Power Flame Incorporated

SUGGESTED SPECIFICATION
FOR MODEL NVC11 THRU NVC17
ULTRA LOW NOx GAS BURNERS
SUB 9 PPM NOx
WITH AUTO FLAME CONTROLS

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Suggested Specification for Power Flame NVC

(Ultra Low NOx Gas Burners from 25,000 to 63,000 MBH)

A. General Requirements

1. Furnish and install NVC(R)XX-G-30 Ultra Low NOx natural gas burner. The burner and burner installation shall meet all applicable code requirements.

B. Low-NOx Burner Description

1. The burners shall be Power Flame Type NVC forced draft surface stabilized combustion. Each burner shall have a maximum fired duty of XX,XXX MBTU/hr. Gas pressure at the burner gas train supply connection shall be a minimum of 5.0 PSI

2. NOx emissions shall be guaranteed to be less than or equal to (9) ppm, corrected to 3% O_2, and CO emissions shall be guaranteed to be less than or equal to 50 ppm, over the full range of burner operation.

   The burner manufacturer shall have a minimum of fifteen (15) burners in operation for over one (1) year that have met the emission requirements stated above. The manufacturer will be required to furnish source test reports for each of the installed and operational burners.

3. The burner shall operate without flue gas recirculation (FGR) with natural gas as the main fuel.

3.A (Optional) The burner shall operate with induced flue gas recirculation (IFGR) with natural gas as the main fuel, to maintain combustion a 5.0% excess 0_2 at high fire. A servo motor shall control the positioning of the IFGR inlet damper.

4. Burner turndown from maximum heat input shall be a minimum of 3:1.

5. The entire combustion head shall be constructed using high temperature stainless steel. The exposed non-firing surfaces shall be protected using high temperature insulation. The surface stabilized combustion head shall use a knitted fiber matrix material (woven material will not be accepted) utilizing an ultra thin, high temperature resistant stainless steel fiber. The fiber matrix material shall be knitted in a manner to create 3-dimensional loops that give flexibility to the material, provide excellent insulation and the optimum cooling to the fibers close to the flame. The knitted structure shall be relatively open creating less chance of contamination and blockage of the surface during operation. The burner manufacturer shall provide a five (5) year written warranty for the combustion head.

6. The combustion head shall be provided with a refractory insulated boiler mounting plate.

7. All combustion air shall be supplied by a blower mounted integral to the burner. The blower wheel shall be of the backward inclined centrifugal design and shall be directly driven by a XX hp 3450 RPM 460 volt, 60 Hz, 3 phase motor. Blower motors

located in the same chamber or blast tube as the premix gas is not allowed. A multi blade damper assembly located on the inlet side of the blower wheel shall meter the combustion air flow.

8. The burner assembly shall be of welded steel construction and have a baked on powder coat finish.

C. Approval Codes

1. Each burner shall adhere to UL NFPA-85-01 design guidelines. Each burner shall be designed and constructed as an integrated combustion system package and shall be factory fire tested.

D. Ignition System

1. The burner ignition system shall utilize natural gas as the fuel source. The gas pilot system components shall include spark ignited pilot assembly, 6000 volt ignition transformer, dual pilot solenoid valve, pilot gas pressure regulator, pilot normally open vent valve with locking shutoff cock, pilot gas strainer, gas pressure gauge and manual gas shutoff valve. The flame proving system shall incorporate a Ultra-Violet flame detector which will monitor both the pilot and main flames. The pilot assembly shall fit within the confines of the burner/pilot assembly front mounting plate.

E. Fuel/Air Control System

1. Main gas supply shall be controlled by dual motorized gas safety shut-off valves with proof of closure interlocks.

2. A servo motor shall control the positioning of the air inlet dampers. Gas flow control shall be achieved by use of a proportional fuel-air ratio controller referenced to combustion air flow (Autoflame). The position of the main gas and combustion air servo motors shall be controlled by a modulating type (temperature) (pressure) controller. When the operating control is satisfied the burner shall shutoff and return to the closed position. The servo motors shall provide a feedback signal to ensure a guaranteed low fire start position prior to the pilot trial for ignition sequence.

F. Gas Control Trains

1. The gas train shall contain the following:
   a. Manual pressure lubricated shutoff cock
   b. Main gas pressure regulator
   c. Automatically operated main motorized gas valve with proof of closure interlock switch
   d. Automatically operated auxiliary gas valve with proof of closure interlock switch
   e. Normally open vent valve with locking shut off gas cock
   f. Manual reset Low and High gas pressure switches
   g. Manual pressure lubricated leakage test cock.
   h. Burner manifold gas pressure gauge
   i. (2) ¼" leak test cocks

G. Burner Operating Controls

1. The On-Off operation of the burner shall be controlled by a (pressure) (temperature) control. System (pressure) (temperature) shall be _____ (PSIG) (Degrees F). A safety manual reset type limit control shall be provided by others to shut the burner down in the event of excessive (pressure) (temperature). The position of the servo motors and other fuel/air components shall be controlled by a modulating type (pressure)(temperature) control in addition to the On-Off operating control.

H. Interlocks

1. The combustion air servo motor shall be sequenced to allow for four (4) complete air changes of the combustion chamber and breaching, and through a feedback signal be electrically interlocked with the control burner circuit to insure the air damper is in the low fire start position before the burner ignition sequence can begin.

I. Flame Safeguard Control

1. The flame safeguard control shall include ultra-violet sensor for flame detection and provide fully automatic sequencing of pre-purge and post-purge, blower motor, interrupted ignition system, and fuel/air flow components. Burner shall purge with full open air louver at 100% of high fire air flow rate for a minimum of four (4) air changes and not less than 60 seconds. Flame safeguard shall provide safety shutdown with manual reset on air flow failure. The flame safeguard control shall be Autoflame with O_2 trim

   A. Provide a fully integrated “Micro Modulation Controller” that will be fully capable of fuel / air ratio control throughout the entire firing range of the burner, such that no mechanical linkages are required for operating the combustion air inlet damper and fuel flow control valves. The control for the specified burner and selected fuel(s) shall include all necessary interface wiring, software and hardware for a complete fuel/air metering and flame safeguard system. The system will be easily programmable with the flexibility of optimizing combustion quality throughout the load range while ensuring the boiler outlet pressure to within 1.5 PSI of set point (or the boiler outlet temperature to within 1^0F of set point).

   B. The “Micro Modulation Controller” will be preprogrammed to allow firing on up to four independent fuel curves. Each fuel/air ratio curve will be commissioned to enable firing of different fuels, over capacity or reduced capacity firing as required for the application. Required temperature/pressure set point will be adjustable locally from the control increase/decrease push buttons or remotely by the use of the chosen BMS using MODBUS protocols. Required temperature/pressure can be locked locally or through a PC/BMS.

   C. The system shall include the panel mounted control module containing a micro computer and power supply and shall include a display panel with tactile key pad selection, data display and status indication all protected beneath a tamper proof plastic cover and metal housing. The system shall be complete to control the fuel /air ratios and have repeatability throughout the firing range.

D. (Optional) Combustion Air Sensor - Combustion air proving pressure sensor is specified and must be installed allowing a graphical display to indicate commissioned and on line pressures.

E. Self Adaptive UV Flame Sensing Scanner - This will monitor the minimum required flame signal strength as set in the system options and will adjust the sampling frequency of the UV circuitry to give a mean signal slightly in excess of minimum. By this function the life expectancy of the UV bulb shall be extended and reliability increased.

F. (Used with Option D) Pre-ignition purge airflow rate shall be no less than 100% of the maximum firing rate airflow. Micro processor interlocks shall be provided to continuously monitor and prove airflow at all times during purge cycles and operation.

G. Electronic safety control shall be interlocked with a scanner signal providing continuously monitored and verified flame signal intensity by detection of ultraviolet radiation.

H. In place of mechanical linkages and cams, the system will incorporate direct drive servomotors for the control of combustion air and fuel. The position of each motor will be monitored by a voltage dividing system enabling digitised position information to be encoded into the controls memory. The relative positions of the air and fuel servomotors will be constantly and automatically checked by the system at a rate of 50 times per second during purge and throughout the firing range.

I. A full three term adjustable P.I.D. load control package shall be included to provide control set point accuracy within 1.5 PSI via a signal from a pressure sensor.

J. A non-linkage fuel flow control valve shall be used for the precise control and metering of fuel input to the burner. Fuel valves will be designed for dual fuel assembly and common servo motor drive when applicable.

K. The controller shall have a non-volatile memory to retain programs and data received in case of power interruptions. This data can be downloaded from the system for storage and also uploaded into the unit.

L. The front of the panel-mounted control will consist of a large ¼ VGA LCD screen providing easy to read numeric and graphical information. Separate displays will be individually selectable for the specific application to provide continuously updated information as follows:

    1) Display Status – on/off differential, hours run/number of start-ups, fuel fired, percentage firing rate, required temperature/pressure, actual temperature/pressure and software versions installed.

    2) Micro Modulation - degrees angular position of servo motors for channels 1, 2, 3 and 4. Analogue input signals for channels 5 and 6 (VFD

channels). Channels can be labeled to reflect channel control. Designated O_2, CO_2 and CO Trim Channel (damper trim or VFD trim).

3) Exhaust Gas Analysis - on Line Values of O_2, CO_2, CO, (NO & SO_2 are optional) exhaust gas temperature, ambient temperature, differential temperature and efficiency. The system will provide comparison of actual online values versus original commissioned values and will be displayed on demand either locally or remotely via MODBUS/Metasys protocols.

4) Lead/Lag (Sequencing) Status - boiler I.D. number, lead boiler designation, reduced set point, lag/standby firing sequence and current boiler status.

5) Fuel Metering – graphical display of the fuel flow metering including gas valve and air damper position, calorific value of the fuel, online fuel consumption for all fuels being fired and totalized fuel consumption for each fuel curve commissioned.

6) (Optional) Variable Speed - vertical bar chart comparison display of analogue input and output from VFD on channels 5 and 6. Vertical bar chart display of percentage firing rate and comparison between commissioned and actual wind box air pressure.

7) Flame Safeguard Graphical display of current Flame Safeguard Sequence Logic with indication of current status showing:

    Flame Intensity Signal Strength for Flame
    Post Purge Time and actual position in cycle
    Pre Purge Time and actual position in cycle
    Combustion Air Damper / VFD Speed Position
    Current Firing Rate Status
    Main Fuel Valve Status (Open or Closed)
    Pilot Fuel Valve Status (Open or Closed)
    Spark Ignition Status
    Combustion Air Fan (Running or Standby)
    Lockout or Run Status Message
    Lockout Reset Capability
    First Out Annunciation status
    Lockout History - display of the last 16 annunciated limit circuit lockouts with description of lockout, time and date occurred and reset time and date.

8) (Optional) Water Level Information – including a virtual gauge glass to indicate the water level position, feed water valve position (angular and percentage), automatic bottom blow down time and number of occurrences, steam flow metering and TDS management.

E. The controller will be capable of setting commissioned options and parameters to suit the specific application including but not limited to the following:

1) Designation of boiler operating range
2) Adjustable burner modulating ramp up speed
3) Intelligent boiler sequencing (lead/lag)
4) External modulation control
5) External set point control
6) Automatic Cold Start (warm up facility from cold) routines to prevent thermal shock or excessive condensation
7) Alarm output signal
8) Adjustable pilot and main flame proving time
9) Adjustable flame signal strength threshold
10) Fuel valve and vent valve proving with adjustable high and low gas pressure limits
11) Adjustable wind box pressure limits
12) Password settings to prevent unauthorized access to commissioning routines. These passwords must be passed to the clients chosen engineer on completion
13) Independent adjustable Proportional Band, Integral Time and Derivative (PID)

F. The controller will be capable of making changes to various non-safety options and parameters online, whilst the burner is firing or in the standby state without having to reset the controller.

Exhaust Gas Analysis

A. EGA (Exhaust Gas Analyzer)- Provide a fully integrated "Exhaust Gas Analysis Trim System (EGA)". The EGA will be data linked to the "Micro Modulation Controller" specified herein to continuously measure and display O_2, CO_2, CO, (NO, SO_2 or NO_2 are Optional) Exhaust Gas Temperature and Combustion Efficiency. The system will provide the necessary control signals via the "Micro Modulation Controller" to automatically adjust the air damper servo motor position (or VFD if selected) ensuring that the commissioned values of O_2, CO_2 and CO are maintained throughout the burner firing rate regardless of variations in stack pressure, fuel pressure boiler house temperature or barometric conditions. O_2 trim only will not be acceptable. A calculated CO_2 value will not be acceptable.

B. In addition to the data link between the EGA and MM controller the EGA will have auxiliary contacts for remote indication of combustion analysis via six 4 to 20 mA signals.

C. As a complete system the EGA will be supplied with a stack probe and thermocouple with sample tubing and armored cable. Both EGA and the stack probe will be supplied with internal removable/serviceable filters.

D. The EGA is supplied with a local display. This will show the combustion readings, and EGA status. Software and hardware design will permit the replacement of factory calibrated gas sensor cells by the keypad on the EGA using a 15 digit code without the use of test gases.

E. The EGA will be supplied complete with integral components for safe, reliable service including an onboard gas sample chiller block with condensate solenoid drain valve, sample vacuum pump filters, pressure and vacuum switches.

F. In conjunction with software communications between the EGA and MM controller the following options and parameters will be available for commissioning the complete MM / EGA system to suit the specific application requirements.

1) Automatic carry forward of relative trim position
2) Upper offset limits for O_2, CO_2, CO, NO and exhaust temperature
3) Lower offset limits for O_2, and CO_2
4) Absolute limits for O_2, CO_2, CO and exhaust temperature
5) Trim threshold offset
6) Trim delay to prevent sampling during boiler warm up periods
7) Adjustable combustion gas residence time
8) Adjustable self-calibration time
9) Adjustable minimum/maximum temperature range

G. The EGA software will incorporate automatic self-calibration and cell integrity check on each burner recycle/start-up.

J. Control Panel

1. Each burner shall be complete with a burner mounted control panel which shall house all required operating electrical components. (Optional remote panel) All wiring for remote panel electrical components shall be factory pre-wired to a terminal strip mounted within the control panel. A junction box pre-wired to the burner components shall be mounted on the burner. It shall have a terminal strip which shall match a terminal strip in the remote panel. Field wiring shall be required between the burner mounted junction box and the remote control panel.

2. Appropriate electrical knockouts shall be provided on both sides of the panel to allow for necessary power and limit control wiring. The control panel shall be constructed of 14 gauge steel and shall be complete with a top switch and control section which shall be hinged to allow for full access to all panel mounted components. The control panel shall have a baked on powder coat finish in a color identical to the burner being supplied.

3. The control panel shall include a step-down control circuit transformer fused on both the primary and secondary windings to power 120 V components.

4. The control panel shall have the following status indicators: Power On –Green; Limit Circuit Closed – Green; Main gas – Blue, Flame Failure – Red. High water or low water – Red

5. Provide an alarm buzzer and auto reset alarm silencing switch to signal any failure status.

K. Documentation

The burner manufacturer shall furnish as a minimum a burner specification sheet, comprehensive Bill of Material, piping diagram, ladder logic wiring diagram and job specific 3-D model of the complete burner that includes dimensional information, “see through” feature for viewing internal assemblies and component identification.

L. Product Liability Insurance

The burner manufacturer will provide an Insurance Certificate documenting his current coverage of Product Liability Insurance (no less than $10 million coverage).

M. Burner Start-up Information and Test Data

On completion of the burner system start up, the installing contractor shall complete a Burner Startup Information Sheet and a Control Setting Sheet and deliver to the Specifying Engineer.