BOILERROOM EQUIPMENT, INC. / HEATSPONGE

Standard Economizer Operation & Maintenance Manual

Conventional, external finned-tube economizers
General guidance for installation review, startup, operation and service

GOVERNING PROJECT DOCUMENT

The project-specific general arrangement drawing signed and released for fabrication is the governing BEI document for the supplied economizer. If this general O&M manual differs from that drawing, the signed, fabrication-released general arrangement drawing takes precedence. Do not resolve a discrepancy by assumption; contact BEI for written clarification before installation or operation. Applicable codes and jurisdictional requirements still apply.

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How to use this manual

This manual describes the routine lifecycle of a conventional HeatSponge boiler economizer: receiving, installation review, pre-start inspection, operation, shutdown, layup, cleaning and service. It is not a design specification, piping design, boiler operating manual, repair authorization, or substitute for trained personnel.

Document hierarchy

- The signed, released-for-fabrication project-specific general arrangement drawing governs over this manual for the supplied unit. Check the unit nameplate and that drawing for equipment-specific ratings, dimensions, weights, materials, flow direction, connections and clearances.
- Use the project piping and instrumentation diagram (P&ID), boiler and burner instructions, site operating procedures, and the water-treatment plan for system-level operation.
- Follow requirements of the authority having jurisdiction, insurer and applicable construction and in-service codes. Refer document conflicts to BEI and the qualified project engineer before operation.

Stop-work conditions

STOP AND ISOLATE

Do not operate when pressure protection is missing, a water or flue-gas leak is suspected, the condensate drain is obstructed, adequate water flow is not established, unexpected steaming occurs, or boiler draft/combustion readings are outside approved limits. Follow the site emergency response procedure and involve qualified personnel.

Contents

Part	Use
1 / Equipment and limits	Identify the supplied unit and design boundary.
2 / Receiving and installation	Verify handling, supports, piping, relief and drains.
3 / Startup and operation	Commissioning sequence and operating log.
4 / Shutdown and maintenance	Layup, cleaning, inspections and tube service.
5 / Reference	Troubleshooting, records and review checklist.

1 Equipment and operating limits

A conventional economizer transfers heat from boiler exhaust to feedwater or another approved water circuit. The finned-tube bank is housed in a flue-gas casing with external water connections. On applicable models, individual tube elements are accessible for service. Construction, flow path, casing arrangement and the ability to tolerate condensing operation depend on the actual project.

The original manual describes a square-pitch tube bank with inlet/outlet headers, a condensate collection point and removable rear access. Those features should be confirmed against the supplied unit. Do not assume that a typical casing thickness, insulation thickness, header connection size, static stack load or clearance applies to every HeatSponge model.

Verify on the actual unit	Record or confirm
Pressure boundary	Nameplate MAWP, design temperature, code stamp, serial number and relief-device requirements.
Flow and duty	Water inlet/outlet, minimum flow or recirculation requirement, design gas flow and allowable gas-side pressure drop.
Materials and fuel	Tube, fin, casing and support materials; approved fuels; intended condensing or non-condensing service.
Connections	Headers, vents, drains, condensate outlet, access panels, flue transitions and any required expansion joints.

CONDENSATION AND FUEL CHANGES

Water-side inlet temperature, exhaust composition, fuel sulfur content and excess air affect the risk of acidic condensate. A unit intended for non-condensing service must not be treated as a continuous condensing unit merely because it has a drain. Consult BEI before changing fuel, operating temperature or duty.

2 Receiving, storage and handling

- Inspect shipping packaging and visible equipment before signing the carrier receipt. Document shortages or damage with photographs and the carrier paperwork. Notify the carrier and BEI promptly.
- Compare delivered components, accessories and documentation with the packing list. Inspect flanges, headers, instruments, lifting points, casing panels and insulation.
- Protect openings from rain, debris and construction dust. Store the unit stable and dry, with components supported so that tubing, casing and connections are not distorted.
- Use only approved lifting points and a rigging plan based on the project shipping weight and center of gravity. Do not lift by headers, nozzles, handholes or insulation.
- Reinspect equipment before installation. Resolve damage or shipping restraints identified in the project documentation before commissioning.

3 Installation review

The installing engineer and contractor are responsible for the site arrangement. Confirm the approved drawings before connecting water or exhaust. The checks below are not dimensional or piping design instructions.

Supports and clearances

- Verify that the supporting structure carries the economizer, its flooded weight and applicable environmental loads. Support upstream and downstream stacks and ducting independently.
- Maintain the project-specified clearance for access-panel removal, inspection, tube withdrawal, lifting and service. Do not substitute a generic clearance for the approved layout.
- Avoid piping loads or misalignment at headers. Provide supports and restraints for field piping as required by the piping design.

No stack loading: static and dynamic

The economizer is not designed to support any stack loading. Static stack loading is the sustained weight of a stack, duct, transition, silencer or other attached equipment transferred to the economizer casing or flanges. Dynamic stack loading is a changing force or moment arising from wind, seismic motion, vibration, pressure pulsation, startup/shutdown or movement of connected equipment. Neither type of stack load may be imposed on the unit. Independently support and restrain connected equipment; have the project engineer verify the load path before installation. Obtain BEI written approval before proposing any exception.

Thermal expansion and expansion joints

The economizer is not designed to accommodate thermal expansion of the boiler, stack, ducting or other connected equipment. The project engineer must determine the expected differential movement and provide independently engineered and supported expansion joints where required. Expansion joints are supplied and engineered by others unless expressly included in BEI scope. Confirm their location, movement rating, installation setting and restraints on approved project drawings; do not use the economizer casing or flanges to absorb expansion forces.

Design flue flow, vibration and responsibility

Operate within the maximum flue-gas mass flow and other design conditions stated on the approved project data. Flow above the design mass flow can increase gas-side pressure drop and cause or aggravate flow-induced vibration. Excessive negative draft at the economizer outlet can draw more flue gas through the bundle than the design allows, increasing gas velocity even when the boiler firing rate has not changed. Verify actual gas flow and draft against the approved operating envelope; draft alone does not establish the flow rate. During commissioning, record the operating flow basis, draft/pressure drop and any abnormal casing or duct vibration; investigate unexpected noise or movement before continuing operation.

UNAPPROVED LOADING AND EXCESS-FLOW VIBRATION

BEI assumes no responsibility for damage resulting from external loads imposed without BEI written approval, or from vibration caused by flue-gas mass flow above the approved design conditions. The applicable contract and warranty govern allocation of liability. Legal review of this statement is required before publication.

Water circuit and pressure protection

- Confirm water flow direction shown on the approved drawing. Where the project specifies counterflow, the coldest water enters at the flue-gas outlet side; check the physical orientation before piping.
- Provide the engineered vent, drain, isolation, bypass, recirculation, instrumentation and relief arrangement shown on the P&ID. Do not isolate a heated liquid volume from its required pressure protection.
- Verify relief-device set pressure, capacity, installation and discharge routing with the project engineer and applicable jurisdiction. Keep discharge piping supported and directed to a safe location.
- Provide a means to establish and monitor adequate water flow whenever hot exhaust may pass through the economizer, including low load and feedwater pump cycling. The old manual gives example recirculation arrangements; these are not universal setpoints or wiring instructions.

Gas path and condensate

- Check transition alignment, gasket materials and bolting; confirm the flue route and any bypass/draft controls operate as designed.
- Connect the casing drain to an approved collection, trap and disposal arrangement suited to the unit draft conditions and condensate chemistry. Confirm the drain cannot admit or release flue gas into occupied areas.
- Where acidic condensate is expected, confirm suitable materials, neutralization, local discharge requirements and freeze protection with the project engineer. Never cap or obstruct a designed condensate outlet.

4 Pre-start inspection

Complete this checklist with the boiler, burner and feedwater systems isolated or in the approved pre-start state. Record results and resolve every exception before firing.

Check	Acceptance evidence
Unit identification	Nameplate and serial/job number match the approved submittal and P&ID.
Mechanical supports	Stack and duct loads bypass the unit; independent supports, restraints, expansion joints and access space match approved drawings.
Design flue flow	Maximum expected flue-gas mass flow is within approved design conditions; commissioning plan includes draft and vibration observations.

Check	Acceptance evidence
Gas path	Ducting is clean; shipping pieces, tools and temporary covers are removed; doors and gaskets are installed.
Water circuit	Piping direction, valves, drains, vents, recirculation and instrumentation match the approved drawing.
Pressure protection	Installed relief devices and discharge path match the approved design; test gags and temporary blanks removed.
Condensate handling	Drain, trap and disposal system are installed and unobstructed; materials suitable for anticipated condensate.
Water treatment	Water quality meets the site treatment plan; debris and cleaning chemicals are controlled.
Tests and permits	Required pressure/leak tests, inspections, documentation and operating permits are complete.

FIELD TESTS

Factory hydrostatic testing does not replace required field testing of field joints and connected piping. Conduct any post-installation pressure test under an approved procedure and applicable jurisdictional requirements. Keep personnel clear of pressure-test hazards.

5 Startup and commissioning

Only trained, authorized personnel should start the unit. Coordinate with the boiler and burner startup sequence. BEI participation, when arranged, supports but does not replace the site operating authority.

01 Confirm the pre-start checklist, valve lineup and pressure-protection status. Verify that the flue path and condensate drain are clear.

02 Fill from the engineered fill point with water meeting the treatment plan. Vent trapped air. Avoid rapid temperature changes between water and metal; do not use a universal minimum water temperature in place of the project specification.

03 Establish and verify the required water flow or recirculation path before admitting hot exhaust. Check pressure, temperature, flow indications and visible joints.

04 Bring the boiler and economizer to temperature gradually under the boiler startup procedure. Confirm stable draft, burner operation and the approved gas-side pressure-drop range.

05 At operating load, record gas inlet/outlet temperature, water inlet/outlet temperature, water flow, water pressure differential, draft and condensate observations. Compare with the accepted design case after conditions stabilize.

06 Inspect accessible external joints, flanges, relief discharge and casing for leakage. Correct abnormal conditions through the approved site procedure before continued operation.

6 Operating checks

Trend actual performance against a stable baseline at comparable boiler load, fuel and water conditions. A single temperature reading does not establish economizer performance.

Frequency / situation	Operator check and response
Each operating shift	Review inlet/outlet water and gas temperatures, water-side pressure difference, boiler draft, signs of leakage and drain condition. Log operating load and fuel.
After changes in firing or fuel	Confirm boiler combustion/draft stability and that inlet water temperature, flow and condensate behavior remain within the approved envelope.
After maintenance or layup	Verify reassembled access covers, drains, vents, pressure protection and instrumentation; repeat applicable startup checks.
Unexpected readings	Compare instruments with known good measurements, inspect for fouling or flow loss, and escalate before operation outside design limits.

Water quality and corrosion

Maintain a site-specific water-treatment program established by a qualified specialist. Control oxygen, solids, pH and other contaminants in the manner required for the boiler circuit and supplied tube materials. On stainless-tube applications, chloride content and temperature warrant particular attention. Avoid applying a generic chloride limit without assessing the actual alloy, stress, temperature and water chemistry.

Fireside deposits and condensate chemistry depend on fuel and operation. If deposits, low-temperature corrosion or unexpected condensate appear, review combustion conditions and materials with BEI before cleaning or altering operation.

7 Shutdown, standby and freeze protection

Normal shutdown

- Follow the boiler and burner shutdown procedure. Maintain the required water flow during cooldown for as long as the approved operating procedure specifies.
- Once the unit is safe to handle, inspect for leaks and record any abnormal temperatures, draft or condensate behavior.
- Do not open vents, drains or access doors on a hot, pressurized or contaminated unit. Use the site isolation, lockout/tagout and confined-space controls where applicable.

Extended standby or freezing exposure

- Choose a wet or dry layup plan with the water-treatment specialist and project engineer; the proper approach depends on duration, materials and circuit arrangement.
- If draining is specified, verify all low points and piping pockets can drain, vent as required, and protect against residual trapped water. Do not assume every installed orientation is completely drainable.
- Keep flue passages dry and protected from precipitation when practical. Maintain condensate drain protection, and inspect before recommissioning.

8 Inspection, cleaning and routine maintenance

Set frequency from fuel, operating hours, observed fouling, water analysis, manufacturer instructions and jurisdictional requirements. The following schedule is a planning baseline, not a code-prescribed interval.

Interval	Typical activity
Shift / daily	Trend temperatures, water pressure differential, draft, leaks and drain behavior; note unusual noise or visible deposits.
Monthly / seasonal	Review log trends, accessible casing and insulation, support condition, trap/drain function and instrument calibration status.
Planned outage	Isolate and cool. Inspect fireside deposits, corrosion, tube supports, casing, door gaskets and accessible water connections. Clean as approved.
Inspection cycle	Coordinate pressure-boundary inspection, safety-device service and any required tests with the authorized inspector and site engineer.

Fireside cleaning

Select a method suited to tube and fin materials and the deposit chemistry. Remove loose material without bending fins or damaging the tube-to-fin bond. If wet cleaning is approved, control water volume, protect instruments and insulation, collect wash water and verify the drain capacity. Dry and inspect before closure. Replace disturbed access-door gaskets with the specified material and follow the approved fastening sequence.

9 Tube leakage and element service

PRESSURE-BOUNDARY WORK

A removable tube is still part of a pressurized circuit. Only trained personnel may service it under a documented isolation and test procedure. Confirm whether the work is a repair or alteration requiring an authorized organization, inspector involvement or formal records. Do not assume a compression fitting eliminates those obligations.

If leakage is suspected

- Identify symptoms: unplanned casing-drain flow, falling water pressure, rising makeup demand or a visible water plume. First distinguish process condensate, rain ingress and wash water from a pressure-boundary leak.
- Reduce load or shut down per site emergency procedure. Isolate, cool, depressurize, drain and verify zero energy. Check common breeching for backflow of flue gases from other operating boilers.
- Inspect the water circuit, headers and individual tubes under the approved access procedure; document location, damage and likely cause.

Replacement sequence - general

01 Confirm the correct replacement element, alloy, dimensions, fittings, ferrules and gasket from the unit bill of materials.

02 Remove the specified access panel after isolation is verified. Protect adjacent finned tubes from mechanical damage and contaminants.

03 Disconnect the affected element using the fitting manufacturer’s instructions. Remove and examine the element; check for corrosion, erosion, fatigue, overheating or water-quality damage.

04 Install the replacement using new parts where required. Follow fitting-maker assembly and tightening instructions; do not substitute a generic torque or reuse a ferrule without approval.

05 Close the casing with the specified gasket. Perform the required pressure/leak test and inspection before returning to service.

06 Restart under the commissioning procedure and confirm stable flow, water-side pressure difference, boiler draft and absence of water or gas leaks. Update the maintenance record.

Temporary isolation of a tube: The old manual suggests capping a failed tube to defer replacement. That changes water flow and pressure drop and may affect boiler feedwater delivery. Do not use a generic number of permissible isolated tubes; obtain a unit-specific engineering assessment and documented operating limit first.

10 Troubleshooting

Observation	Check first / next action
Water at casing drain	Distinguish normal condensate or rain from a tube leak; correlate with water pressure and makeup. Escalate suspected pressure-boundary leakage.
Gas outlet temperature rising	Compare boiler load, inlet temperature and water flow with baseline; inspect fouling and instrumentation.
Water outlet temperature low	Verify gas conditions, flow direction, flow rate and bypass/recirculation status; inspect fouling.
High gas-side pressure drop	Check fouling, duct restrictions and draft instruments; avoid operation beyond boiler fan limits.
High water-side pressure drop	Check strainer, valves, fouling, air binding, flow and isolated tubes; protect boiler feedwater supply.
Unexpected condensate/corrosion	Check fuel, water inlet temperature, exhaust conditions, drain function and material suitability with engineering.

11 Records, spares and service support

- Keep the nameplate data, BEI job number, unit serial number, approved drawings, original submittal, factory test record, repair documentation and current P&ID together.
- Maintain a log of load, inlet/outlet temperatures, flows, pressure differences, draft, water chemistry, inspections, cleaning and deviations.
- Stock spare elements, fitting components and access gaskets appropriate to the unit’s material and service. Confirm quantities with BEI and the site maintenance plan.
- When requesting parts, provide the model, job and serial number, element position, material, photographs and observed failure mode. Contact sales@heatsponge.com or 1-866-666-8977.

Appendix A Unit-specific commissioning record

Complete this page from approved equipment documents before releasing this manual for a specific installation. Blank fields are intentional.

Item	Approved project value / reference
Model / BEI job / serial	_____
Code basis / nameplate MAWP	_____
Design temperature / materials	_____

Item	Approved project value / reference
Approved fuels / sulfur limits	_____
Water inlet temperature range	_____
Minimum required water flow	_____
Maximum gas-side pressure drop	_____
Maximum water-side pressure drop	_____
Relief device / discharge reference	_____
Condensate drain / neutralization	_____
Recirculation / bypass arrangement	_____
Tube removal / service clearance	_____
Support / expansion-joint drawings	_____
Water-treatment plan / limits	_____

Appendix B Engineering release checklist

The legacy manual contains several statements that should not be carried forward as universal specifications. BEI should approve the unit-specific treatment of these points before this draft replaces the current published manual.

- Pressure-vessel code and jurisdictional inspection language, including relief-valve configuration and whether tube work is a regulated repair.
- Supported casing, insulation, header sizes, weights, stack loads, access clearances and drainability for each covered product variant.
- Approved water-temperature and fuel envelope, sulfur/acid-dew-point assessment, condensing capability and material selection.
- Minimum flow, recirculation and pump-interlock arrangements; sequence for upset conditions and on-off feedwater pumps.
- Cleaning methods, replacement-ferrule/fitting instructions, post-service pressure test and the acceptability of temporary tube isolation.

Source and references: BEI, HeatSponge.com Standard O&M Manual, Version 1.0 (legacy source); the project’s approved drawings and data report; applicable ASME Boiler and Pressure Vessel Code; National Board Inspection Code; and the current instructions of supplied component manufacturers. This document intentionally does not assert a universal edition, interval, pressure, temperature or dimension.

Release record - complete before publication

Review area	Responsible reviewer / disposition
Pressure boundary and jurisdiction	_____
Boiler integration and controls	_____
Materials and corrosion envelope	_____
Service procedures and spare parts	_____
Technical approval date / revision	_____

This draft should be issued as a replacement operating manual only after the five areas above have been reviewed against the current HeatSponge product line and the final equipment-specific documents. A revision number, approval date and scope of covered models should then be assigned.