

# Immersed Electrode High Voltage Steam Boiler

## 4.16 KV to 25 KV

### CEJWS Immersed Electrode Steam Boilers for Every Application

These Electrode Boilers have unlimited application possibilities wherever a need for process or space heating exists. A partial list of possible uses includes:

- Hospitals, schools, hotels
- Catering and Food processing
- Clothing and textile plants
- Industrial plants
- Plastic and Chemical Plants
- Washing Utilities
- Power plants

### Electrical Requirements

CEJWS boilers are designed for use on 3-phase, 4-wire distribution (or 3-phase, 3-wire with a special grounding connection) to the circuit breaker. The boiler shell and cage must be grounded to the building steel and ground mat.



# IMMERSED ELECTRODE STEAM BOILER

## Operation Principles for Electrode Boilers

Electrode boilers utilize the conductive and resistive properties of water to carry electric current and generate steam. An A.C. current flows from an electrode to one phase to the grounded counter electrode using the water as the conductor.

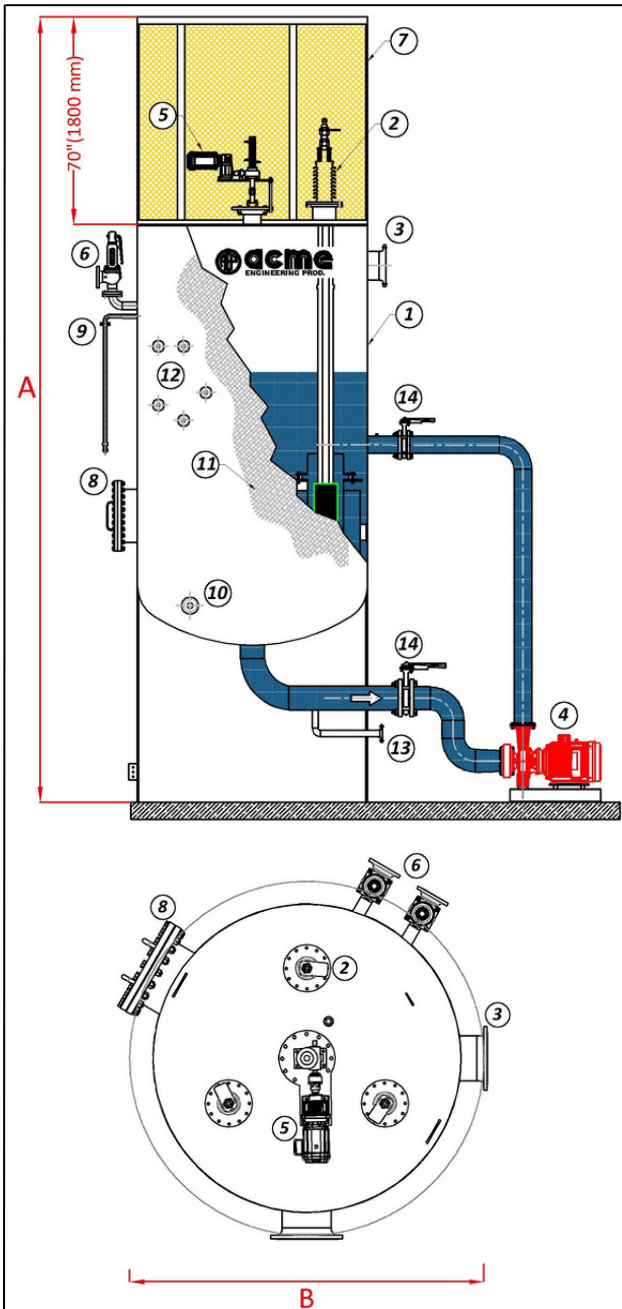
In the section view of the boiler, water cooling flow is provided by the recirculation pump and is forced up through three jet guide pipes around the electrodes.

Since the water is the electrical resistance, this current flow generates heat directly in the water itself. The more current (amps) that flows, the more heat (BTU) is generated and more steam produced. Almost 100% of the electrical energy is converted into heat.

The amount of the steam generated is compensated by the feedwater system which is added to the recirculation water flow to have more cooling effects on the electrodes. An electronic driving system is used to interpose a concentric insulating shield between the electrode and the neutral counter electrode.

The movement of the shield increases the exposure between the electrode and counter electrode resulting in an increase of current between the two.

The barrier shield can be used to turn the boiler output down to about 10% or a 10:1 turn-down ratio. To turn the boiler down below 10%, the supply power must be interrupted.



|    |                                 |
|----|---------------------------------|
| 1  | Pressure Vessel                 |
| 2  | Power Feeds (Electrodes)        |
| 3  | Steam Outlet                    |
| 4  | Recirculation Pump              |
| 5  | Motorized Drive System          |
| 6  | Pressure Safety Valves          |
| 7  | Safety Cage                     |
| 8  | Manhole                         |
| 9  | Instrument Manifold             |
| 10 | Feed Water Connection           |
| 11 | Insulation                      |
| 12 | Water Column Connection + Gauge |
| 13 | Bottom Blowdown + Drain         |
| 14 | Isolating Valves                |

## Equipment for Model CEJWS

### CONTROL

- Freestanding control panel NEMA 12 (IP54) from a separate lower source
- Pre-programmed PLC processor with HMI display
- Operating capacity control tracking MW demand
- Pressure limits
- High and low water cut-offs
- Feed Water Pump Control from water level
- Remote monitoring and reporting available

### OPTIONAL ITEMS

- Duplex sets of circulation pumps if requested
- Special valves and Instrumentation
- Chemical dosing systems
- Steam separators and deaerators
- Superheaters
- Feed water system; Blowdown tank

# SELECTION TABLE FOR IMMERSED ELECTRODE STEAM BOILERS

| Model #  | Voltage    | Maximum Power Capacity | Steam Generation (212°F) Feed Water at 175 PSI (12 BAR) | Pressure Available    | Boiler Dia. (B) | Boiler Height (A) | Initial Clearance Height for Power Feeds Insertion |
|----------|------------|------------------------|---|-----------------------|-----------------|-------------------|--|
|          | (KV)       | (KW)                   | Lbs/hr. (T/hr.)   | PSI (BAR)             | Inch (mm)       | Inch (mm)         | Inch (mm)  |
| CEJWS-6  | 4.16 - 6.9 | 2,500 - 4,200          | 8,300 (3.8) - 14,000 (6.4)                              | 100 (6.9) to 300 (21) | 83 (2,100)      | 205 (5,200)       | 250 (6,400)  |
|          | 10 - 13.8  | 6,000 - 10,000         | 20,100(9.1) - 33,500(15.2)                              |                       |                 |                   |  |
| CEJWS-10 | 4.16 - 6.9 | 4,200 - 7,000          | 14,000(6.4) - 23,400(10.6)                              |                       | 100 (2,550)     | 225 (5,700)       | 270 (6,900)  |
|          | 10 - 13.8  | 10,000 - 15,000        | 33,500(15.2) - 50,200(22.8)                             |                       |                 |                   |  |
|          | 20 - 25    | 18,000                 | 60,300(27.4)  |                       |                 |                   |  |
| CEJWS-15 | 4.16 - 6.9 | 6,500 - 10,000         | 21,700(9.9) - 33,500(15.2)                              |                       | 100 (2,550)     | 248 (6,300)       | 310 (7,800)  |
|          | 10 - 13.8  | 15,000 - 20,000        | 50,200(22.8) - 67,000(30.4)                             |                       |                 |                   |  |
|          | 20 - 25    | 27,000                 | 90,400(41.1)  |                       |                 |                   |  |
| CEJWS-20 | 4.16 - 6.9 | 7,500 - 12,000         | 25,100(11.4) - 40,200(18.2)                             |                       | 115 (2,900)     | 270 (6,900)       | 355 (9,000)  |
|          | 10 - 13.8  | 20,000 - 25,000        | 67,000(30.4) - 83,700(38)                               |                       |                 |                   |  |
|          | 20 - 25    | 32,000                 | 107,000(48.7)   |                       |                 |                   |  |

Besides the standard models, CEJWS immersed electrode steam boilers are available to meet specific capacity and operating conditions by doubling the number of electrodes.

## Special Design, Advantages and Features

- For direct network connection at up to 25KV/3PH/4 Wires
- Special shape design for electrodes to have the best performance in current density as well as a cooling effect
- Economical even for capacities between 2 & 20 MW
- Simple controls
- Working in low conductivity makes it suitable for pure steam demand
- Factory assembled key component POWER FEED, tested and certified for 3 times of applying volt-age and 1.5 times of working pressure.
- Can be added to an existing steam distribution system.
- Taking advantage of low off-peak electricity rates and demand charges
- Proximity sensors to control and monitor the movement and position of the shield and adjust the desired power.
- To prevent having a local high temperature around the electrodes, a high flow rate recirculation pump produces a water-cooling effect around the electrodes all the time.



## Performance

**High performance:** convert almost 100% of the electrical energy into heat. Rapid response (full load within 30-40 minutes from cold start or within one minute from hot start).

**Economical Installation:** Operating at distribution voltages, eliminates the need for fuel lines, storage and handling equipment, economizers, and emission control equipment, saving on capital expenditures.

**Lower operating costs:** easy to operate and simple to maintain. Automatic controls reduce the operating personnel requirements.

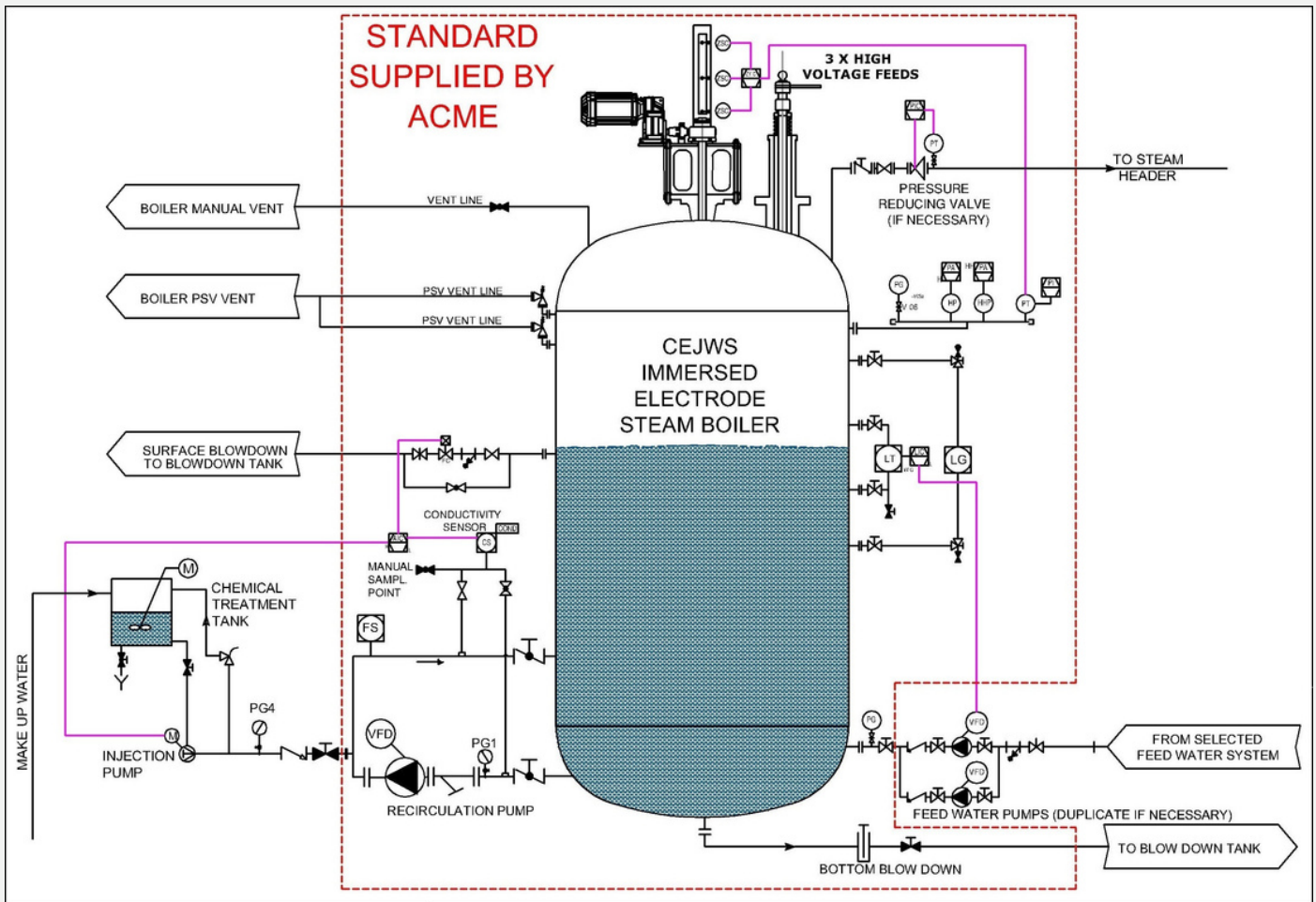
**Solves energy problems:** for areas affected by allocations or interruption of natural gas and costly oil supply, electrode boilers provide a dependable source of steam. Offers a clean, easier-to-use alternative to fossil fuels.

**Safer operations:** there are no flames, fumes, fuel lines or storage tanks. No low water danger since the current cannot flow without water. Thermal shock is eliminated. Electrically safe due to grounded pressure vessel.

**Minimal maintenance:** long-life electrodes are cooled by water jets produced by an integrated loop pump. Having a minimum number of components and electrical controls, provide maximum reliability. Without fuels, cleaning and maintenance are reduced.

**Pollution-free:** without combustion, the operation of CEJWS boilers is quiet, clean, and emissions-free. Problems associated with other energy sources such as noise, fuel fumes, fly ash, large stacks, do not exist for electrode boilers.

# GENERAL P & I DIAGRAM



## Water Treatment and Conductivity

The simplest way is to fill the boiler with demineralized water and add caustic soda solution (NaOH) or phosphate solution (Na<sub>3</sub>PO<sub>4</sub>) to achieve the conductivity required at the operating temperature.

The conductivity has to be supervised on a constant basis in order to maintain or avoid exceeding the MW capacity.



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