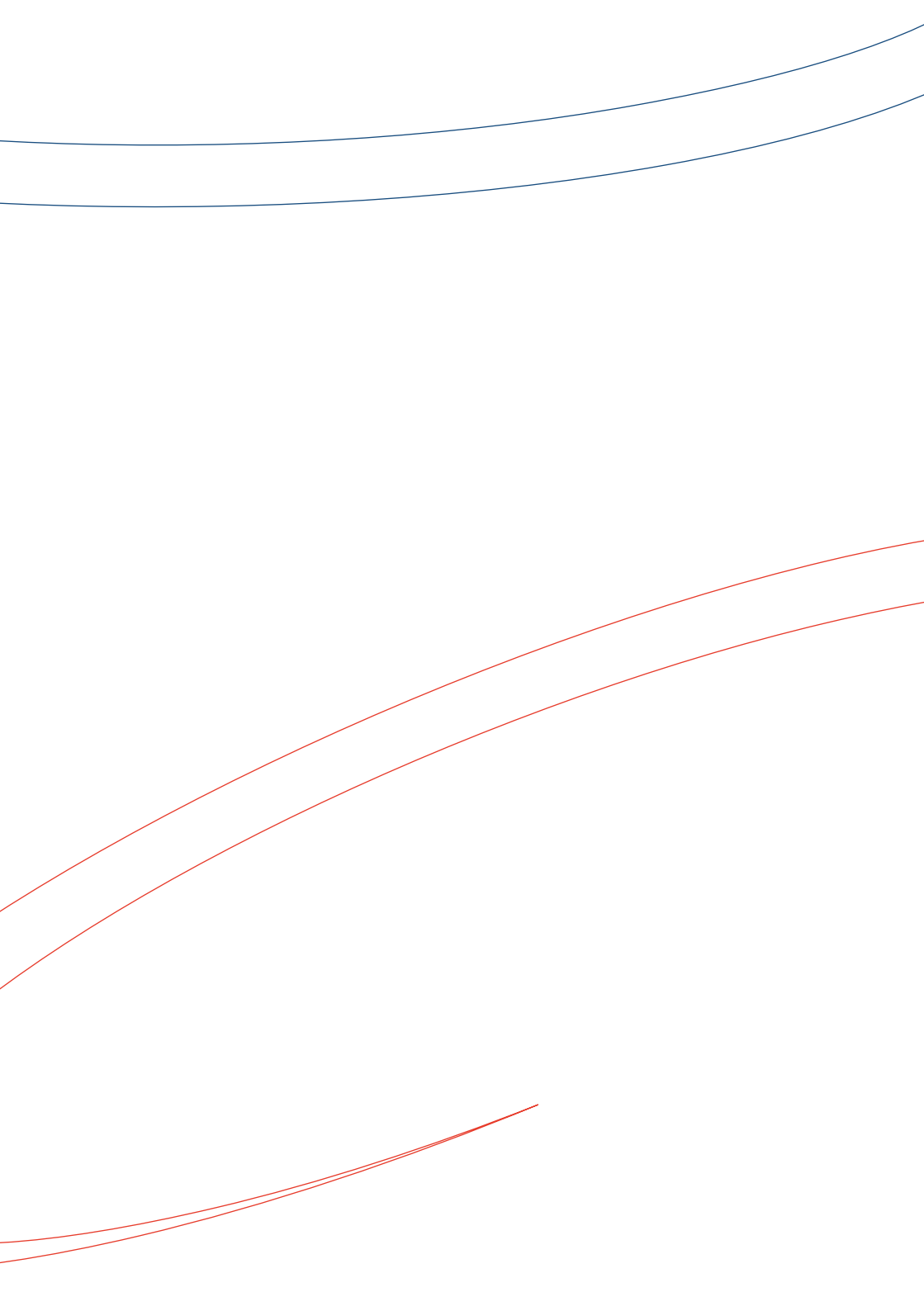


SEMICONDUCTOR INDUSTRY IN THE CZECH REPUBLIC



czech taiwanese
business chamber

October 2021
Prague







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INTRODUCTION

The backbone of the Czech industry is in producing electrical, electronic and optical devices, as well as cars, transport vehicles, and machinery. These innovative sectors are characterized not only by their high share in exports but also by their lion's share of private R&D funding, and as a result, creative industries are growing.

There is hardly a country with a more extensive tradition in the semiconductor industry in the CEE region, as semiconductor manufacturing in the Czech Republic dates back to the beginning of the 1950s. Innovation and creativity have long been hallmarks of the Czech Republic. After all, this country invented the term "robot" when Czech writer, Karel Čapek, coined the word back in 1921. The Czech Republic also has a very high penetration of industrial robots. In the latest IMD World Digital Competitiveness Ranking 2021, Czechia has achieved a favorable 16th place worldwide in robot distribution and 17th place in education and R&D in robotics.

The Czech Republic can boast a considerably developed knowledge base, modern infrastructure enabling world-class R&D in photonics and micro/nanoelectronics, and sufficient potential for R&D application results in relevant companies. Furthermore, the university talent pool, combined with an excellent research environment, provides a good base for further expansion of research and production capacities. The country also has a high share of R&D personnel and R&D expenditures. In the latest IMD World Digital Competitiveness Ranking 2021, Czechia occupies 18th place worldwide in total R&D personnel per capita and 19th place in total percentage expenditure on R&D.

The R&D has a long-standing tradition with research institutions working on high-quality projects in global comparison, as well as R&D centers focusing on applied research. For example, R&D in optical light source research (particularly lasers) can offer a globally unique research infrastructure with international research teams.

In the semiconductor industry, Czech companies can bring a particular value-added in the area of equipment production for semiconductors manufacturing, particularly in the area of process control tools and assembly and packaging tools, where many Czech companies and research institutions build on long-standing experiences.

The Czech Republic as a whole – is a true superpower in the development and production of microscopes. Roughly one-third of the world's microscopes originate in Brno, home of Tescan, Thermo Fischer Scientific, and Delong Instruments. The city has a long tradition in developing scientific instruments and is also referred to as the world center of electron microscopy.

Furthermore, the Czech Republic benefits from its location in the very heart of Europe. Prague is less than two hours drive from Dresden, Saxony, the German Silicon Valley, and Europe's biggest semiconductor production hub, where Bosch recently opened a new semiconductor factory, and further investments are expected.

The following study offers a glimpse into research and production capacities in the Czech Republic, showcasing areas in which Czech companies can offer cooperation and R&D activities. The list of presented companies is not encompassing but provides a representative sample that can be further enlarged.



RESEARCH AND DEVELOPMENT ACTIVITIES IN PHOTONICS AND MICRO & NANO-ELECTRONICS

Czech research in photonics and micro-/nanoelectronics is concentrated around the following topics:

- Photonics materials, nanoelectronics, optoelectronics and their characteristics (monocrystals, TLC plates, nanomaterials, quantum dots, conductive polymers, electrolytes, photovoltaics materials)
- Communication components (quantum communications, optical fibers, fiber-optic cables)
- Optics and Optoelectronics components and devices (solar cells, optical sensors)
- Optical sources, lasers, quantum sources, lamps, lighting
- Electronic components (printed circuit boards, condensers)
- Measurement techniques and instrumentation (electron microscope, magneto-optics, mass spectrometry, signal processing electronics)
- Numerical methods

Czech participation in international cooperation in R&D is relatively high and comparable with EU-15 countries. The R&D support is rather significant, particularly in the case of research institutions; the share of R&D granted to companies and their research organizations is still relatively low. The same situation is with companies

applying to Horizon 2020 funds, even though the participation from the Czech Republic was considered high.

Even though Czech publication activity is average in the international comparison, the patent activity in photonics and micro-/nanoelectronics is in the international comparison above average. Moreover, the number of submitted patents grows faster than in other EU countries. Research institutions submit most of the patents.

FZU – Institute of Physics of the Czech Academy of Sciences

The public research institute FZU – Institute of Physics of the Czech Academy of Sciences is one of the Czech Republic's most successful research institutions. Its international scientific teams focus on elementary particle physics, condensed matter physics, solid-state physics, optics, plasma physics, and laser physics. It is located in Prague and nearby Dolní Břežany.

New Centre of Excellence SOLID 21 has been recently opened by the Institute of Physics of the Czech Academy of Sciences. A multi-purpose pavilion with clean rooms for advanced technologies and biophysics laboratories will allow scientists to use the extremely sensitive instruments needed for their search. Starting in November 2021, 55 unique laboratories will be used to research nanoelectronics, photonics, magnetism, functional and bioactive materials, and plasma technologies. An international team of more than 200 scientists will be involved in solid-state physics research and its translation into applications in the new pavilion.

HiLASE – Institute of Physics of the Czech Academy of Sciences

The public research institute HiLASE – Institute of Physics of the Czech Academy of Sciences aims to push the frontier of laser technology beyond its current limits and serves as a bridge between the academic world and industry. The current research program of the Institute comprises five branches of physics: particle physics, the physics of condensed matter, solid-state physics, optics, and plasma physics. It is located in Prague and nearby Dolní Břežany.

TOPTEC – the Institute of Plasma Physics of the Czech Academy of Sciences

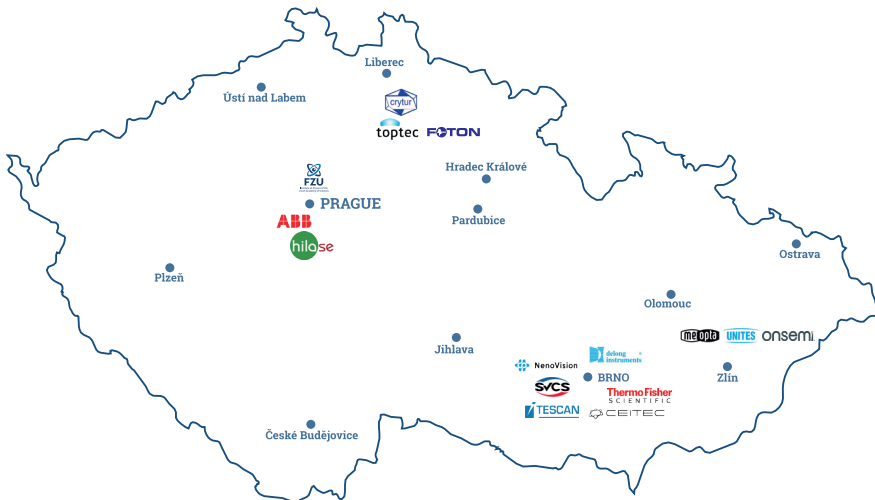
TOPTEC, the Research Centre for Special Optics and Optoelectronic Systems, is a department of the public research Institute of Plasma Physics of the Czech Academy of Sciences and one of its application centers. It is located in Turnov, a town in northern Bohemia of great importance to the optical industry in the Czech Republic. It has long experience of bringing together the academic and the industrial spheres. Its team consists of approximately 40 researchers and technicians. It has a state-of-the-art facility for research and development in optical element processing, thin film deposition, and ultra-precise measurement.

The Central European Institute of Technology (CEITEC)

CEITEC is a multidisciplinary science center focused on life sciences and advanced materials and technologies. CEITEC represents a consortium whose partners include the most prominent universities and research institutes in Brno. CEITEC offers state-of-the-art infrastructure for research divided into 61 groups and seven programs: Advanced Nanotechnologies and Microtechnologies, Advanced Materials, Structural Biology, Genomics and Proteomics of Plant Systems, Molecular Medicine, Brain and Mind Research, and Molecular Veterinary Medicine. Modern laboratories encompass an area of 25,000 m² in Brno.

Selected companies in the semiconductor industry in the Czech Republic

The semiconductor industry is concentrated in three key areas in the Czech Republic: Prague, Northern Bohemia, Brno, and Roznov pod Radhostem.



Czech companies excel particularly at the production equipment for semiconductors manufacturing: process control tools, assembly, and packaging tools, and etch and clean tools.

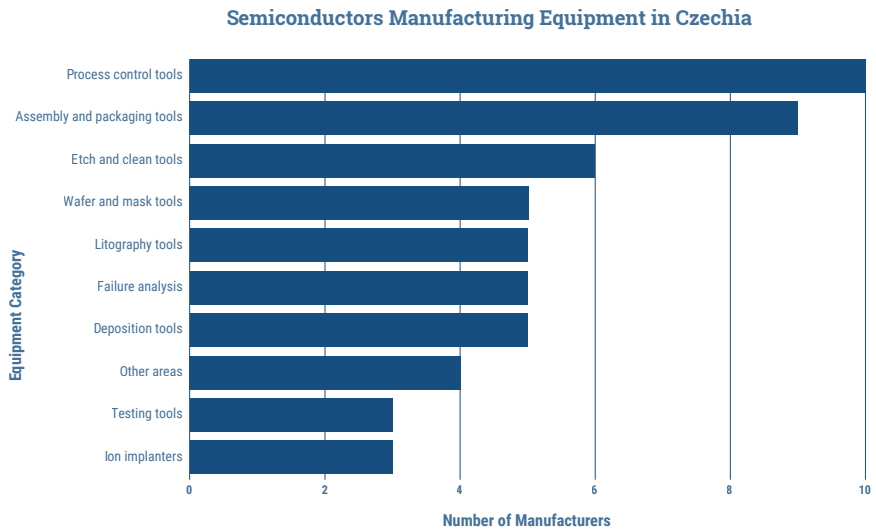


ABB s.r.o.

The Czech company ABB is part of the ABB Group. It has its engineering, research, and development centers and production plants in Prague, Brno, Ostrava, Pilsen, Trutnov, and Jablonec nad Nisou. It has more than 3,300 employees in the Czech Republic. In 2019, the company spent CZK 62 million on research and development. The company exports two-thirds of its production.

It focuses on electrical engineering, process automation, motion and robotics, and automation. Its portfolio also includes products for measurement and analytics. In Ostrava, it has a global center with 550 employees, which offers automation solutions, software development, machinery construction, design and commissioning of electrical systems and drives, supply chain management, and project management and support. One of the group's global centers for robot repairs and overhauls is also located in Ostrava.

The department in Pilsen provides solutions in automation for industry and energy and engineering and technical support in digitization and Industry 4.0. The application center for welding and cutting materials in Prague-Vestec focuses on the applied development, production, and testing of standardized cells and integrated and ready-made systems. There is also a DEMO station for arc and laser welding.

CRYTUR, spol. s r.o.

CRYTUR is one of the world's leading companies engaged in crystal manufacturing and processing with a strong focus on materials research and the development of crystal-based applications. CRYTUR is continuing the tradition of growing and processing crystals dating back to 1935. It has its research and production facility based in Turnov in northern Bohemia. It has 290 employees – one-third of which have a university degree. The company invests around 20 % of its turnover into research (i.e., more than 50 million CZK for R&D in 2020). The company exports almost all of its production.

Crytur characterizes itself as an integrated provider of optoelectronic solutions for science and hi-tech industrial applications. Crytur is one of the world's leading synthetic crystal manufacturing and processing companies, focusing on niche applications and client-specific projects built on the high expertise and close cooperation in research and development. Crytur is the world's leading supplier of scintillation detectors for electron microscopy.

Delong Instruments, a.s.

Delong Instruments is a Czech company with a very long and significant history. In 1948, a team was formed to build the first electron microscope in Czechoslovakia. One of its four members was a student – Armin Delong. The team succeeded. Their benchtop electron microscope won a gold medal at EXPO Brussels in 1958 and became one of the world's most-produced EMs. It had 87 employees in 2019.

Delong has been active in electron optics, micro, and nanotechnologies since 1992. Delong provides low voltage transmission electron microscopes LVEM and Schottky electron guns DIGUN to scientists around the world.

Foton, s.r.o.

FOTON is a company specializing in designing and manufacturing advanced scientific instrumentation. It has about 10 employees in 2021. Foton activities include high voltage supplies, special electronics systems, optoelectronics, micro-positioning automation, plasma diagnostics, vacuum control technology, and instrumental engineering. It specializes in highly customized scientific instrumentation. Its products have been used in many prestigious scientific and technical projects, e.g. vacuum control technology for high-power laser labs (PALS, ELI-BEAMLINES, Prague, IST, Lisbon) and particle accelerators (nuclotron, JINR, Dubna), high voltage supplies for nuclear technology, and particle accelerators (NRI Rez, NRI, Kiev, CERN), as well as the high-temperature plasma diagnostic instrumentation (tokamaks, stellarators).

Meopta group

Meopta is an international group of companies with a long rich tradition of developing, manufacturing, and assembling world-class optical, optomechanical, and optoelectronic products. Meopta Prerov traces its roots back to the year 1933. Meopta's state-of-the-art design, engineering, manufacturing, and assembly capabilities enable it to provide the highest quality products and services to the industrial, military, and consumer markets. Meopta - optika, s.r.o. had about 1800 employees in 2020.

Meopta develops and manufactures sub-assemblies that are used in complex wafer inspection systems in the semiconductor industry, leveraging the experience gained from the semiconductor industry for over the past two decades.

The optical and mechanical components of these systems are developed and produced in Meopta using cutting edge technologies, which support customer requirements in a wide spectrum from IR, visible, and DUV areas (most commonly in 466, 266, 193nm but with capabilities from 1700nm down to 150nm) for the semiconductor industry.



NenoVision s.r.o.

NenoVision is a technology company based in Brno, Czech Republic, the first spin-off from the Brno University of Technology and the Central European Institute of Technology (CEITEC). It had 11 employees in 2020.

NenoVision develops, manufactures, and sells a revolutionary type of atomic force microscope (AFM) LiteScope™ designed for fast and easy integration into scanning electron microscopes (SEMs). It allows scientists to do measurements and analyses, which are normally nearly impossible, time-consuming, or very expensive. AFM-in-SEM approach in semiconductor manufacturing, failure analysis, research, and development. Key application areas are material science, nanostructures, semiconductors (solar cells, integrated circuits), and life sciences.

LiteScope microscope, launched in 2016, is the only one in the world that can connect simultaneously a two-dimensional image from an electron microscope and a three-dimensional image from an atomic force microscope with great precision. As a result, this technique can be applied to analyses of samples in various fields, including nanotechnology, materials research, the semiconductor industry or, for example, solar cell research.

ON SEMICONDUCTOR CZECH REPUBLIC, s.r.o.

The Czech company ON SEMICONDUCTOR CZECH REPUBLIC, s.r.o. is part of the global ON Semi group. It has its manufacturing facility and design center in Rožnov pod Radhoštěm, in northern Moravia. It has 1,597 employees in the Czech Republic. Its design services and production of a high-volume wafer fab and a raw silicon wafer and epitaxy are used within the group.

ON Semiconductor has a long and storied history in Rožnov pod Radhoštěm, Czech Republic. It is the largest employer in the region and also includes a location in Brno, Czech Republic. ON Semiconductor in the Czech Republic was established in 2003 by the merger of TESLA SEZAM (production of semiconductor chips) and TEROSIL (production of silicon). The two companies were the successor organizations of the former state-owned company TESLA, whose current semiconductor manufacturing tradition continues. The design center was established in 1994 and operated on the same campus as the manufacturing operations.

The site has state-of-the-art six and eight-inch fabs and silicon wafer manufacturing capabilities. It produces devices to serve advanced power-related applications in end markets such as computing, consumer, industrial, automotive, and portable devices.

SVCS Process Innovation, s.r.o

SVCS Process Innovation designs and manufactures Horizontal/Vertical Furnaces for the Semiconductor and Photovoltaic industry. The furnaces are of outstanding quality because of selected components, the long-term experience of its engineers, and competitive prices. The last public annual report for 2018 declared that SVCS Process Innovation had 29 employees, ten of which were employed in R&D.

In the last year, SVCS concentrated on developing automation for both Wafer Transfer from Cassettes to Boats and for lifting the Boats onto the Horizontal Furnace cantilever. Furthermore, we developed various robotic systems for our new Vertical Furnace. A great success was the facelift of our Tabletop model of R&D Small Batch Horizontal Furnace. Last but not least – SVCS joined the team developing Minimal Fab Equipment – PE ALD – as the first non-Japanese company.

TESCAN Brno, s.r.o.

The Czech company TESCAN is part of TESCAN ORSAY group, a multinational company established through the merger of the Czech company TESCAN, a leading global supplier of scanning electron microscopes (SEMs) and focused ion beam workstations, and the French company Orsay Physics, a world leader in customized focused ion-beam and electron-beam technology. It designs and manufactures a suite of world-class imaging, modification, and microanalytical instruments for the scientific community. Its product range can be grouped into state-of-the-art SEMs, FIB-SEMs (Ga and Xe plasma), and micro-CT's (Computed Tomography). It has around 300 employees in Brno. In 2019, the company spent CZK 217 million on research and development.

Over the course of more than twenty-five years of existence, the TESCAN brand has built a formidable reputation for developing and manufacturing scanning electron microscopes and system solutions for micro-and nanotechnology and related applications. Over 2000 SEMs installed in more than 75 countries are a testament to TES-

CAN's first-class quality and proven technology. TESCAN's portfolio includes thermal emission and field emission SEMs. Along with this, TESCAN also produces Ga and Xe plasma source dual-beam FIB-SEM systems, dedicated solutions for special applications, a newly developed multimodal holographic microscope, as well as a range of detection systems and tailored solutions for specific analytical needs.

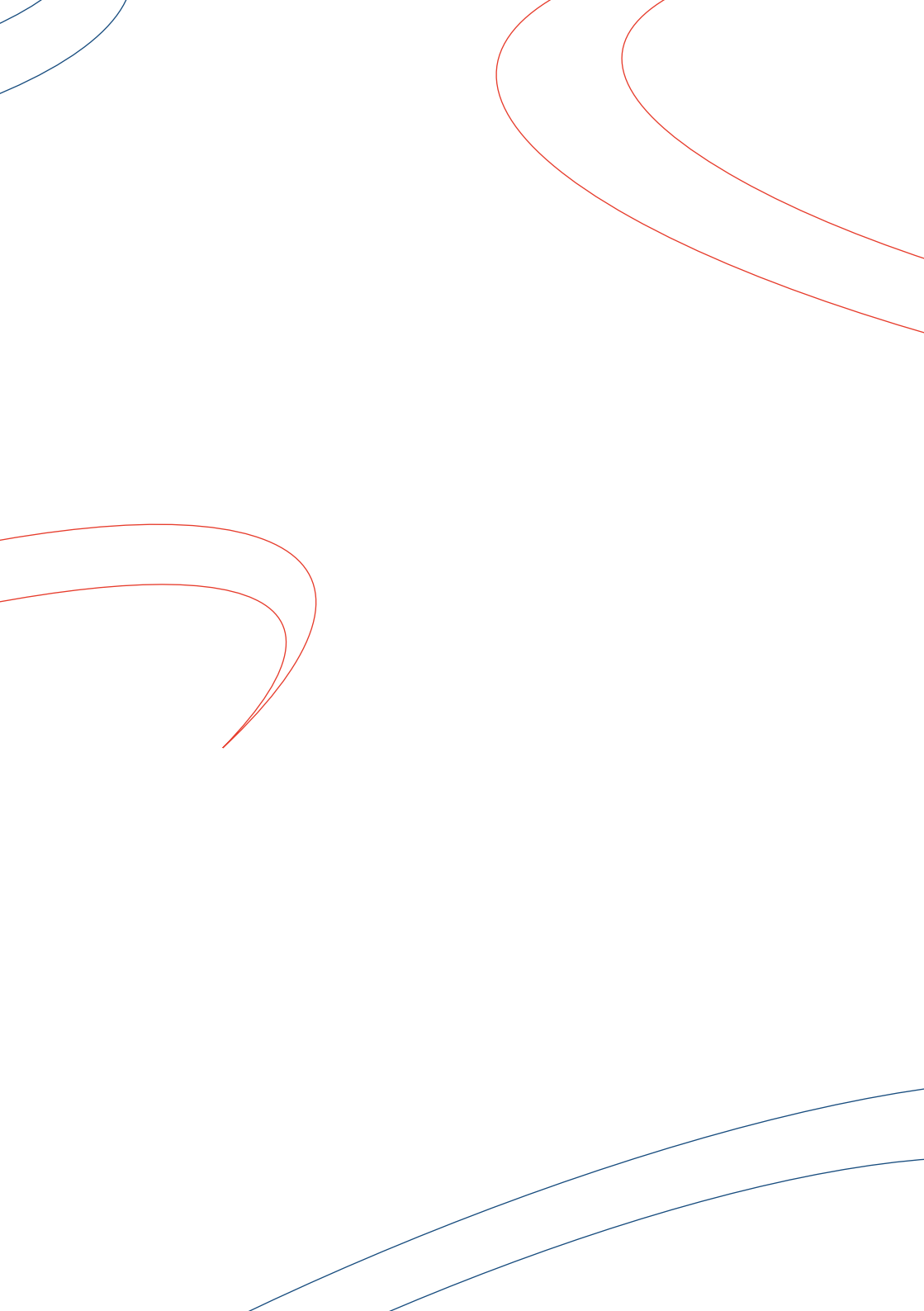
Thermo Fischer Scientific Brno, s.r.o.

Thermo Fischer Scientific produces cutting-edge electron microscopes and spectrometers. Its technology center is the biggest production site for electron microscopes in the world and further supports the tradition this industry has in Brno. Thermo Fischer Scientific employs more than 1 200 specialists and spent CZK 803 million on R&D in 2020.

Its microscopes help to speed up the research and its application into everyday life. Electron microscopes are used in microelectronics production, new drugs development, or modern materials. Thermo Fischer Scientific has global universities, top electronics producers, pharmaceutical companies, and development centers in the cosmetics, semiconductors, automotive, or aviation industry among its customers.









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