HAWK INTEGRATED BOILER CONTROL SYSTEM

The HAWK is a state-of-the-art boiler control system that integrates the functions of a Programmable Controller and Burner Management Controller, as well as other boiler operating and ancillary controls. The HAWK system incorporates a graphical Human Machine Interface (HMI), which displays boiler parameters, fault annunciation and alarm history, as well as providing access to boiler configuration and control functions. The HAWK system includes complete boiler firing rate controls for steam or hot water boilers. The HAWK's advanced technology features utilize the latest communication methods, such as Modbus, Ethernet, and the Internet. The HAWK also has the capability of interfacing with various building/plant automation systems. Additional features include lead/lag capability; e-mailing and paging of alarms, remote monitoring, and HMI alarm history printing.

The HAWK Integrated Control System may be used on most types of steam or hot water boilers, including firetube, industrial watertube, and commercial watertube. It is designed to operate with a gas, oil, or combination burner using a single-point modulating control or a parallel-positioning fuel-air ratio control system.

In addition to installation on new boilers, the HAWK can be added as a retrofit to existing boilers. Contact your local authorized Cleaver-Brooks representative for details.

The HAWK system is offered in Advanced, Intermediate, and Base packages. Table D-1 shows a feature comparison.

FEATURES AND BENEFITS

Advanced Technology

Standard Features:

- Integrates control function of burner sequencing and safety with firing rate, fuel-air ratio, and operating limit controls
- Incorporates a programmable controller
- Touch screen graphical human machine interface (HMI)
- Monitors and displays connected boiler parameters
- Optimizes boiler firing rate control
- Alarm/fault indication and history
- On-screen fault diagnostics
- Built-in two boiler lead/lag control
- Night/day setback control
- Thermal shock protection
- Remote modulation
- Remote setpoint
- Assured low fire cut-off
- Assured start permissive safety interlocking

- High stack temperature alarm and shutdown
- Boiler efficiency calculations

Optional Features:

- E-Mail and pager alarm/fault forwarding
- Fuel-air ratio control
- Display of boiler water level with optional CB Level Master (Advanced and Intermediate systems only)
- Building/plant automation system interface
- Remote monitoring and diagnostics
- O_2 monitoring and trim
- Internet parts and service lookup
- Lead/lag capability for multiple boiler systems
- Variable speed drive on combustion air fan
- Expanded annunciation

Safety Provisions and Diagnostics:

A. Integrated Burner Management

- Utilizes the CB780E or CB120E flame safety control
- Communicates with the programmable controller via Modbus
- Burner Control status, faults, and diagnostics displayed on HMI

B. Integrated Boiler Controls

- Operating and modulating controls
- Variable speed drive fault shutdown – communicates via Modbus (optional)
- Password protection of programmable controller logic
- Password protection of parallel positioning control (optional)

Powerful Display/Diagnostic Capabilities:

- Touch screen graphical human machine interface (HMI).

  Advanced system: 10" color touch screen

  Intermediate system: 6" color touch screen standard - 10" color screen optional

  Base system: 5.5" monochrome touch screen
- HMI allows easy screen navigation to monitor various boiler parameters & diagnostics and to configure boiler controls.
- Displays alarms/faults, burner status, and flame signal from the flame safety control.
- Diagnostics in plain English and prioritized fault annunciation simplify troubleshooting. Last 100 faults are stored.
- Displays boiler steam pressure, water temperature, firing rate, Stack temperature, boiler efficiency, combustion air temperature (optional), Flue gas O_2 concentration (optional), combustion air fan motor speed and kw (vsd option), combustion air pressure (with VSD option), water level (CB-Level Master option), shell water temperature (steam boilers), and other control points.

- Displays boiler operating status (e.g. “Warm Up”, “Auto/Manual”, “Boiler On”, fuel selection, etc.).
- Displays boiler firing rate control parameters and settings.
- Provides remote monitoring and diagnostic capabilities (optional).
- Touch screen controls simplify screen navigation and boiler configuration
- Reliable and accurate controls using microprocessor-based programming

Simplified Servicing:

- Diagnostics and fault history, up to 100 faults, through touch screen display simplifies troubleshooting procedures
- E-Mail forwarding and paging of system fault codes (optional)
- Connection to user building automation system (optional)

PRODUCT OFFERING

Included in each HAWK system is the following:

- Programmable controller
- Touch screen HMI
- Modbus communication interface to burner management or optional Variable Speed Drive
- Built-in Ethernet/IP capability via L35E (Advanced system) or L32E (Intermediate and Base) processors
- Various controller input/output modules
- Flame safety controller (CB780E or CB120E)
- Various temperature and pressure sensors
- E-mailing via Ethernet

Optional Features and Equipment: (see individual specifications for these options)

- OPC server software for interface with building/plant automation system
- Lead/Lag control of multiple boilers
- Fuel-Air Ratio Control system and actuators
- Variable speed drive for combustion air fan motor
- O_2 analyzer and/or external O_2 trim system
- Combustion air temperature sensor
- Economizer stack flue gas temperature, feed water temperature, oil temperature, and gas & oil pressure sensors
- Steam, water, and fuel flow monitoring
- CB Level Master primary safety water level control
- Paging via phone line with modem

ENGINEERING DATA

- Supply voltage: 120 VAC (+10%/-15%) 50 or 60 Hz.
- Maximum total connected load: 1200 VA
- Operating temperature limits: 32 to 130°F
- 85% RH continuous, non-condensing, humidity
- 0.5G continuous vibration

SAMPLE SPECIFICATIONS
HAWK INTEGRATED BOILER CONTROL SYSTEM

PART 1 GENERAL

1.1 GENERAL

A. Each unit shall be factory equipped with a boiler control system providing technology and functions equal to the Hawk boiler control system.

B. Each Boiler Control System shall be factory equipped with a pre- configured Programmable Controller and Human Machine Interface (HMI).

PART 2 PRODUCTS

2.1 MAJOR SYSTEM COMPONENTS

A. Major system components shall include:

1. Programmable controller
2. Touch screen HMI
3. Modbus communication interface to burner management or optional Variable Speed Drive
4. Various controller input/output modules
5. One burner management controller and wiring sub-base
6. One flame scanner: Infrared, Ultra-Violet, or UV Self-Check
7. One flame amplifier, to correspond with the selected flame scanner
8. Various temperature and pressure sensors

B. Major functions that the Boiler Control System shall provide:

1. Automatic sequencing of the boiler through standby, pre-purge, pilot flame establishing period, main flame establishing period, run and post purge
2. Flame proving and lockout on flame failure during pilot flame proving, main flame proving, or run
3. Low fire damper/valve position for flame ignition trials
4. Full modulating control of fuel and combustion air
5. Utilize solid state controls and sensors to provide various control functions, such as:
    a. On/Off, and Modulating control
    b. Modulating control algorithm shall be Proportional- Integral-Derivative (PID) type
    c. Thermal shock protection based on water temperature and setpoint
    d. Various high and low limit alarms and shutdowns

6. Touch screen graphical operator interface and monitoring
    a. Manual control of the boiler-firing rate utilizing control screens on the HMI to increment and decrement the firing rate
    b. On screen indication of burner management controller status and diagnostics
    c. On screen real-time display of all connected process parameters
    d. On screen display of system alarms and faults
    e. On screen history of alarms and faults
    f. On screen water level indication (optional) and alarm(s)
    g. Printing Alarm/Fault history
7. E-mail or paging of boiler alarms (with either Ethernet/IP or modem option)
8. Building/plant automation system interface (with Ethernet/IP option)
9. Ethernet communications (with Ethernet/IP option)
10. Tamper resistant control logic and password protection.
11. Night/day setback control
12. Stack flue gas, combustion air (optional), and shell (water) temperatures
13. Boiler efficiency calculation (corrected efficiency with O_2 option - Advanced and Intermediate systems)
14. Outdoor reset for hot water boilers
15. Remote modulation or firing rate setpoint control
16. Assured low fire cut-off (ALFCO)
17. Assured start permissive safety interlocking

C. The Boiler Control System shall provide the following safety provisions for:
    1. Integrated burner management
        a. Examine all load terminals to assure it is capable of recognizing the true status of the external controls, limits and interlocks. If any input fails this test, the burner management system should lockout on safety shutdown.
        b. Closed-loop logic test verifies integrity of safety critical loads (ignition, pilot, and main fuel valves) and must be able to lockout on safety.
        c. Pre-ignition interlocks (fuel valve proof of closure, etc.) and flame signal checked during Standby and Pre-Purge.
        d. Dynamic checking of the flame signal amplifier. The control flame signal amplifier must be able to recognize a no flame signal during this dynamic amplifier check.
        e. Safe start check and expand check to include monitoring flame signal during standby.
        f. High and Low fire switches checked for proper sequencing.
        g. Tamper-proof purge timing and safety logic.
    2. Integrated boiler controls
        a. Operating and Modulating control
        b. Variable Speed Drive (if used) fault shutdown

c. Password protection of programmable controller Logic

d. Password protection of parallel positioning control (if used)

D. The Boiler Control System shall provide annunciation and diagnostics:

1. Active alarm annunciation
2. Provide historical alarm information for on screen display
3. Detects and isolates an alarm, and reports internal circuit faults
4. Printer output capable for logging alarms
5. Capability of printing alarm history of date, time, cycle of occurrence and date and time of acknowledgement up to the most recent 100 faults
6. English text description of the system fault and troubleshooting procedures
7. Water level indication and low water shutdown alarm
8. Dynamic self-checking

E. The Boiler Control System shall be able to operate in these environmental conditions.

1. Supply Voltage: 120 VAC (+10%/-15%) 50 or 60 Hz
2. Maximum total connected load: 1200 VA
3. Operating temperature limits: 32 to 130°F
4. 85% RH continuous, non-condensing, humidity
5. 0.5G continuous vibration

F. All Boiler Control System wiring shall be in accordance with the National Electrical Codes and local electrical codes.

G. Boiler Control System component functions shall be as follows:

1. Burner Management Controller: Provides burner sequencing logic to meet FM/IRI/UL/cUL approval body requirements.
2. Touch Screen Graphical Interface: Provides user interface to the control system, boiler overview screen with connected boiler parameter readouts, burner management control status screen, alarm banners, diagnostic screens for fault troubleshooting, alarm history screen, system firing rate screen and system configuration screens.
3. Modbus communication network: provides communication between the programmable controller and burner management system (and optional Variable Speed Drive).
4. Various programmable controller input/output modules: Provides interface for discrete powered and/or isolated relay signals, as well as for analog signals, from and/or to other input/output devices.
5. Stack temperature sensor: measures and transmits a signal to the programmable controller in relation to boiler exit flue gas temperature. It is used for indication and in the calculation of boiler efficiency; it can also be used for high stack temperature alarm and shutdown.
6. Steam pressure transmitter (steam boiler): provides an analog signal to the programmable controller for indication of boiler steam pressure; utilized for on/off and modulating control of the burner.

7. Water temperature transmitter (hot water boilers): provides an analog signal to the programmable controller for indication of boiler water temperature; utilized for thermal shock protection, on/off, and modulating control of the burner.
8. Water (shell) temperature sensor (steam boilers): measures and transmits a signal to the programmable controller in relation to boiler water temperature; used for indication and thermal shock protection.

H. Optional equipment/features (see also individual Boiler Book sections below)

1. Lead/Lag Control for multiple boiler systems
2. Parallel Positioning hardware (Advanced and Intermediate systems)
3. Variable Speed Drive for combustion air fan motor (Advanced and Intermediate systems)
4. O_2 analyzer and/or external O_2 trim system
5. Combustion air temperature sensor (Advanced and Intermediate systems): measures and transmits a signal to the programmable controller in relation to the combustion inlet temperature for indication and for use in the calculation of boiler efficiency; also can be used for high combustion air temperature alarm and shutdown, based on setpoint
6. Economizer flue gas inlet and outlet temperatures, feed water temperature, economizer water in and out temperature (no thermocouple inputs with Base system)
7. Steam, water & fuel flow monitoring
8. CB Level Master primary safety water level control
9. Email and paging (text messaging) via Ethernet
10. Paging via phone line (requires modem)
11. Building automation interface
12. Remote monitoring with RSView software

SAMPLE SPECIFICATIONS
HAWK ICS PARALLEL POSITIONING SYSTEM

PART 1 GENERAL

The purpose of the parallel positioning system is to control fuel, combustion air and flue gas recirculation (FGR) if applicable. Individual actuators will be used to control each of above functions.

PART 2 PRODUCTS

2.1 CONTROLLER - A/B COMPACT LOGIX PLC COMPRISING THE FOLLOWING COMPONENTS

Row 1

Processor L35E

SM2 Modbus Module

Power Supply 1769-PA4

Discrete Input Module 1769-IA16

Discrete Output Module 1769-OW8I

Analog Input Module 1769-IF4

Analog Output Module 1769-OF2

Themocouple input module 1769-IT6

Discrete Input Module 1769-IA16

Analog Input Module 1769-IF4

Analog Output Module 1769-OF2

Row 2

Power Supply 1769-PA2

Analog Output Module 1769-OA16

Analog Input Module 1769-IF4

Analog Input Module 1769-IF4

Expansion cable

Right hand terminator

2.2 HMI (HUMAN MACHINE INTERFACE)

10" color PanelView touch screen with serial communication.

2.3 ACTUATORS

Quantity up to 4.

Typical actuators arrangement:

Combustion air

Gas

Oil

FGR

ACTUATOR SPECIFICATIONS

General: Reversing Motor with Position Feedback

Application: Control of Dampers and Fuel Valves

Note: Position will be controlled by a PLC; no Servo-Positioning Module is required.

Rotary: 90 Degree Rotation

30 Second Timing (for 90 Degrees)

36 in-lb Torque

0.1% Resolution (over 90 Degrees)

Electrical:

120 VAC Preferred

Control Signal: Pulse position with 0-10 VDC feedback

Duty: Continuous

Enclosure: NEMA 1 Minimum; NEMA 3 or 4 Optional

Approvals:

UL Listed or Recognized and/or FM Approved

Environmental: Temperature 0-130°F.

Whenever possible design without linkages shall be used.

Control Description

Control shall be parallel positioning with cross limiting.

Note: System will not be capable for simultaneous fuel firing.

Air control

Firing rate control signal is compared with corrected fuel actuator position signal. Highest of the two values is a control signal for the combustion air actuator. Velocity limitter with adjustments in both directions (up and down) shall be provided.

Control signal to the actuator is compared with feedback signal. If unacceptable error is detected for the preset amount of time, system will be shut down and fault will be annunciated.

Fuel control

Firing rate control signal is compared with air actuator position signal. Lowest of the two values is an input to the function generator. Output of the function generator is a control signal for the fuel actuator. Function generator has to have a minimum of 10 break points. The X-axis and Y-axis parameters must follow the relationship:

X[1] < X[2] < X[3] <... < X[n]

Y[1] < Y[2] < Y[3] < … <

Y[n]

Where n is the number of break points (20 maximum).

Velocity limiter with adjustments in both directions (up and down) shall be provided.

Control signal to the actuator is compared with feedback signal. If unacceptable error is detected for the preset amount of time, system will be shut down and fault will be annunciated.

FGR control

Firing rate control signal is compared with air actuator position signal. Lowest of the two values is an input to the function generator. Output of the function generator is a control signal for the FGR actuator. Function generator has to have a minimum of 10 break points. The X-axis parameters must follow the relationship:

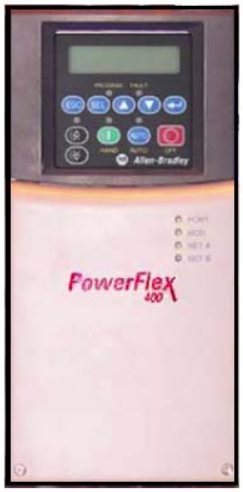
X[1] < X[2] < X[3] <... < X[n]

Where n is the number of break points (20 maximum).

Velocity limitter with adjustments in both directions (up and down) shall be provided.

Control signal to the actuator is compared with feedback signal. If unacceptable error is detected for the preset amount of time, system will be shut down and fault will be annunciated.

HAWK COMBUSTION AIR FAN VARIABLE SPEED DRIVE



Provides variable speed output to the burner's Combustion Air Fan blower motor for the purpose of improving boiler efficiency and reducing electrical energy consumption.

FEATURES AND BENEFITS

Improved Efficiency:

Energy Savings:

- Reduces electrical energy consumption
- Soft starting reduces electrical and mechanical stress on the motor, extending the life of the motor
- Provides Substantial Savings from Mid to Low Fire modulation points
- Average Payback in approximately 6 – 8 Months

Communication:

- Communicates with the Boiler Controller via Modbus
- Provides Drive process information on the Boiler Control Panel Display
- Provides Drive faults and troubleshooting suggestions, in "Plain English", on Boiler Control Panel Display

PRODUCT OFFERING

- Cleaver-Brooks shall supply the following equipment:
- Adjustable Frequency Variable Speed Drive.
- Modbus communications
- VSD Compatible Combustion Air Fan Motor.

ENGINEERING DATA

Drive:

- Ambient Operating Temperatures: 32 – 122°F
- Altitude: 3300 Ft (1000 m) Max without derating
- Shock: 15G peak for 11ms duration (±1.0 ms)
- Vibration: 0.152 mm (0.0006 in.) displacement, 1G peak
- Voltage Tolerance: -10% of minimum, +10% of Maximum
- Frequency Tolerance: 47 – 63 Hz
- Input Phases: Three-phase input provides full rating of all drives, Single- phase operation provides 50% of rated current
- Frequency Accuracy: Digital Input – Within ±0.01% of set output frequency, Analog Input – Within ±0.4% of maximum output frequency
- Intermittent Overload: 110% Overload capability for up to 1 minute, 150% Overload capability for up to 3 seconds
- Current Limit Capability: Proactive Current Limit programmable from 20 to 160% of rated output current; Independently programmable proportional and integral gain
- Line Transients: Up to 6000 volts peak per IEEE C62.41-1991
- Ground Fault Trip: Phase-to-ground on drive output
- Short Circuit Trip: Phase-to-phase on drive output
- Drive Overcurrent Trip: Software – 20 to 160% of rated current, Hardware – 200% of rated current (typical), Instantaneous – 220 to 300% of rated current (dependent on drive rating)
- Electronic Motor Overload Protection: Class 10 protection with speed sensitive response. Investigated by U.L. to comply with N.E.C. Article 430, UL File E59272 Volume 12
- See Drive Manual for other, Model and Voltage Specific, specifications.

Motor:

- Motor suitable for variable speed drive service
- Variable Torque, 3 phase
- Other specifications based on Specific Horsepower, Voltage, and Frequency requirements. Contact your local Authorized Cleaver-Brooks Representative for further details.

SAMPLE SPECIFICATIONS
HAWK COMBUSTION AIR FAN
VARIABLE SPEED DRIVE

PART 1 GENERAL

A. The Boiler Manufacturer shall provide a Variable Speed Drive controller for use on the burner's Combustion Air Fan blower motor for the purpose of providing Improved Boiler Efficiency and Reduced Electrical Energy consumption.

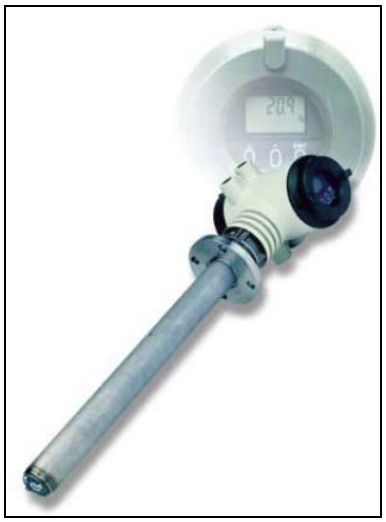
B. The Drive's voltage, frequency, and current ratings shall be rated in accordance with the electrical requirements as dictated by job site specifics, and for the properly rated motor horsepower.

C. The Variable Speed Drive must be capable of communicating over the Modbus protocol.

D. A Motor suitable for variable speed drive service must be supplied for use in conjunction with the Variable Speed Drive, and sized to match the motor requirements of the Combustion Air Fan Blower.

E. Variable Speed Drive shall be interlocked with boiler control to ensure safe operation.

HAWK OXYGEN MONITORING SYSTEM



The HAWK Oxygen Monitoring System provides indication and monitoring of the boiler's exit flue gas O_2 concentration. In conjunction with Stack Flue Gas and Combustion Air Temperature measurements, the system also provides means for a more accurate boiler efficiency calculation.

If O_2 Trim is desired see page D-50, Oxygen Trim, of the CB Boiler Book.

FEATURES AND BENEFITS

Integrated Type In-Situ Zirconia Oxygen Analyzer:

- Reduces wiring, piping and installation costs
- Allows replacement of the zirconia cell on site
- Built-in heater assembly of the probe can be replaced on site
- Can be configured on site without opening the cover using an infrared sensor
- O_2 measurement circuitry built into probe head electronics
- O_2 Level percentages displayed on the Boiler Control Panel Human Machine Interface (HMI)
- Provides accurate Boiler Efficiency Calculations with the HAWK Programmable Controller
- Separate analyzer/converter display panel not required

User Configurable Alarm Points

- Low O_2 Alarm

Analyzer Probe is Direct Insertion, In-situ Zirconia Type Which Provides:

- High accuracy
- Fast Response
- Proven Reliability

PRODUCT OFFERING

- In-Situ Zirconia Probe and Analyzer
- Process Variable% O_2 Readout on Control Panel HMI
- Accurate Efficiency Calculations

Options:

- Separate O_2 Converter/Display Panel
- Replacement Zirconia Cell
- Auto Calibration Pneumatics
- Replacement Heater Assembly
- Remote Indicator/Alarm
- Probe Stack Mounting Adapter
- Calibration Gas Kit

ENGINEERING DATA

Ambient Temperature: -4 to 131°F (-20 to +55°C)

Sample Gas Temperature: 32 to 1292°F (0 – 700°C)

Sample Gas Pressure: -1.5 to 73.8 in Hg (-5 to +250 kPa)

Output Signal: 4 – 20mA DC, One Point, Maximum Load Resistance 550 Ohms

Digital Output (HART): 250 – 500 Ohms

Contact Output Signal: Two Points, 30 VDC 3A, 250 VAC 3A (one is fail safe normally open)

Contact Input Signal: Two Points

Reference Air: Natural Convection, Instrument Air, pressure compensated

Instrument Air: 200 kPa plus the pressure in the furnace

Power Supply: 100 – 240 VAC, 50/60Hz

Power Consumption: Max 300 W, approx. 100 W for ordinary use

SAMPLE SPECIFICATIONS
HAWK OXYGEN MONITORING SYSTEM

PART 1 GENERAL

A. This specification covers the hardware and monitoring functions of the HAWK Oxygen monitoring system. The system monitors and displays Oxygen concentration and is used, in conjunction with combustion air and stack flue gas temperature sensors, to calculate the overall efficiency of the boiler.

B. The system shall be completely configured from the factory requiring only job specific data to be entered (or modified) in the field.

Note: O_2 Sensor Requires calibration in the field!

PART 2 PRODUCTS

2.1 HARDWARE

A. Hardware shall consist of the following:

1. Oxygen Sensor
2. Integrated type Zirconia Oxygen Analyzer
3. Direct Insertion Type
4. Built-in Heater Assembly
5. 4-20mA DC Process Variable Output
6. Heater to be of field replaceable construction
7. Cell to be of field replaceable construction

B. Analyzer

1. Shall be of the Integrated Type (in probe head)
2. Provide 4 – 20mA DC Signal output in relation to process variable for remote display

C. Monitoring System

1. Indicate O_2 Percentages
2. Provide Low O_2 Alarm Indication
3. Perform Efficiency Calculations and display results using O_2 percentages

PART 3 EXECUTION

This system is applicable to modulating burners using the HAWK Integrated Control System. This system shall monitor and display O_2 concentration in the boiler's exit flue gas and provide overall boiler efficiency calculations.

HAWK — ETHERNET COMMUNICATION

The HAWK Ethernet communication package provides Ethernet communications between the HAWK programmable controller and otherEthernet compatible devices such as the Boiler Room Master Lead/Lag Control Panel, Building/Plant automation system, and the Internet.

FEATURES AND BENEFITS

- Provides communication between the HAWK programmable controller unit and other Ethernet Compatible Devices
- Provides interface capability with many Building/Plant automation systems when utilizing OPC server or protocol bridge
- Provides interface with plants LAN/WAN
- Provides interface to the Internet (requires static IP address)
- E-mailing of boiler alarms/faults
- Provides means of connection between various boiler room control systems, such as the HAWK Master Panel for lead/lag control
- Provides means of connection to a remote Personal Computer
- Ethernet Industrial Protocol
- IEEE 802.3 Physical and Data Link Standard
- Ethernet TCP/IP protocol suite industry standard
- Control and Information Protocol (CIP) Compliant

PRODUCT OFFERING

- Optional Ethernet Communication Hub (necessary for stand-alone boiler (no Master Panel) connection to LAN/WAN and/or Paging Modem option)
- E-mail functionality — requires customer provided e-mail service and address

ENGINEERING DATA

- Modular connection to HAWK Programmable Controller unit
- Ethernet Industrial Protocol (Allen-Bradley EPIC)
- Follows Ethernet Rules and Practices
- High Noise Rejection
- Cabling: Category 5E rated twisted pair cable (solid core, PVC jacket with RJ45 connections).
- Meets Open Industrial Network Standards
- IEEE 802.3 Physical and Data Link Standard

- Ethernet TCP/IP protocol suite industry standard
- Control and Information Protocol (CIP) Compliant
- OPC (OLE Process Control) communication compatibility with RSLinx OPC Server software

SAMPLE SPECIFICATIONS
HAWK — ETHERNET COMMUNICATION

PART 1 GENERAL

The Boiler Manufacturer shall furnish and install a control module capable of Ethernet communications between the boiler's programmable logic control system and other Ethernet compatible devices, as needed, and provide the following minimum requirements:

A. Interface with the Compact Logix Programmable Controller Protocol

B. Ethernet Industrial Protocol (Allen-Bradley EPIC)

C. Follows Ethernet Rules and Practices

D. High Noise Rejection

E. Open Industrial Network Standards

F. IEEE 802.3 Physical and Data Link Standard

G. Ethernet TCP/IP protocol suite industry standard

H. Control and Information Protocol (CIP) Compliant

HAWK — PAGING AND REMOTE DIAL-UP ACCESS WITH MODEM

Provides Paging of Alarms Faults, via Modem, from the HAWK Control System to the customer provided pager or a compatible cell phone.

FEATURES AND BENEFITS

- Paging of boiler system alarms. (Paging Service and Pagers furnished by customer)
- Allows Remote Dial-Up Access for monitoring and troubleshooting.

PRODUCT OFFERING

- Remote Access Paging Modem
- Easy to use configuration software
- Requires customer provided, dedicated phone line
- Requires customer provided Paging Service and pagers (or paging compatible cell phones)
- Requires Pager Numbers and PINs supplied by customer
- Configure up to 10 unique pagers

ENGINEERING DATA

- Voltage: 24 VDC
- Baud Rate: 56K
- Type: External, Serial
- Paging functionality utilizes TAP Protocol

SAMPLE SPECIFICATIONS
HAWK — PAGING AND REMOTE DIAL-UP ACCESS WITH MODEM

PART 1 GENERAL

The boiler manufacturer shall provide a Paging and Remote Dial-Up Access Modem, using customer provided paging systems for the purpose of paging boiler system alarms and providing remote access to the control system.

Pager number(s) and PINs to be supplied by customer.

Dedicated telephone connection to be supplied by customer.

HAWK — LEAD/LAG FOR TWO BOILER SYSTEMS

Provides Lead/Lag control for a two-boiler system when used in conjunction with the CB-HAWK ICS integrated boiler control system.

FEATURES AND BENEFITS

Controls Header Pressure and Temperature:

- Maintains steam pressure or hot water supply temperature based on system load demand.
- Compensates for varying losses between boiler and header.

Sequences of Operation for Two Boilers:

- Provides maximum system efficiency.
- Reduces cycling and boiler wear; thereby reducing maintenance and downtime costs.
- Optimizes fuel savings.

Lead/Lag Start with Lead/Lag Modulation:

- Lead boiler operates at full capacity prior to starting lag boiler.
- Lag boiler starts modulation when lead boiler reaches maximum firing rate position.
- Ideal for steam boilers.

Lead/Lag Start with Unison Modulation:

- Lead boiler operates at full capacity prior to starting lag boiler.
- Lag boiler operates at the same firing rate as a lead boiler.
- Ideal for hot water boilers.

PRODUCT OFFERING

Cleaver-Brooks shall supply the following equipment:

- Boiler control for each boiler shall be HAWK.
- Pressure (steam) or temperature (hot water) transmitter shipped loose for mounting in the common header.

SAMPLE SPECIFICATIONS
HAWK — LEAD/LAG FOR TWO-BOILER SYSTEMS

PART 1 GENERAL

1.1 GENERAL

A. Lead/Lag Start with either Lead/Lag or Unison Modulation.

B. Boilers' Start and Stop

1. Steam pressure, or hot water temperature, is compared with the setpoint and controller's processor executes PID algorithm. Lead boiler is commanded to come on line first. Lag boiler is commanded to come on line when a firing rate signal for the lead boiler reaches lag boiler start point. Lag boiler is commanded to stop when a firing rate signal for the lag boiler reaches lag boiler stop point.

C. Lead/Lag Modulation - Lag boiler starts modulation after lead boiler reaches maximum firing rate.

D. Unison Modulation - Firing rates for both boilers are equal.

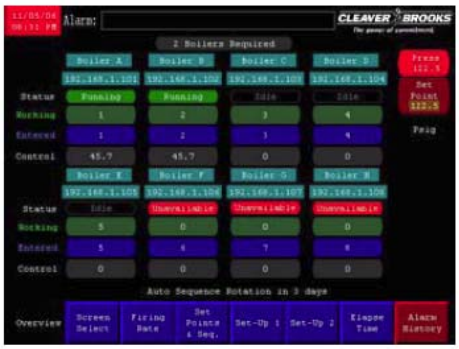
E. Hot Standby - System shall have a provision for keeping lag boiler in hot standby. Standby routine shall be based on a water temperature signal.

1.2 APPLICATION AND SYSTEM REQUIREMENTS

A. This option is applicable to full modulation burners utilizing the CB- HAWK ICS advanced boiler control system and modulating controls.

B. All logic for Lead/Lag Control shall reside in the boiler controller. No additional control panels shall be required.

HAWK — LEAD/LAG FOR UP TO EIGHT BOILERS SYSTEM



Provides Lead/Lag control for up to eight boilers when used in conjunction with the HAWK integrated boiler control system.

FEATURES AND BENEFITS

Controls Header Pressure and Temperature:

- Maintains steam pressure or hot water supply temperature based on system load demand.
- Compensates for varying losses between boiler and header.

Benefits:

- Maximizes system efficiency.
- Reduces cycling and boiler wear, thereby reducing maintenance and downtime costs.
- System shall be provided with a sequence to automatically rotate sequence in which the boilers are fired. Rotation shall be based on the elapsed time.
- Optimizes fuel savings.

Lead/Lag Start with Lead/Lag Modulation:

- Lead boiler operates at full capacity prior to starting lag boiler #1.
- Lag boiler #1 starts when the lead boiler's firing rate is close to the maximum. Operator can select this parameter via HMI.
- Lag boiler #1 starts modulation when the lead boiler reaches the maximum firing rate position.
- Subsequent lag boilers operate in the same fashion.
- Ideal for steam boilers.

Lead/Lag Start with Unison Modulation:

- Lead boiler operates at full capacity prior to starting the lag boiler.
- All boilers operate at the same firing rate as the lead boiler.
- Ideal for Hot Water boiler systems.

PRODUCT OFFERING

Cleaver-Brooks shall supply the following equipment:

- Boiler control for each boiler shall be the HAWK.
- Pressure (Steam) or temperature (Hot Water) transmitter shipped loose for mounting in the common header.
- Master Control Panel shipped loose for field mounting.
- Requires Ethernet/IP Communication Option

SAMPLE SPECIFICATIONS
HAWK — LEAD/LAG FOR UP TO EIGHT BOILERS SYSTEM

PART 1 GENERAL

1.1 GENERAL

A. Lead/Lag Start with either Lead/Lag or Unison Modulation.

B. Boilers' Start and Stop

1. Steam pressure, or hot water temperature on hot water systems, is compared with the setpoint and controller's processor executes PID algorithm. Lead boiler is commanded to come on-line first. Lag boiler #1 is commanded to come on-line when a firing rate signal for the lead boiler reaches lag boiler start point. Lag boiler #1 is commanded to stop when a firing rate signal for the lead boiler reaches lag boiler stop point.
2. Lag boiler #2 is commanded to come on-line when a firing rate signal for the lag boiler #1 reaches lag boiler #2 start point. Lag boiler #2 is commanded to stop when a firing rate signal for the lag boiler #1 reaches lag boiler #2 stop point.
3. Subsequent boilers operate in a similar fashion.

C. Lead/Lag Modulation

1. Lag boiler #1 starts modulation after lead boiler reaches maximum firing rate (or firing rate selected by the operator).
2. Lag boiler #2 starts modulation after lag boiler #1 reaches maximum firing rate (or firing rate selected by the operator).
3. Subsequent boilers operate in a similar fashion.

D. Unison Modulation - Firing rates for all boilers are equal.

E. Hot Standby - System shall have a provision for keeping lag boilers in hot standby. Standby routine shall be based on a water temperature signal.

F. Firing Sequence Selection - Sequence in which boilers come on-line shall be selected via HMI. Adequate check shall be provided that does not allow improper sequence selection.

G. Automatic Rotation of the Boilers - System shall be provided with a sequence to automatically rotate sequence in which the boilers are fired. Rotation shall be based on the elapsed time.

1.2 HMI (HUMAN MACHINE INTERFACE)

A. Master panel shall include HMI for display and selection of the following parameters:

B. Display

1. Available boilers
2. Number of boilers required
3. Selected sequence of firing
4. Control output to each boiler

5. Header steam pressure or water temperature on hot water systems
6. Setpoint
7. Elapsed time from last rotation

C. Selection

1. Number of boilers
2. Sequence of firing
3. Automatic or manual rotation
4. Individual boiler start and stop points with timers
5. Setpoint
6. Proportional, integral and derivative gains for control algorithm

1.3 APPLICATION AND SYSTEM REQUIREMENTS

A. This option is applicable to full modulation burners utilizing the HAWK advanced boiler control system and modulating controls.

B. Logic for Lead/Lag control shall reside in the Master Control Panel. Communication between the Master Panel and the individual Boiler Control Panels shall be via Ethernet communication or hard wiring.