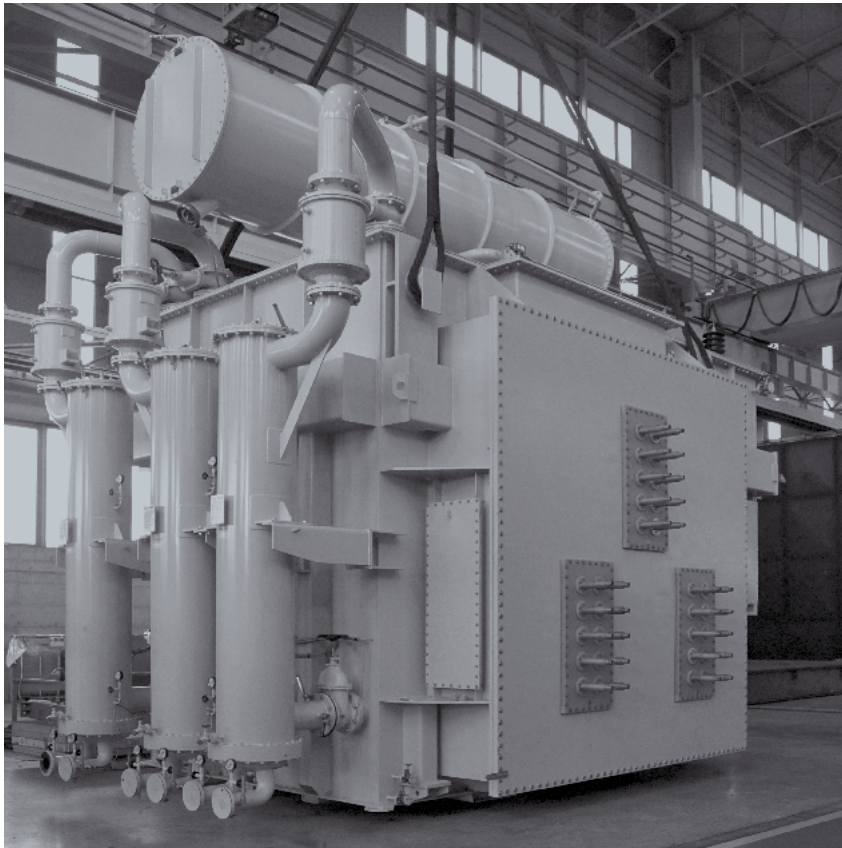




TAMINI INDUSTRIAL APPLICATIONS



TAMINI
ENERGY TRANSFORMERS

 **Terna Energy
Solutions**
MORE VALUE, TOGETHER.

TAMINI
ENERGY TRANSFORMERS

THE GROUP

Tamini designs, produces and installs transformers for power and industrial applications, designed to meet the specific needs of the customers, that we support throughout the whole product life cycle with personalised after-sales services.

Tamini is part of the Terna Energy Solutions Group, a company within the Terna Group, which, through specific and diversified skills of its member companies, offers 360° support that covers the entire life cycle of projects, including the supply of strategic components for the energy transition, such as cables and electrical transformers.

Thanks to the existing synergies between the various Group companies, TES is the partner of excellence in the energy and digital transition of its customers in Italy.

The other companies in the Terna Energy Solutions Group are:



Design, manufacture, installation, and maintenance of cables, accessories, and systems solutions for energy suppliers, TSOs and industrial applications.



Advanced solutions and comprehensive support, tailored to each phase of the life cycle of high and medium voltage infrastructure, photovoltaic systems and storage systems.



High Voltage



Storage



Photovoltaics



Energy Efficiency



The Group also provides connectivity services to the market, supporting customers in building customised project solutions.



INDUSTRIAL APPLICATIONS

Unique solutions, developed on customer needs.

Unique in Quality

Our transformers are the result of a unique mix: the artisan excellence of Made in Italy combined with the best available technology.

Unique in Technology

We have unique research and development methodologies to ensure the highest standards of products and services for our customers.

Unique in Customization

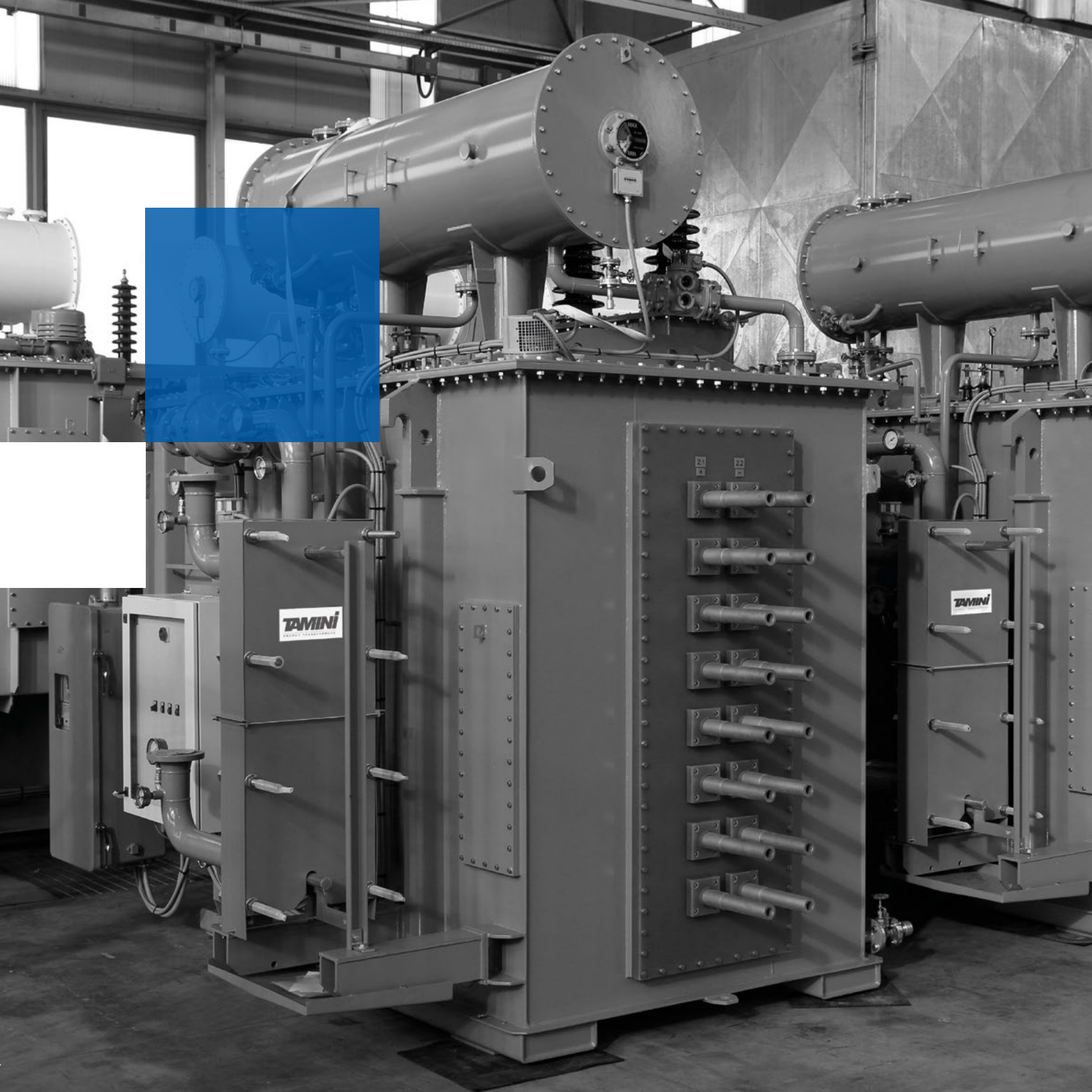
We meet the specific needs of each client through our ability to customize each solution, backed by more than a century of experience in the industry.

Unique in Design

Our experienced and qualified team designs unique products, thanks to the incomparable know-how gained Worldwide.

INDUSTRIAL APPLICATIONS

We produce transformers
for every industrial application,
designed to satisfy most diverse
customers' requirements.





TRANSFORMERS FOR INDUSTRIAL APPLICATIONS

Tamini has always produced Industrial Transformers of high quality and reliability, designed to satisfy the most diverse and complex technical requirements.

A large share of its resources is devoted to the development of transformers for any industrial application, such as furnace transformers, reactors, power transformers for industrial distribution and rectifier transformers.

In the last ten years, Tamini has manufactured more than 1,000 transformers. Among them approximately one third are industrial transformers and the majority is exported all over the world.

Year after year, Tamini has become a leading market player for industrial transformers and is now even stronger to effectively cope all future challenges.

Tamini also operates through its branches in USA and India. At the moment, over 60% of company turnover comes from exports.

RESEARCH & DEVELOPMENT

In order to adapt the design and the characteristics of the industrial transformers to the most advanced technology, a constant liaison between engineering and manufacturing is carried out by Tamini.

As a result, Tamini has reached a prominent worldwide positioning in the supply of furnace transformers, rectifier transformers for electrolytic processes, aluminum smelters and other metal refining processes, DC furnaces for electrometallurgy industries and DC electric traction.





QUALITY, ENVIRONMENT AND SAFETY INTEGRATED SYSTEMS

Integrated Systems are carried out and certified according to ISO 9001:2015, ISO 14001:2015, ISO 45001:2018 and ISO-37001-2016 Standards. Quality Controls are performed at every step: engineering, manufacturing cycles, procurement, testing and on-site installation.

All Tamini's factories have their own testing facilities suitable for the routine, type and special tests in accordance with IEC or IEEE (ANSI) and other worldwide recognized Standards (ASA, CSA, BSS, SEV etc.).
Tamini definitely complies with the most updated International Legislation for Safety and Environmental protection.



Tamini's organization is dedicated to performing activities in compliance with the highest standards of quality, environmental protection, health and safety.

Integrating ESG principles, recognised certifications and responsible innovation is an integral part of how Tamini designs and produces transformers every day.

The company is qualified by independent international platforms:

- **Ecovadis** – Global ESG rating
- **Synesgy / Cribis** – Assessment of corporate sustainability
- **Open-es** – Environmental, social and governance performance
- **Achilles** – Qualification of suppliers for regulated markets





AC AND DC FURNACE TRANSFORMERS FOR METALLURGY

The Electric Arc Furnace and Ladle Furnace Transformers are the key equipment in a steel plant, therefore specific engineering solutions are adopted in order to guarantee over time the best performances under the dielectric, thermal and mechanical stresses which daily involve these transformers.

Furnaces transformer's life is affected by heavy stresses during operation. Frequent on and off switching, high magnitude inrush currents, high operation currents, variable frequencies, often close to short circuit values, fast transient overvoltages, significant harmonic content and elevated number of operations carried out by the on-load tap changer are the everyday challenges for a furnace transformer.

Electrical stresses are due to overvoltages generated both by the melting process and by transient state resulting from a sudden disconnection of HV circuit breakers, especially if vacuum-type ones are installed.

Tamini pays special attention to this issue adopting a specific design and manufacturing procedures to guarantee a stronger transformer insulating structure. Moreover, during furnace operation, the transformers undergo thermal and

mechanical stresses due to the continuous daily steel melting process. Continuous stresses and vibrations might make the windings loose if they are not properly treated and robustly clamped. In order to avoid any inconvenience due to such heavy and frequent stresses, Tamini has adopted improved procedures for windings pressing and thermal treatment operation.

Different solutions can be adopted according to the customer requirements:

- Single or double core “booster” solution;
- LV delta closure either inside or outside the tank;
- LV bushings either in copper bars or water-cooled pipes;
- LV outlets either on the top cover of the transformer tank or on the lateral side.

Product scope:

- Rated power up to 360 MVA (the highest rating ever built);
- L.V. current up to 150 kA.





Furthermore, Tamini has developed a special winding clamping system which guarantees an exceptional resistance against any electrodynamical stresses even under the most arduous operating conditions.

This system has been successfully used for many years and it is subject to continuous improvements.

Tamini also provides:

- Special furnace transformers as **Submerged Arc Furnace (SAF)**, **Electroslag Remelting (ESR)** and **Smelter Transformers** used to power furnaces for the production of special iron alloys. These alloys often require the deployment of three single-phase furnace transformers instead of a single three-phase transformer in order to balance the total phase impedance through an equilateral-triangle layout of the units or in applications of modern steel processes.
- **Regulating transformers**, with either stepped or stepless regulation of the output voltage, for those applications/ processes where a fine regulation is needed.

SERIES REACTORS FOR FURNACE APPLICATIONS

Series Reactors connected to Furnace Transformers are often used to stabilize the arc current. In order to achieve better efficiency of the melting process, series reactors may have tapplings to adjust the reactance in coordination with arc furnace needs.

Series reactors can be designed as Gapped-Core Reactors or Coreless Reactors (with core- frame).

Product scope:

- Up to 150 Mvar.

Reactors are used in the furnace operation with the purpose of:

- Arc stability and power regulation;
- Optimisation of electrodes consumption;
- Limitation of current during melting process;
- Reduction of flicker on the feeding network.

Core and windings are of the same type of the transformer with the difference that in the magnetic core limbs suitable gaps designed for specified reactance and reactive power values are inserted.

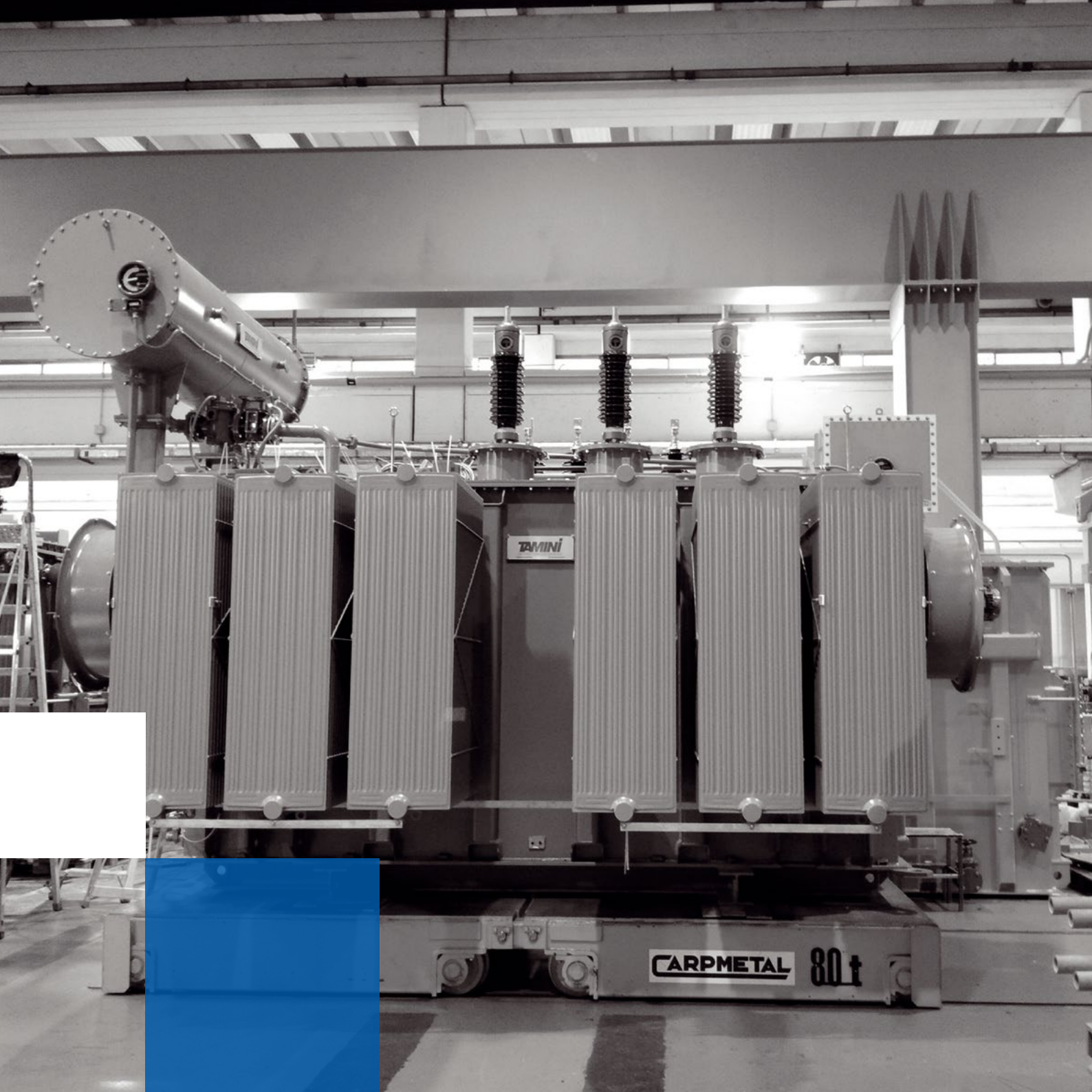
The reactance is generally requested to be constant up to 2 times the rated current; when higher, a core-less solution is normally applied.

Reactors are adjustable in steps by a tap changer (TC), in order to select the proper value of reactance at any operational set-point achieving a quick furnace regulation.

Tamini has designed and successfully supplied many different types of transformer-reactor solutions. The series reactor can be as well installed into the transformer tank (built-in) to optimize the size of the system.

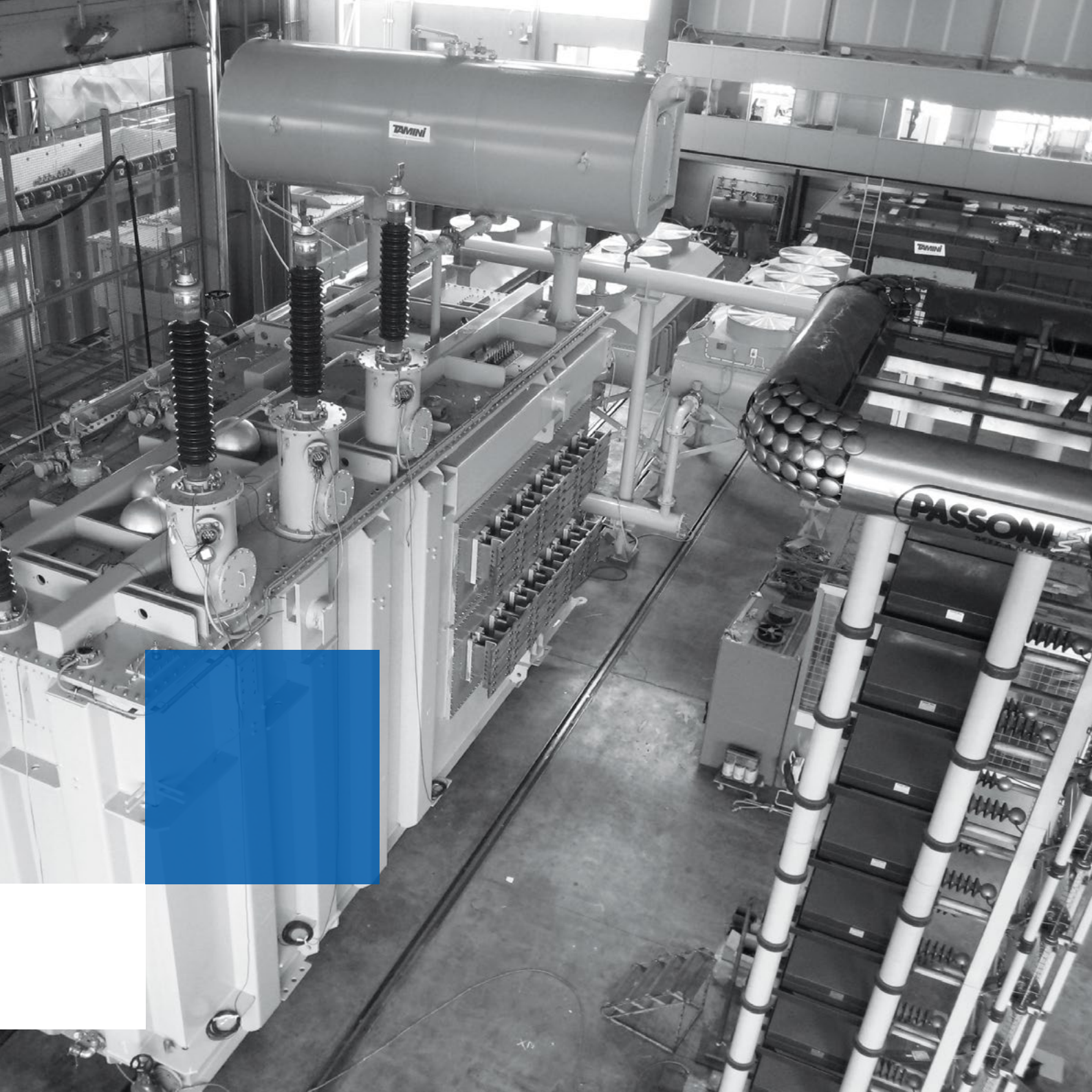
The reactor can be also assembled:

- Inside the main transformer tank;
- Entirely separated from the transformer.



TAMINI

CARPMETAL 80t



RECTIFIER TRANSFORMERS

The Rectifier transformer is the link between the electrical grid and the AC/DC converter. Therefore, it has the aim to provide the number of phases, the voltage shifts needed to realize the conversion and to adjust the rectifier input to vary the DC output voltage.

To do it, the rectifier transformer is often coupled with components as regulating transformers (or autotransformers), saturable reactors and interphase transformers.

All these components may be assembled in one or in separate tanks for transportation optimization and site restrictions.

Product scope:

- Rated power up to 200 MVA;
- L.V. current up to 150 kA.

Rectifier transformers face high operating currents combined with a huge amount of harmonic content due to the distorted waveform caused by the semiconductor converters connected to the transformer.

Typical applications are for: DC arc furnaces, electrolysis, scrap melting furnaces, aluminum smelter, graphitizing furnaces, traction substations, metal refining and inverters for variable speed drives.

DISTRIBUTION TRANSFORMERS FOR INDUSTRIAL APPLICATIONS

Distribution Transformers

Distribution Transformers are used wherever it is necessary to connect systems for distribution and utilization of electrical energy.

They are nowadays used as well in mobile substations, needed to feed energy where a standard substation is not or cannot be built.

Tamini's experience has allowed the company to become a leading brand both nationally and abroad in the HV/MV and MV/MV distribution transformers market. The company's products are used across a wide spectrum of applications by a plethora of major clients.

Distribution transformers for energy distributions are usually three or single phase, fluid immersed, with different cooling methods, with conservator technology or sealed construction (with or without nitrogen/ air filling), with either off-circuit tap changer or on-load tap changer.

Furthermore, transformers for railway application with various loading cycles can be manufactured.

HV/MV Transformers

Product scope:

- System voltage up to 550 kV;
- Power rating up to 900 MVA.

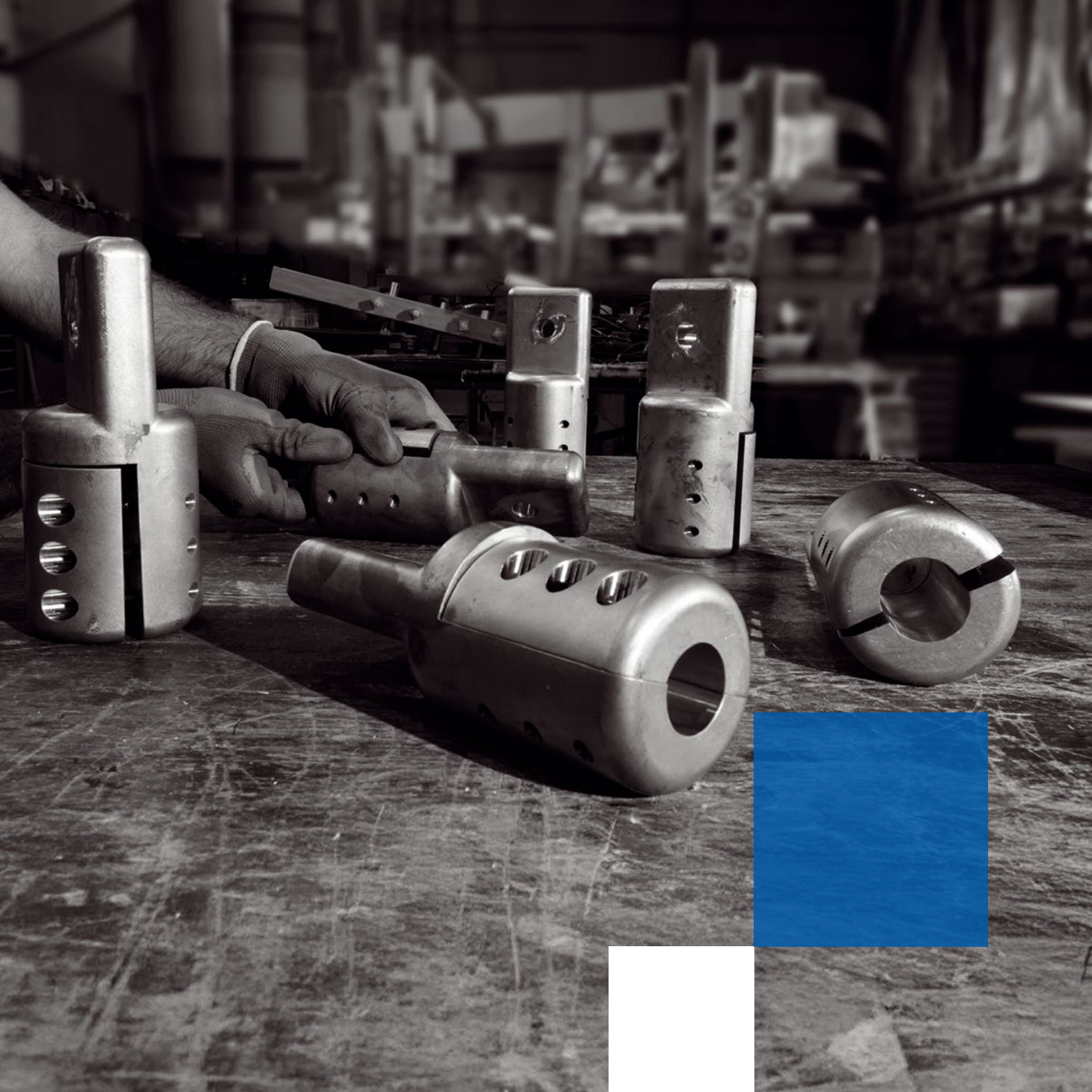
MV/MV Transformers

Product scope:

- System voltage up to 52 kV;
- Power rating up to 100 MVA.



DESTRA
AVANTI
SINISTRA
INDIETRO



MAIN ACCESSORIES

LV Outlets

In the past, outlets for furnace transformers were mainly done by copper bars positioned either on the top cover of the transformer tank or on the later side.

The increase of transformer ratings requires many bars in parallel for each LV outlet. The bars have different arrangements depending on the type of connection to the furnace electrodes.

Today, the improvement in technology for LV connections brought an alternative solution for transformers of large rating: water-cooled bushings are often used instead of bars.

The design and construction of these water-cooled bushings avoid any risk of water leakage into the transformer oil.

The arrangement of the LV outlets depends on the connection of the LV windings. The delta closure of the LV windings can be realized either outside or inside the tank. When delta closure is requested inside the tank, the LV outlets normally have a triangle shaped arrangement.

This solution facilitates the connection to the furnace and, at the same time, guarantees a good symmetry of the three phases and current distribution among them.

For rectifier units the used solution is the copper bars. The shape and size are customized based on rectifier input interface.

Tank

The tank is made by welded steel sheets creating a strong and stiffened structure to support full vacuum and over pressure.

The internal walls of the tank are painted with a hot oil resistant coating while externally the tank is painted according to a standard procedure established by the Tamini Quality Assurance Department.

Specific painting requirements can be adopted on request.

In furnace and special transformers the tank is equipped with an oil conservator divided in two sections for the transformer oil and for the OLTC oil switch. Suitable manholes for internal inspection and maintenance are provided on the tank.

In correspondence of the LV outlets, the tank has one or more nonmagnetic insulating plates bolted to the tank through suitable gaskets.

Bushings

The bushings can be either of the oil/air type or oil/oil, in case of connections to cables in oil filled terminal boxes, or also oil/SF₆ for connection to SF₆ filled bus-bar ducts.

HV Bushings are usually of the condenser type with oil impregnated or with resin impregnated paper.

Tap Changer

The transformers can be equipped either with on-load tap changer fitted on the HV side. The on-load tap changer is composed by a tap selector normally immersed in the same oil of the transformer and by a diverter switch located in an oil filled sealed container separated from the transformer oil. On request, a barrier board inside the transformer tank can be provided to divide the oil of the transformer and the oil in which the selector is immersed. With this solution it is possible to check the tap changer selector by only removing the oil from the separate section in which it is positioned.

Moreover, as a further solution, the whole OLTC can be located in a separately associated oil filled tank and connected through bushings.

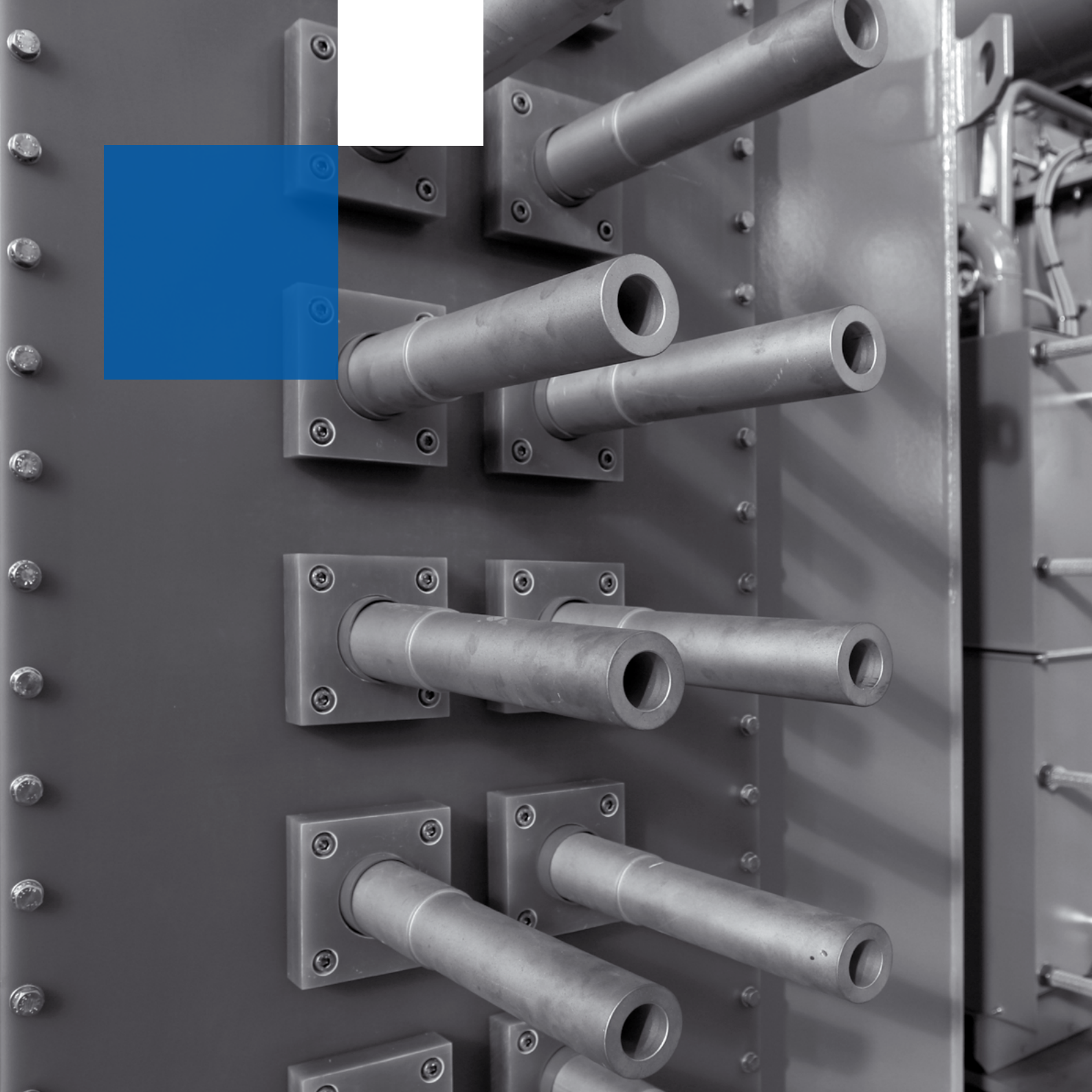
Ancillaries

The transformers are equipped with the following main fittings and accessories:

- Air silica gel breathers for the conservator sections;
- Oil level indicators with electric contacts for the conservator sections;
- Buchholz relay with alarm and trip contacts;
- Oil drain, filling and filtering valves;
- Oil thermometer complete with alarm and trip contacts and, on request, a device for remote temperature monitoring;
- Current transformers;
- Over-pressure protection;
- Lifting lugs for core and winding;
- Lifting lugs for the complete transformer;
- Marshalling box for signaling and protection auxiliary circuits;
- Earthing terminals;
- Oil sample valve.

Upon request additional and/or specific accessories could be fitted on the transformers. As example:

- Surge arresters on HV side;
- RC filters on HV side;
- Capacitors on LV side;
- PLC and/or i/o cards.





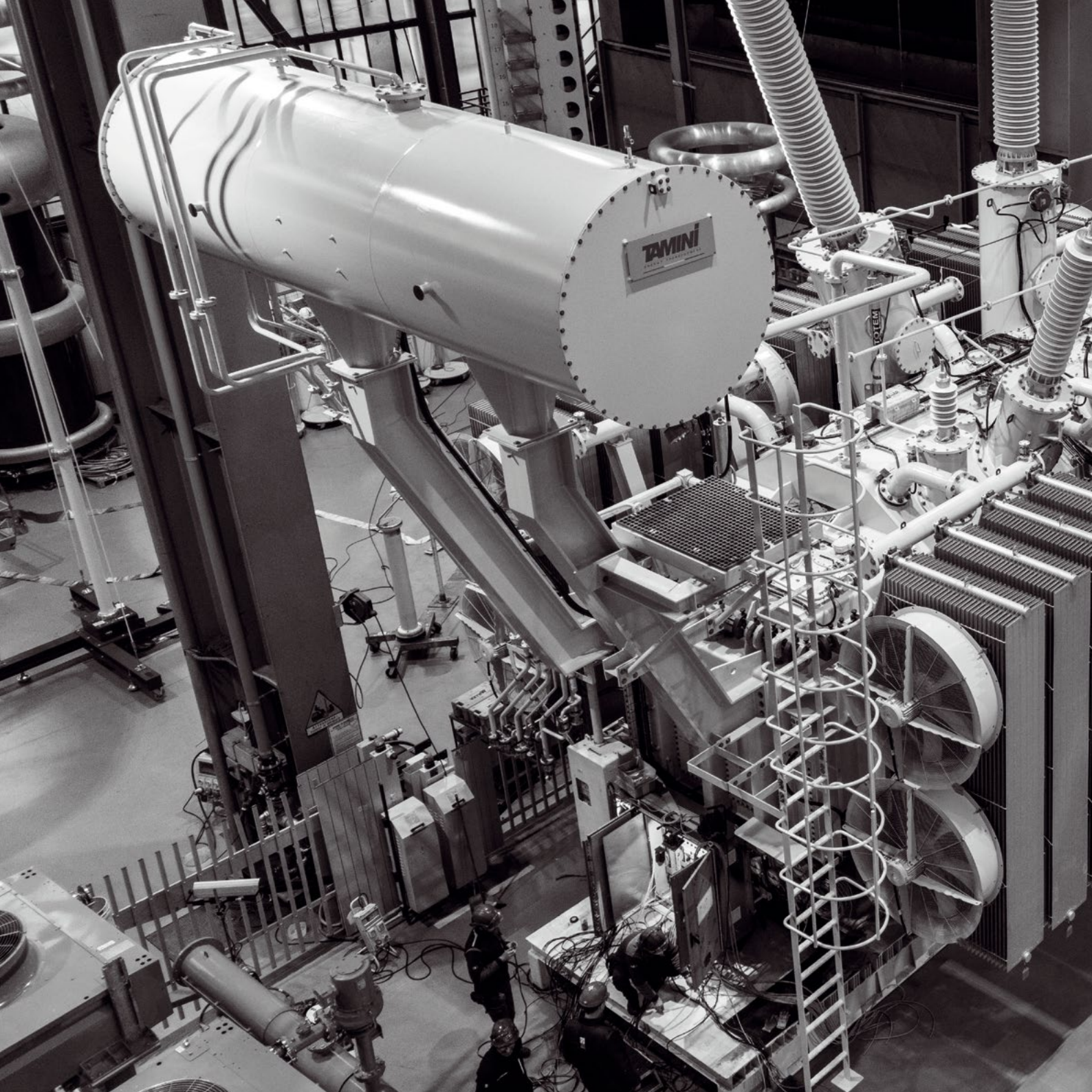
Cooling System

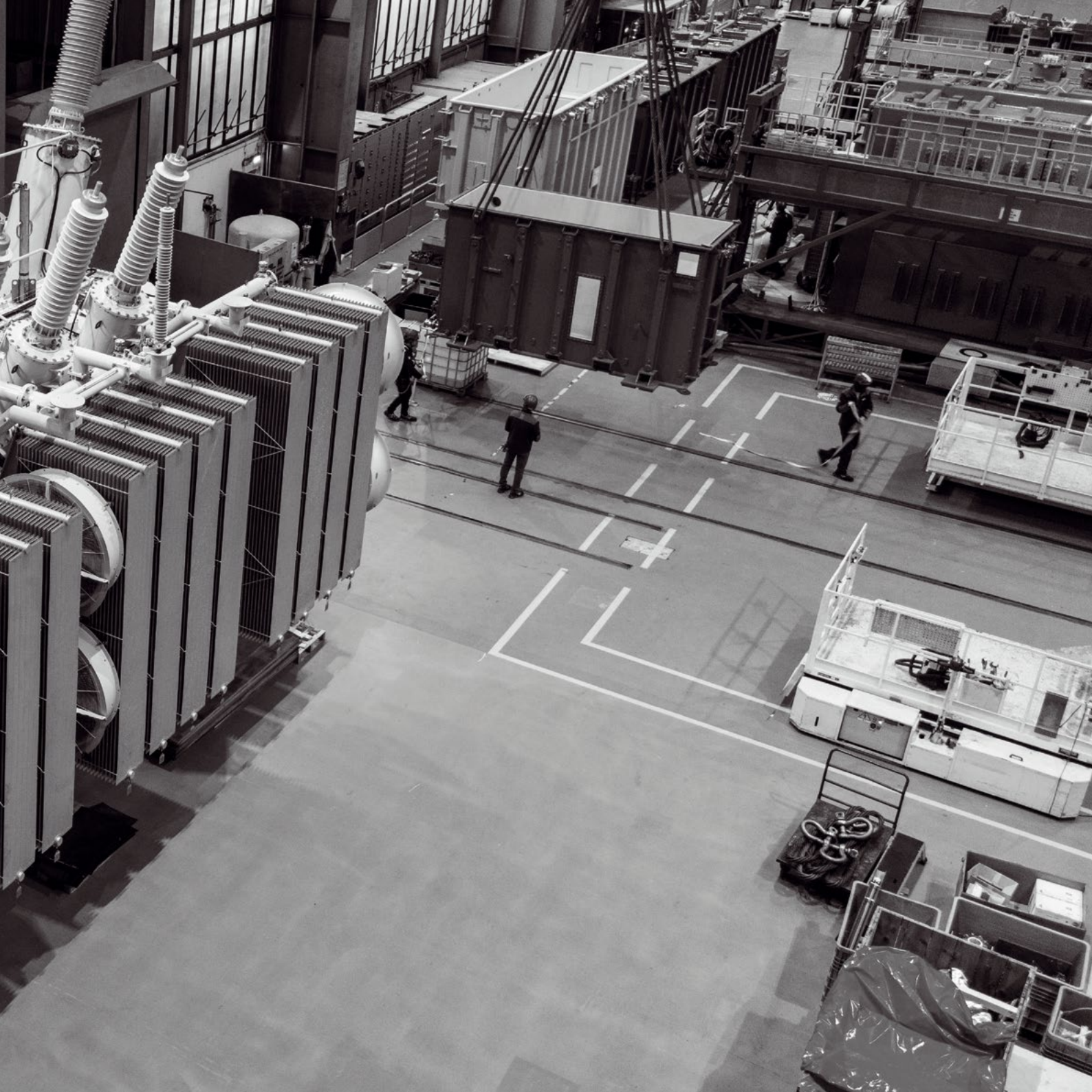
The transformers can be designed for any applicable cooling system following the requirements of the end user.

The industrial transformers are mostly provided with an OFWF cooling system. Different positioning of the coolers, including horizontal installation, can be adopted to satisfy specific requirements for easier connection to the external water piping system. The coolers are normally composed by a single-walled or, on request, a double-walled system. The design of the coolers is such that any possible risk of water leakage into oil is absolutely avoided.

The coolers can be equipped with many accessories line: water and oil flow indicators with alarm contact, water and oil thermometers, water and oil drain taps or other special ones, on request. When water is not available, the cooling is generally OFAF.

The most used cooling systems for power transformers are ONAN and ONAF. These systems are achieved by radiator banks, mounted on the sides of the transformer tank, or in separate banks, with or without cooling fans. The cooling can also be OFAF (or ODAF) and OFWF (or ODWF) with coolers assembled on the transformer tank or in a separate bank.









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