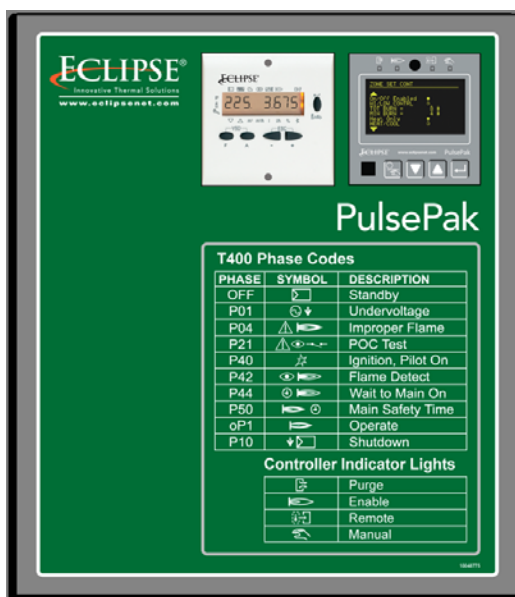


Eclipse PulsePak Pulse Firing Control System

Version 1



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Document Conventions

There are several special symbols in this document. You must know their meaning and importance.

The explanation of these symbols follows below. Please read it thoroughly.

How To Get Help



This is the safety alert symbol. It is used to alert you to potential personal injury hazards. Obey all safety messages that follow this symbol to avoid possible injury or death.



Indicates a hazardous situation which, if not avoided, will result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in death or serious injury.



Indicates a hazardous situation which, if not avoided, could result in minor or moderate injury.

NOTICE

Is used to address practices not related to personal injury.

NOTE

Indicates an important part of text. Read thoroughly.



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Introduction

1

Product Description

The Eclipse PulsePak is a standardized product that is field configurable for zone temperature control based on pulse sequencing of burners. The components are modular and can be combined as needed to meet the requirements of a furnace design. Each temperature zone on the furnace is controlled by its own PulsePak Zone control panel for PID control of up to 8 pulse fired burners. Each zone panel can be independently operated or can communicate to a furnace master system for centrally coordinated temperature control.

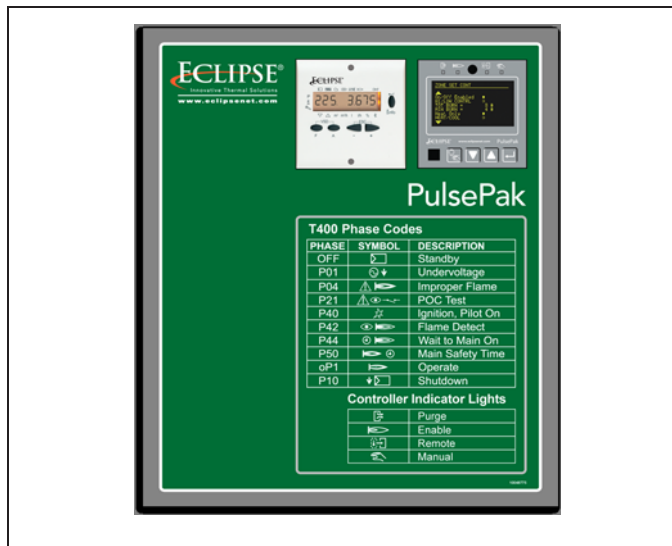


Figure 1.1. PulsePak Zone Panel

Audience

This manual has been written for people who are already familiar with all aspects of a burner system and its controls and add-on components, also referred to as “the burner system”.

These aspects are:

- Design/Selection
- Use
- Maintenance

The audience is expected to have previous experience with this type of equipment.

PulsePak Documents

Design Guide No. 862

- This document

Datasheet, Series No. 862

- Available for individual PulsePak models
- Required to complete installation

Installation Guide No. 862

- Used with Datasheet to complete design

Related Documents

- EFE 825 (Combustion Engineering Guide)
- Eclipse Bulletins and Info Guides:

791-3 Datasheet
791-4 Datasheet
791-2 Installation Guide

Worksheet No. 862

- Required to provide application information to Eclipse Engineering

Purpose

The purpose of this manual is to ensure that you carry out the installation of a safe, effective, and trouble free combustion system.

Safety

2

Important notices about safe operation will be found in this section. Read this entire manual before attempting to start the system. If any part of the information in this manual is not understood, contact Eclipse before continuing.

Safety Warnings



DANGER

- **Read entire manual before attempting to start this system. If you do not understand any part of the information contained in this manual, contact Eclipse before continuing.**
- **The safety of this device is only ensured when the device is used correctly for its intended purpose within the limits and environmental conditions that have been specified. Any application beyond these limits is prohibited. Claims of any kind against the manufacturer, for damages resulting from misuse of the instrument are precluded, liability is limited to the user.**
- **The user is responsible for keeping the operating manual in the immediate vicinity of the instrument and always accessible for the operating personnel.**
- **All electrical wiring must conform to local standards. See the “Specifications” section for more details.**

Capabilities

Adjustment, maintenance and troubleshooting of the mechanical and the electrical parts of this system should be done by qualified personnel with good mechanical aptitude and experience with combustion equipment.

Operator Training

The best safety precaution is an alert and trained operator. Train new operators thoroughly and have them demonstrate an adequate understanding of the equipment, its operation and any related hazards. A regular retraining schedule should be administered to ensure operators maintain a high degree of proficiency.

Replacement Parts

Order replacement parts from Eclipse only.

Determining Architecture

The PulsePak system can be applied in three basic architectures:

1. Communicating with a furnace master control system.
2. Hard-wired to a furnace panel with purge logic.

3. Communicating burner control only, zone pulse and temperature not included.

In all architectures, the PulsePak system does not include control functions that apply to the whole furnace, such as main gas supply, air supply and purge logic. Refer to Figure 3.1 through Figure 3.3 for a graphic representation of the three architectures.

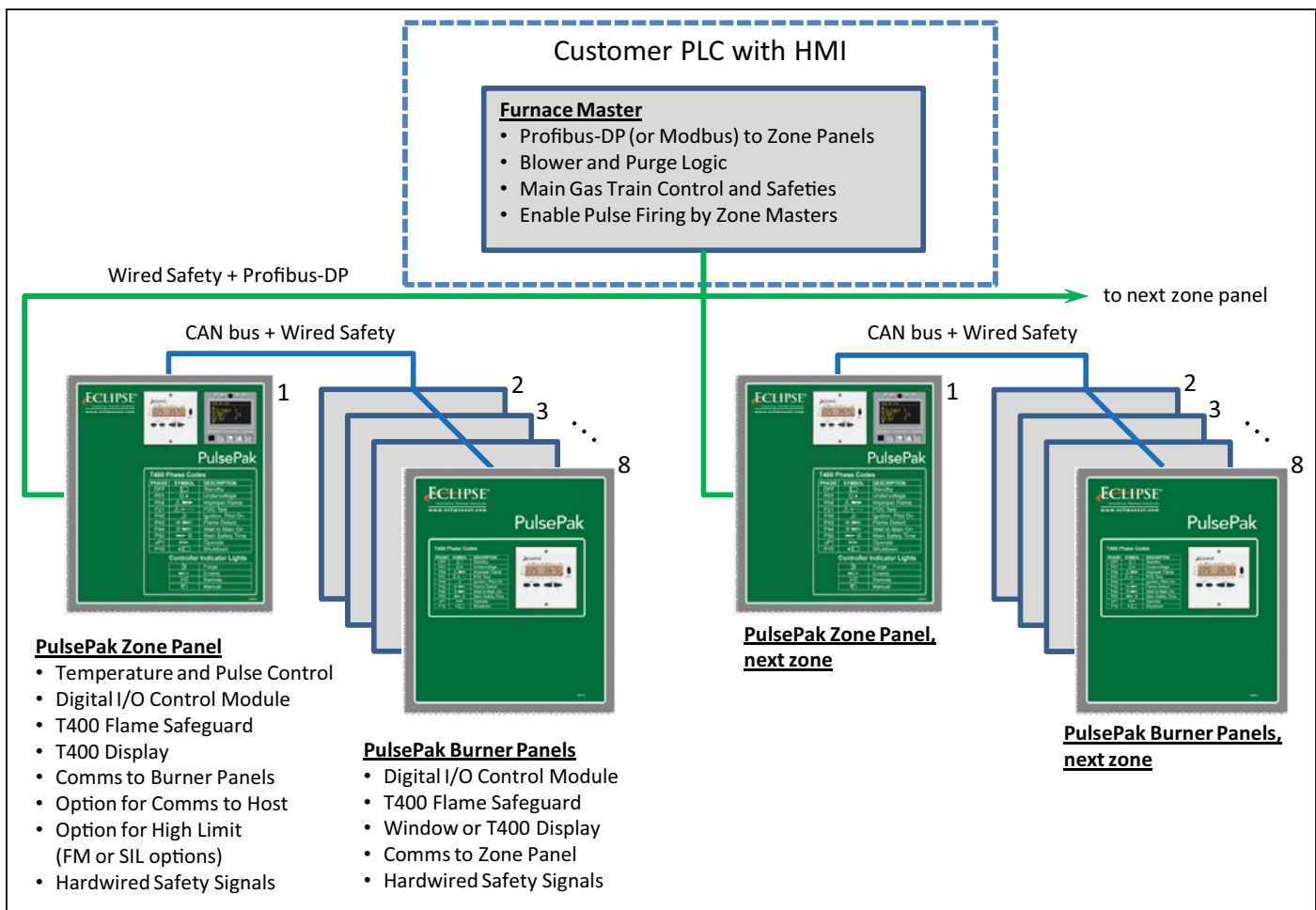


Figure 3.1. Architecture 1, Communicating to Furnace Master

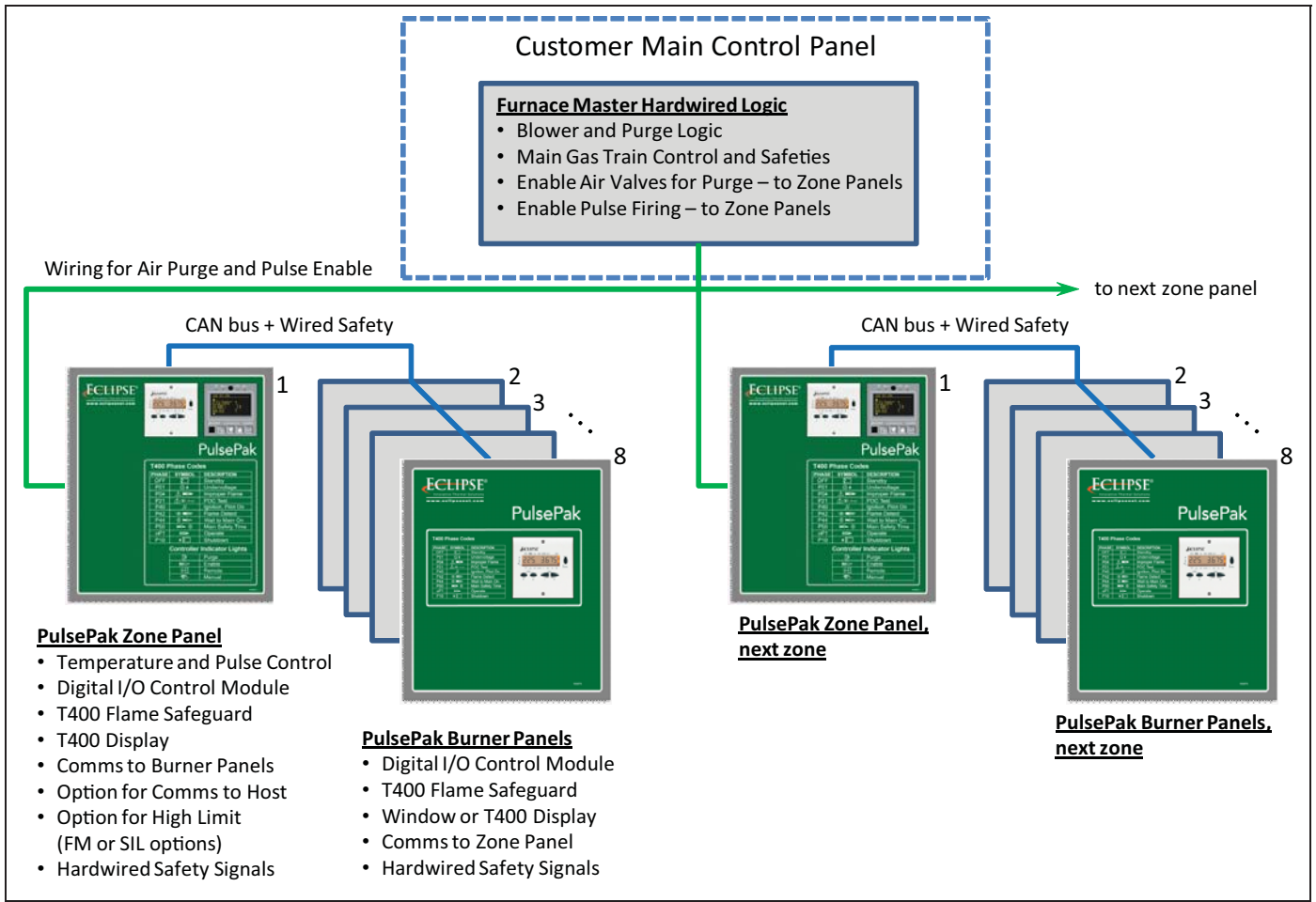


Figure 3.2. Architecture 2, Hard-wired to Purge Logic

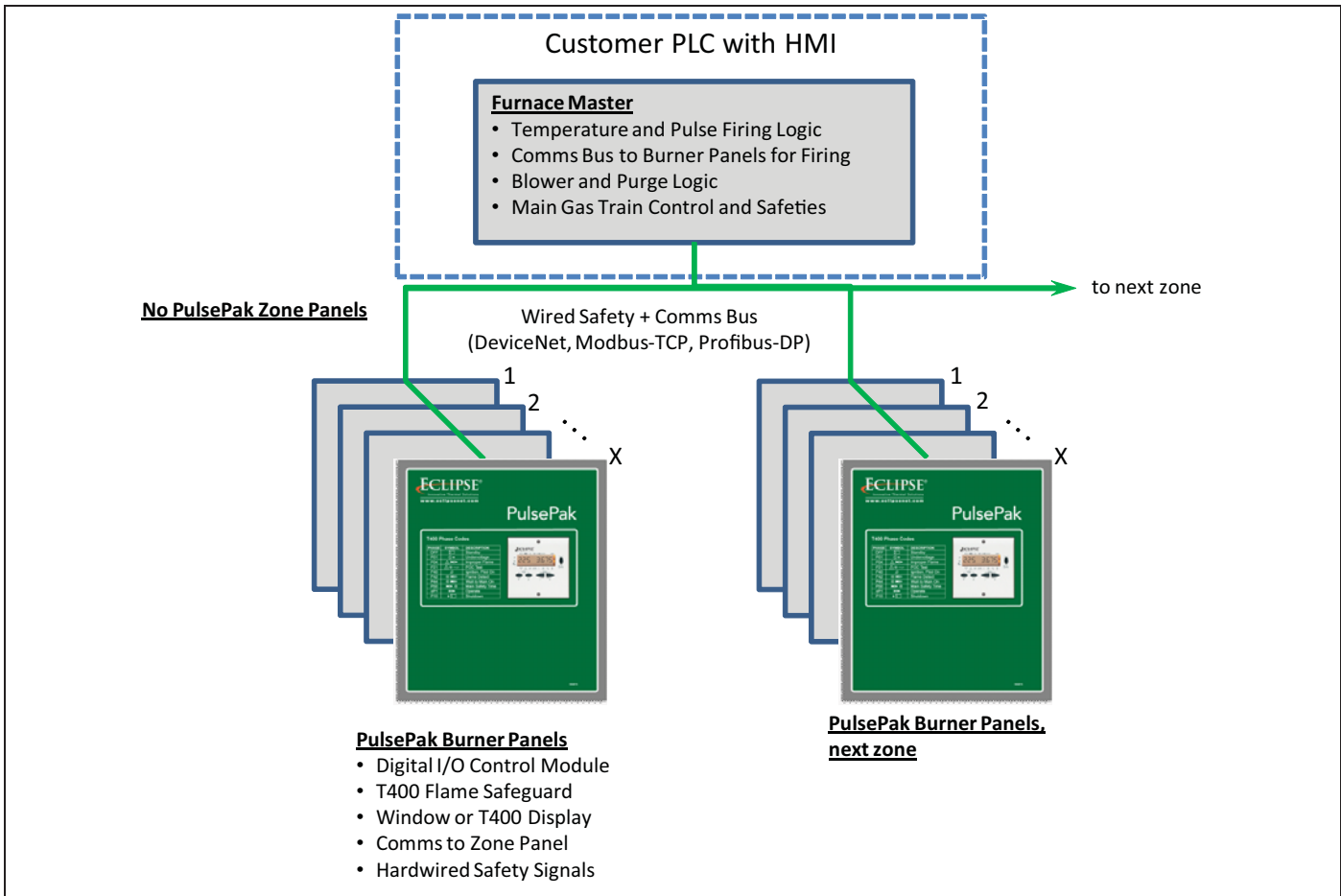


Figure 3.3. Architecture 3, Burner Control Only

How to Order

The designer must determine the number of zones on the furnace, the number of burners for each zone, the burners and their flow rates to order the PulsePak system components. The PulsePak system consists of zone panels, burner panels, gas valve train segment, air train segment and interconnecting cables.

- The PulsePak Zone Panel has selection options for the communication bus type to a host, the supply voltage, inclusion of a high temperature limit, and an alarm relay contact addition.
- The PulsePak Burner Panel has options for a flame safeguard display, the supply voltage, and its control bus type.
- Both gas and air valve trains have options for pipe size, thread type, voltage, and direction.
- Various lengths of the pre-wired interconnecting plug cables are used to join the panels to the valve trains and from panel to panel for hard-wired safety signals.

Other components may be necessary to complete the furnace control system.

Determining Zones

The number of zones depends on the expected temperature distribution across the load inside the furnace. The furnace designer must rely on experience and knowledge of the loads and how they are placed in the work area. The total heat requirement must be divided amongst the number of burners and are usually all the same size in a zone. There may be sections of the furnace with walls or other dividing structures that guide zone selection. One particular volume may need more heat input than an adjacent area and so they should be split into separate zones. The zones can be horizontal, vertical or a combination of both. However, the zone temperature sensor must provide a signal that is more directly affected by the burners in its own zone rather than burners from an adjacent zone. If too many burners are in the zone, then the turndown may not be sufficient when using high - low firing mode. The PulsePak has a limit of no more than 8 burners per zone.

Determining Panels

One PulsePak Zone Panel is needed for each zone (Architectures 1 and 2). It provides control for the first burner of the zone. Then a PulsePak Burner Panel is needed for each of the remaining burners of the zone. For example, suppose the furnace has 4 zones with 4 burners in zone 1 and 6 burners in zones 2 through 4. The furnace would need 4 PulsePak Zone Panels and $3 + 5 + 5 + 5 = 18$ PulsePak Burner Panels.

Valve Train Sizing

Selection of the proper size for a valve train segment requires knowledge of the maximum flow demand and the maximum allowable pressure drop. Maximum flow is determined by the capacity of the burner fed by the valve train. The maximum pressure drop is determined by the available source pressure, the pressure requirement at the burner, and the other pressure drops caused from other series connected components such as piping, fittings, and valves. Refer to the pulse valve train segment datasheets 791-3 and 791-4 to select the appropriate gas and air trains in accordance with each burner's data sheet flow rates.

If necessary, refer to Design Guide 791 "Step 1" and the Eclipse Engineering Guide for more information on pipe size, flow, velocity and manifolds.

Main Gas Header

Gas to the burner valve train segments must be supplied from a main gas valve train. Sizing depends on the total amount of flow from all zones supplied by the header. If necessary, refer to Design Guide 791 "Step 4" for information on possible additional components and to the Eclipse Engineering Guide for information on pipe sizing.

To meet NFPA 86 standard for ovens and furnaces, there must be an upstream manual valve to serve for emergency shut-off or equipment isolation. It must be followed by a drip leg and strainer/filter. Often a pressure reducing regulator and possibly overpressure protection must be provided. With total flow capacity over 400,000 Btu/hr, the NFPA standards require at least one valve proved closed for the purge cycle and it must have visual position indication. Proving the valve closed can be from a proof-of-closure switch or by a valve leak proving system. Also high and low gas switches must be interlocked to burner operation.

To meet the EN 746-2 standard for thermo-processing equipment, there must be an upstream manual valve, a strainer/filter, usually a pressure reducing regulator and possibly overpressure protection. At least one valve (class A) must be used and a valve proving system is required when the system capacity exceeds 1.2MW. With flame safeguard control, technically only a high gas pressure

switch is required but Eclipse recommends installing a low gas pressure switch. The switch will prevent unstable burner operation that might not be detected quickly by the flame safeguard and prevent high levels of unwanted emissions that may be produced under low gas pressure conditions.

Information on manual valves can be found in catalog 710, regulators in catalog 682 and 684, main gas valves in catalog 750, 756, 790, 791 and 799, and pressure switches in catalog 840.

Combustion Air System

Refer to the burner design guide for information on the required air pressure and flow. Refer to the Eclipse Engineering Guide for information on pipe sizing and corrections for altitude and temperature. Refer to Data Sheet 610 for selection and sizing of the combustion air blower.

An air pressure switch must be interlocked for burner operation and air flow must be proved for the purge cycle. Air flow can be proved by several methods:

1. monitoring air source pressure and damper position
2. an air flow switch (such as sail or vane type)
3. a differential pressure switch across an orifice plate

When using the first method, then any adjustable dampers that can reduce the required air flow must have a position switch to prove sufficient flow.

Eclipse blowers can be found in catalog 610 and pressure switches are in catalog 840.

Burner Air Proving

Determine if the air flow to each individual burner must be proved. The following might be reasons for proving air flow at each burner:

1. The purge flow at startup for the furnace requires the air to flow through the burners and the above method 1 (monitoring air source pressure and damper position) is used.
2. The pulse sequence is ON-OFF, must meet NFPA 86, and the minimum air flow must be proved to insure that the maximum off time does not accumulate more than 25% of the lower flammable limit (LFL) in the furnace with the gas leaking at 1 scfh.
3. A non-standard pulse valve train is used without a ratio regulator (not recommended)

Depending on the system and safety analysis, the designer may need to order either a pressure switch or a position switch to add to the standard pulse air valve train.

Zone Temperature Control

The zone temperature can be controlled at the zone panel with a local set-point adjustment. The standard sensor is a thermocouple type K (chromel-alumel) for temperatures up to 2500°F or 1350°C. It is possible to measure temperature separately of the zone controller and send a firing rate (load) signal to the zone panel. For this case, a thermocouple should still be connected to avoid seeing an improper temperature displayed on the local zone screen.

Eclipse thermocouples can be found in catalog 960.

Zone High Limit

The designer must decide where the high temperature limit should reside. It can be incorporated into each zone panel, so that each zone of the furnace is protected from over-temperature damage. Otherwise, the high limit function can reside in the customer furnace panel. Two options are available when including the limit controller in the zone panel and both use type K thermocouple:

- an FM approved limit with dual display of both actual temperature and limit set-point
- a SIL rated controller for two thermocouples and dial set-point

The FM version is appropriate for NFPA 86 requirements and also has a CE mark for European applications. The SIL rated controller is appropriate for systems where the limit function is being evaluated as part of a risk analysis on a Safety Instrumented Function (SIF) according to such standards as ANSI/ISA 84.01, ISO/EN 13849-1, IEC/EN 61508, IEC/EN 61511, or IEC/EN 62061.

Eclipse thermocouples can be found in catalog 960.

Cable Connections

Determine the cable distances and the total number of each type required:

- 2 cables (3-pole) from the zone panel to the first burner gas train
- 1 cable (3-pole) from the zone panel to the first burner air train
- If using optional Burner Air Proving, add 1 cable (4-pole) from the zone panel to the air train
- 2 cables each (3-pole), from the burner panels 2 through 8 to the burner gas train
- 1 cable each (3-pole), from the burner panels 2 through 8 to the burner air train
- If using optional Burner Air Proving, add 1 cable (4-pole) from the burner panels 2 through 8 to the air train
- 1 cable each (6-pole) safety interlock for zone panel to burner panel, and from burner panel to each successive burner panel

Refer to Data 862-1 or Data 862-2 for the cable part numbers to be ordered.

Communication Bus

The control communications cable from the zone panel to burner panel and to each successive burner panel must be supplied per the specification in Data 862-2. If using host communication to each zone panel, the cable must be supplied per the specification in Data 862-1. These cables can be purchased from an electrical supply distributor.

Maintenance Planning

Pulse firing puts a high number of operational cycles on the valves and control contacts. The user must plan for regularly scheduled maintenance. The interval should be based on 1 million cycles and must not exceed 1 year. In addition, the gas safety shut-off valves must be leak tested semi-annually to meet NPFA 86 requirements.

The following table gives examples of the yearly accumulations of cycles on the pulse components. The lifetime is based on 1 million cycles but is not a representation of warranty. For high-low pulse mode, only the air valve and ratio regulator are cycled at high accumulations. For on-off pulse mode, the air and gas valves, the flame safeguard and the ignition components are cycled.

Table 3.1 Component Wear for Various Timings

Operating Conditions				Results	
Pulse Timings		Furnace Operation		Accumulated	Repair/Replace
Cycles / Hour	Seconds / Cycle	Hours / Day	Days / Year	Cycles / Year	Years
600	6	16	300	2,880,000	0.3
300	12			1,440,000	0.7
100	36			480,000	2
60	60			288,000	3
600	6	10	300	1,800,000	0.5
300	12			900,000	1
100	36			300,000	3
60	60			180,000	5

NOTE: Safety standards require annual (high-low mode) or semi-annual (on-off mode) testing of the safety devices.



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