

TRANSFORMER BUSHINGS

Product Spectrum



Our Solution

HSP & Trench provide a wide range of bushing products, including bushings for power transformers and HVDC transmission. HSP & Trench transformer bushings are designed to be connected to oil-insulated and ester power transformers and operate with the following environmental media: outdoors, cable junction box-oil and gas insulated substations. Our product spectrum includes transformer bushings with condenser grading and a choice of active part insulation: resin-impregnated paper (RIP), resin-impregnated synthetic bushings (RIS), resin-impregnated glassfiber (RIG), oil-impregnated paper (OIP) and ester fluid impregnated paper.

PROVEN RELIABILITY

- Pioneer of Dry-type Bushings technologies
- **More than 80 years experience** in bushing manufacturing
- **More than 380,000 units installed worldwide** in various environments and under operation for decades

PREMIUM QUALITY

- Extremely Robust Design through best-in-class insulating stress control, increasing safety, durability & reliability
- Rigorous Quality Control for entire supply chain and manufacturing processes

EVOLVING PORTFOLIO

- Complete Product Portfolio available **up to 1200 kV**
- High level of customization allows us to meet the widest range of customer design requirements based on various industry standards (IEC, IEEE, GOST, etc.) and to match other vendors' products for replacements

CONTINUOUS INNOVATION

- We are finely tuned to our customers' evolving requirements, constantly innovating with improved, more efficient and more **environmentally-friendly products** and technologies

GLOBAL PRESENCE

- Our worldwide presence ensures customer proximity, allowing access to expert technical support at all times
- Largest production capacity offering maximum flexibility for our customers



Context

Bushings are the components of the Power Transformer specified to realize the connection to the high voltage electrical network and switchgear devices, allowing the flow of the electrical power.

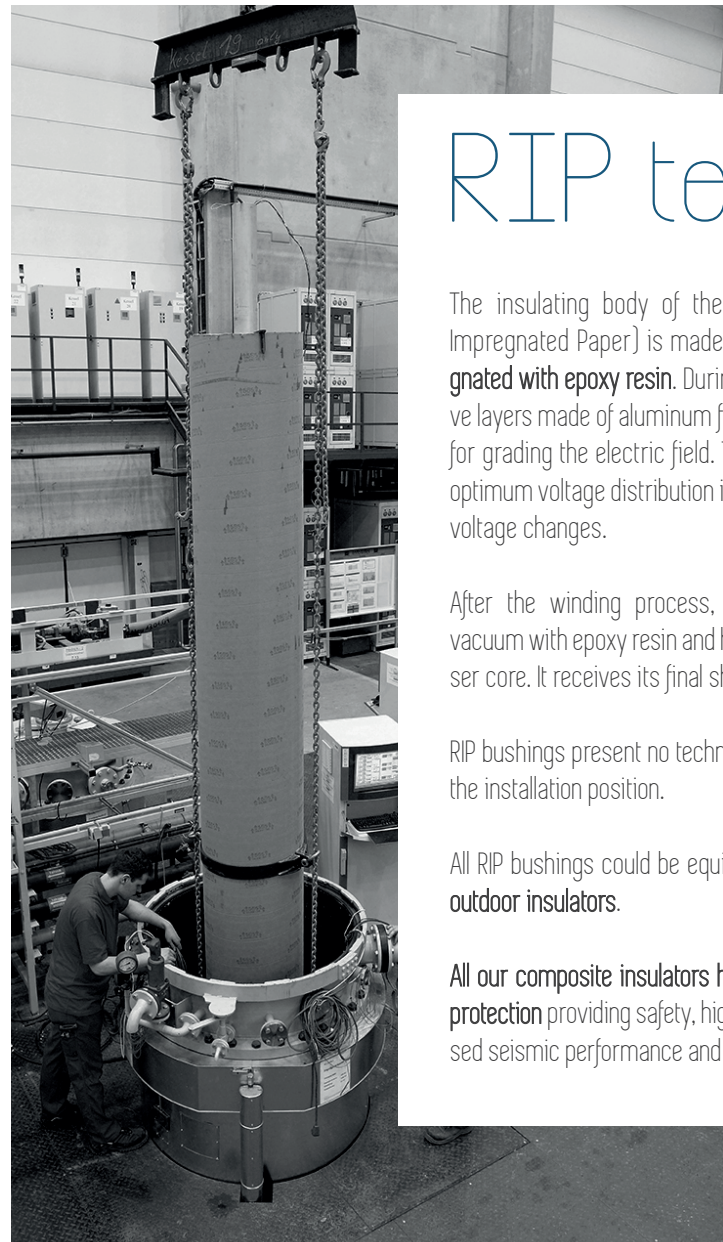
Power Transformers need extremely reliable High Voltage Bushings for performing their task. The highest product quality level is therefore essential.

Bushings must be able to carry the Power Transformer current of thousands of Amperes, while subjected to high voltage of thousands of Volts, withstanding mechanically stressed conditions.

Should the Bushing fail its task, the complete function of the Power Transformers will be jeopardized and, in some cases, the Transformers could also go to fire.

We are **world leaders** in power engineering and in the design of specialized electrical products, with long history as manufacturers of high-voltage bushings, in both **Dry and Oil impregnated technologies**, using state-of-the-art manufacturing and testing facilities.

Our bushings are certified in accordance with the latest international standards, such as ISO/EN, IEC, IEEE, CSA, NFC.



RIP technology

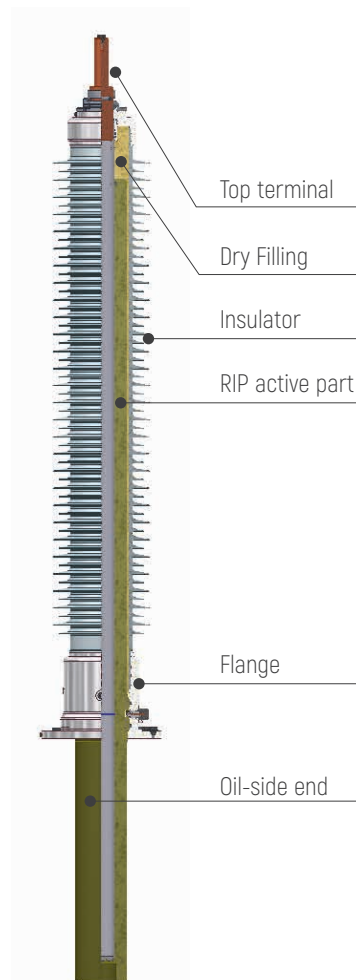
The insulating body of the RIP condenser bushing (Resin Impregnated Paper) is made of special paper **vacuum-impregnated with epoxy resin**. During the winding process, conductive layers made of aluminum foil are inserted between the paper for grading the electric field. Thanks to their good conductivity, optimum voltage distribution is guaranteed even in case of rapid voltage changes.

After the winding process, the core is impregnated under vacuum with epoxy resin and hardened to form the solid condenser core. It receives its final shape by means of turning.

RIP bushings present no technological constraints with regard to the installation position.

All RIP bushings could be equipped with **porcelain or composite outdoor insulators**.

All our composite insulators have **fiberglass tubes** as additional protection providing safety, higher mechanical protection, increased seismic performance and extended lifetime of the bushing.

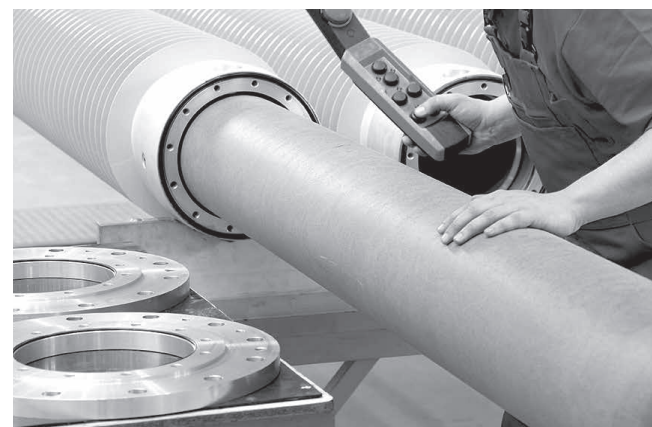


AC and HVDC application

HSP & Trench is pioneer and leader for dry type HVDC design.

Today we offer special HVDC bushings for high voltage direct-current transmission systems, which can be connected to HVDC transformers, according to the maximum installed power in the world: **1200kV rated voltage**, to allow a transmitted power capacity of 12 GW.

In addition to standardized products, we also offer our customers individualized products tested in our fully equipped, internationally accredited test facility.



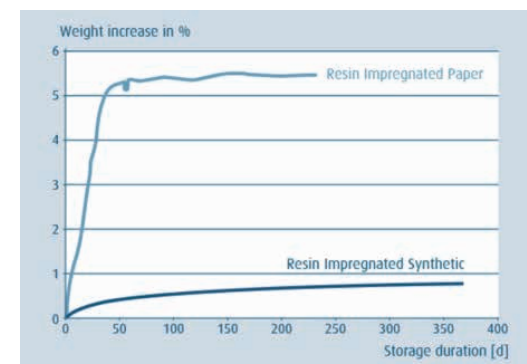
RIS technology

RIS (Resin Impregnated Synthetic) bushings, the new **paper-free bushings**, are based on the RIP technology that has been proven in use for more than 60 years now.

RIS bushings are characterized by their extremely stable dielectric properties, which are attributable in part to the major reduction in moisture absorption at exposed active surfaces, (e.g. the oil end of transformer bushings), thanks to the paper-free active part.

All RIS bushings could be equipped with **porcelain or composite outdoor insulators**. All our composite insulator have fiberglass tubes as additional protection providing safety, higher mechanical protection, increased seismic performance and extended lifetime of the bushing.

Available portfolio up to 550kV - 3000A.



Cost efficient long term storage solution

The RIS type bushings offer the following advantages:

- Not sensitive to humidity ingress during transport and storage
- Highly stable dielectric properties
- Partial discharge free
- Homogeneous field profile
- Optimized production process
- Positive effect on service life
- Available for ambient temperature up to -60°C



our portfolio

RTP



KEY TECHNICAL DATA - IEC															
Standard		IEC 60137-2017													
U _m	kV	24	36	52	72,5	100	123	145	170	245	300	362	420	550	800
Lightning impulse [BIL]	kV	125	170	250	325	450	550	650	750	1050	1050	1175	1550	1800	2400
Switching impulse [SIL]	kV	-	-	-	-	-	-	-	-	850	850	950	1175	1300	1550
STANDARD	Maximum Rated Current [Draw-lead/removeable cond.]	A	800/1600	800/1600	800/1600	800/1600	-	800/1600	800/1600	800/1250	800/1250	-	-	-	-
	Maximum Rated Current [Solid conductor]	A	2500	2500	2500	2500	-	2000	2000	2000	1600	-	-	-	-
	Temperature range	°C	-30°C / +40°C standard - down to -60°C up to +55°C available on request												
	Seismic withstand		Up to 0.5 g			Standard design up to 0.3 g acc. to IEC 61463-2016									
CUSTOMIZED	Maximum Rated Current [Draw-lead/removeable cond.]	A	1250/2500	1250/2500	1250/2500	1250/2500	1250/2500	1250/2500	1250/2000	1250/2000	1250/2000	1250/2000	1250/2000	1250/1600	1250/2000
	Maximum Rated Current* [Solid conductor]	A	4000	4000	4000	3150	3150	3150	3150	3150	3150	3150	3150	3150	1600
	Temperature range	°C	-30°C / +40°C standard - down to -60°C up to +55°C capability up to 550kV upon request												
	Seismic withstand		0.5g acc. to IEC 61463-2016 up to 550kV available on request												

*Higher ratings up to 6000A are available on request

Key Technical Data - IEEE												
Standard		IEEE C57.19.01-2017										
U _m	kV	25	34,5	46	69	115	138	161	230	345	500	765
Lightning impulse [BIL]	kV	150	200	250	350	550	650	750	900	1175	1675	2050
Switching impulse [SIL]	kV	-	-	-	-	-	-	-	-	825	1175	1450
Maximum Rated Current [Draw-lead/removeable cond.]	A	800/2000	800/2000	800/2000	800/2000	800/2000	800/2000	800/2000	800/2000	800/2000	800/2000	-
Maximum Rated Current** [Solid conductor]	A	5000	5000	4000	4000	3000	4000	3000	5000	3000	3000	2000
Temperature range	°C	-30°C to +40°C standard; down to -60°C up to +55°C available on request										
Seismic withstand		High seismic level up to 500 kV for certain designs only, acc. to IEEE 693-2018										

**Higher ratings up to 230kV are available on request



our portfolio

RIS



KEY TECHNICAL DATA - IEC															
Standard		IEC 60137-2017													
U _m	kV	24	36	52	72,5	100	123	145	170	245	300	362	420	550	550
Lightning impulse [BIL]	kV	125	170	250	325	450	550	650	750	1050	1050	1175	1550	1675	1800
Switching impulse [SIL]	kV	-	-	-	-	-	-	-	-	850	850	950	1175	1175	1300
STANDARD	Maximum Rated Current [Draw-lead/removeable cond.]	A	800/1600	800/1600	800/1600	800/1600	-	800/1600	800/1600	800/1250	800/1250	-	-	-	-
	Maximum Rated Current [Solid conductor]	A	2500	2500	2500	2500	-	2000	2000	2000	1600	-	-	-	-
	Temperature range	°C	-30°C /+40°C standard; down to -60°C up to +55°C available on request												
CUSTOMIZED	Maximum Rated Current [Draw-lead/removeable cond.]	A	800/2500	800/2500	800/2500	800/2500	800/2500	800/2500	800/2000	800/2000	800/2000	800/2000	800/1600	1250/1600	1250/1600
	Maximum Rated Current* [Solid conductor]	A	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	2500	2000
	Temperature range	°C	-30°C/+40°C standard; down to -60°C up to +55°C available on request												

*Higher ratings up to 6000A are available on request

Key Technical Data - IEEE												
Standard		IEEE C57.19.01-2017										
U _m	kV	25	34,5	46	69	115	138	161	230	345	500	500
Lightning impulse [BIL]	kV	150	200	250	350	550	650	750	900	1175	1675	1800
Switching impulse [SIL]	kV	-	-	-	-	-	-	-	-	825	1175	1175
Maximum Rated Current [Draw-lead/removeable cond.]	A	400	400	400	400	800	800	800	800	800	800	800
Maximum Rated Current** [Solid conductor]	A	5000	5000	4000	4000	3000	4000	3000	5000	3000	3000	3000
Temperature range	°C	-30°C/+40°C standard; down to -60°C up to +55°C available on request										

**Higher ratings up to 230kV are available on request

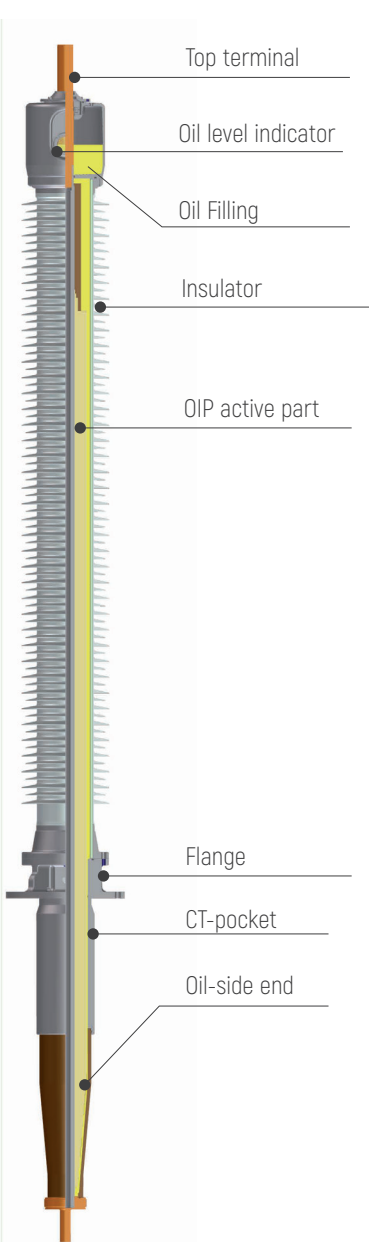




OIP technology

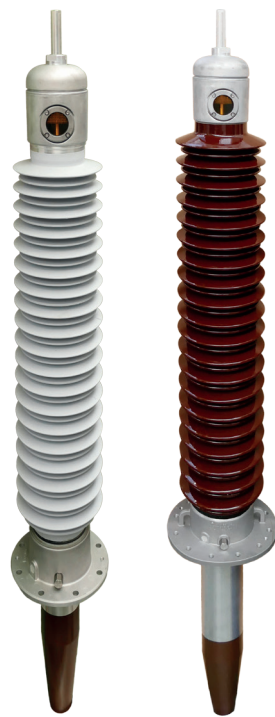
The condenser body of OIP (Oil Impregnated Paper) bushings is manufactured winding around a central conductor insulating kraft paper, dried under temperature and vacuum and then impregnated with insulating mineral oil. During the winding process, a series of aluminum foils are coaxially inserted between the layers of the paper, to achieve the best possible distribution of the radial and longitudinal electrical gradients between the central tube and the flange, which is grounded. Every winding is then impregnated with mineral oil. Each bushing is placed under pressure to ensure thorough impregnation and to test that it is properly sealed. After impregnation, the bushing is head filled with a nitrogen cushion.

All OIP bushings could be equipped with **porcelain or composite outdoor insulators**.



our portfolio

OIP



Key Technical Data - IEC																
Standard		IEC 60137-2017														
	U _m	kV	24	36	52	72,5	100	123	145	170	245	300	362	420	550	550
IEC	Lightning impulse (BIL)	kV	125	170	250	325	450	550	650	750	1050	1050	1300	1425	1675	1800
	Switching impulse (SIL)	kV	-	-	-	-	-	-	-	-	750	850	950	1050	1175	1300
	Maximum Rated Current (Draw-lead/removeable cond.)	A	1000/1250	1000/1250	1000/1250	1000/1250	1000/1250	1000/1250	1000/1250	1000/1250	1000/1250	1000	1000	1000	1000	1000
	Maximum Rated Current (Solid conductor)	A	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150	3150
	Temperature range	°C	-30°C / +40°C standard - down to -60°C up to +55°C available on request													
Seismic withstand		Standard design up to 0.5 g acc. to IEC 61463-2016 (except 550kV), On request: IEEE 693-2018 High seismic level up to 550 kV for certain designs only														

Key Technical Data - IEEE											
Standard		IEEE C57.19.01-2017									
IEEE	U _m	kV	25	34,5	69	115	138	161	230	345	500
	Lightning impulse [BIL]	kV	150	200	350	550	650	750	900	1175	1675
	Switching impulse [SIL]	kV	-	-	-	-	-	-	-	825	1175
	Maximum Rated Current [Draw-lead/removeable cond.]	A	800/ 1200	800/ 1200	800/ 1200	800/ 1200	800/ 1200	800/ 1200	800/ 1200	800	800
	Maximum Rated Current [Solid conductor]	A	3000	3000	3000	3000	3000	3000	3000	3000	3000
	Temperature range	°C	-30°C to +40°C standard; lower temperatures and up to +55°C available on request								
Seismic withstand		Standard design: Low seismic level acc. to IEEE 693-2018									

IEEE OIP bushings are branded "STAROIP" and "STARON" and manufactured under Siemens Energy license



Ester impregnated bushing

HSP&Trench helps you to reduce the environmental impact and developed the **first Ester fluid insulated bushing** on the market. The Ester bushing portfolio is derived from the design of standard OIP transformer portfolio, providing the same main features and full product range available.

In addition, Ester impregnation brings complementary customer benefits:

- Readily **biodegradable**
- Reduced containment measures for transformer installation or bushing storage
- **Fire safety**
- Demanding overload conditions
- **Longer working life**, thanks to the improved life characteristics of kraft paper when combined with ester liquid

Available with composite and porcelain outdoor insulator.
Can be used for traditional oil transformers as well as for ester transformers.

Increased safety and extended lifetime

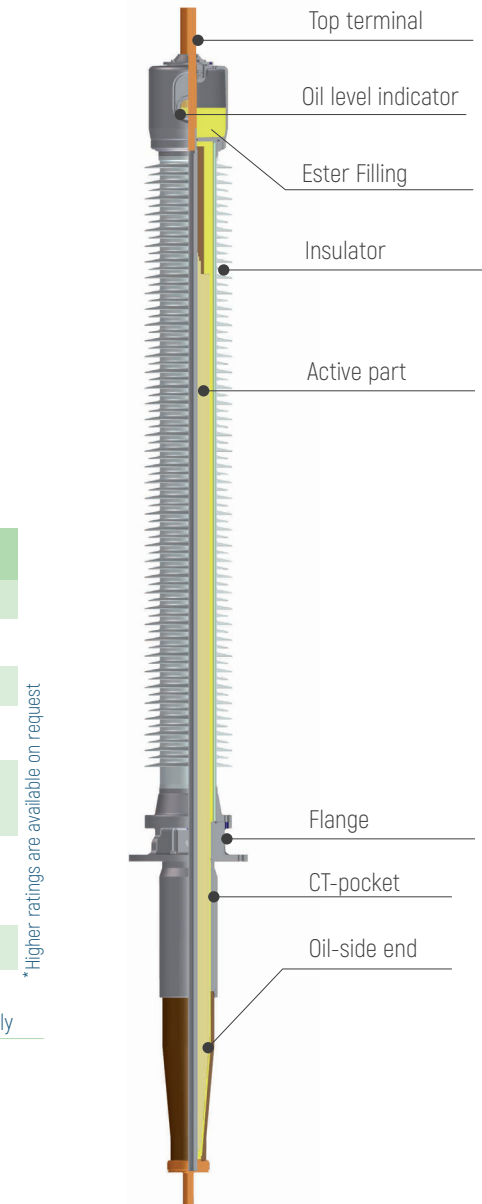
Eco-friendly bushing solution



Key Technical Data - IEC								
Standard		IEC 60137-2017						
IEC	U _m	kV	72,5	100	123	145	170	245
	Lightning impulse (BIL)	kV	325	450	550	650	750	1050
	Switching impulse (SIL)	kV	270	375	460	540	620	850
	Maximum Rated Current (Draw-lead)	A	800	800	800	800	800	1000
	Maximum Rated Current (Removeable conductor)*	A	1250	1250	1250	1250	1250	1250
	Temperature range	°C	-30°C / +40°C standard					
	Seismic withstand	Standard design up to 0.5 g acc. to IEC 61463-2016. On request: IEEE 693-2018 High seismic level for certain designs only						

TM

* Higher ratings are available on request.





Other transformer connections

High current bushings are designed to connect an oil filled power transformer (GSU) to a generator bus in a duct. Different designs are available based on the transformer rated current and service conditions, such as the ambient temperature in bus duct.

Oil-to-gas types are used for the direct connection of power transformers to gas-insulated switchgear; **oil-to-oil types** are designed for direct connections within the power transformer and cable-junction box. It is no longer required to join the transformers to the switchgear by means of overhead lines or cables, thus saving outdoor bushing or cable end boxes on both switchgear and transformer side. The design of bushings connecting transformers and gas insulated switchgears is in line with latest requirements of IEC 62271-211 for gas side connection.

These connection types are available with different insulating technologies.

High current bushing
for GSU transformers



RIG/RIP technology

- 24 – 36 kV
- Up to 31.500 A

Transformer - SF₆ switchgear &
Transformer - Cable junction box



OIP technology

- 123 – 550 kV
- Up to 2.500 A

Transformer - SF₆ switchgear



RIP/RIS technology

- 72,5 – 550 kV
- Up to 3.150 A

Transformer - Cable junction box



RIP/RIS technology

- 72,5 – 550 kV
- Up to 1.600 A

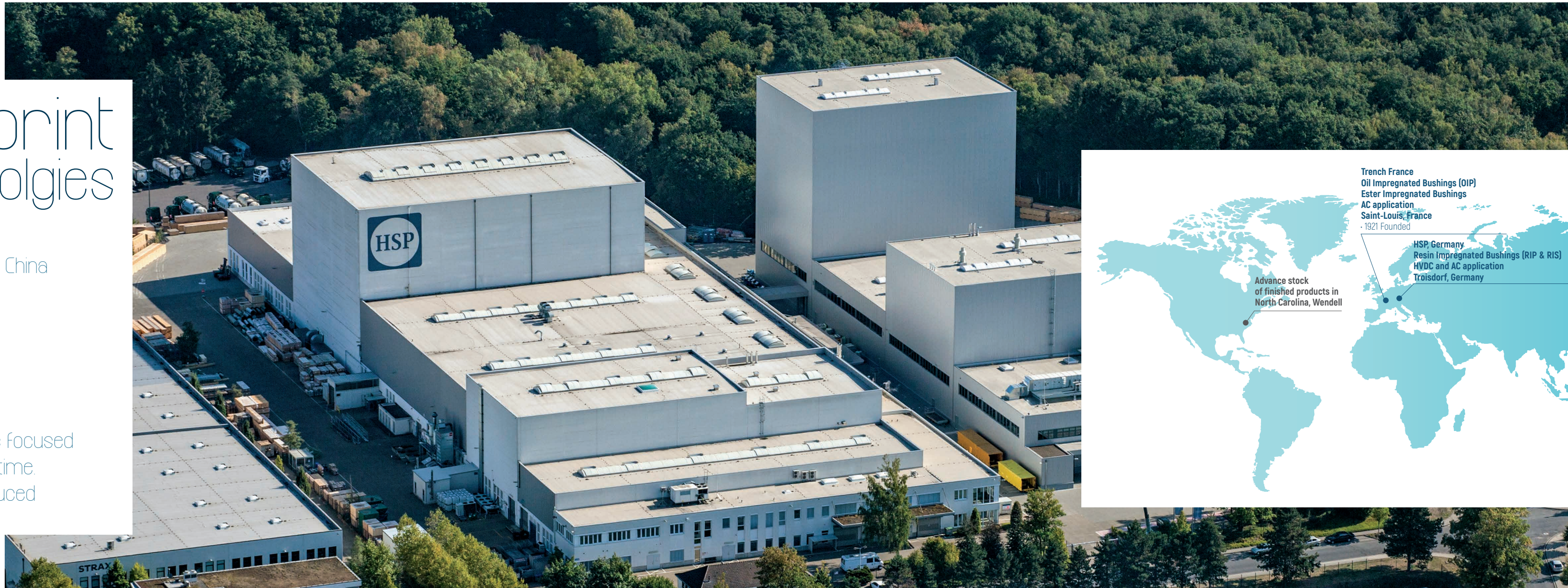
Global footprint and technologies

" Full engineering and R&D team
available in France, Germany and China
to support your requests "

INSTALLED BASE:

- OIP technology: 230.000 bushings installed
- RIP/RIS technology: 150.000 bushings installed

We are standing for high quality
and the best technology, we are focused
on constantly reducing delivery time.
Our average lead times got reduced
by 30% over the last two years.



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