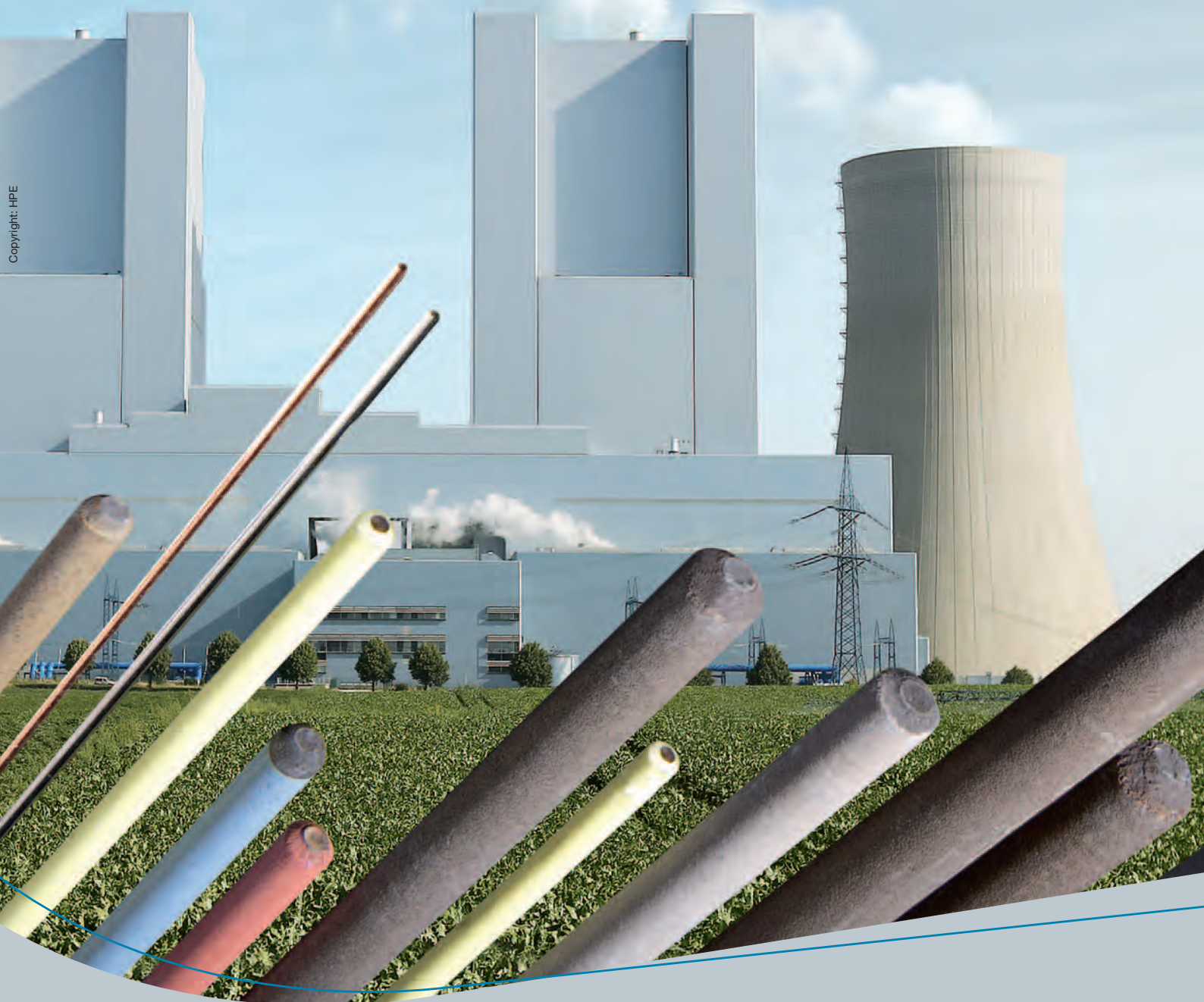


# Welding Solutions for Thermal Power Generation

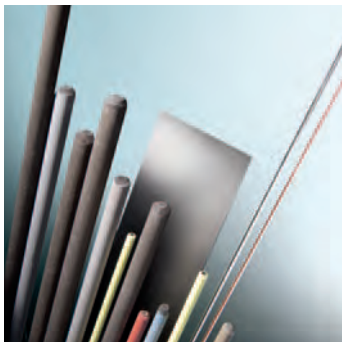
Copyright: HPE



# voestalpine Böhler Welding

## Metallurgical Expertise for Best Welding Results

voestalpine Böhler Welding (formerly Böhler Welding Group) is a leading manufacturer and worldwide supplier of filler metals for industrial welding and brazing applications. With more than 100 years of experience, the enterprise has decisively influenced the development of welding technology, setting the benchmark with its innovative solutions. The solidity is also reflected in the confidence of our employees who, as owners of the enterprise, hold a good portion of the shares.



As a part of the voestalpine Group, Austria's largest steel manufacturer and one of the world's leading suppliers of specialized steel products, we are a part of a global network of metallurgy experts.

Our customers benefit from:

- Comprehensive welding and steel know-how under one roof
- Coordinated complete solutions comprised of steel and welding filler metals
- A partner offering maximum economic stability and technological expertise

### Customer first

Absolute customer focus is our guiding principle. We see ourselves as a provider of solutions to challenging welding projects. We ensure that our customers get the right filler metals, use them correctly, and that all welding process parameters are adjusted for the best possible performance. We consider it as our responsibility to guarantee that we deliver to our customers, now and in the future, the best possible solutions. We also strive to develop new products, optimize existing products, and streamline processes so as to achieve very short turnaround times.

### Experienced and committed employees

We rely on committed employees who have been trained to the highest standards. It is their knowledge, skills, and personal commitment that ensure the long-term success of our company and its customers. In combination with our premium quality products, the individual technical support provided by our globally acting application technicians and specialist welding engineers empowers our customers to master even the most difficult and challenging welding tasks.



### Three competencies – three brands

In our efforts to afford our customers the best possible support and promote development in line with specific targets, we have built our core competences within Joint Welding, Repair & Maintenance Welding and Soldering & Brazing. This way we offer our customers the largest and most comprehensive product portfolio of filler materials within our three brands:

- Böhler Welding
- UTP Maintenance
- Fontargen Brazing

### Welding Solutions for demanding industries

We focus on industries with high technological standards and deliver products tailored to

industry-specific requirements. In the development and optimization of filler materials, we collaborate closely with customers, manufacturers, and research institutes.

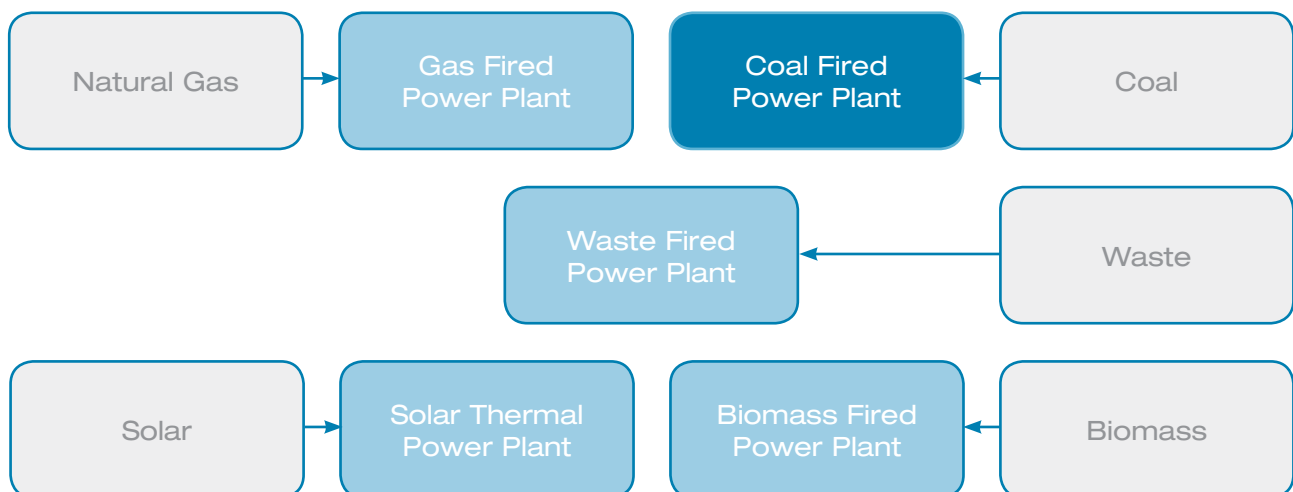
Whether destined for use in challenging scenarios or in standard applications – our high quality filler materials are ideally suited for all applications in the following industry sectors:

- Oil and Gas
- Pipeline
- Chemical
- Power Generation
- Transportation & Automotive
- Maintenance & Repair
- Brazing Industries

# Join Experience

High class welding consumables for a demanding industry

Welding consumables for Thermal Power plants are a core competence of voestalpine Böhler Welding. With decades of experience, a product range to fulfill the most specific requirements and a worldwide distribution network voestalpine Böhler Welding is your partner. The experienced welding engineers will assist you in matching the optimum and most economic welding solutions referring to your requirements.



This brochure deals only with coal-fired power plants. For detailed information to other power plants, please contact us.

Undoubtedly there is worldwide an increasing demand of electricity generation. In high industrialized countries programs are arranged to reduce the amount of electricity and to shutdown nuclear and fuel fired power plants. The gap of electricity in those countries will be closed by the expansion of renewable energy. However fossil fired power plants meet a substantial part of the global electricity demand and will remain a central pillar of the future electricity generation. Coal is the most abundant fossil fuel on the planet. Coal currently amounts to almost 40% of the world's electricity needs. In the majority of the fastest growing economics such as in the Asian region, in particular China and India, the necessity of coal is substantial for their growth. In fact, since the beginning of the 21<sup>st</sup> century the last decade's growth in coal use has been driven by the economic growth of the mentioned regions. Therefore there is a need for new efficient and environmentally friendly coal

fired power plants in these regions using modern technologies like Advanced Ultra Super Critical (A-USC) and Carbon Capture Storage (CCS). Besides coal (hard coal and lignite coal) there are other fossil fuels like natural gas or synthetic gas and biomass. Waste-to-energy is also process of generating energy in the form of electricity from the incineration of waste.

In some regions with high direct solar radiation the solar energy is used to generate electricity. In case of concentrating solar power (CSP) for instance a large area of sunlight is focused into a small beam using mirrors or lenses. With the aid of a heat engine, usually a steam turbine, electrical power can be produced.

This brochure only deals with coal fired power plants. If detailed information to the other mentioned power plants is wanted, please contact us. All mentioned different power plants produce steam in high pressure and high temperature operations. This means in all these power plants heat and creep resistant steels are used. The selection of different tube and pipe grades depend on the required temperature and pressure conditions.



# Coal Fired Power Plant

In coal fired power plants the chemical energy stored in fossil fuels such as coal (hard or lignite coal) and oxygen of the air is converted successively into thermal energy, mechanical energy and, finally, electrical energy.

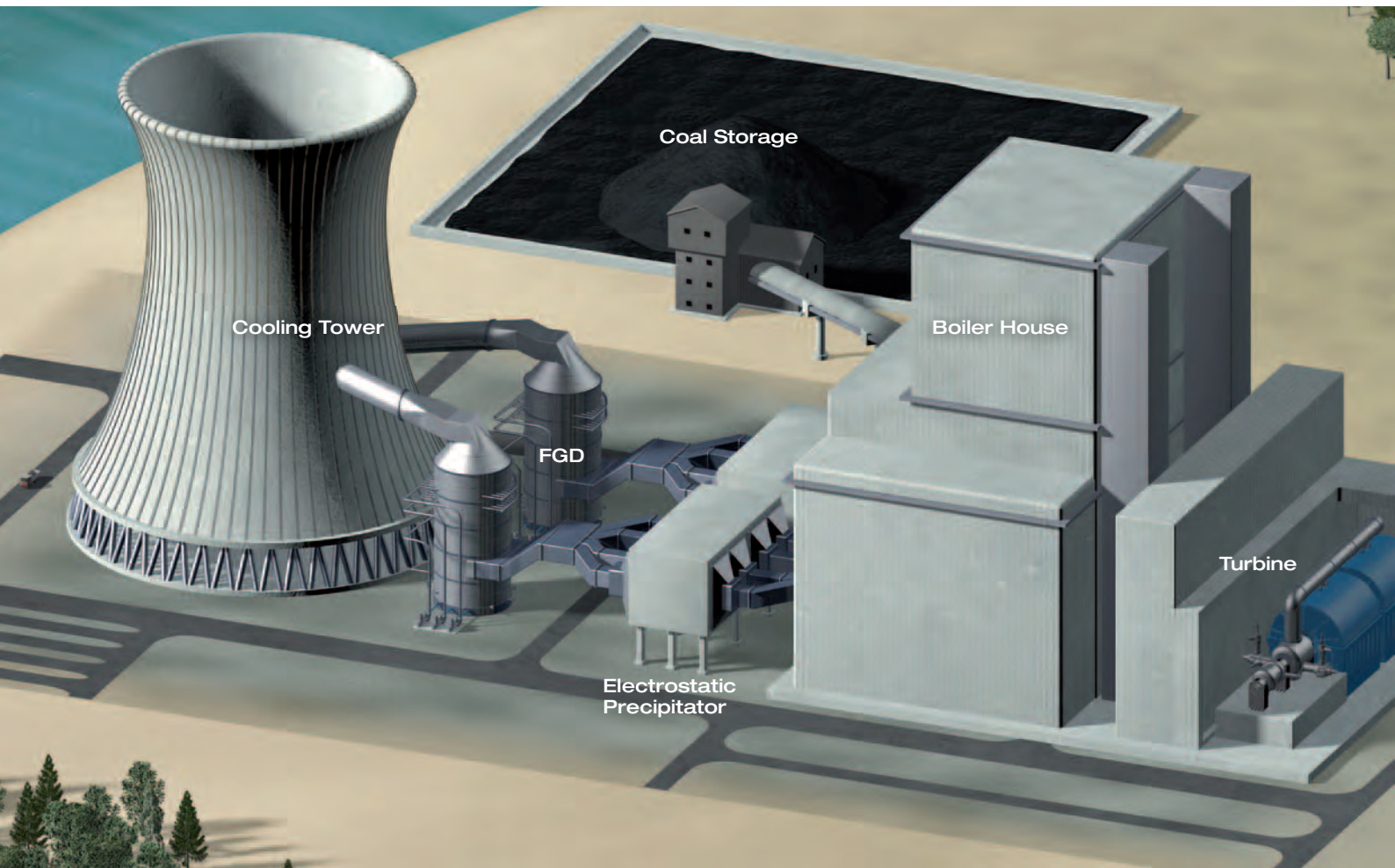
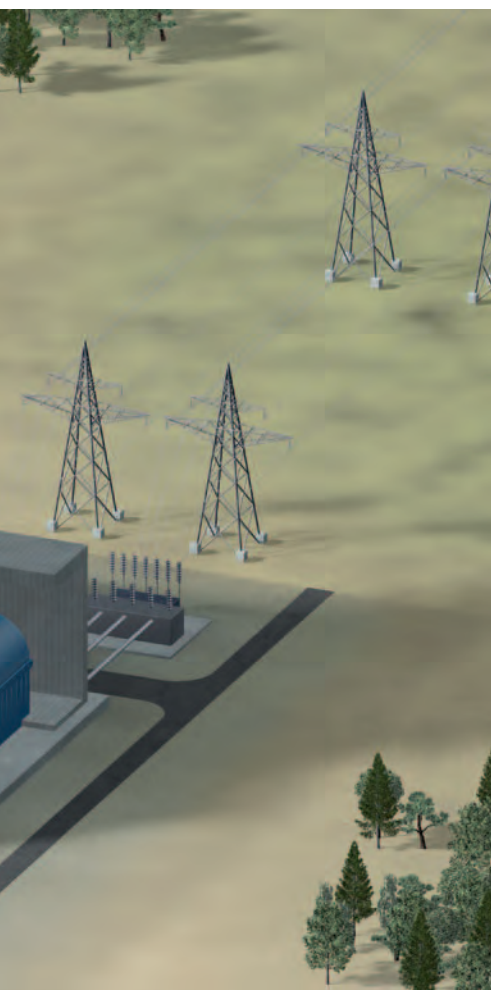


Figure 1 shows an overview of a modern coal fired power plant.

Each coal fired power plant is a complex, custom – designed system. Chunks of coal are crushed into fine pulver and are fed into a combustion unit where it is burned. Heat from the burning coal is used to generate steam that is used to rotate one or more turbines to generate electricity. The thermal efficiency of old power plants is around 33%. Raising the furnace temperature improves the efficiency but complicates the design with loss of profitability, primarily by the selection of materials used for construction, making the power plant more

expensive. However there are worldwide a lot of efforts to reduce the specific fuel-energy consumption per kilowatt-hour. The key to this must be a further increase in the efficiency of new power plants. New design and process solutions represent only part of the whole spectrum of possibilities. The main factors influencing a rise in efficiency are the steam parameters, i.e. pressure and temperature. Newest power plants realize thermal efficiency of 46%. But this can only be realized with modern steels like T/P92, VM12-SHC, 304H Cu which enable steam temperature up to 625°C. Beside these modern martensitic and austenitic steels new bainitic steels for the water walls are necessary like T23 and T24.



	Alloy Group	Base Material Examples ASTM/EN
Bainitic Steels	0,5 Mo	T/P1 / 16Mo3
	1 1/4 Cr; 0,5 Mo	T/P12 / 13CrMo4-5
	1 Cr; 1 Mo; V	-- / 15CrMoV5-10
	0,5 Cr; 1 Mo; V	-- / 14MoV6-3
	1 Ni; 0,5 Cu; 0,5 Mo; Nb	-- / 15NiCuMoNb5 (WB36)
	2 1/4 Cr; 1 Mo	T/P22 / 10CrMo9-10
	2 1/4 Cr; 0,5 Mo; 1,5 W; V; Nb; B	T/P23 / 7CrWVMoNb9-6
	2 1/4 Cr; 1 Mo; V; Ti; B	T/P24 / 7CrMoVTiB10-10
Martensitic Steels	9 Cr; 1 Mo; V; Nb	T/P91 / X10CrMoVNb9-1
	9 Cr; 0,5 Mo; 1,5 W; V; Nb	T/P92 / X10CrWMoVNb9-2
	9 Cr; 1 Mo; 1 W; V; Nb	T/P911 / X11CrMoWVNb9-1-1
	11 Cr; 0,5 Mo; 1,5 W; 1 Co; V; Nb	VM12-SHC / X12CrCoWVNb11-2-2
	10 Cr; 1 Mo; V	-- / X20CrMoV11-1
	9 Cr; 1,5 Mo; 1 Co; V; Nb	CB2 (GX13CrMoCoVNb9-2-1)
Austenitic Steels	18 Cr; 9 Ni; 3 Cu; Nb	304HCu
	25 Cr; 21 Ni; Nb	310N (HR3C)
	18 Cr; 10 Ni; Nb	347H FG
Ni-Base Alloys	22 Cr; 9 Mo; 12 Co; 0,3 Ti; 1 Al; Ni balance	Alloy 617
	20 Cr; 6 Mo; 20 Co; 2 Ti; 0,5 Al; Ni-base	Alloy 263
		Dissimilar welds

Table 1 enables heat and creep resistant steels and alloys which are used for modern power plants and for refurbishments.

The development and production of welding consumables for heat and creep resistant steels for power plant application have been a focus point at voestalpine Böhler Welding since decades. Consequently, there are numerous references available in processing the wide range of creep resistant steels. voestalpine Böhler Welding is producing suitable tried and tested TUV-approved welding consumables for the mentioned base metals in Table 1.

The selection of welding filler metals for these steels is partially aligned with the long-term properties, especially in the case of tubes and pipes that are subjected to temperature above 450°C. The latest developments can always be related to state-of-the-art base metals like grades T/P23, T/P24, T/P91, T/P92, VM12 – SHC and 304H. All the matching filler metals for these creep resistant steels and alloys are tested under creep conditions at elevated temperature and above. Creep tests have been done on all weld metal and real welds. There are creep data available for more than 50,000 hours.

# Steam Generator / Boiler

The heart of every coal-fired power plant is the utility steam generator (boiler). This is where the pulverized coal is combusted at above 1,200°C and evaporates water which flows through planar super heater tube bundles in the furnace and in the wall of the steam generator. There, the fully desalinated and demineralized water (feed water) evaporates to make so-called main steam. It leaves the steam generator at a temperature of up to 620°C and pressure of up to 300 bar (temperature and pressure depends on design, capacity and material selection). Thus charged with energy, it flows into a turbine.

## A Water walls (or membrane walls)

Water walls (or membrane walls) build the gastight chamber of a boiler. Many kilometers of tubes and fins are welded together and form the outside wall of the boiler. Depending on the design of the boiler, the capacity, the temperature and pressure different tube and fin material is used. Table B informs about different steels which are used nowadays for water walls. As higher the steam temperature and pressure as higher alloyed the tubes for the water walls. Due to different temperature ranges in a boiler different tube steels are used. A boiler for modern power plants with a capacity of 1,000 MW can reach a height of more than 100 meter (depends on design). In such a boiler more than 30,000 tube to tube welds are necessary (GTA welded).

## B Headers

Headers are thick-walled extruded pipes in which the fluids carried by the tubes are mixed and homogenized. They serve either as receptacles (Inlet header) or dischargers (Outlet header). Below a thick wall-pipe penetrated by a number of tubes is shown. These heavy-section components have to meet creep strength requirements. Table B informs about different pipe steels used for headers. With the pipe steel P92 feed water temperature up 620°C can be realized.

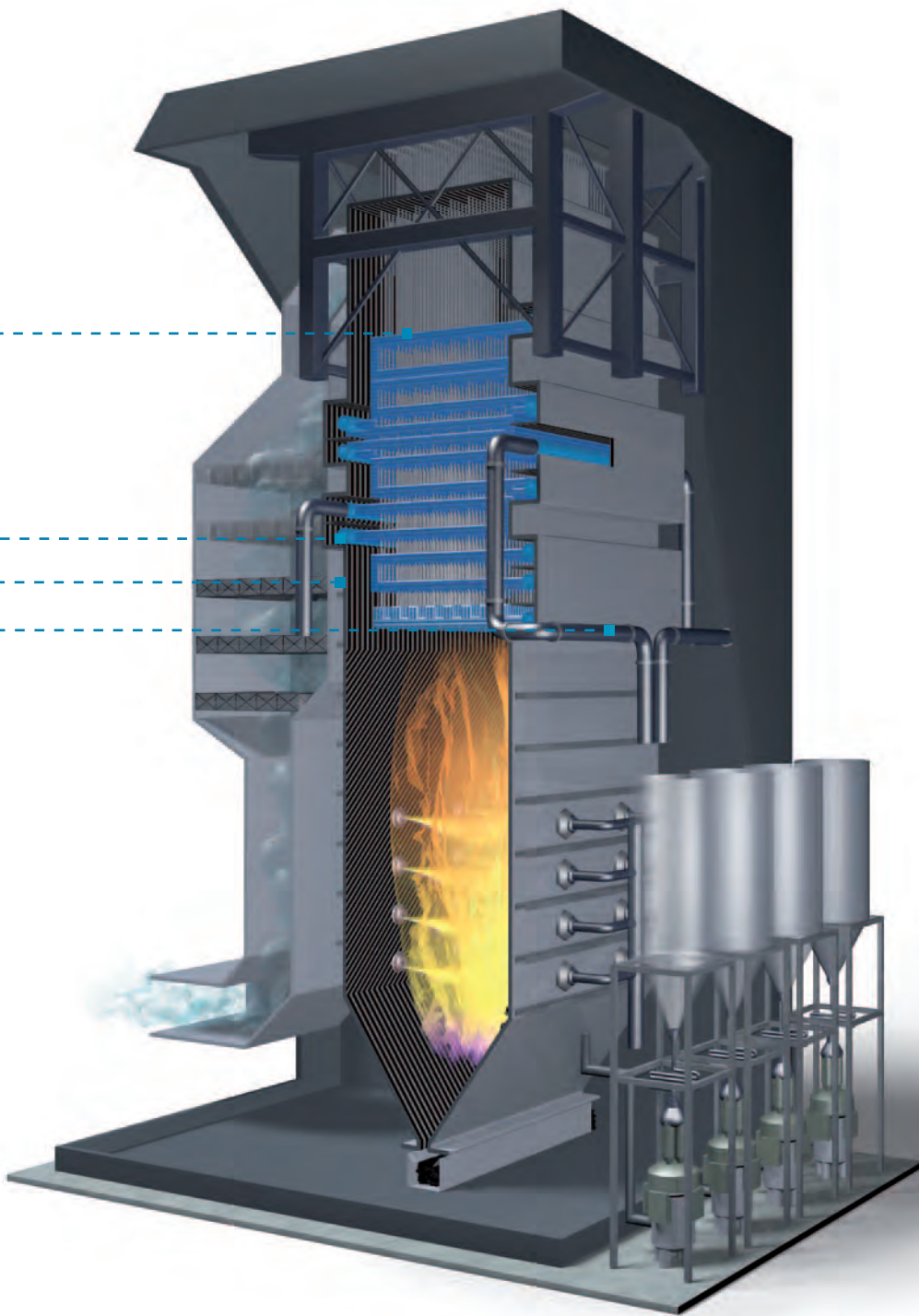
## C Superheater / Reheater

Superheater and reheater tubes are necessary to convert wet, saturated steam into dry steam. These tube bundles are located within the combustion chamber of the boiler. According to the design of the power plant and steam parameter (temperature and pressure) different tube steels and alloys are used. Table B informs about common steels for these applications.

## D Main steam / hot reheat piping

The main steam and hot reheat piping are thick walled seamless pipes which transport the dry steam from the headers to the turbine. Wall thickness of these pipes up to 100 mm are used. Due to the high temperature (up to 620°C) and pressure (up to 350 bar) the requirements for the pipe material, filler metal and for manufacturer of pipe construction are highly demanding. Table B shows suitable pipe steels.





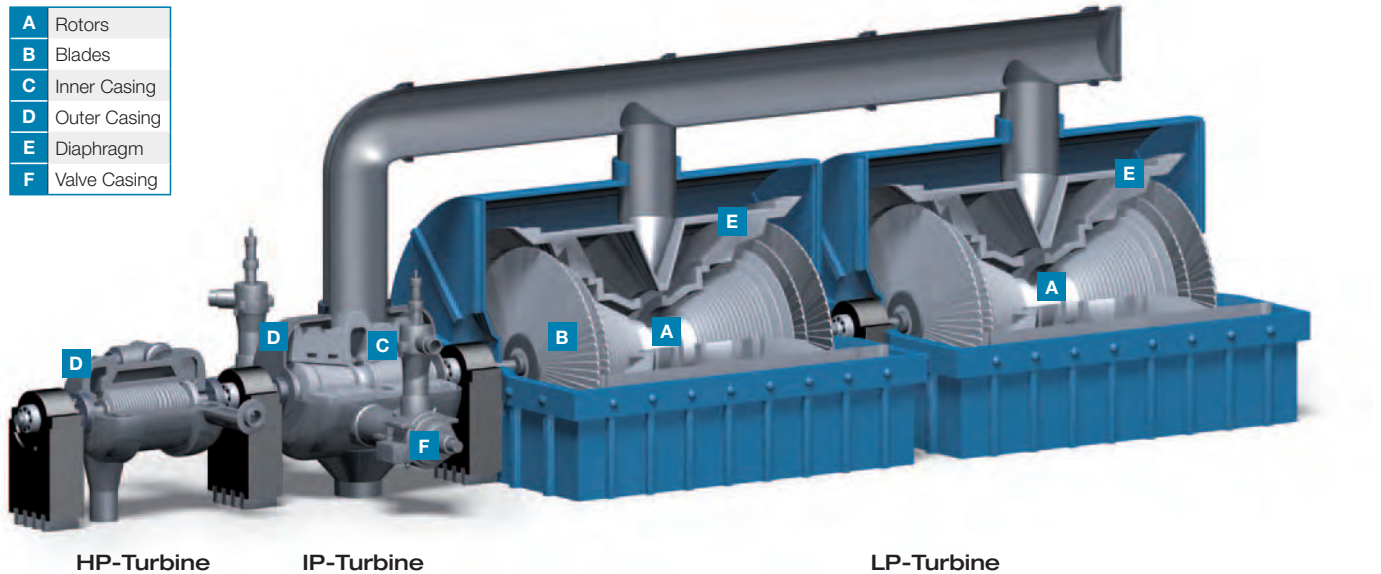
	16Mo03, T/P1	13CrMo4-5; T/P12	15CrMoV5-10	14MoV6-3	15NiCuMoNb5, (WB36)	10CrMo9-10; T/P22	7CrWMoNb9-6; T/P23	7CrMoVTiB10-10; T/P24	X10CrMoVNb9-1; T/P91	X10CrWMoVNb9-2; T/P92	X11CrMoVNb9-1-1; T/P911	X12CrCoWMNb11-2-2; VM12-SHC	X20CrMoV11-1	304H Cu	310N, HR3C	347H FG	Sanicro 25	Alloy 263	Alloy 617B	Alloy 740H
Economizer	•				•	•	•													
Water Wall	•	•					•	•	•	•		•							•	
Supporting Tubes							•	•												
Feedwater Pipe					•															
Superheater Tubing		•				•	•	•	•	•		•		•	•	•	•	•	•	•
Reheater Tubing	•	•				•			•	•			•	•	•	•	•	•	•	•
Header	•	•	•	•	•	•			•	•	•		•						•	
Main Steam Pipe									•	•	•		•					•	•	•
Reheater Steam Pipe									•	•	•		•					•	•	•
Separator									•	•										

Table B gives an overview about the allocation of base metals to different components of power plant components.

• Candidates for 700°C - technology (A-USC)

# Turbine

The high pressure steam produced in the steam generator enters the high pressure section of the steam turbine and initiates the mechanical operation, while expanding and cooling. The turbine is linked to a generator via a shared shaft, the generator converts its rotary motion into electricity according to the dynamo principle.



For high stressed components such as valves, turbine housing and rotors, special steels are required. Heavy steel castings and rotor forgings, made of creep resistant steels, play a key role in fossil fuel fired power plants for highly loaded components in the high and intermediate pressure sections of a turbine casting.

Table C illustrates an overview about casting steels and recommended filler metals for different applications. As welding is an important cycle in the manufacturing process of steel castings, the development of high integrity welding consumables is a critical issue for the foundries. In general the PWHT temperature of welds in cast steels is very often lower than that used for forged steel, however the holding time is longer and sometimes two or more PWHT cycles are necessary. All our filler metals fulfill the requirements of the foundries.

Turbine and generator rotors withstand high stresses and from a safety aspect are the most significant components of a turbine generator system. Depending on the appropriate operating

temperatures, the shafts can be fabricated out of low/high alloy heat/creep resistance material or of low alloyed, highly toughened material for low pressure application.

Table D illustrates all steels available to use with the customary permissible operating temperatures. There is no commercial forging alloy which meets all the necessary material requisitions, therefore combinations of different steels are used for welded rotors. By contrast the welding of low pressure shafts require matching filler metals. Combined intermediate-low pressure shafts and combined high-low pressure shafts are welded using different steels. These dissimilar welded joints are designed to be located in low stress shaft areas. For this reason, the strength requirements for these welded joints are lower than for the high alloyed base material. On the other hand, impact energy values of the weldments are even higher than minimum base material values. For the LP end of the rotor, creep is not a problem but high yield strength, high ductility and low Fracture Appearance Transition Temperature (FATT) behavior is required. We offer tailor-made solutions for specific customer requirements regarding different steel combinations. A general recommendation for the right filler metal selection can be found in Table D. Each turbine manufacturer has its own individual specification and requirements and will specify different welding processes. Our technical application departments will support you by finding the best welding solutions.



**Table C: Casting materials for Steam Turbine Components**

Steel	Application-temperature	Filler Metal	Remarks
EN-GJS-400-18U-RT (GGG40.3)	≤450 °C	Thermanit FeNi	Outer casing (LP)
G20Mn5 0,2 C; 1 Mn; max. 0,8 Ni	≤450 °C	BÖHLER FOX EV 50 Phoenix 120 K	Pressure parts
G20Mo5 0,2 C; 0,7 Mn; 0,5 Mo	≤500 °C	BÖHLER FOX DMO Phoenix SH Schwarz 3 K	Pressure parts, casings, valves
G17CrMo9-10 0,17 C; 2,25 Cr; 1 Mo	≤550 °C	BÖHLER FOX CM 2 Kb Phoenix SH Chromo 2 KS	Inner Casing, Valve casing, blade carrier
G17CrMo5-5 0,17 C; 1,25 Cr; 0,5 Mo	≤530 °C	BÖHLER FOX DCMS Phoenix Chromo 1	Inner casing, outer casing, diffusor, nozzle, steam chests, blade carrier
G17CrMoV5-10 0,17 C; 1,3 Cr; 1 Mo; 0,25V	≤560 °C	BÖHLER FOX DCMV Union I CrMo Phoenix SH Kupfer 3 KC	Inner casing, valve casing, inlet carrier, steam chests, elbows
GX23CrMoV12-1 0,23 C; 12 Cr; 0,9 Ni; 1 Mo; 0,3V	≤600 °C	BÖHLER FOX 20 MWV Thermanit MTS 4	Valve casing, seal ring, outer shells
G-X12CrMoVNB9-1 0,12 C; 9 Cr; 1 Mo; 0,2 V; 0,06 Nb; N	<600 °C	BÖHLER FOX C 9 MV Thermanit Chromo 9 V	Valve casing, flanges, nozzle boxes, inlet piping
GX12CrMoVNB10-1-1 0,12 C; 10 Cr; 1 Mo; 1 W; 0,2 V; 0,06 Nb; N	<625 °C	BÖHLER FOX C 9 MWV Thermanit MTS 911	Valve casing, connecting pipes, bonnets
G-X13CrMoCoVNB9-2-1 (CB2) / 0,13 C; 9 Cr; 1,5 Mo; 1 Co; 0,2 V; 0,06 Nb; N; 100ppm B	<625 °C	BÖHLER CB 2 Ti-FD Thermanit MTS 5 Co 1	Valve casing
GX5CrNiMo13-4 0,04 C; 13 Cr; 4 Ni	<350° C	BÖHLER FOX 13/4 CN13/4-IG, CN13/4-MC	Blade carriers
Alloy 625 0,06 C; 21 Cr; Ni-base; 9 Mo; 3,5 Nb	≤720 °C	BÖHLER NIBAS 625 Thermanit 625	Inner casing, valve body, nozzles
Alloy 617 0,05 C; 23 Cr; Ni -base; 9 Mo; 12 Co; 1,2 Al; 0,5 Ti	≤750 °C	BÖHLER NIBAS 617 Thermanit 617	Inner casing, nozzle, valves

This List is not exhaustive; includes the most engaged casting material.

**Table D: Forging materials for Steam Turbine – and Generator Rotor Turbine – and Generator Rotor**

Steel	Application-temperature	Filler Metal	Remarks
27NiCrMoV11-6 / 3 Ni; 1,5 Cr; V	≤350 °C	NiCrMo2,5	LP; Gen.
27NiCrMoV15-6 / 3,5 Ni; 1,5 Cr; 0,4 Mo; V	≤350 °C	NiCrMo2,5	LP disk; Gen.
22CrNiMo9-9 / 2,2 Cr; 2,2 Ni; 0,7 Mo	≤350 °C	3NiCrMo2,5	LP shaft
22Cr2Ni3MoV / 0,8 Cr; 0,5 Mo; 3 Ni; V	≤350 °C	3NiCrMo2,5	LP; Gen.
21CrMoNiV5-9 / 1,2 Cr; 0,9 Mo; 0,6 Ni; V	≤560 °C		HP; IP
28CrMoNiV4-9 / Cr; 1 Mo; Ni; V	≤560 °C		HP; IP
25CrMoV3-8 / 0,8 Cr; 0,8 Mo; 0,6 Ni; V	≤560 °C		HP; IP
23CrNiMo7-4-7 / 1,8 Cr; 0,7 Mo; 1 Ni	≤530 °C	NiCrMo1	HP; LP
22CrMoNiWV8-8 / 2 Cr; 0,8 Mo; 0,7 Ni; 0,7 W	≤530 °C		HP-LP; Rotor
X12CrMoWVNB10-1-1 / 10 Cr; 1 Mo; 1 W; V, NB (E911)	≤600 °C	BÖHLER C 9 MWV Thermanit MTS 911	HP; IP; Steam turbine rotor
FB2 / 9 Cr; 1,5 Mo; 1 Co; V; Nb	≤630 °C	BÖHLER C 9 MWV Thermanit MTS 911	HP; IP

Gen = Generator shaft; HP = High Pressure; IP = Intermediate Pressure; LP = Low Pressure

# Flue Gas Desulphurisation (FGD)

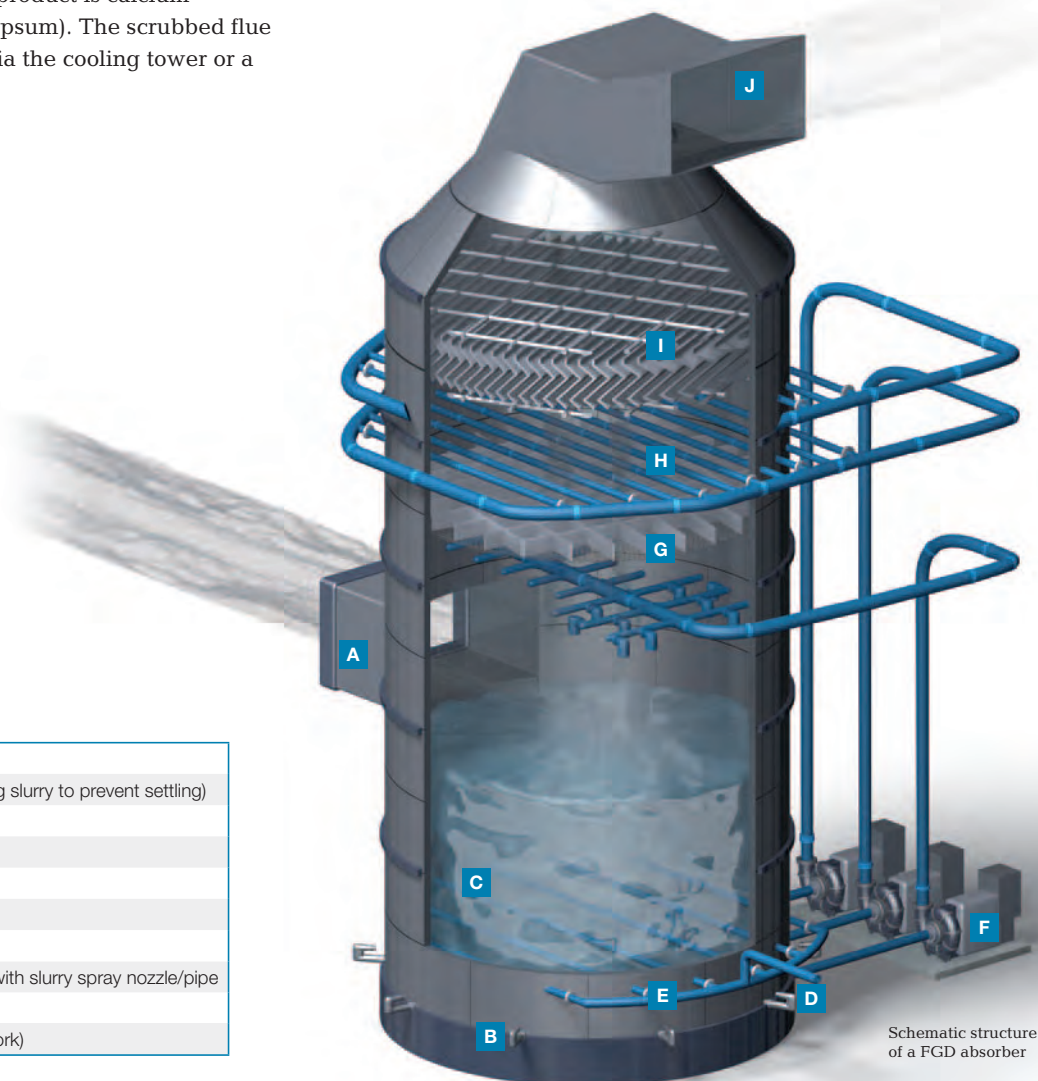
The steam generators are equipped with pulverized – hard or lignite coal burners which should be operated with low excess air and optimized airflow. This reduces the emergence of nitrogen oxides. In addition, nitrogen oxides can be reduced in a downstream flue-gas denoxing plant. There, the nitrogen oxides react with ammonia using a catalyst to become water and pure nitrogen. The flue gases flow through electrostatic precipitators. Dust is separated by electrostatically charging via discharge electrodes and drawing it to oppositely charged surfaces. Hereafter the sulphur dioxide has to be removed.

A variety of FGD processes are available. The most widely used processes are the limestone gypsum processes. In this wet scrubbing process the flue gas is treated with limestone slurry, in order to remove the  $\text{SO}_2$  and neutralize it. The final product is calcium sulphate dehydrate (gypsum). The scrubbed flue gases are discharged via the cooling tower or a separate stack.

This is the most common FGD process worldwide over 40 years. FGD-Plants require high corrosion resistant steels and Ni-alloys, depending on the application for tanks, piping, absorber etc. The selection criteria for the steels and alloys depend on the chloride and pH concentration. In general the flue of lignite coal fired power plants are more aggressive than of hard coal fired power plants. Therefore the FGD's of lignite coal fired power plant needs in general high corrosion-resistant Ni-base alloys with increased CPT-values.

A basic requirement is that the weld seam must at least show the same corrosion resistance as the base material. This can be achieved often by using welding consumables which are higher alloyed than the base material. The only exception is when so called C-alloys like alloy 59, C 2000 and 686 are used.

A	Flue gas inlet (ductwork)
B	Slurry agitator (for stirring slurry to prevent settling)
C	Oxidation zone
D	Oxidation header
E	Oxidation air supply
F	Recirculation pumps
G	Gas distribution trays
H	Interspatial spray level with slurry spray nozzle/pipe
I	Moisture separator
J	Clean gas outlet (ductwork)





#### Austenitic and Ni-base alloys which are used in FGD plants.

Alloy Common Name	UNS Designation	Material No	Alloy Group	Filler Metal (GTAW)
316L	S31603	1.4435	18 Cr / 14Ni / 3Mo	BÖHLER ASN5-IG / Thermanit 18/17E Mn
316LN	S31653	1.4429	17 Cr / 13 Ni / 3 Mo	BÖHLER ASN5-IG / Thermanit 18/17E Mn
317LMN	S31726		18 Cr / 15 Ni / 4 Mo / N	BÖHLER CN 20/25 M-IG / Thermanit 20/25 Cu
904L	N08904	1.4539	20 Cr / 25 Ni / 4 Mo / 1,5 Cu	BÖHLER CN 20/25 M-IG or NIBAS 625-IG Thermanit 20/25 Cu or 625
Alloy G	N06007		22 Cr / Ni Bal / 7 Mo / 2 Cu / 1,5 Co / 2 Nb	BÖHLER NIBAS 625-IG Thermanit 625
1925hMo	N08926	1.4529	20 Cr / 25 Ni / 6 Mo / 1 Cu / 0,2 N	BÖHLER NIBAS 625-IG / Thermanit 625
6XN	N08367		21 Cr / 24 Ni / 6,2 Mo / 0,2 N / 0,2 Cu	BÖHLER NIBAS 625-IG / Thermanit 625
254 SMO	S31254	1.4547	20 Cr / 18 Ni / 6 Mo / N / Cu	BÖHLER NIBAS 625-IG / Thermanit 625
Alloy 31	N0831	1.4562	27 Cr / 31 Ni / 6,5 Mo / / 1,2 Cu / N	BÖHLER NIBAS C 24-IG / Thermanit Nimo C 24
Alloy 625	N06625	2.4856	21 Cr / Ni Bal / 9 Mo / 3,5 Nb	BÖHLER NIBAS 625-IG / Thermanit 625
654 SMO	S32654		24 Cr / 22 Ni / 7 Mo / 3,5 Mn / Cu	BÖHLER NIBAS C 24-IG / Thermanit Nimo C 24
Alloy C-22	N06022	2.4602	22 Cr / Ni Bal / 13 Mo / 3 W / 2,5 Co	Thermanit 22
Alloy C-276	N10276	2.4819	16 Cr / Ni Bal / 16 Mo / 4 W	BÖHLER NIBAS C 24-IG / Thermanit Nimo C 24
Alloy 59	N06059	2.4605	23 Cr / Ni Bal / 16 Mo / Al	BÖHLER NIBAS C 24-IG / Thermanit Nimo C 24
AlloyC-2000	N06200		23 Cr / Ni Bal / 16 Mo / 1,6 Cu	
Alloy 686	N06686		21 Cr / Ni Bal / 16 Mo / 4 W	Thermanit 686
255	S32550	1.4507	26 Cr / 6,3 Ni / 3,5 Mo / 1,7 Cu / 0,2 N	BÖHLER CN 25/9 CuT-IG / Thermanit 25/09 CuT
2705	S32750	1.4410	25 Cr / 7 Ni / 4 Mo / 0,27 N	BÖHLER CN 25/9 CuT-IG / Thermanit 25/09 CuT
Zeron 100	S39276	1.4501	25 Cr / 7 Ni / 3,5 Mo / 0,7 Cu / 0,7 W / 0,25 N	BÖHLER CN 25/9 CuT-IG / Thermanit 25/09 CuT

# References

voestalpine Böhler Welding provides welding solutions for thermal power stations since 1926. Whenever high temperature and creep resistance properties are essential, voestalpine Böhler Welding is the competent partner and supplier. Therefore it was not surprising back in 1990 that our filler metals were chosen for the first application of P91 in the thermal power industry.

Today with more than twenty years' experience of researching these filler metal types to meet and exceed the industries ever more demanding applications, voestalpine Böhler Welding has moved forward in line with the principle material manufacturers to introduce new filler metals for alternative pipe and tube. Grades like T/P 92, VM12-SHC, T/P23, T/P24 Super 304H – all these materials have confidently been joined and are in service at principle power plants since the beginning of the individual industrial application – all using voestalpine Böhler Welding filler metals. In addition the high integrity welds produced using our filler metals are supported by many thousands of hours, proofed creep properties of all weld metal and real welds. Therefore, we are not surprised but delighted that our reputation for high quality filler metals has resulted in our products being used for numerous newly built power plants worldwide.

We would like to acknowledge and thank the following companies for referencing voestalpine Böhler Welding filler metals for power plant component fabrication and construction (this list is not completed).


Ansaldo Energia	Dongfang	Kraftanlagen München	SES Tlmace
Alstom	Doosan Heavy Industries	Mitsubishi Heavy Industry	Shanghai Boiler Works
Babcock + Wilcox	Energomontaz	Larsen and Toubro Piping	Shanghai Electric
Bharat Heavy Electricals Ltd.	Forster Wheeler	Larsen and Toubro MHI	Siemens
Bilfinger Berger	Harbin Boiler	Rafako	Skoda
Bilfinger Power System	Hitachi Power (Europe)	Remak	
DEE Development	IHI	Sefako	

voestalpine Böhler Welding filler metals have been used for new ultra super critical power plant projects. A choice of projects in Europe and South Africa is listed:

<u>Germany:</u>	<u>Netherlands:</u>	<u>Poland:</u>	<u>South Africa:</u>
Neurath 2 x 1100 MW	Rotterdam (EBL2) 800 MW	Lagiza S.C. (C.F.B) 460 MW	Kusile 3 x 800 MW
Walsum 750 MW	Maasvlakte 1100 MW	Belchatow, S.C. 833 MW	Medupi 6 x 800 MW
Boxberg 670 MW	Eemshaven 2x800 MW		
Datteln 1100 MW		<u>Slovenia:</u>	
RDK8 Kralsruhe 900 MW	<u>Czech Republic:</u>	Sostary 6 600 MW	
Westfalen D+E 2x800 MW	Ledvice S.C 660 MW		
Wilhelmshaven (EBL1) 800 MW		<u>Estonia:</u>	
Staudinger 1100 MW	<u>Italy:</u>	Tartu 234 MW	
Moorburg A+B 2x800 MW	Torrevalduga Nord 3x660 MW		
GKM Mannheim 911 MW			

There are numerous thermal power plant projects all over the world today, in particular in China, India and the United States of America. We are proud that our customers rely on quality assured products. voestalpine Böhler Welding filler metals are engineered to produce high integrity joints. They have been developed from years of careful formulation backed by factual technical research and testing to enable our customer to enjoy the confidence that our products can offer during many years in plant service.

If the product list is missing, please contact us.



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# voestalpine Böhler Welding

## Welding know-how joins steel

Customers in over 120 countries join the expertise of voestalpine Böhler Welding. Focused on filler metals, voestalpine Böhler Welding offers extensive technical consultation and individual solutions for industrial welding and soldering applications. Customer proximity is guaranteed by 40 subsidiaries in 28 countries, with the support of 2,200 employees, and through more than 1,000 distribution partners worldwide. voestalpine Böhler Welding offers three specialized and dedicated brands to cater our customers' and partners' requirements.



**Böhler Welding** – More than 2,000 products for joint welding in all conventional arc welding processes are united in a product portfolio that is unique throughout the world. Creating lasting connections is the brand's philosophy in welding and between people.



**UTP Maintenance** – Decades of industry experience and application know-how in the areas of repair as well as wear and surface protection, combined with innovative and custom-tailored products, guarantee customers an increase in the productivity and protection of their components.



**Fontargen Brazing** – Through deep insight into processing methods and ways of application, Fontargen Brazing provides the best brazing and soldering solutions based on proven products with German technology. The expertise of this brand's application engineers has been formulated over many years of experience from countless application cases.

forwarded by:

Global Industry Segment Management  
Thermal Power Generation

T. +49 2381 271-624  
F. +49 2381 271-569  
E. [welding.thermalpower@voestalpine.com](mailto:welding.thermalpower@voestalpine.com)