DIEHL
Metall Schmiedetechnik

Performance from within

Die-Forgings from Diehl Metall Schmiedetechnik

Diehl Metall Schmiedetechnik

Ensuring that we go above and beyond the standard

Diehl Metall Schmiedetechnik – We stand for quality

Diehl Metall Schmiedetechnik has one of the largest forging capacities in Europe. We are thus an efficient partner to the sanitary, fittings, automotive, electrical and building industries. We also apply our expertise in the area of special drinking water installations.

Every product from Diehl Metall Schmiedetechnik is the result of long-standing technological development competency and a high level of know-how when it comes to metals. We bring together precision, innovation and quality.

We provide an integrated value-added chain. Diehl Metall Schmiedetechnik thus stands for flexibility, quality and trust at all stages:

Foundry > Semi-Finished Products > Forgings > Machining > Die Shop > Laboratory / R&D > Test Benches

At each of these stages, our experienced team takes into account specific wishes in order to fulfill customer expectations completely.

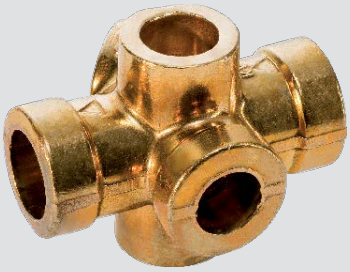
Thanks to their high strength, homogeneity, dimensional accuracy and surface quality, our forged parts are the products of choice for the following applications:
gas, water, heating, measurement, control, electrical, medical, air conditioning, drive, rail transport and vehicle technologies, musical instruments, the building industry and fire protection.
We forge diverse materials for our customers:

> Copper
> Brass
> Aluminum
> Other non-ferrous metals

Products

Diehl Advantages and Attributes

- **High strength**
- **Dimensional accuracy**
- **Good surface quality**
- **Homogenous grain structure**
- **Core competency in forging & machining highly sophisticated parts (10g - 35kg)**
- **Production according to customer-specific requirements**



Diehl Metall Schmiedetechnik – Inspirational Expertise

Die-forgings made of brass, lead-free copper and lightweight metals from Diehl Metall Schmiedetechnik perform from within – anytime, anywhere. You may not always be able to see them, but you can certainly feel their effect.

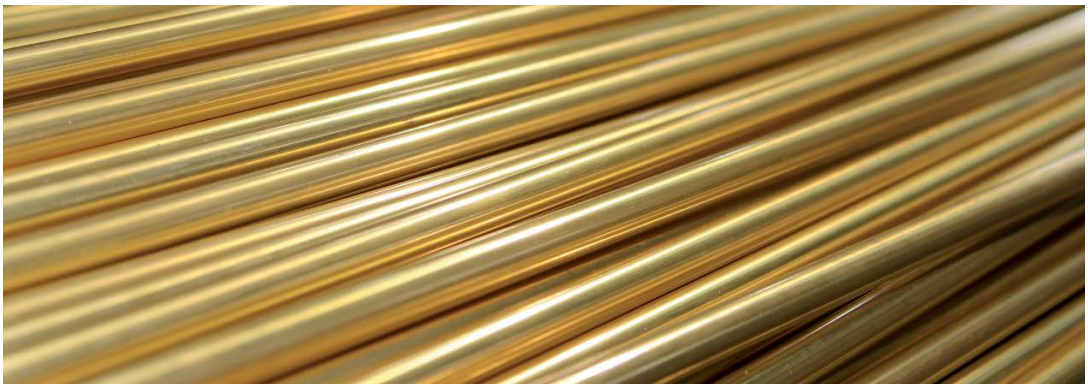
Right from the design phase, we join forces with our customers to work on specific solutions for harmonizing functionality, forgeability and quality with market-oriented production costs.

Die-forgings from Diehl Metall Schmiedetechnik are just as much in demand from traditional industries as from customers working in the megatrends of water, health, green technologies, mobility and energy.

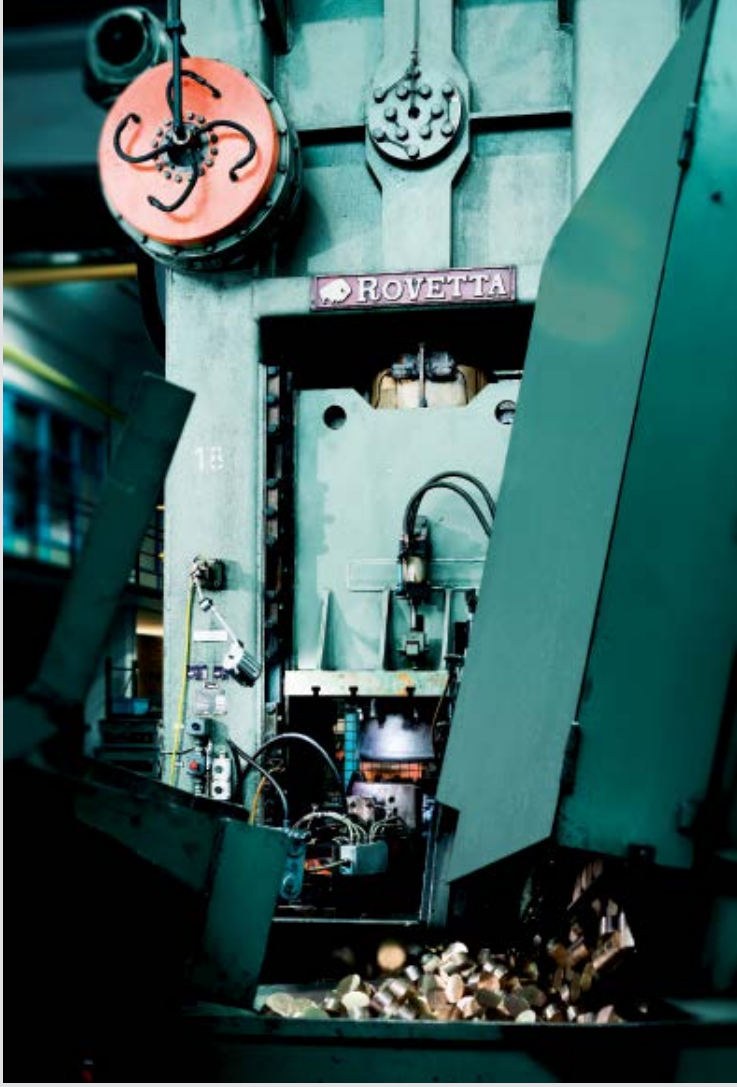
Sustainable product quality worldwide

We have achieved great success with respect to environmental thinking and our depth of commitment in the research and development of new materials.

Diehl Metall Schmiedetechnik does not simply fulfill the standard; we ensure that we go above and beyond during all phases of product development – from the customer inquiry to the finish-machined forged part.



Production

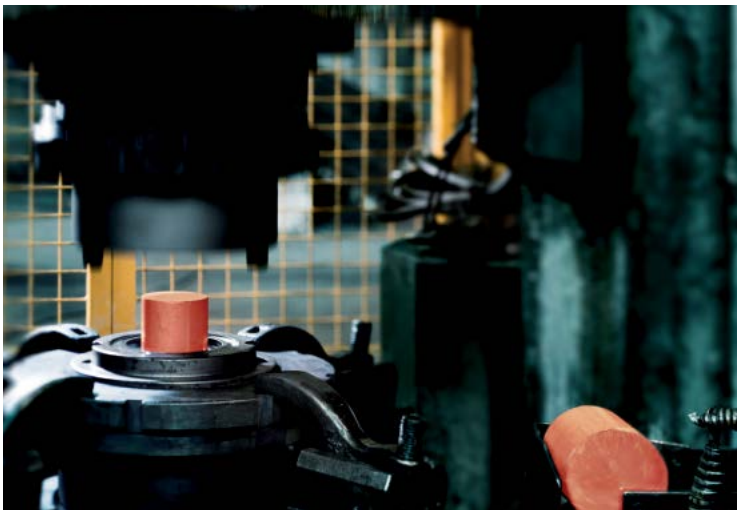


Diehl Advantages and Attributes

- > Automation
- > Comprehensive expertise
- > High quality standard
- > Well-coordinated processes
- > In-house die production

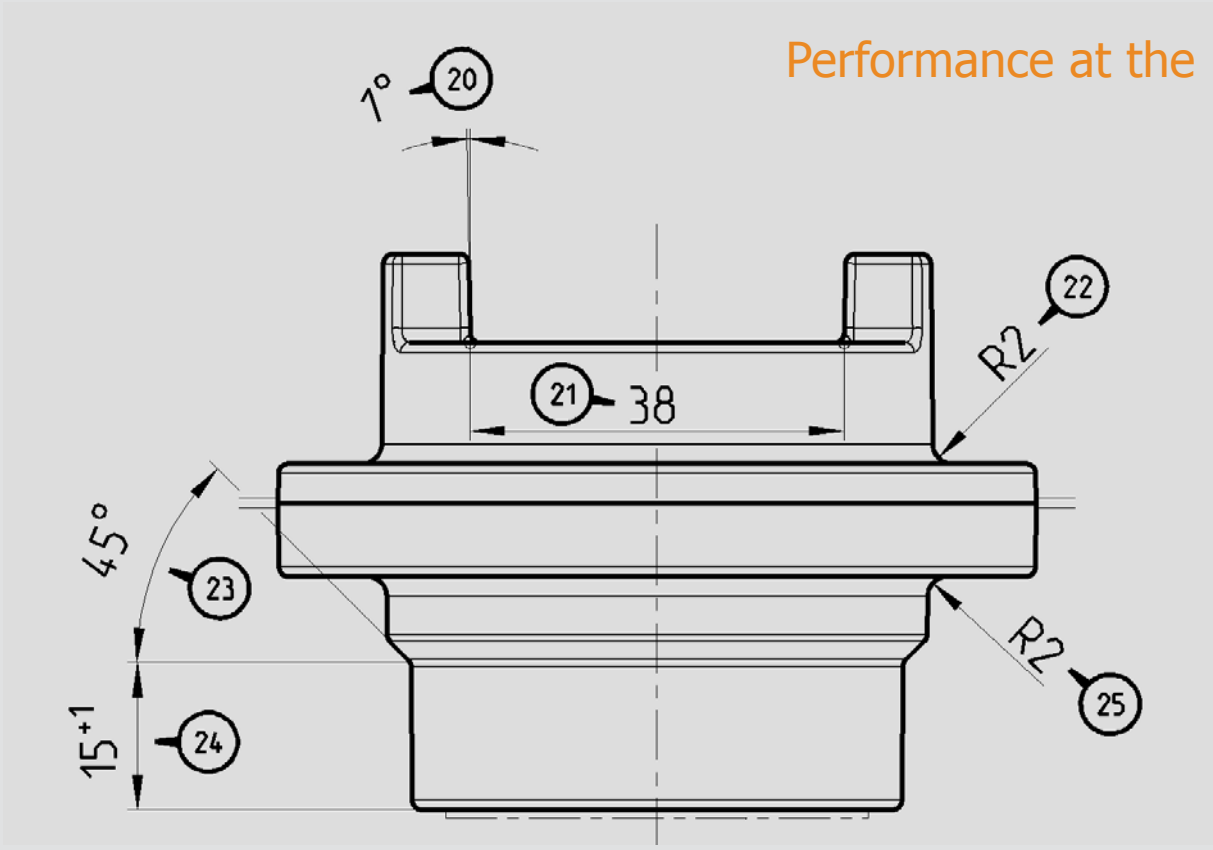
Forging Process

Bringing the billet to temperature and placing it in the die



Forging the billet in the press

Performance at the highest level



The shaped forging

At Diehl Metall Schmiedetechnik, over 50 million closed-die forged parts are produced per year. Forgings made of various raw materials can be manufactured using state-of-the-art design and production processes. CNC machining centers with integrated measurement technology and inline quality control are available. We provide an integrated production process – from in-house raw material production to the finish-machined forging.

Diehl Metall Schmiedetechnik leads when it comes to developing and producing innovative solutions in the area of non-ferrous metals. We develop alloys for the applications of today, thereby shaping the technologies of tomorrow.

The strong international network within the Diehl Group and the high degree of specialization bring great advantages to our company with respect to development and production.

Machining

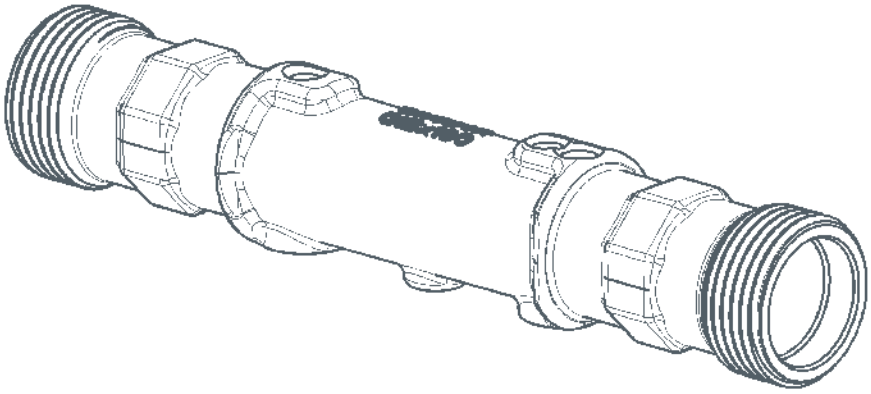
Precision and maximum quality in all that we do

Diehl Advantages & Attributes

> **Precision machining**
> **Heterogeneous machinery**
> **Machining of special alloys**

Diehl Metall Schmiedetechnik brings many products to series maturity each year. Quality, precision, production reliability and production speed may only be achieved through optimum collaboration between Product Development, the customer, the Die Shop and Machining.

The customer-specific design of the production process and the precise machining of forged parts are add-ons which we offer our customers. We bring together long-standing experience with the latest technological know-how.



Die Shop

A measure of independence

Diehl Advantages and Attributes

- **In-house Design and Die Shop**
- **Forging and stamping tools**
- **Measuring equipment**
- **Fixtures**

At our Die Shop, we carry out all process steps in-house, from CAD to the finished tool. This allows us to implement new products and tool modifications very rapidly.

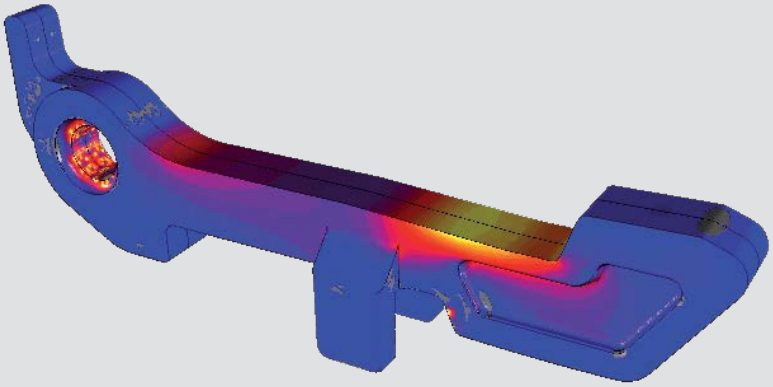
Our tools are produced using state-of-the-art CNC machines and machining centers. The customer benefits from briefer development times, cost reductions, increases in flexibility and higher quality through advanced development expertise.

Laboratory

The heart of our quality assurance and material development

Diehl Advantages and Attributes

- **Quality inspection and testing (mechanical and physical values, grain structure properties)**
- **Materials testing**
- **Special tests as part of development projects**
- **Providing comprehensive support and consultation to our customers with respect to materials**



Our extensively equipped laboratory is at the heart of material development and quality assurance.

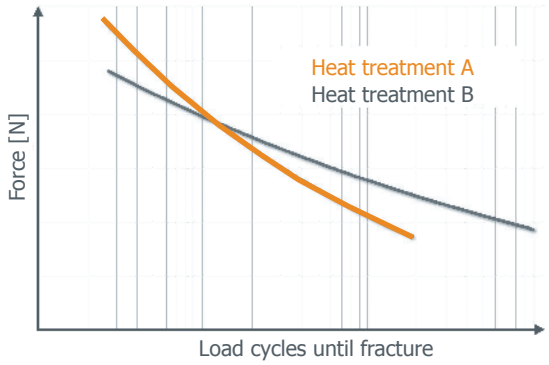
The development process is always directed to the goals of our customers. Hardness tests, micro-hardness tests, tensile tests, metallography, quantitative grain structure analysis, scanning electron microscopy, EDX micro analysis and chemical analyses are all part of our broad spectrum of possibilities.

The function and service life of the forgings is dependent on the material, geometrical design and the optimum interplay between the individual components of the part. To attain the best possible solution to meet the particular requirements, comprehensive testing methods may be carried out as part of our product development process. The values gained in this way allow us to provide competent advice to our customers in all issues relating to materials.

Research & Development

Actively recognizing and shaping the future requirements of the market since 1902

Temperature
Strain
Fold detection
Die filling
Forging force
Grain structure



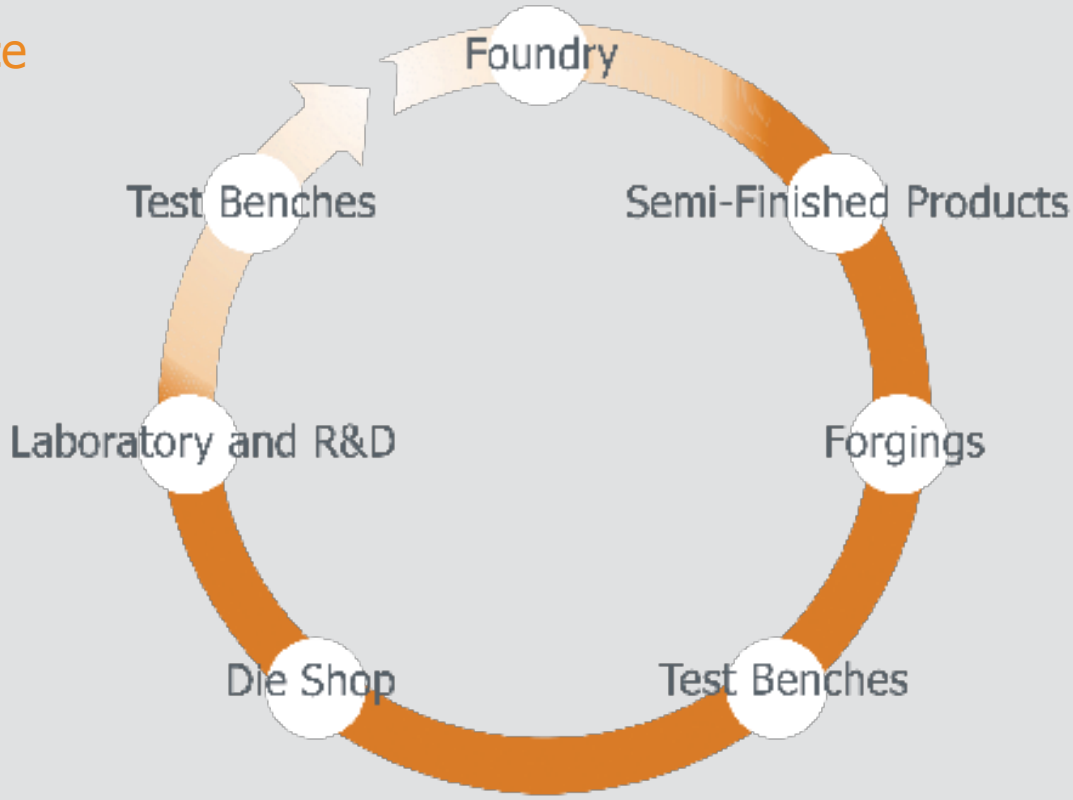
Numerical simulation of forging processes are utilized in order to fulfill diverse customer requirements as quickly and cost effectively as possible. This enables precise and detailed process design already at the planning stage. Furthermore, simulation results are used for successive improvement of existing products and processes.

Taking into account the working conditions and the associated dynamic loading of our forged products, determination of the fatigue strength of our brass alloys is of great importance. For this purpose, brass samples as well as formed parts are tested under dynamic bending loads and the corresponding alloy- or part-specific Wöhler curve is generated.

To further increase our competitiveness and to advise our customers in all product areas and forming related technologies, we are also active in several fields, such as: flashless or net-shape forging, determination of the stiffness of the entire forging system and compensation of its effect on the dimensional accuracy of the forged parts.

Integrated Production Process

From one source



Copper materials are environmentally sound, almost completely retain their high value and have a particularly high recycling ratio. We, for example, take back all the chips and leftover pieces generated during further processing from our customer, so that we can return this material to the production process again.

This not only protects valuable raw materials but also saves energy. When recycling copper, we save on the energy consumption associated with ore mining, processing and transport.

> Over 60 different copper alloys
> Customer- or product-specific alloys
> In-house production

Alloys

We develop alloys for the applications of today, thereby shaping the technologies of tomorrow.

Special Alloys

Diehl Metall DIN EN	DIN EN Symbol	Heat Treatment State	Mechanical Properties Brinell Hardness HBW 2.5/62.5 min.	Tensile strength [2] R_m (MPa) min.	Elastic limit [2] $Rp_{0.2}$ (MPa) min.	Elongation [2] A_5 (%) min.	Typical Applications	Material Behavior
356 [3] –	CuZn36Mn3Al2Si1		170-220 HBW2.5/62.5	630	330	13	Wear-resistant transmission parts, synchronizer rings	Very high strength, good sliding wear properties
363 / 364 [3] –	CuZn35Mn3Si1Pb1		80 [1] HRB	400	170	35	Structural parts in mechanical engineering	Good sliding wear properties
412 CW725R	CuZn33Pb1AlSiAs	H060	60 HBW2.5/62.5	280	120	20	Structural material	Resistant to dezincification, good resistance to seawater
416 CW626R	CuZn33Pb1.5AlAs	H060	60 HBW2.5/62.5	280	120	20	Structural material	Resistant to dezincification, suitable for use in faucet water; Complies with the German Drinking Water Ordinance DIN 50930-6
442 - CuTouch CW703R	CuZn23Al3Co		140 HBW2.5/62.5	480	340	32	Electrical engineering, contact surfaces, door handles, fittings	Tarnish-resistant, antimicrobial
452 CW713R	CuZn37Mn3Al2PbSi	H130	130 HBW2.5/62.5	580 550	270 200	20 8	Automotive parts such as synchronizer rings, gearshift forks, sliding blocks	Good wear properties, excellent oil corrosion resistance
454 CW713R	CuZn37Mn3Al2PbSi	H130	130 HBW2.5/62.5	580 550	270 200	20 8	Worm wheels, pump impellers	Good sliding properties, good oil corrosion resistance
455 [3] –	CuTn36Mn2Al1FePbSiSn		160 HBW2.5/62.5	580	270	20	Synchronizer rings, gearshift forks, sliding blocks	High strength, good toughness, good oil corrosion resistance
458 CW713R	CuZn37Mn3Al2PbSi	H130	130 HBW2.5/62.5	580 550	270 200	20 8	Synchronizer rings, gearshift forks, valve guides	High strength, good sliding wear properties
466 CW704R	CuZn23Al6Mn4Fe3Pb		200 HBW2.5/62.5	780 700	540 500	8 5	Coated synchronizer rings, bushings, worm wheels	Very high strength
467 [3] –	CuZn23Al6Mn4Fe3		200 HBW2.5/62.5	780	540	8	Coated synchronizer rings, bushings, worm wheels	Very high strength
470 [3] –	CuZn13Mn8Al5Si2Fe1Pb		180 HBW2.5/62.5	630	430	12	Wear-resistant transmission parts, synchronizer rings, sliding blocks	Very high strength
474 [3] –	CuZn13Mn8Al5Si2Fe1		180 HBW2.5/62.5	630	430	12	Wear-resistant transmission parts, synchronizer rings, sliding blocks	Lead-free
479 [3] –	CuZn30Mn3Al3Si1NiCr		195-225 HBW2.5/62.5	650	400	15	Synchronizer rings	High level of hardness, high wear resistance
482 [3] –	CuZn29Al4Ni3Co1SiFePb		190 HBW2.5/62.5	790	710	5	Synchronizer rings	High level of hardness, high wear resistance
488 [3] –	CuZn32Ni7Al4Si2Fe		240-300 HV50	830	720	3	Synchronizer rings	Highly wear resistant, high strength
489 [3] –	CuZn18Mn8Al5Si2Fe1Pb		220-300 HV50	840	800	5	Synchronizer rings	Highly wear resistant, high strength
490 [3] –	CuZn35Ni14Si4Pb		170 HV50	560	400	4	Synchronizer rings	Highly wear resistant
492 [3] –	CuZn18Mn8Al5Si2Fe1		220-300 HV50	840	800	5	Synchronizer rings	High-strength material with high corrosion resistance

Aluminum Bronze Alloys

700 CW307G	CuAl10Ni5Fe4	H170	170 HBW2.5/62.5	720 650	360 350	12 12	Bearings, worm wheels	High-strength material with high corrosion resistance

[1] Solution annealed and precipitation hardened

[2] Heat treated

[3] Not standardized to EN 12420

Information according to Diehl material data sheet

Information according to EN 12420

Standard Alloys

Diehl Metall DIN EN	DIN EN Symbol	Heat Treatment State	Mechanical Properties: Brinell Hardness HBW 2.5/62.5 min.	Tensile strength [2] R_m (MPa) min.	Elastic limit [2] $Rp_{0.2}$ (MPa) min.	Elongation [2] A_5 (%) min.	Typical Applications	Material Behavior
002 CW614N	CuZn39Pb3	H070	70	350	140	15	Primary alloy for forgings of all kinds: in particular for fittings, housings	Very good machinability, difficult to cold forge
003 CW617N	CuZn40Pb2	H070	70	350	140	15	Forgings of all kinds, particularly for thin-walled parts	Very good machinability, difficult to cold forge
008 CW612N	CuZn39Pb2	H070	70	350	140	15	Forgings for machining and cold forging	Good machinability, possible to cold forge
014 CW608N	CuZn38Pb2	H070	70	350	140	15	Forgings for machining and cold forging	Good machinability, possible to cold forge
015 CW610N	CuZn39Pb0.5		75	340	100	25	Fittings	Easy to hot and cold forge
040 CW004A	Cu-ETP	H040	40	200	50	30	Parts for the electrical industry	Easy to hot and cold forge, possible to polish
062 – Ecomerica CW511L	CuZn38As	H060	60	280	120	20	Suitable for use in the area of drinking water	**Resistance to dezincification** Possible to cold forge, machinable
095 CW111	CuNi2Si	H140[1]	140	470	320	12	Screws and bolts	High strength, medium electrical conductivity
362[3] –	CuZn36Mn3Si		120	450	320	15	Sliding components	Easy to cold forge, good sliding wear properties
402 CW602N	CuZn36Pb2As	H060	60	280	120	20	Fittings	Resistant to dezincification, possible to cold forge, easy to machine
430 – Cuphin CW724R	CuZn21Si3P	H120	120	500	250	15	Forgings of all kinds	Corrosion resistance, **lead-free alloy,** good machinability, high strength
451 CW720R	CuZn40Mn1Pb1	H080	85	350	160	15	Roller bearing cages, sliding components	Good machinability, medium strength
453[3] –	CuZn37Mn1Al1FePbSi		110	440	180	20	Bevel gears, gears	Medium machinability Medium to high strength
458 CW713R	CuZn37Mn1Al1FePbSi	H140	140	550	200	8	Gearshift forks, worm wheels, high-strength structural parts	Good sliding wear properties, high strength
460 CW710R	CuZn35Ni3Mn2AlPb	H100	100	440	180	10	Apparatus engineering, ship fittings	Medium machinability, resistant to seawater, medium to high strength

[1] Solution annealed and precipitation hardened [2] Heat treated [3] Not standardized to EN 12420

Information according to Diehl material data sheet

Information according to EN 12420

Aluminum Alloys

Diehl Metall DIN EN	DIN EN Symbol	Heat Treatment Condition	Cross Sectional Dimension t [2] in mm	Mechanical Properties: Brinell Hardness [3] HB 2.5/62.5 min.	Tensile strength R_m (MPa) L [4] min.	Tensile strength R_m (MPa) T [5] min.	Elastic limit $Rp_{0.2}$ (MPa) L [4] min.	Elastic limit $Rp_{0.2}$ (MPa) T [5] min.	Elongation A_5 (%) L [4] min.	Elongation A_5 (%) T [5] min.	Typical Applications	Material Behavior
502 AW 2014	AlCu4Mg1	T4	t ≤ 100	105	420		260		8		Mechanical engineering, fastening elements	Hardens at room temperature, high strength
503 AW 7075	AlZn5.5MgCu	T6	t ≤ 50	135	510	480	430	410	7	4	Vehicle construction, mechanical engineering, aviation industry	Hardens by tempering, maximum strength
			50 < t ≤ 100	130	500	470	425	400	6	4		
		T73	t ≤ 50	120	455	420	385	360	6	4		
			50 < t ≤ 100	112	445	410	375	350	6	3		
506 AW 2014	AlCu4SiMg	T6	t ≤ 50	120	440	430	380	370	6	3	Vehicle construction, mechanical engineering, aviation industry	Hardens by tempering, maximum strength
			50 < t ≤ 100	120	440	430	370	360	6	3		
510 AW 6082	AlSi1MgMn	T6	t ≤ 100	90	310	290	260	250	6	5	Electrical engineering, vehicle construction, mechanical engineering	Hardens at room temperature and by tempering, medium strength
511[1] AW 6012	AlMgSiPb		t ≤ 100	80	275	260	220	200	6	5	Parts for machining across a large surface area	Hardens at room temperature and by tempering, easy to machine
519[1] –	AlSi12.5MgCuNi	T6	–	90	270		210		5		Structural parts with increased wear resistance, transmission parts	Hardens by tempering, medium strength

Besides these alloys, we also produce forgings made of other aluminum alloys upon request.

1) Not standardized according to EN 586
2) Diameter of the largest sphere which can be drawn into the forging
3) For acceptance tests if no tensile test can be carried out
4) Direction parallel to the main fiber flow
5) Any direction which is not parallel to the main fiber flow

T4 = Undergoes solution heat treatment and natural aging
T6 = Undergoes solution heat treatment and artificial aging
T73 = Undergoes solution heat treatment and is artificially overaged (artificial aging) to achieve optimum resistance to stress corrosion cracking

Brass – up to 100% recyclable with no quality compromises

Special alloys with outstanding properties

CUPHIN

- Lead-free material for fittings with high resistance to stress corrosion cracking and dezincification
- Thanks to its unique combination of technical properties, this material ensures safety, hygiene and well-being. It also has a low impact on the environment

AQCUARIN

- A brass of the new generation that is resistant to dezincification and used especially for drinking water installations due to considerably reduced levels of lead release into the drinking water
- Already fulfils the pertinent, more stringent limit values of the German Drinking Water Ordinance

ECOMERICA

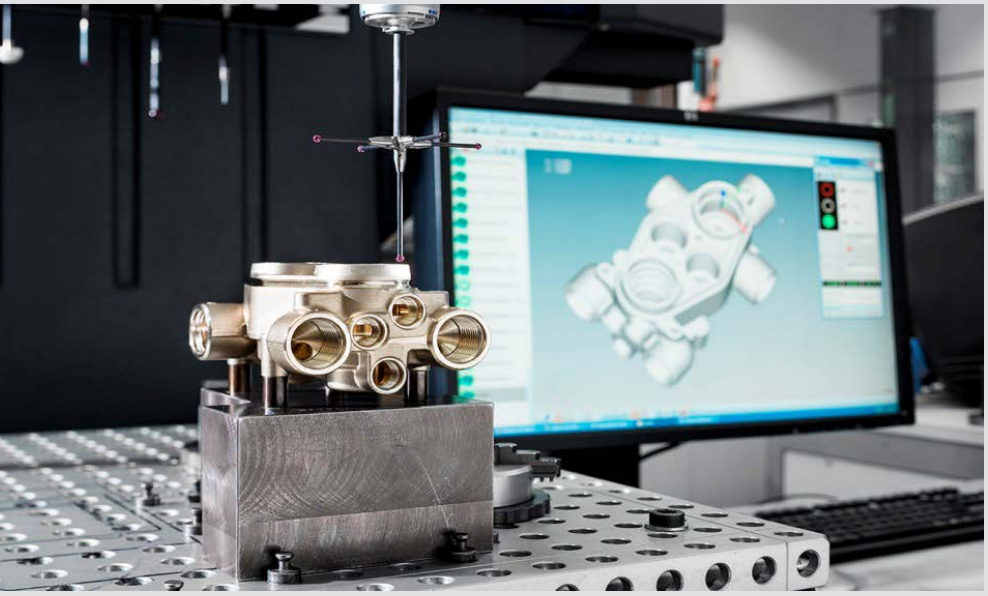
- Lead-free brass alloy for drinking water applications according to US legislation

CuTouch

- Antimicrobial effect
- High copper content prevents the spread of infections and has an antimicrobial effect anytime and anywhere

Quality Management

We fulfill the international demand for the supply of products at the highest quality



We have a certified quality management system according to the international quality standards ISO 9001 and ISO TS 16949.

Quality Management

At Diehl Metall Schmiedetechnik, quality management is an integrated part of the process chain to ensure that all aspects of quality assurance – even beyond the relevant standards – are taken into consideration for the benefit of the customer.

Certified quality at Diehl Metall Schmiedetechnik

Due to our international customer base, quality management involves bringing together various quality standards valid in the relevant industry. Diehl Metall Schmiedetechnik is certified according to ISO 9001 and ISO TS 16949. Furthermore, our environmental and energy management system is certified according to ISO 14001 and ISO 50001. This also assists us in continually optimizing our business and production processes.

Responsibility

We embrace the challenges of the future

We take responsibility for the protection of our climate and resources.

Sustainability

Environmental thinking and action are fundamental components anchored in our corporate policy. We wish to achieve completely integrative environmental protection in which all environmental aspects are taken into account right from the initial product concept. Our actions are thus guided by national and European environmental regulations. We practice sustainable management by handling resources carefully, reinforcing recycling efforts and, as an energy-intensive company, by paying particular attention to energy efficiency and reducing CO2 emissions. With optimized logistics processes at the plant and on the way to the customer, we lay the foundation for sustainable products.

Megatrends

Alternative energies are supported through the use of recyclable forged parts.

Non-ferrous metals, particularly brass, are almost 100 % recyclable.

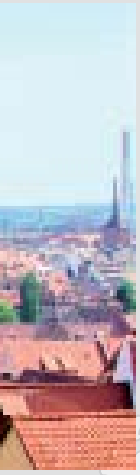
In the megatrend area of water, forged parts made of copper alloys have an antimicrobial effect.

Global Presence – We are always within reach

We change the world, not from the outside but from within .
We are characterized by our global presence: We are the global leader in the production of high-performance synchronizer rings made of brass and steel for manual transmissions in the area of automotive engineering.

Diehl Metall sets standards for the future.
Diehl Metall Schmiedetechnik is a company of the Diehl Group, a family-run, self-financed enterprise founded in 1902. The innovative technology know-how of the entire Diehl Group enables us to draw on impetus generated in other technical areas for use in our developments in all industrial sectors.

São Paulo (Brazil)



Röthenbach (Germany)
Wuxi (P.R. China)
Pune (India)

Diehl Metall Schmiedetechnik
Heinrich-Diehl-Straße 9
90552 Röthenbach a.d. Pegnitz
Germany
Phone +49 911 5704-0
Fax +49 911 5704-490
www.diehl.com/metall

V-Oe/11/2014/Au