BMW GROUP

The BMW Group home plant in Munich

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Foreword

Built to Shape Tomorrow

Munich is BMW's beating heart. Next to the Olympia Park, the home plant sits alongside the BMW Welt, the BMW Museum and the company headquarters – the so-called 'Four Cylinders' tower. The Munich site is completed by the nearby BMW Group Classic, the BMW Research and Innovation Center (FIZ) and the BMW dealership, as well as the exhibition pavilion in the city centre.

The plant's roots go back to 1913. Since 1922 the company has been manufacturing its products on these premises in the Milbertshofen neighbourhood – initially motorcycles and aero engines and then, from 1952, automobiles. The plant has developed in parallel with the city's urbanisation and is now in the heart of the city. The smooth interaction between the production technologies and supporting areas in a very confined space is a triumph in the automotive engineering world. The plant has always set an example for environmentally friendly and sustainable production – precisely because of its city-centre location.

Working with the FIZ, the BMW Group plant in Munich also serves as an internal specialist centre: from here, the process and technology expertise and the experience gained from 100 years of vehicle construction also extend to other production sites around the world.

This third version of our book is being published in the Munich plant's centenary year. It looks back on the plant's eventful 100-year history and portrays its exciting present. 'Built to shape tomorrow' is the centenary slogan. It underpins how capable of transformation the plant and its workforce are, their constant innovative strength and creativity. In recent years, for example, the company has prepared the home plant to the highest degree for the changes in the automotive industry by expanding its body shop and assembly, as well as constructing a resource-conserving paint shop. The combination of innovative and sustainable production structures and the transition to e-mobility with the BMW i4 has significantly strengthened the home plant's future viability.

The BMW Group's roots are fixed in Munich. History was and is made here. Our history lives in the buildings, production facilities and in the more than 7,000 employees from over 50 nations. Thanks to their hard work, commitment and insistence on perfection, BMW products are seen globally as something special. For the BMW Group home plant, the motto is: At home in Munich, at home in the world. With its unique architecture, history and extraordinary location, it is and will remain a Munich landmark, future forum and tourist attraction in equal measure.

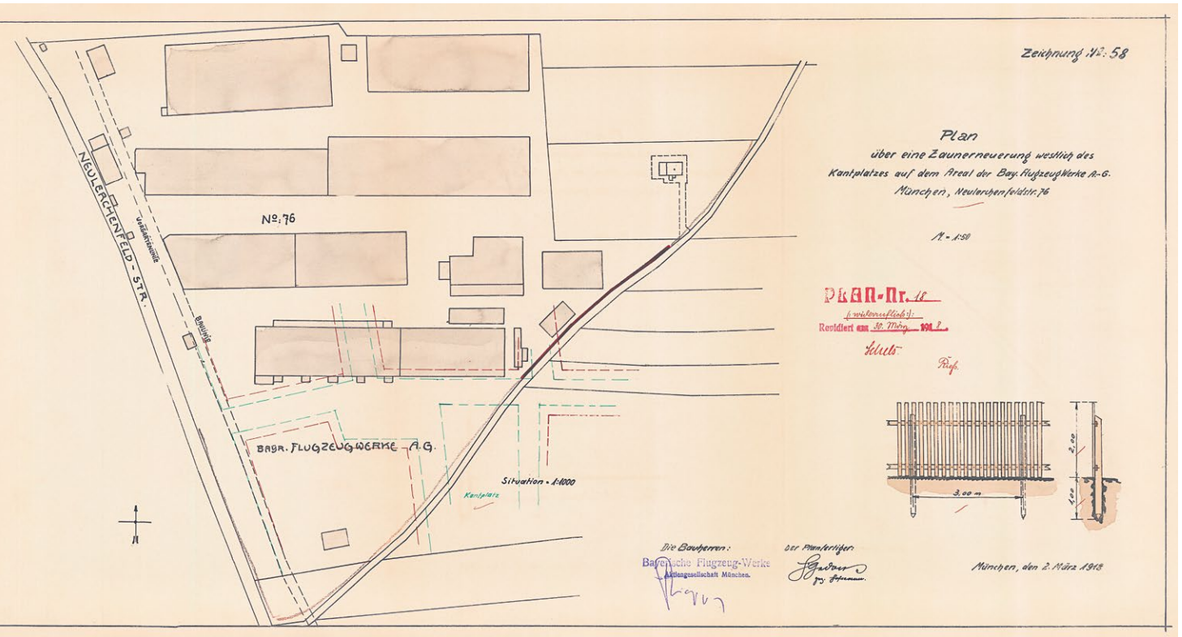
The origin of BMW’s home plant

In 1913, aircraft manufacturer Gustav Otto began building a new plant at Munich’s Oberwiesenfeld military base. In 1916, Bayerische Flugzeugwerke (BFW) took over the assets of the company, including the plant. The production halls were built using lightweight construction because of the constraints of wartime production, although this was only regarded as an interim solution.

1913 – 1920

Otto-Werke and Bayerische Flugzeugwerke (BFW)

The beginnings of BMW's home plant in Munich go back to the period before BMW actually came into existence. The land was originally acquired and developed by aircraft manufacturers "Flugmaschinenwerke Gustav Otto". Gustav Otto founded the company, which was named after him. He was the son of the inventor of the four-stroke internal combustion engine, Nikolaus Otto. Gustav Otto established his first production plant in Puchheim to the west of Munich before transferring operations to Schleißheimer Straße 135 in 1911. This move located the facility alongside Munich's Oberwiesenfeld military base. The base was at that point gradually being converted into an aerodrome. If a company wanted to do business with the military authorities, it was absolutely essential to establish a presence nearby. In addition to the facilities located in Schleißheimer Straße, Gustav Otto continued to use the production facilities in Puchheim, but he also



Site plan of Bayerische Flugzeugwerke AG, 1918.

Main gate at Otto-Werke on Neulerchenfeldstraße, 1915.

had two sheds in Neulerchenfeldstraße (later Neulerchenauer Straße) directly adjacent to the Oberwiesenfeld site.
At the beginning of 1913, Otto-Werke received an order for more than 40 military biplanes, and this meant that a new plant had to be constructed. Otto selected Neulerchenfeldstraße and started to build the plant the following year. The development was carried out by Munich construction company Ackermann & Cie. By June 1917, five large production buildings had been completed. They were configured from west to east and were built parallel to each other. The arrangement of the buildings allowed the aircraft to be rolled out of the hangars onto the airfield located to the west of the buildings without the need for any complex manoeuvres. The following buildings were constructed facing Neulerchenfeldstraße and ran from south to north: the pre-assembly building, the carpentry shop, the

warehouse and the assembly shop. A new aircraft hangar was constructed to the east of the warehouse.

The construction of the buildings was typical of the method used in the aircraft industry during the war. They were single-storey hangars built in lightweight construction, and the main material used was wood as this significantly cut down the construction time compared with methods using brick and steel. Since the plant was built during the First World War, the hangars had to be erected as quickly as possible in order to provide the company with the facilities to complete the orders placed by the military authorities. Another problem was caused by the difficulties of sourcing building materials, which also made it necessary to resort to wood. However, from the outset the plans envisaged that these buildings would only be used on a temporary basis. The aim was to replace the buildings with more robust structures after the war had come to an end.

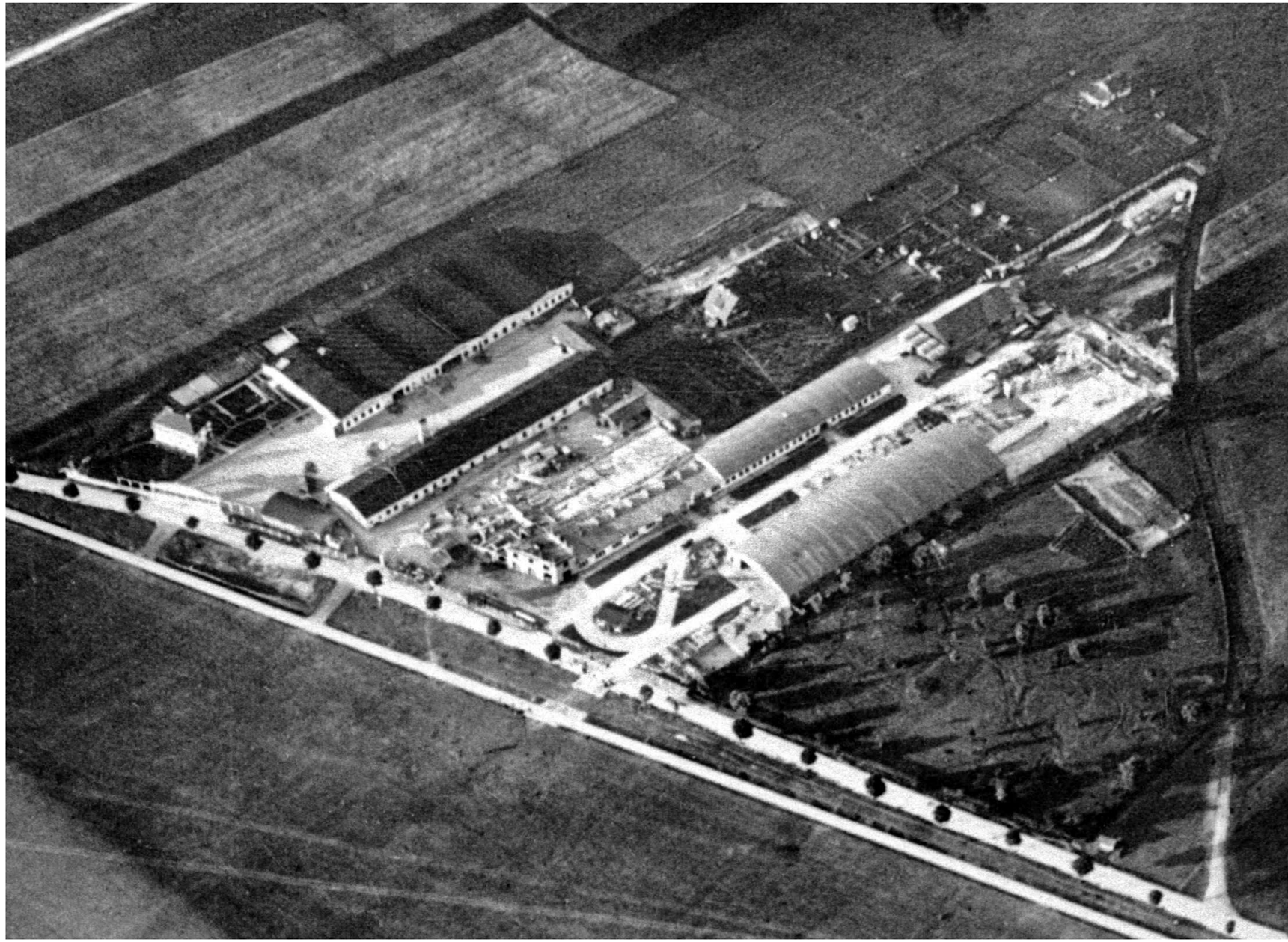
Although Gustav Otto started the construction work at the plant, he was unable to make much use of the new premises. The financial situation of the company deteriorated steadily during the first two years of the war. This was partly due to the fact that the aircraft being produced at Otto-Werke had ceased to be competitive. Another factor was that, although Gustav Otto was a technically talented pioneer in the context of Bavarian aviation, he had little understanding of how to manage a factory on commercial principles geared to success in the marketplace. By the end of 1915, Otto-Werke was insolvent and the continuation of the company as a going concern was uncertain. However, since the military significance of aviation had increased enormously during the course of the war, the state was keen to have the maximum number of aircraft manufacturers. A government initiative therefore ensured that the shares of the company were incorporated within a new company, namely Bayerische Flugzeugwerke AG (BFW).

BFW and hence the plant located at Neulerchenfeldstraße expanded steadily. In 1917, a workforce of 2,400 people was already employed to manufacture up to 200 aircraft a month. However, the end of the war and the conditions of the Treaty of Versailles brought aircraft production to a standstill at BFW.

1913 Start of building work at the plant

1916 Bayerische Flugzeugwerke takes over the aircraft factories operated by Gustav Otto

1917 All production buildings are completed



Aerial view of Otto-Werke, 1915.

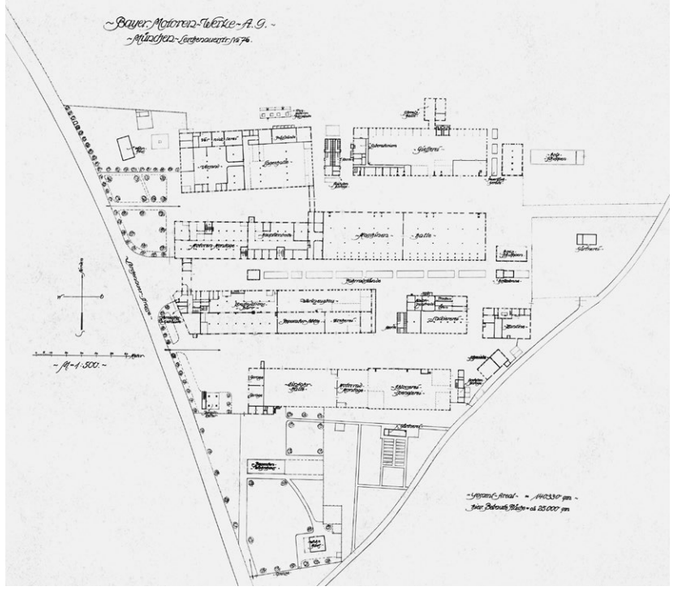
From BFW to BMW AG: the plant during the 1920s

In 1922, BMW AG transferred operations to the plant located in Neulerchenfeldstraße. During the course of the following year, the company started to manufacture a new product: the motorcycle. The increasing demand for aero engines and motorcycles necessitated expansion of the plant facilities from the mid-1920s.

1920 – 1930

Status in 1922 at the time of “transfer to BMW”

The history of the establishment of BMW AG proceeded in several stages. In 1917, Rapp Motorenwerke became BMW GmbH. Rapp Motorenwerke had been founded in 1913 by Karl Rapp. In order to expand the capital base of the company, it was converted into a joint stock company during the following year. After the end of the First World War, BMW faced a situation where there were no customers for the company’s only product – the BMW IIIa aero engine – because all government orders had been cancelled. Production of aero engines was in any case prohibited under the terms of the Versailles Peace Treaty ratified in 1919/20. In June 1919, the company concluded a licence agreement with Knorr-Bremse AG to manufacture train brakes in order to keep the workforce in employment and ensure that the machines were not standing idle. In 1920, the sole owner of BMW AG, Camillo Castiglioni, sold his shares in the company to Knorr-Bremse AG. But two years later, he went back to Knorr-Bremse with an offer to purchase the engine construction facilities including all the technical



Site plan of the BMW plant, 1922/23.

Main entrance to BMW AG in Lerchenfeldstraße, 1922.

drawings, the machinery assets and workforce, and the company name BMW. At this point, Castiglioni was engaged in negotiations with the Czech Ministry of Defence for the possible manufacture under licence of the aero engines BMW IIIa and BMW IV. Licensed production of this nature offered the owner of BMW substantial opportunities for profit, and this was the reason for Castiglioni’s renewed interest in the company. Since 1921, Bayerische Flugzeugwerke AG (BFW) with the factory in Lerchenauer Straße had been under Castiglioni’s ownership, and he now transferred the shareholding he acquired to BFW. During the immediate post-war period, BFW manufactured motorcycles and wooden furniture, although the majority of the production buildings were empty. BMW engine production was therefore able to move into these facilities.

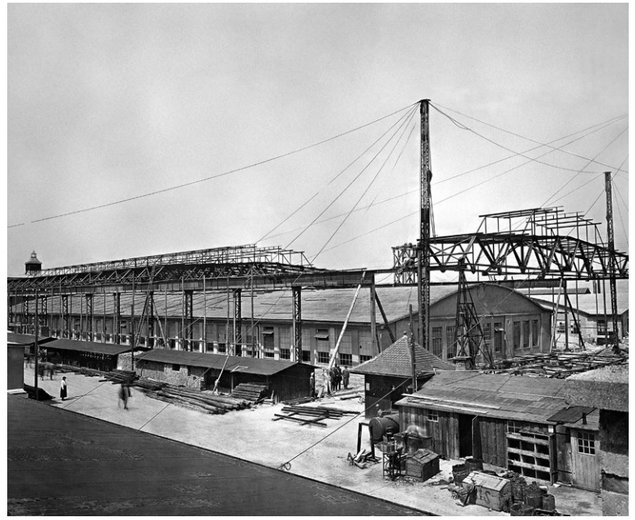
A triangular plot of land facing south was developed in 1922. This site was bounded by Lerchenauer Straße to the west and by a public footpath to the east. Six large production halls were available. The machine shop and the run-in facility/garage were located in the southernmost building. The building for assembly and inspection was sited to the north, together with a warehouse building. This in turn was connected with an engineering

workshop to the east. The warehouse and dispatch department were built at the northerly end on the western side and the foundry was positioned to the east.
The year 1923 brought two changes at BMW AG: firstly, the Allies permitted limited reinstatement of aero engine production. Secondly, manufacture of stationary engines and installed units for different vehicles developed into a second mainstay for the fledgling company: engineers at BMW AG designed a motorcycle built around the "Bayern-Kleinmotor". The R 32 became the first vehicle to take to the road emblazoned with the blue and white BMW logo.

1917 Rapp Motorenwerke becomes BMW GmbH
1920 BMW loses its independence
1922 BMW AG is transferred to BFW
1923 Commencement of motorcycle production

Rebuilding of Hall 17

Starting up production of a new product – the motorcycle – and the return to manufacturing aero engines necessitated a number of changes at the factory site from 1923. The increase in orders also meant that the equity capital of BMW AG had to be increased several times. Some of the funds raised were used to expand the plant during the mid-1920s and, most importantly, to carry out a programme of modernisation.
In 1924, the company management decided to replace Hall 17, previously used for component production, with a new brick building. In order to avoid interrupting operations, the external structure in steel and bricks was erected around the existing wooden buildings. The new Hall 17 was built as a single space with a gallery running around the walls. The original wooden buildings located in the interior of the new structure meant that this gallery could not be supported by columns, so it was suspended from the roof structure instead. The wooden buildings were only demolished once the new production building had been completed. The machines were reconfigured to take account of the production workflow. The large Machine Hall 17 became the core of the BMW plant during the second half of the 1920s, and the following



Construction around Hall 17, 1924/25.

The heart of the plant in the 1920s: Hall 17, 1926.

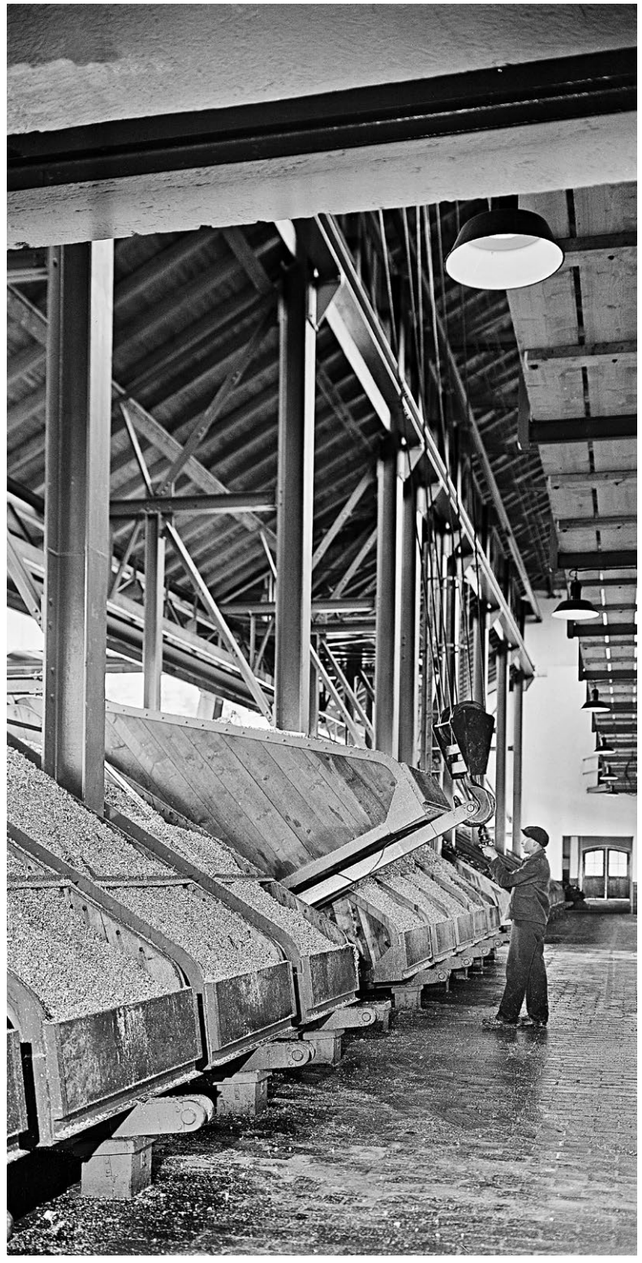
production facilities were located here: component production for aero engine manufacture and part of the motorcycle custom orders.
In 1928, a steel-framed building was constructed at the front and to the eastern end of Hall 17. The hardening shop was located on the ground floor and company offices were accommodated on the first floor. The hardening shop was an extremely important element in aero engine construction. In order to be able to withstand the high loads exerted on components during flight, certain components and materials had to be given special treatment. The hardening shop was equipped with oil-fired, gas-fired and electric furnaces of different sizes for standard heat treatments. It was also fitted with special equipment for carburisation and nitride hardening. Refitting the building allowed the most advanced technology to be used and created optimum working conditions. The interior of the building was 6.5 metres in height and this was combined with a powerful ventilation system to ensure that heat and hazardous vapours were extracted from the building as quickly as possible.

1924 Commencement of expansion at the plant
1924 Construction around Hall 17
1928 Construction of a new hardening shop

The foundry

The increasing volume of production, especially in motorcycles, necessitated a number of changes and an enlargement of the factory. In 1928, a new foundry was built. Already in 1918 high-quality products were being manufactured at the BMW foundry, and this reputation was the reason why other companies were sourcing cast components from BMW. Construction of the new building took account of all the latest statutory heath and safety requirements. The electron-beam foundry was located separately from the other departments in order to protect associates from the sulphur dioxide emissions produced.
The new foundry was equipped with the most advanced production facilities available at the time. It included departments for aluminium, electron-beam, iron and bronze casting and the associated smelting chambers, as well as a facility for cleaning up all the castings. A model-makers' workshop, offices and recreation rooms were arranged around a gallery in the hall. Sand treatment machines were positioned at the western and eastern ends of the foundry, with two conveyor belts taking the sand to the bunkers that were distributed along the entire length of the building. From here the sand was then delivered directly to the moulding machines. The smelting building for producing grey-cast iron was connected to the eastern end of the sand treatment room located to the west. The building with the cleaning facility for the castings was positioned alongside. The aluminium smelting building was also located facing the east. Access to the electron-beam foundry from the aluminium smelting building was through the sand preparation room for the aluminium foundry. The electron-beam foundry extended over the entire height of the building and was completely separated from the other rooms in the foundry. The core-making facility was located at the northern end of the building and was supplied with sand in the same way as the moulding machine.

The new foundry, 1929/30.



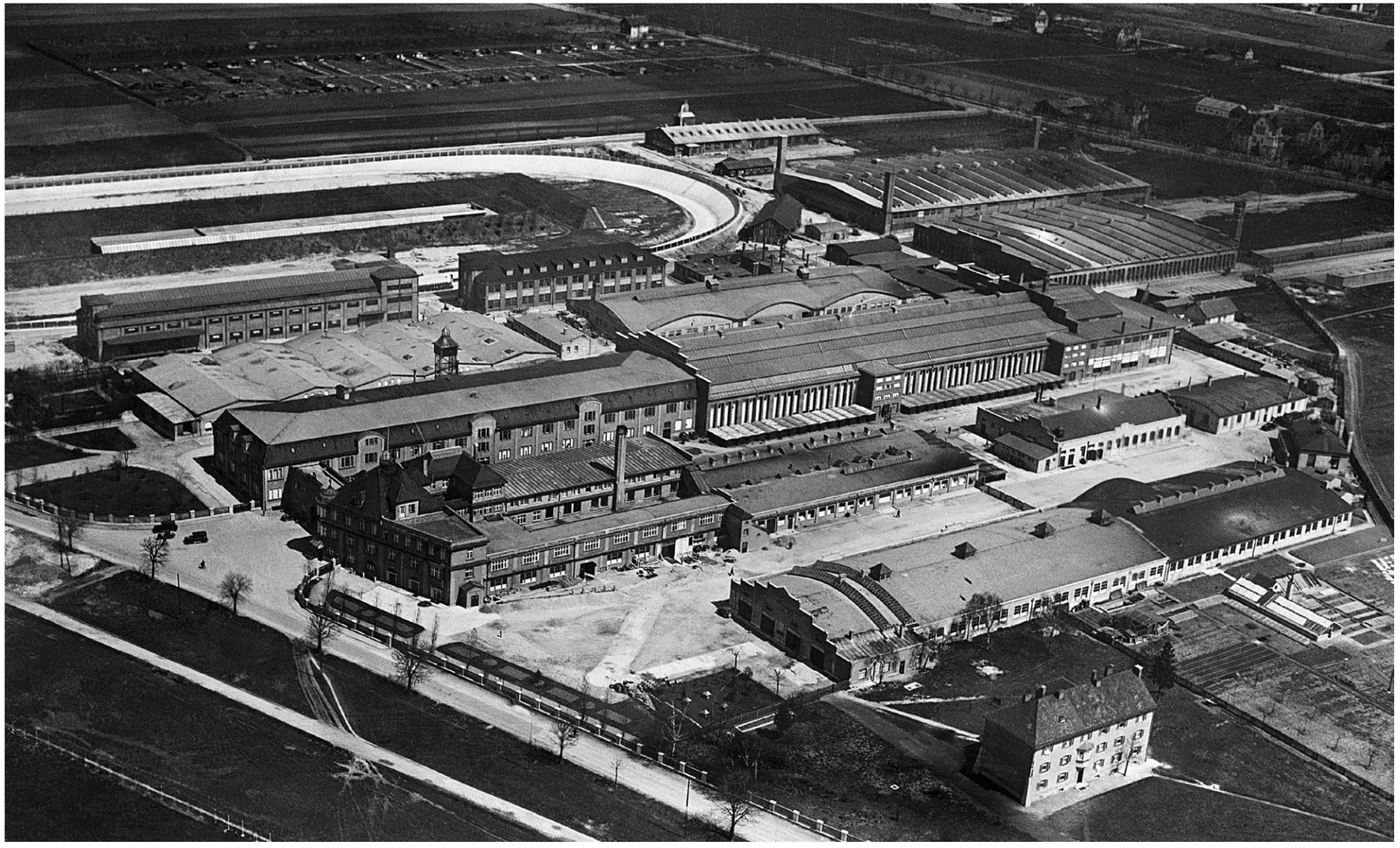
Sand bunkers in the foundry, c.1930.

Inside the new foundry, 1930.

The test track

In 1927, a new motorcycle test track was constructed on the northern periphery of the site along what was then Keferloher Straße. Up until that point, the quality of the motorcycles rolling off the production line had been tested inside a building. A circuit 750 metres in length was now available on which the test riders were able to take the machines to a top speed of 140 km/h. New aero engine test rigs were located inside the circuit. They were sunk into the ground to a depth of around four metres. A tunnel passed under the test circuit to link the test rigs with a new two-storey building where aero engine reassembly was located on the ground floor. This configuration created short routes so that the quality of the tested engines could be checked in the reassembly area as quickly as possible. The apprentices' workshop was initially located on the first floor of the building. The testing department was sited to the west of the reassembly facility and access from the test circuit was also through a tunnel. The new logistics saved time because the motorcycles could be washed, checked and prepared for shipment immediately after they had been tested. The dispatch department was also located in this building. A rail spur to the complex was added at the same time as the test track, allowing the checked and crated motorcycles and engines to be shipped directly by the dispatch department.

Running in BMW motorcycles, 1929.



Aerial view of BMW's Munich plant with the test track in the background, 1928.

1927 Construction of a new test track

Aero engine production

The most important product manufactured at BMW up to 1945 was aircraft engines. Because aero engine production initially had to be suspended after the end of the First World War, BMW engineers set about turning the existing registered models of aero engines into power units for other purposes. The company hoped that the good reputation of the first BMW unit, the BMW IIIa, would ensure that the newly developed marine, lorry, automobile and motorcycle engines would generate good sales. Sadly, these expectations proved to be unfounded and the engines brought in virtually no profit for the company. Partial revision of the Versailles Treaty in 1922 once again opened the door for aero engine production. However, the main customers for BMW engines were not in the German market: major orders came mainly from the Soviet Union, the Czech Republic and Japan.
Aviation during the period between the wars focused on ongoing development of aircraft which required more powerful engines and consistent operational safety. Instead of pursuing costly new developments, engineers at BMW concentrated on developing and refining the proven models. In 1928, BMW also acquired a licence from American aircraft manufacturer Pratt & Whitney to manufacture an air-cooled radial engine.
Right from the start, BMW aero engines were built to extremely high quality standards. In order to maintain this level of quality, BMW always took great care to ensure that its associates were highly trained and appropriately

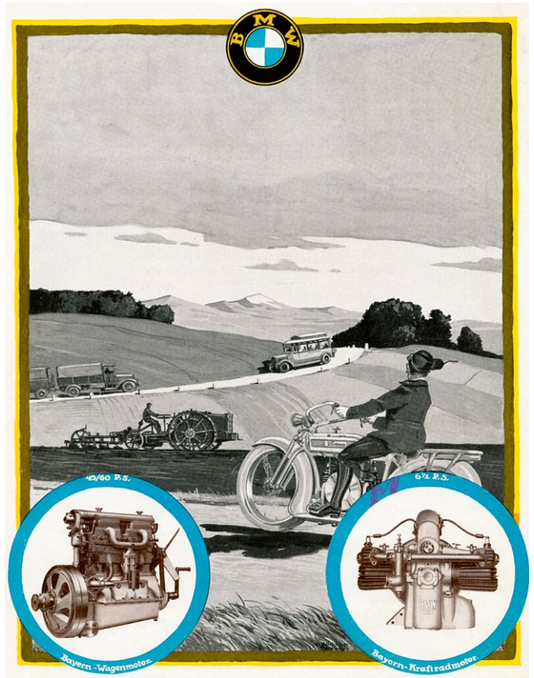
Designers at the drawing board, 1925.
Left: BMW VI aero engines in the reassembly facility, 1926.

qualified. Power units were also subjected to a system of continual quality checks and inspections. Already during the production process, most of the materials used were subject to very precise testing. The important role of quality in the production process is reflected in the incoming goods inspection that checked raw materials and all outsourced parts and components. But such inspection was not simply carried out in the preparatory stages prior to production: checks were also implemented during the actual manufacturing process. When associates were being trained in a new area of activity, their first products were put through a rigorous testing process in a "first article inspection", although workers often regarded this as unnecessary "nannying". However, the inspection established that all the instructions issued by the master craftsman had been understood and were being properly implemented. Such checks reduced the level of rejects and enhanced the quality of the engines.
Once the quality of the individual components had been subjected to rigorous testing, a great deal of effort was also put into ensuring that the engines lived up to the high standards. This is why only specialist craftsmen were normally used to assemble engines. Since monthly production figures during the 1920s were never higher than around 50 units, volume production was not an issue. The power units were therefore assembled as specials or in groups of two or three. Once assembly of the aero engines had been completed, the units were put through the final inspection, which constituted the last stage of production. Initially, each engine was run for several hours on a test rig. It was then returned to reassembly and completely taken apart. After all the components had been cleaned in a petrol bath, they were examined for material faults or damage, such as cracks. After ascertaining that all the components were in perfect condition, the engine was reassembled. It was then run at maximum power on the test rig for another two hours. Only when the engine had been taken apart again to establish that all the components were perfect and free of faults was it put back together and crated ready for shipment. Quality specifications to these exacting standards were normal in the aero industry, and they were absolutely essential because engine defects during operation could have untold consequences.

1920 Prohibition on aero engine production by the Versailles Treaty

1922 Partial amendment of the Versailles Treaty

1928 Acquisition of the licence to manufacture an air-cooled radial engine from Pratt & Whitney



Advertisement highlighting the different uses for BMW engines, 1920.

Dornier "Wal" flown by Wolfgang von Gronau after landing in New York, 1930.

The BMW VI aero engine

During the first half of the 1920s, BMW manufactured six-cylinder engines – the BMW IIIa and BMW IV units – before going on to manufacture a 12-cylinder engine, the BMW VI. This model allowed BMW to meet the requirements of the market for more powerful engines. The BMW VI was a design derived from the BMW IV. The principle of developing existing products was typical for BMW at that time and the two engines contained many identical parts. During the summer of 1924, the first BMW VI engines were run on the test rigs. Two years later, the first power unit was put through its first type inspection at the German Laboratory for Aviation (DVL). When production came to an end in 1937, BMW had produced around 6,000 units of the engine. Numerous record and long-distance flights were achieved with the BMW VI. In 1930, for example, Wolfgang Gronau undertook the first crossing of the Atlantic from east to west in a flying boat, in a Dornier "Wal" powered by two BMW VI engines. Numerous variations in the design of the BMW VI engine were produced and the engine was also manufactured under licence in Japan and the Soviet Union..

In 1924 the R 32 was still built without flow production techniques.

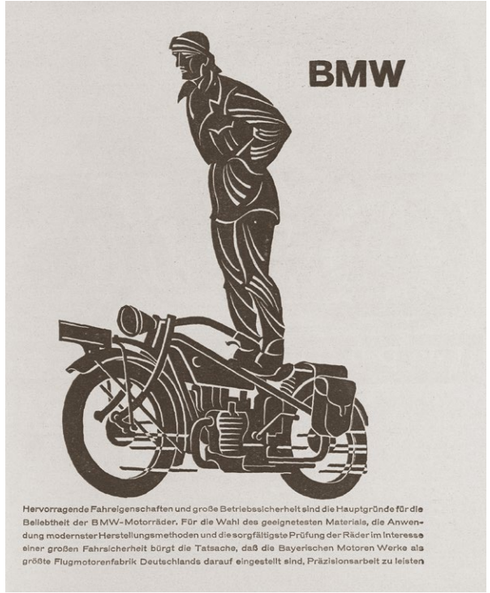
Motorcycle production

After the individual components for the motorcycles had been manufactured, they were first inspected in the parts warehouse and subsequently transferred to the assembly departments. On the assembly lines, gearboxes, front forks and rear-wheel drives were assembled from individual components to form assemblies. After testing these were then ready for mounting in motorcycles. Each assembly line came to an end precisely at the point on the final assembly line where the incoming assembly had to be incorporated into the frame of the motorcycle, which was mounted on an assembly dolly. The engines were in turn assembled on an assembly line where they were mounted on dollies and passed on from one worker to the next before being transferred to the engine testing area. Finally, each power unit was put through a test run on the test rig. The fully assembled motorcycles were then transported to the running-in department where they were tested for smooth-running operation. This process was often carried out by passionate and experienced motorcycle riders who could "sense" even the smallest defect. Construction of the test track around the end of the 1920s allowed the motorcycles to be tested over a longer distance and at higher speeds.

The BMW R 32 marked the start of a long series of high-quality BMW motorcycles. Up to the beginning of the 1930s, motorcycles and aero engines were grouped in a single production unit at BMW. This was necessary

due to the very erratic flow of orders for aircraft engines. In order to provide continuity in the supply of work for the highly qualified specialist fitters necessary for aero engine production, the workers were employed in motorcycle manufacture when aero engine production was slack. Organising the manufacturing process in this way meant that the production costs of BMW motorcycles were so high that they numbered among the most expensive motorcycles in the world. By the same token, the standard of quality was well above the average for the market, which meant that the company was able to generate profits from motorcycle production.

The range of motorcycles produced at BMW AG was continuously expanded during the 1920s. Production of the R 37 sports model, developed from the R 32, started up in 1924. The single-cylinder R 39 motorcycle came on stream during the following year to complement the production programme at the entry-level end of the range. However, the high price of this model proved to be uncompetitive in this market segment and production was phased out as early as 1926. By contrast, demand for the flat-twin "boxer" models was extremely high. This encouraged BMW to steadily expand the product range during the 1920s. The product portfolio always included touring and sports motorcycles. This differentiation was based on the principle of "same frame – modified engine".



Promoting the quality and reliability of BMW motorcycles, 1929.

R 52 solo motorcycles and sidecar combinations in the Reichswehr army version ready for shipment, 1928/29.