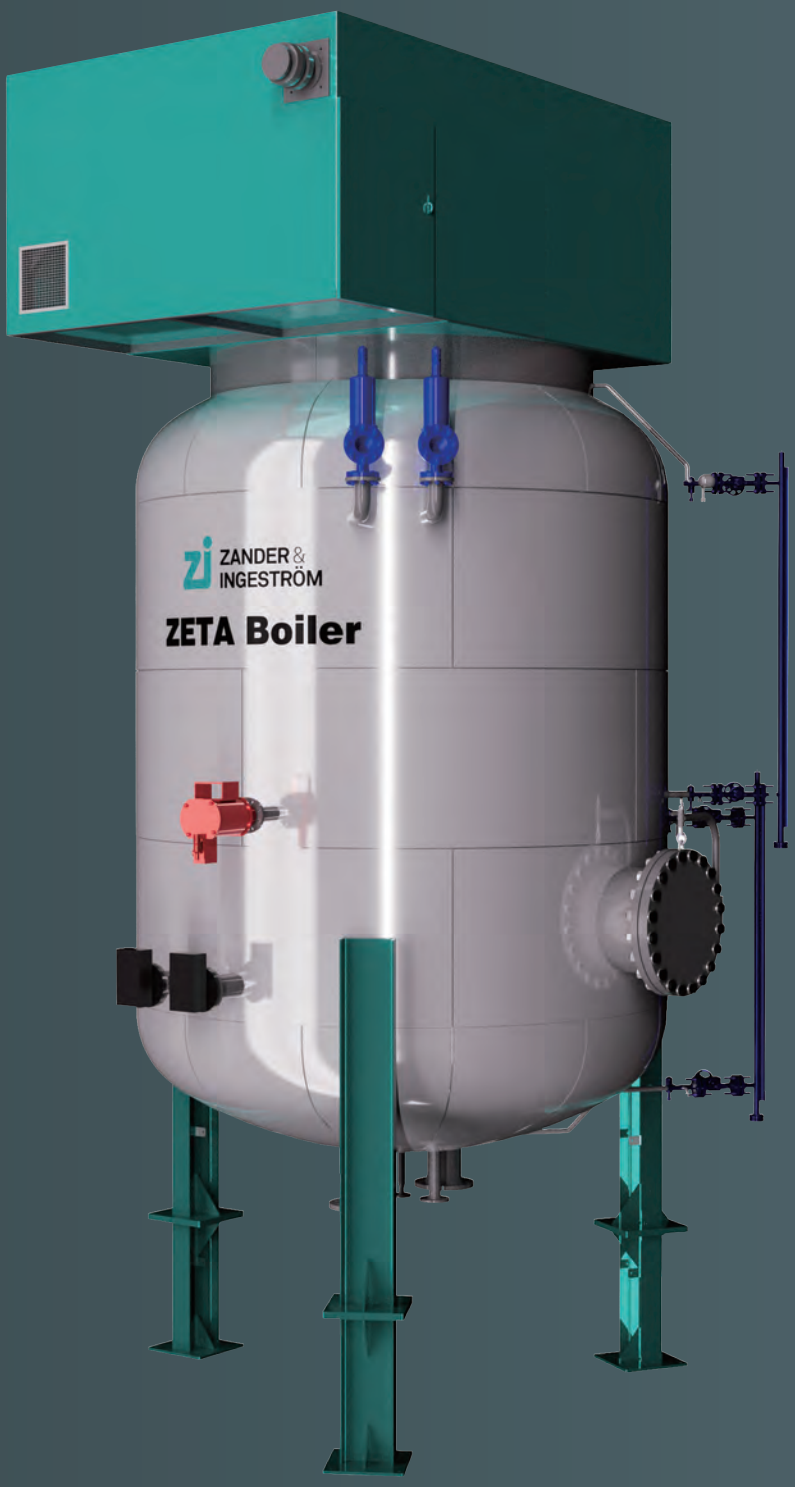
ZETA Boiler

Electrode Steam and Hot Water Boilers



Reducing the Carbon Footprint of Steam and Hot Water Systems

ZANDER & INGESTRÖM
A PART OF CHRISTIAN BERNER

COMPANY BACKGROUND

Zander & Ingeström (Z&I) was established in 1898 by Oscar Zander and Bengt Ingeström. The company marketed steam turbines and centrifugal pumps.

Of the many inventions that was developed by Z&I, the electrode boiler is still being used today and one of the great inventions that has withstood the test of time.

Z&I's ZETA Electrode Boilers was developed in the 1920s and patented in 1930s. It has undergone several generations of product improvements. As the effort for decarbonization and focus in sustainability becomes more relevant, Z&I will continue to provide this time tested product to reduce our reliance on fossil fuel and meet today's operational requirements.

Z&I offers its line of medium voltage electrode steam and hot water boilers throughout the globe. There are more than 3000 references of these boilers installed worldwide. In 2018, the company became part of the Christian Berner Group (listed on NASDAQ Stockholm: CBTT-B).

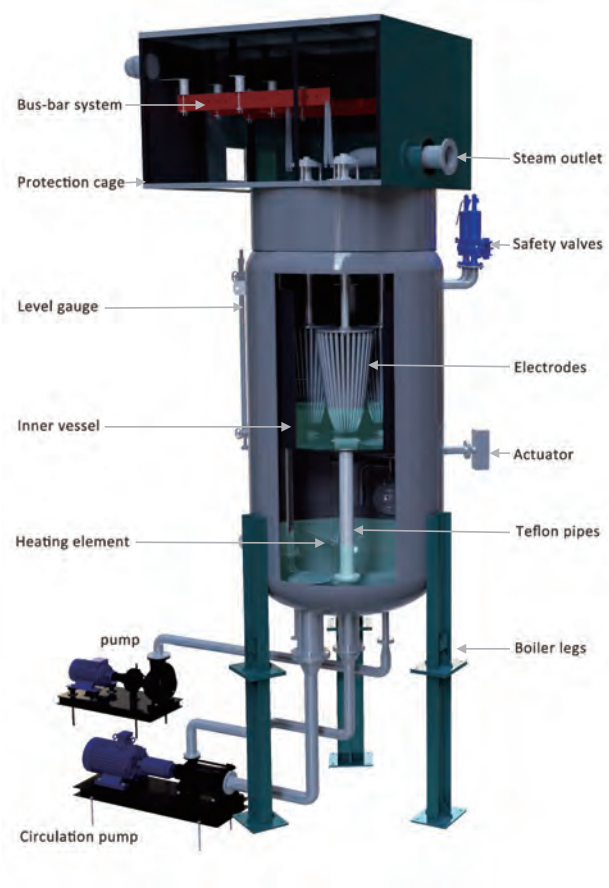
Why are Electrode Boilers used?

Electrode Boilers can be used to:

- Reduce carbon footprint by eliminating fossil fuel boilers and utilize renewable energy Easy to install, plug and play replacement for existing oil/gas boilers
- Takes advantage of negative electrical rates during curtailment
- Fast response time - can be used for peaking loads

Electrode Boilers and its working Principles

The operation of ZETA electrode steam boiler utilizes medium voltage three-phase electricity directly to produce heat in the form of steam or hot water. Electrical current is conducted via the electrodes directly to boiler water to produce. As the electrical current passes through the water, heat is generated depending on the surface area of the electrode and the conductivity of the water. Heat is generated directly in the boiler water without the use of resistance elements. Feed water enters into boiler outer vessel from the feed water pump. The water is pumped to the inner vessel via a VFD-controlled circulation pump. Heat output is directly related to electrical power input. The steam output is modulated by raising or lowering the inner vessel water level.



Advantages Over Gas Boilers

- No Onsite CO_2 Emission or NOx emissions
- No stack, no gas line, no oil tank
- Nearly 100% efficiency
- Near full turndown (3-100%)
- Quiet operation/Easy commissioning/Low maintenance

Comparison to Jet Type Boilers

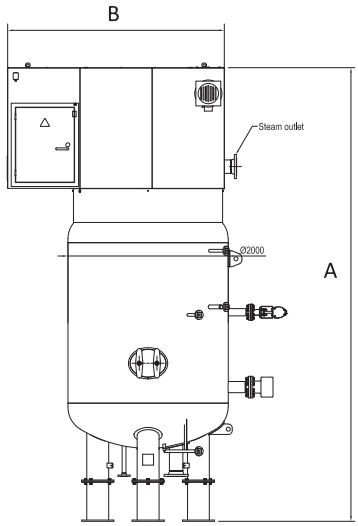
ZETA Electrode boilers is an immersion type boiler, used throughout Europe and Asia. Unlike jet-type electrode boilers, which have a reputation of arcing, poor steam quality, and poor modulation range, immersion boilers are extremely reliable, with more than 3000 references throughout the world and the oldest operating unit was installed sixty years ago. It produces excellent steam quality, suitable for the strictest steam turbine requirements such as from Siemens Energy. ZETA Boilers can be connected with a 3-wire connection directly from medium voltage networks without the use of an expensive isolation transformer.

Steam Boiler

The ZDKI steam boiler is an immersion type electrode baler. It has an outer vessel and an inner tank. Water circulates between the outer and inner tank. Power is modulated by raising or lowering the water level in the inner tank. For example, the higher the water level, more power is consumed and more steam is produced. This design gives the ZETA boiler very fast startup time and wide modulation range. Due to large steam space of the immersion boiler and very calm steaming surface, it can generate very clean steam with very little carryover. That is one of the reason why ZETA steam boilers are the preferred auxiliary boilers in the nuclear power plant, where they require 99.9+% steam quality. ZETA Electrode boilers are inherently safe from low water condition as at low water level, no power is consumed and no risk for steam explosion.

Steam Boiler Features:

- Voltage Input: 4-24kV
- Power Input: 3-70MW (220K PPH)
- Pressure: Up to 950 psig
- Steam Quality: >99.9%
- Efficiency: >99.8%
- Startup time: 1 minute from standby
- Modulation range: 3-100%
- Inherently Safe-Low Water Auto Shutoff

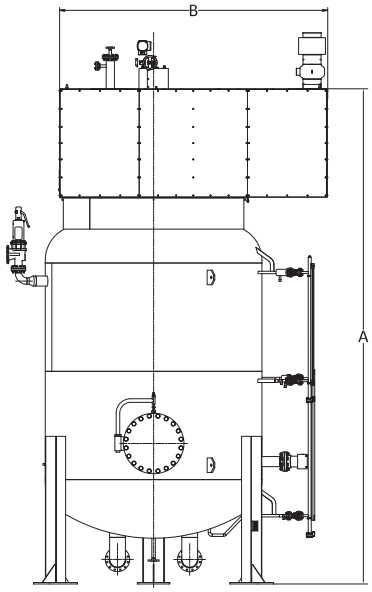


ZDKI

Type	Capacity (MW)	A (inch)	B (inch)
2000	0-15	281	106
2500	16-20	291	106
2700	21-27	308	118
3200	28-42	308	154
3400	43-60	327	183
3600	>60	370	183

Hot water Boiler

The ZBVA Hot Water Electrode Boiler is an immersion type boiler that produces hot water directly. It uses a gas pressure system to prevent the water in the inner vessel from steaming. Water circulates between the outer and inner tank. Power is regulated by the water level in the inner tank. For example, the amount of water in contact with the electrodes. The hot water is directly pumped out of the boiler and transfers energy via a Plate Heat Exchanger.

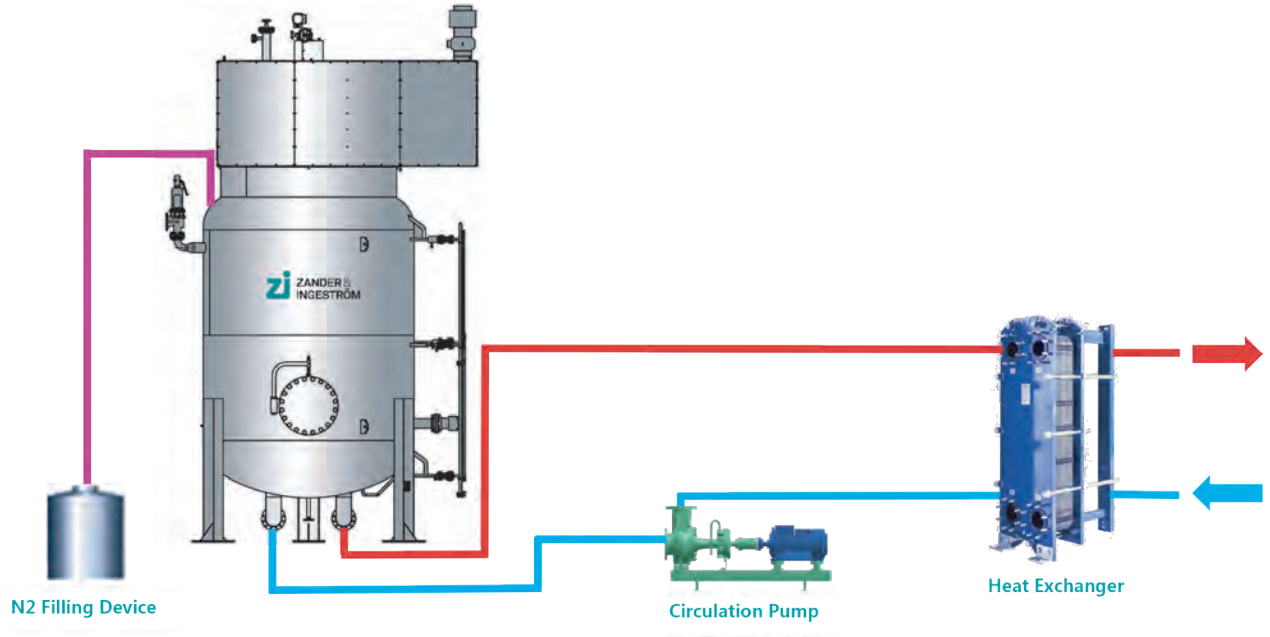


Hot Water Boilers Features:

- Voltage Input: 4-24kV
- Power Input: 3-40MW
- Temperature Max: 180°C (350°F)
- Produces hot water directly
- Modulation range: 3-100%
- Startup time: 30 seconds from standby
- Inherently safe - low water auto shutoff

ZBVA

Type	Capacity (MW)	Height (inch)	Width (inch)
2000	0-20	282	108
2700	20-25	309	108
3000	25-40	312	125



HISTORY

ZETA Boilers have almost 100 years history and development behind it. Starting out with 1 phase connection, it has grown to 3-phase. We are now able to offer 3-wire connection up to 24kV and at steam pressures up to 950 psig. Our largest boiler installed is 67MW. It now boasts fast startup time, sufficient to serve as a load to maintain frequency on the electrical network used by electrical utilities. We offer the latest PLC control in both Siemens and Allen-Bradley.

1920s

1930s

1940s

1970s

1960s

1950s

1980s

1990s

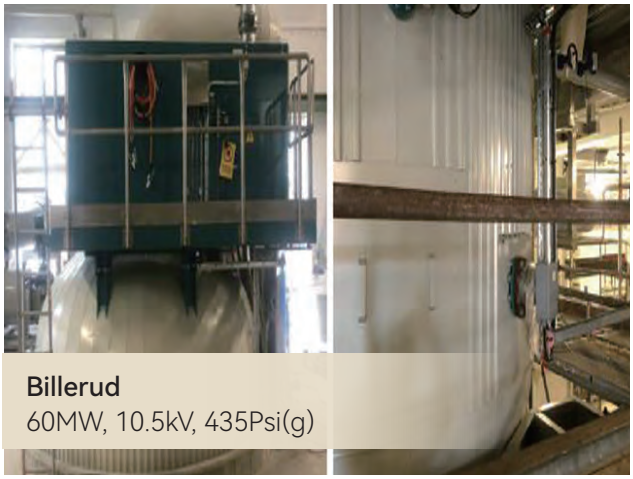
2000s

REFERENCES

Below are selected references from our over 3000 installations worldwide, the most in the industry.

LKAB Mining Gällivare
9MW, 6kV, 232Psi(g)

Hainan Changjiang NPP
2*26MW, 6kV, 290Psi(g)



Billerud
60MW, 10.5kV, 435Psi(g)

Panjin plant Hot water boilers
9*40MW, 11kV, 218Psi(g)

Sichuan Yongxiang Plant
38MW, 10kV, 363Psi(g)

Shandong Haiyang NPP
2*28MW, 10kV, 290Psi(g)

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