

STANDARD ECONOMIZER PRODUCT GUIDE



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Overview

An Economizer recovers heat from flue gases and uses it to increase boiler feedwater temperatures, prior to entering the boiler. Cleaver-Brooks offers two types of Standard Economizers - CCE (Cylindrical) and CRE (Rectangular) units.

Reduces Fuel Use and Cost:

- Recovers heat from flue gases that would otherwise be wasted
- Heat is used to raise boiler feedwater temperature prior to entering the boiler

Load Changes:

- Rapid changes in load demands can be met faster due to higher feedwater temperature

Emissions:

- Reduced fuel-firing rates for any given steam output means reduced NOx emissions

ASME Construction:

- Ensures high quality design and manufacturing standards
- Provides safety and reliability

High Efficiency Heat Exchanger:

- Provides uniform fin-to-tube contact for maximum heat transfer
- Fin tubing offers up to 12 times the heat exchange surface of bare tubing of the same diameter

Self-Draining Design:

- Suitable for outdoor installation.

Low Pressure Drop:

- Provides low gas side pressure drops.
- Permits use of smaller forced draft fans.
- Permits use of existing fans in almost all installations.

Gas Tight Combustion Stack:

- Stainless Steel casing.
- Compact dimensions provide for easy installation.

Applications

Note:

- Must always have continuous water flow through the economizer when flue gas is travelling through the economizer.
 - Not Recommend
 - Running the economizer dry.

Boiler Feedwater

- Running Feedwater directly through the economizer (direct feedwater heating) – continuous run pump and modulating feedwater control is required.

On/Off Feedwater Control

- Convert to modulating control OR
- Supply Circulating Pump and Tank System must be proposed
 - Circulating pump and tank systems are only available up to 150 lb boiler design pressure.
 - Storage Tank Selection
 - Based on MBH of Economizer Recovery
 - General rule of thumb is to pick 20-30 GPM for the circulating pump flowrate.
 - Minimum water flow rate through the economizer should be the maximum evaporation rate of the boiler.
 - Add liquid temperature control assembly
 - ByPass Damper Open reduces the heat recovery by up to 50%
 - May need additional means of removing the excess heat within the system.

Make-up Water Heating

- Must have Minimum of 50% makeup to ensure a sufficient heat sink
- Even with this guideline, flow may still be interrupted, which can cause steaming in the economizer.
 - Add a tank and pump upstream of the feedwater tank.
 - Then flow is not interrupted.
- Recommend SS Headers (All SS Liquid Side)
 - Untreated Condensate – Carbonic Acid
 - MU Water – O₂ Corrosion
- If water is less than 150°F, may recommend a C1X – Single Stage Condensing Economizer

Hot water boilers

- Supply Circulating Pump to draw water from, and return it to, the system hot water return.
- Use approximately 2-3 gpm per economizer tube as the minimum water flow rate.
- Note:
 - Saturated Steam Temp versus Feedwater Temperature
 - High Fire use lowest flow possible to keep a Temperature difference of 15 or 20°F below the sat. temp of the boiler
- Supply Temperature + Boiler Delta T (LPS/HW) = Flue Gas Temp

Potable Water

- Depends on local code if you can run direct through economizer or need a secondary heat exchanger
- Quote a circulating pump kit
- Select a second identical pump
- Second pump not with the kit
- Controller with kit is set up to only control one pump
- Would have to provide own means of switching over to the backup pump

*Guide:***Special Applications (Contact Milwaukee Sales):**

- Low Pressure Steam
- Hot Water Boiler
- Operating Pressure Less Than 35 psi
- Heavy Oil Fuel
- On/Off Feedwater Control
- Maximum Feedwater Temperature is greater than what is allowed within the program
- Multiple Boilers into 1 Economizer
 - Not Recommended
 - Size for maximum capacity
 - Must include a SCCA

Tab 1: Application Data**Model Selection**

- Select the correct Cleaver Brooks boiler model.
 - For non Cleaver Brooks models select "Other"

Load Points

- Firetube Models will provide 4 Load Points
- Model 4/ Model 5 will provide 1 Load Point at 100% Load
- Model FLX will Provide 2 Load Points

Fuel Series Consideration

- **Natural Gas Only:**
 - Condense Temperature ~140°F
 - Stack Temperature (Economizer leaving temp)
 - 290 – 300°F target
 - Stack corrosion control assembly not required.
 - 290°F (85% efficiency requires 265 - 275°F stack temp)
 - May require the Stack Corrosion Control Assembly if temperature falls below @ 230°F at low fire.
 - SCCA also recommended for tall or un-insulated stacks to prevent condensation.
 - Feedwater Temperature
 - 40°F minimum.
 - Inlet water temperature below 100°F requires all stainless steel liquid side surfaces.
 - Construction
 - Standard Al-Fuse stainless tube/aluminum fin construction.
 - Fin Spacing:
 - Maximum 6 Fins/inch.
- **Natural Gas and/or #2 Oil:**
 - Natural Gas Condense Temp ~140°F
 - #2 oil Condense Temperature: ~180°F
 - Stack Temperature (Economizer leaving temp)
 - 300 – 325°F target,
 - Stack corrosion control assembly not required.
 - Below 290°F (85% efficiency requires 265 - 275°F stack temp)
 - Stack Corrosion Control Assembly is required.
 - Feedwater Temperature
 - 120°F minimum.
 - Construction
 - Standard Al-Fuse stainless tube/aluminum fin construction.

- Fin Spacing
 - Maximum 6.0 Fins/inch.

- **#6 Oil:**
 - Forward all #6 oil selection to Cleaver Brooks.
 - Stack Temperature (Economizer leaving temp)
 - 325 – 350°F target
 - Stack corrosion control assembly required for all applications.
 - Automatic sootblower required
 - Feedwater Temperature
 - 220°F minimum required.
 - Feedwater must be from DA or otherwise preheated
 - Maximum fuel sulfur content
 - 3%
 - Construction
 - Stainless Steel tube/ Carbon Steel fin for low sulfur
 - Stainless Steel tube/ Stainless fin for 2% or greater sulfur content.
 - Fin Spacing
 - 4 – 5 fins/inch.

Pressure Drop:

- Majority of Cleaver Brooks Boilers
 - 0.25" w.c. maximum Gas Side pressure drop
- Some Cleaver Brooks Boilers
 - 0.50" w.c. maximum Gas Side pressure drop.
- Industrial watertube boilers
 - 0.8" w.c. maximum pressure drop.

Feedwater Temperature

- Maximum Temperature
 - Calculated and set at a temperature to assure at least a 25°F Differential between the Boiler Operating Temperature and the Economizer Outlet Feedwater Temperature

Flue Gas Temperatures

- Predicted Values are Calculated
- Can override the Defaulted Value

Hours of Operation

- Can override the Defaulted Value: 2190

Tab 2: Economizer Selection**Boiler Performance Baseline**

- Display field in the upper left corner
- Shows the Boiler Information formed from Tab 1 Selections

Stack Temperature Loss

- Display field in the upper right corner
- Shows the minimum recommended exit temperature from the economizer to avoid condensation.
- Uses Stack Height, Feet and Stack Construction for calculation

Economizer Type

- CCE
 - Cylindrical Model
 - Horsepower is less than or equal to 250HP
 - Base price includes economizer and stack transitions with flanges, Qty. (2) mating flanges, and Qty. (2) mating flange gaskets.
 - Standard Design Pressure
 - 300psig
 - Standard Test Pressure
 - 375 psig
 - 150psi – 250psi Boiler Design
 - Switch Design Press/Test to 400/600
 - Change Relief Valve to 400psig
 - Above 550°F
 - Special Request
 - Other materials required
 - Features
 - Does not have a field replaceable tube core
 - The Unit can be rebuilt at the factory if needed.
 - Header manifold for high liquid flow rates
 - UM Stamp Standard

- Hinged stainless steel access door panels
- Quick release tension for doors
- Manual bypass control lever
- Stainless steel internal bypass assembly
- Vertical Flow Only
- Internal thermal expansion design
- Built in by-pass damper
 - Allow manual stack temperature control and heat adjustment
- Mounting flanges for bolting to mating flanges or adapters
- Single Row Construction
 - Have much higher water side pressure drops.
 - Water side pressure drop limit is 10 psig, unless the rep can accept a higher drop.
- 2 Row Construction (CRE-M2D, L2H, etc.)
 - More likely to achieve higher efficiency
 - Will have much higher gas side pressure drops.

- CRE
 - Rectangular Model
 - Boiler HP 150 HP up to 2200 HP
 - Standard Design Pressure
 - 300psig
 - Standard Test Pressure
 - 450 psig
 - 150psi – 250psi Boiler Design
 - Switch Design Press/Test to 400/600
 - Change Relief Valve to 400psig
 - Above 550°F
 - Special Request
 - Other materials required
 - Features
 - Removable tubes with unions and Compression fittings
 - Tube replacement without welding or cutting
 - Hinged access door
 - Water Side Pressure drop is not a concern with rectangular CRE units.

- UM stamp standard
- Stainless steel interior shell
- Built in by-pass damper
 - Allow manual stack temperature control and heat adjustment
- Removable panels allow for complete cleaning
- Vertical or Horizontal Flow
- Built-stainless steel condensate pan and drain
- Mounting flanges for bolting to mating flanges or adapters
- Square pieces for transitions are 2x2 angle flanges

Exhaust Flow Direction

- CRE
 - Vertical or Horizontal
- CCE
 - Vertical Only

Target Stack Temperature

- Default: 310 – 330 Deg. F (84 - 84.5)
 - Selects Economizers that would produce an outlet flue gas temperature between 310 to 400
- 290 – 310 Deg. F (84.5 - 85)
 - Selects Economizers that would produce an outlet flue gas temperature between 290 to 310
- 275 – 290 Deg. F (85 plus)
 - Selects Economizers that would produce an outlet flue gas temperature between 275 to 290

Tube Construction

- 316L SS Tube w/Al-Fuse Fin
 - Standard Offering
 - Most efficient for the price
 - Higher Allowed Maximum Temperature than Duplex SS
- CS Tube / CS Fin, Nickel Brazed
- Duplex SS Tube w/ Al-Fuse Fin

Selection Criteria

- Used to narrow down the Economizer Selections
- Best Payback
 - Best Heat Transfer Recovered versus Cost
- Lowest Price
 - Lowest Dollar Amount in selection range

Economizer Model

- Select economizer model
- Clarification Example: CCE-16A6AL
 - CCE – Model Type (CCE – Cylindrical; CRE – Rectangular)
 - 16 – Core Size (Ex.: 16, 18, 20, etc.)
 - CCE – Diameter; CRE – Length x Width
 - A – Number of Rows (Ex.: 6 = 6 Rows; 8 = 8 Rows; A = 10 rows, etc.)
 - Determines Economizer Height
 - 6 – Fin Spacing (per inch)
 - AL – Fin and Tube Construction
 - AL = 316L SS Tube w/ Al-Fuse Fin
 - DS = Duplex SS Tube w/ Al-Fuse Fin
 - CS = CS Tube / CS Fin, Nickel Brazed
- Total Height of Economizer with Transition Pieces
 - If (core size – vent size) \geq 12
 - (Model Size – Vent Size) + 10 + Height of Economizer
 - If (core size – vent size) $<$ 12
 - $5 \times 2 = 10$ + Height of Economizer

Economizer Model Displays

- Displays all of the information once an Economizer model is selected
- Economizer Weights and Dimensions
 - Links
 - CCE_Dims and Weights.pdf
 - CRE_Dims and Weights.pdf
- Sales Brochure Link
 - Links
 - CB-8089_Stack_Economizer_NL.pdf
- Dimensions – Charted DD's

- Links
 - [DD_CCE_06-08.pdf](#)
 - [DD_CCE_10-14.pdf](#)
 - [DD_CCE_16-20.pdf](#)
 - [DD_CCE_H2-J2.pdf](#)
 - [DD_CCE_L2-M2.pdf](#)
 - [DD_CRE_16-30_Flat Tran.pdf](#)
 - [DD_CRE_36-42_Angle Tran.pdf](#)
 - [DD_CRE_36-42_Flat Tran.pdf](#)
 - [DD_CRE_48_Angle Tran.pdf](#)
 - [DD_CRE_54-60_Angle Tran.pdf](#)
 - [DD_CRE_66-72_Angle Tran.pdf](#)
- Estimated Performance (Based on Fuel Series Selection)

Tab 3: Economizer Options

Standard Equipment

- Designed and fabricated in accordance with the ASME Boiler and Pressure Vessel Code, 'UM' Stamp
- Incorporates self-draining design.

Boiler Vent Mating Flanges and Gaskets

- Standard on CCE Model (Qty. 2)
- CRE Models Option

Flange Size (CB Mating Flange)	Mating Flange Gasket
6" I.D.	6" I.D.
8" I.D.	8" I.D.
10" I.D.	10" I.D.
12" I.D.	12" I.D.
16" I.D.	16" I.D.
18" I.D.	18" I.D.
20" I.D.	20" I.D.
24" I.D.	24" I.D.
32" I.D.	32" I.D.
36" I.D.	36" I.D.
42" I.D.	42" I.D.

Relief Valves

Cannot be sized any higher than the Design Pressure of the Economizer

- ¾" NPT ASME Relief Valve: 300 PSI
- ¾" NPT ASME Relief Valve: 400 PSI
- PRV Sized For
 - ¾" 300psi
 - Relieves 106 gpm
 - 880 lbs/min
 - 1" 300psi
 - Relieves 165 gpm
 - 1370 lbs/min
 - Criteria
 - Only way to build up pressure is if close off the valves and continue to run
 - Example: 227°F (5psi) ¾" 300psi relief
 - Raise to 300psi or 421°F

- Delta T = 196
- = 196 x 500 x 106gpm
- Relieves Over 10million btu/hr

Outdoor Coat – Paint

Required for outdoor insulations

Flue Gas Thermometer

- Recommend: (2) Two
- Gauge Mounting
 - Inlet - 2 pipe diameters away from inlet
 - Outlet - 2 pipe diameters away from outlet
 - Allows for mixing of the gas moving through the bypass damper and gas moving around the bypass damper to mix adequately for an accurate reading.

Flue Gas Thermometer
3" Dial; 150-750°F
3" Dial; 200-1000°F
3" Dial, Adjust. < 150-750°F
3" Dial, Adjust. <200-1000°F
5" Dial; 150-750°F
5" Dial 200-1000°F
5" Dial, Adjust. < 150-750°F
5" Dial, Adjust. <200-1000°F

Liquid Thermometer

- Recommend: (2) Two
- Gauge Mounting
 - Water (inlet and outlet)
 - Before and after the headers

Liquid Thermometer
3" Dial, bimetal 150-750 w/well
3" Dial, bimetal 50-300 w/well
3" Dial, bimetal 50-500 w/well

Timed Automatic Sootblower

The Timed Automatic Sootblower has a ring nozzle assembly that travels the length of the economizer while jetting steam at the finned tubes. The traveling action of the sootblower, along with the single row arrangement of the finned tubes, ensures coverage of the finned tubes by the steam jets. Maximum steam pressure to the sootblower is 100 psig, pressure reducing valve, if required, is to be supplied by others.

Select by Model and Core Size

- Ex: **CCE-108A**
 - Select if Model is CCE and Core Size is 08

Sizes

Timed Automatic Sootblower	Timed Automatic Sootblower
CCE-108A	CRE-114
CCE-110A	CRE-116A
CCE-114C	CRE-118B
CCE-116C	CRE-120B
CCE-118D	CRE-124C
CCE-120D	CRE-130E
CCE-124D	CRE-136H
CCE-130D	CRE-142G
CCE-136E	CRE-148H
	CRE-154H
	CRE-160L
	CRE-166N
	CRE-172T

Options

- NEMA 4 panel in lieu of NEMA 12
 - Only (1) Adder Required if a SCCA and a Sootblower is selected

Stack Corrosion Control Assembly

The Stack Corrosion Control Assembly (SCCA) automatically modulates the internal exhaust gas bypass to control the temperature of the cooled exhaust gas leaving the economizer. A desired minimum temperature is entered on the digital indicating controller. The controller has a continuous temperature display.

Includes

- Damper Actuator Factory Mounted
- One controller (Pre-Programmed)
- Thermocouple
- Thermocouple wire shipped loose.

Sizes

- Core Size 42 and Lower
- Core Size Larger than 42
 - SCCA 600"lbs Torque/120V./10S

Options

- NEMA 4 panel in lieu of NEMA 12
 - Only (1) Adder Required if a SCCA and a Sootblower is selected

Circulating Pump and Tank Systems:

- Only applicable to boilers with design pressures of 150 psig or less
 - Circulating pumps with higher pressure ratings
 - Not readily available to support higher design pressures
- Tanks are only rated to 200 psig.
 - Storage tank selections based on MBH of Economizer Recovery
- Circulating pump and tank systems consist:
 - (1) Pump kit assembly
 - (1) BTU Storage tank.
- The pump kit includes:
 - (1) circulating pump
 - (1) flow control valve
 - (1) check valve
 - (1) relief valve (for the storage tank, economizer relief valve is still required)
 - (1) pump controller
 - (2) Gas side thermometers.
 - Do not include Gas Side Thermometers Separately
 - Included in pump kit

Vent Extension

- Only Required for CBLE, 4WI, and CBR boilers.
- 2000lb. 12" Vent Stub Extension
- Available for 70 HP to 800 HP
- Additional support is needed to completely secure an Economizer

12" 2000lb. Vent Extension (Equivalent Horsepower)
70 HP to 100 HP
125 HP to 225 HP
250 HP to 350 HP
400 HP to 800 HP

Economizer Supports

- Option available within the Firetube Program (Tab: Pressure Vessel)

ASME Stamp / CRN

- ASME National Board "UM"
 - Standard
- ASME National Board Stamp – Sec. VIII; Div. I ('U')
- Optional
- Required (Water Volume is larger at the specified Design Pressure)
 - 1-1/2 ft³ @ 600psi (Design Pressure)
 - 3 ft³ @ 350psi (Design Pressure)
 - 5 ft³ @ 250psi (Design Pressure)
- ASME National Board Stamp – Sec. I ('S')
 - Optional
- CRN (Must Specify CRN Province)
 - Optional

International Orders

- Ship to Thomasville
- Export Packaging

Other offerings

- C1X
 - Single Stage Condensing Economizer
 - Process or Make-Up Water
 - Hot Water or Low Pressure Steam Application
- C2X
 - Two Stage Condensing Economizer
 - 1st Stage
 - Boiler Feedwater

BOILER EXHAUST ECONOMIZER SPECIFICATIONS

CRE Section VIII

1.0 GENERAL DESIGN

1.1 Furnish and install an exhaust gas economizer in the vertical exhaust duct of the boiler in accordance with the following specifications as designed and manufactured by Cain Industries, Inc.

1.2 The economizer shall be a light weight design for easier installation, rectangular, and manufactured and tested in accordance with the requirements of Section VIII, Division I of the ASME Boiler and Pressure Vessel Code.

1.3 The economizer shall be designed to include as standard, an internal, high temperature heat resistant design Flue Gas By-pass Diverter to provide for: emergency by-pass, requiring no additional duct work for controlling either:

A. Stack Corrosion B. Turn Down Performance C. Excessive flue gas back pressure due to fouling

1.4 The Economizer shall have a hinged, full face, gas tight, inspection door, providing access to the heating surface for inspection and/or cleaning.

1.5 The Economizer must be completely drainable when mounted in the vertical position or horizontal position.

1.6 Header manifolds for low liquid flow pressure drop shall be provided. The liquid header manifolds shall also contain 3/4" NPT connections for venting, draining, and/or safety relief valves as required.

1.7 Compression fitted Al-Fuse fin tubes shall be connected to header manifolds for ease of tube replacement requiring no welding.

2.0 CONSTRUCTION

2.1 Design Pressure: 300 psig @650°F.; Test Pressure: 450 psig; Max. Flue Gas Inlet Temperature: 750°F.

2.2 Fins: pitch 6 Fins/In. Max.; Material: Aluminum; Thickness: .020"; Height: .50"; Alfuse metallurgically bonded to the tube.

2.3 Tube: outside diameter: 1.0"; Wall Thickness: .065"; Material: TP316 Stainless steel ERW

2.4 Headers: material: SA106 Gr.B/ SA 53 Gr. B

2.5 2" thks. 1000°F thermofiber factory installed, high temperature insulation shall cover the shell less the header assemblies and stack adapters.

2.6 Exterior surfaces shall be 10ga. carbon steel and shall be primed and painted with a high temperature metallic paint rated for 1000°F. The inner shell shall be 304 stainless steel.

3.0 OPTIONAL EQUIPMENT

3.1 (2) 50-500°F, bimetal, 3" adjustable dial, water temperature thermometers with wells

3.2 (2) 150-750°F Bi-metallic flue gas temperature thermometers, 5" dial.

- 3.3 (1) 300 psig safety relief valve.

CRE Section I

1.0 GENERAL DESIGN

- 1.1 Furnish and install an exhaust gas economizer in the vertical exhaust duct of the boiler in accordance with the following specifications as designed and manufactured by Cain Industries, Inc.
- 1.2 The economizer shall be a light weight design for easier installation, rectangular, and manufactured and tested in accordance with the requirements of Section I of the ASME Boiler and Pressure Vessel Code.
- 1.3 The economizer shall be designed to include as standard, an internal, high temperature heat resistant design Flue Gas By-pass Diverter to provide for: emergency by-pass, requiring no additional duct work for controlling either:
- A. Stack Corrosion B. Turn Down Performance C. Excessive flue gas back pressure due to fouling
- 1.4 The Economizer shall have a hinged, full face, gas tight, inspection door, providing access to the heating surface for inspection and/or cleaning.
- 1.5 The Economizer must be completely drainable when mounted in the vertical position or horizontal position.
- 1.6 Header manifolds for low liquid flow pressure drop shall be provided. The liquid header manifolds shall also contain 3/4" NPT connections for venting, draining, and/or safety relief valves as required.
- 1.7 Tubes are welded to the header manifolds.

2.0 CONSTRUCTION

- 2.1 Design Pressure: 300 psig @650°F.; Test Pressure: 450 psig; Max. Flue Gas Inlet Temperature: 750°F.
- 2.2 Fins: pitch 6 Fins/In. Max.; Material: Carbon Steel; Thickness: .030"; Height: .50"; Nickel brazed/welded to the tube.
- 2.3 Tube: outside diameter: 1.0"; Wall Thickness: .083"; Material: SA178 Gr.A
- 2.4 Headers: material: SA106 Gr.B/ SA 53 Gr. B
- 2.5 2" thks. 1000°F thermofiber factory installed, high temperature insulation shall cover the shell less the header assemblies and stack adapters.
- 2.6 Exterior surfaces shall be 10ga. carbon steel and shall be primed and painted with a high temperature metallic paint rated for 1000°F. The inner shell shall be 304 stainless steel.

3.0 OPTIONAL EQUIPMENT

- 3.1 (2) 50-500°F, bimetal, 3" adjustable dial, water temperature thermometers with wells
- 3.2 (2) 150-750°F Bi-metallic flue gas temperature thermometers, 5" dial.
- 3.3 (1) 300 psig safety relief valve.

Notes