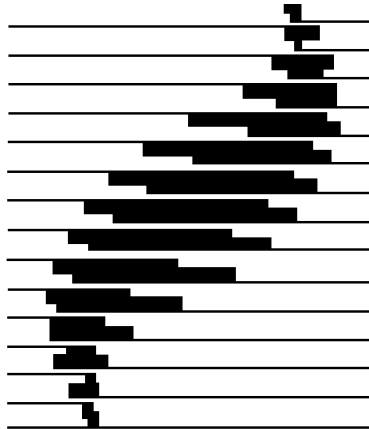


# INSTRUCTION MANUAL

## Continuous Fire and Overheat Detection Systems for Industry (CFD)

### Installation, Operation and Maintenance



The contents of this manual are proprietary to FENWAL and are submitted in confidence. Neither the manual nor any part thereof may be disclosed to others or used for purposes other than the maintenance of FENWAL equipment. To assure safe and proper performance, read these instructions carefully before attempting to install or operate this Fenwal Continuous Fire and Overheat Detection System. Please retain this manual for future reference.



Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry

\*\*\*\*\*

**RECORD OF REVISIONS**

Rev. No.	Issue Date	Rev. No.	Issue Date
1	30 April 1992		
2	21 November 1996		

**TABLE OF CONTENTS**

<u>Section</u>	<u>Page</u>
SECTION I. DESCRIPTION AND PRINCIPLES OF OPERATION	1
1. Sensing Element Description and Specifications	1
A. Sensing Element Descriptions	1
B. Sensing Element Specifications	3
2. Control Unit Description and Specifications	4
A. Control Unit Description	4
B. Control Unit Specifications	7
3. Mounting and Interconnecting Hardware	13
A. Mounting Hardware	13
(1) Flange and Nut Assembly	13
(2) Mounting Clips	13
(3) Grommets	15
B. Interconnecting Hardware	15
(1) Cable Assemblies	15
(2) Wire End Fittings	15
(3) Special Sensing Element Connectors	17
(4) Connector Plug Assemblies	17

**Fenwa Inc.**  
Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

**TABLE OF CONTENTS (Cont'd)**

<u>Section</u>	<u>Page</u>
SECTION II. SYSTEM DESIGN AND INSTALLATION	18
1. Design Recommendations for use of Fenwal CFD Systems	18
2. Installation Procedures for Fenwal CFD System	20
A. Mounting the Control Unit	20
B. Wiring the 35003-38 AC/DC Control Unit	21
C. Wiring the 35003-39 DC Only Control Unit	22
D. Handling and Installing the Sensing Elements	23
E. Installation Steps	26
SECTION III. OPERATION AND MAINTENANCE	28
1. System Operation	28
2. Equipment Limitations and Restrictions	28
3. Inspection/Check of the Installed System	29
A. Visual Inspection	29
B. System Functional Check	29
C. Control Unit Check	31
D. CFD Element Check	32
4. Line Maintenance, Cleaning and Maintenance Checks	37
A. CFD System Repair	37
B. Handling Procedures	37
C. Cleaning	37
SECTION IV. SENSING ELEMENT IDENTIFICATION BY PART NUMBERS	38

**LIST OF ILLUSTRATIONS AND TABLES**

Figure 1. Typical Sensing Element Installation	2
Figure 2. Cross Section of an FSS CFD Sensing Element	3
Figure 3. Drip-Tight Enclosure	5

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry

\*\*\*\*\*

**LIST OF ILLUSTRATIONS AND TABLES (Cont'd)**

	<u>Page</u>
Figure 4. Explosion-proof Enclosure	6
Figure 5. FSS CFD Control Unit P/N 35003-38, AC/DC	9/10
Figure 6. FSS CFD Control Unit P/N 35003-39, 10 to 16 Vdc Only	11/12
Figure 7. Flange and Nut Assemblies	14
Figure 8. Mounting Clips	14
Figure 9. Grommets	15
Figure 10. Cable Assemblies	16
Figure 11. Wire End Fittings	16
Figure 12. Special Sensing Element Connector	17
Figure 13. Connector Plug Assemblies	17
Figure 14. Power Selection Jumper	21
Figure 15. Terminal Block Connections for P/N 35003-38, AC/DC	22
Figure 16. Terminal Block Connections for P/N 35003-39, DC Only	23
Figure 17. Terminal Block Connections for Control Unit Check, P/N 35003-38	33
Figure 18. Terminal Block Connections for Control Unit Check, P/N 35003-39	34
Figure 19. CFD Element Maximum Conductance	36
Figure 20. CFD Element Center Conductor Resistance	36
 Table 1. Part Number Identification of FSS CFD Sensing Elements for Repair and Replacement Purposes	 39

# Fenwal

## Fenwal Continuous Fire and Overheat Detection System for Industry

\*\*\*\*\*

### INTRODUCTION

This manual is provided as a guide in the design, installation, and maintenance of Fenwal Safety Systems (FSS) Continuous Fire and Overheat Detection Systems (CFD) for industry. It pertains especially to installation of the sensing elements in a protected structure or protected area. Careful attention to its guidelines in the installation and use of the Fenwal system will equip your installation with the most reliable, precise and trouble free means available for the important job of temperature monitoring for possible overheat.

Each industrial application has its own particular characteristics and its own special requirements. It is important therefore that the installation of the heat sensing system be well designed. Proper installation requires the technician and field maintenance personnel to follow the design specifications carefully for the location of attachment points, mountings and routing of the sensing elements and their connectors.

Fenwal Safety Systems does not furnish drawings for its CFD system installations. It does however, offer consultation, guidance, and recommendations so that the user will be able to lay out his system and create the detailed drawings that will be needed for its installation and maintenance. FSS strongly recommends that plans and drawings for the installation be prepared prior to ordering system components.

This manual does not cover all details of the equipment provided. Fenwal Safety Systems is not responsible for any loss or damage resulting from its use. Should further information be required, or should problems arise that are not covered sufficiently for the purchaser's purposes, the matter should be referred to Fenwal. This manual will be revised whenever necessary.

.Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

SECTION I. DESCRIPTION AND PRINCIPLES OF OPERATION

The Fenwal Safety Systems (FSS) Continuous Fire Detection (CFD) System possesses the unique ability to detect specific overheat conditions at any point along the entire length of its sensing elements without regard for rate of temperature rise or average ambient temperature.

This "discrete" sensing capability offers greater sensitivity and response than systems relying on the "averaging" technique in which the whole sensing system must reach a certain average temperature level to create an alarm. Further, the system is the only system in which a single controller can be connected to sensing elements set at a variety of alarm point temperatures to provide coverage in several areas of different heat tolerances each operating within its own environment.

The FSS CFD System may be wired to employ a sensing element "loop" circuit, see Figure 1, that will still signal fire or overheat should an open circuit occur. If multiple opens occur in the loop, only a section broken out of the network becomes inoperative. The remaining sensing element network continues to function. Sensing elements are typically connected in a single loop configuration as shown in Figure 1 and are then connected to a control unit.

1. Sensing Element Description and Specifications.
  - A. Sensing Element Description. The sensing element of the Continuous Fire Detection System is the nerve network of the system. It is constructed of a pure nickel center conductor surrounded by a porous aluminum oxide insulator impregnated with a eutectic salt and encased in a hermetically sealed Inconel tube with an outside diameter of approximately 0.090 inches, see Figure 2. Voids in the porous insulator are saturated with the eutectic salt compound, which, when heated to its alarm point, forms a conductive path between the center conductor and the outer sheath. When temperatures return below the alarm set point, the eutectic salt resumes its nonconductive properties and the system resets.

This unique impedance-temperature characteristic manifests itself as follows:

At a temperature more than 100° F (56° C) below the alarm point, the impedance between the center conductor and the outer sheath is very high. When heated to the alarm point the salt melts resulting in a very low impedance. The elements return to high impedance as they cool.

Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry  
 \*\*\*\*\*

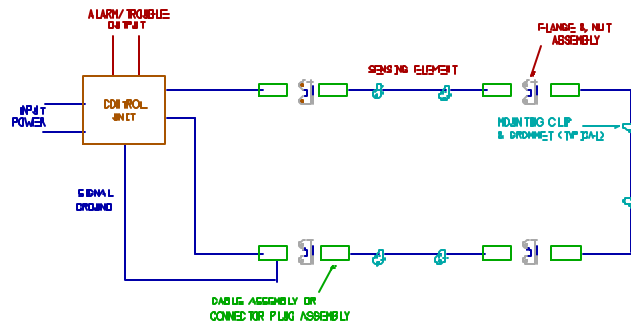
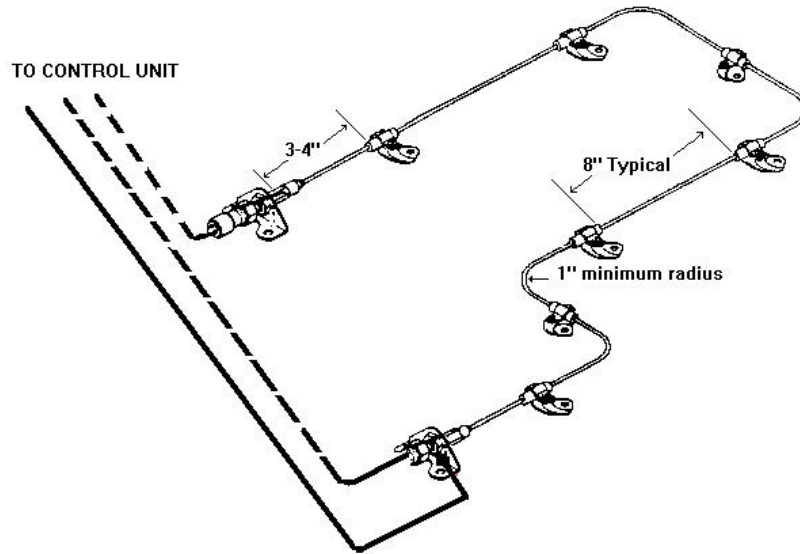


Figure 1. Typical Sensing Element Installation.



Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

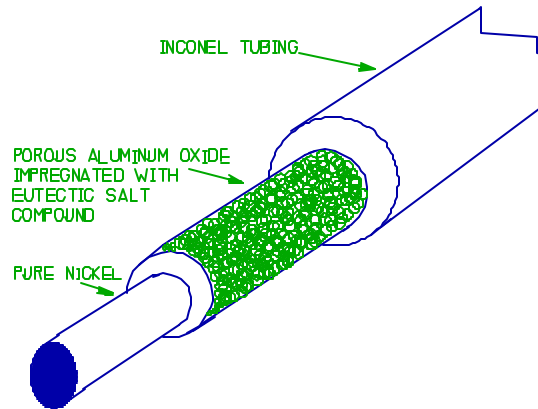


Figure 2. Cross Section of an FSS CFD Sensing Element.

As a result of this automatic return to high impedance, these elements are reusable time and again. Lengths of these sensing elements are connected in series to the control unit that detects a change of impedance in the sensing elements to create an alarm should an alarm temperature be reached. The elements may be of equal or varying length and of the same or different temperature settings.

Fenwal sensing elements are manufactured in lengths of 18 inches to 20 feet in 1 inch increments. Connectors are hermetically sealed to each end.

Their alarm set points range as follows: 255°, 310°, 400°, 575°, and 765° F (124°, 154°, 204°, 302°, and 407° C, respectively).

B. Sensing Element Specifications.

- |                                 |  |
|---------------------------------|--|
| (1) Center Conductor Resistance | 0.2 ohm per foot<br>(0.66 ohm per meter) maximum |
| (2) Set Point                   | As marked on each unit $\pm 5\%$                 |

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

2. Control Unit Description and Specifications.

- A. Control Unit Description. The control unit detects the impedance change in the sensing elements and provides the electrical contacts that control the external alarm or indicator circuit.

It is designed for use in industrial environments and operates on a variety of selected field voltages. Its design permits installation in standard panel boxes and racks, or it may be obtained from Kidde Fenwal in the configurations shown in Figure 3, mounted in a drip-tight enclosure, on page 5, or Figure 4, in an explosion-proof enclosure, page 6. One of these enclosures may be purchased with the control unit. The printed circuit board is itself epoxy coated for hermetic seal against moisture, dirt and corrosion.

The AC/DC control unit, P/N 35003-38, will operate on inputs of either 120, 208, and 220 to 240 Vac, or on 18 to 40 Vdc. This control unit's input selection is made by connecting to the proper terminals and positioning its AC/DC selection jumper to either AC or DC. The second control unit, P/N 35003-39, operates only on 10 to 16 Vdc. The Fenwal CFD control unit provides a relay output signal when the sensing element alarm temperature is reached. A second relay output signal is activated if an open circuit condition occurs in the sensing element network.

The Fenwal Safety Systems' Industrial CFD Control Units have been designed to function with Fenwal's CFD temperature sensing elements. Their wide operating temperature range makes them adaptable to most industrial environments. The mounting holes in the printed circuit board accept a #10 screw.

NOTE: P/N 35003-40 and 35003-42 come with the 35003-38 Control Unit (AC/DC Operation).

P/N 35003-41 and 35003-43 come with the 35003-39 Control Unit (DC Operation only).

**WARNING:** OPERATION OF THE CONTROL UNIT OUTSIDE SPECIFICATIONS COULD RESULT IN FAILURE OF THE PRODUCT AND OTHER EQUIPMENT WITH POSSIBLE INJURY TO PEOPLE AND PROPERTY.

Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry  
 \*\*\*\*\*

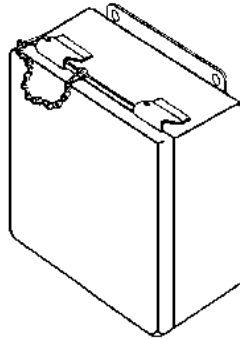
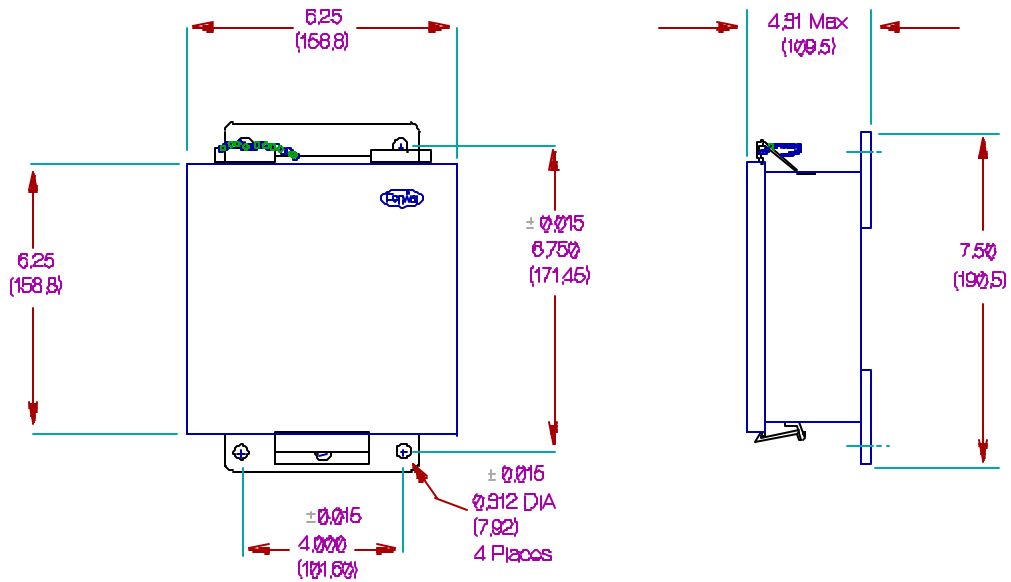


Figure 3. Drip-tight

models 35003-40 or 35003-41



Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

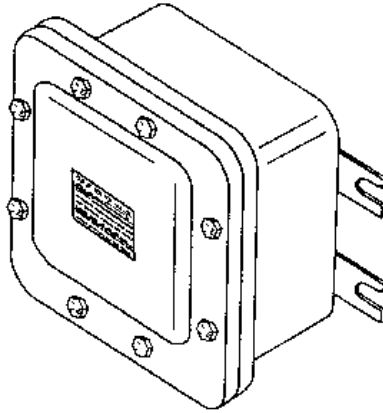
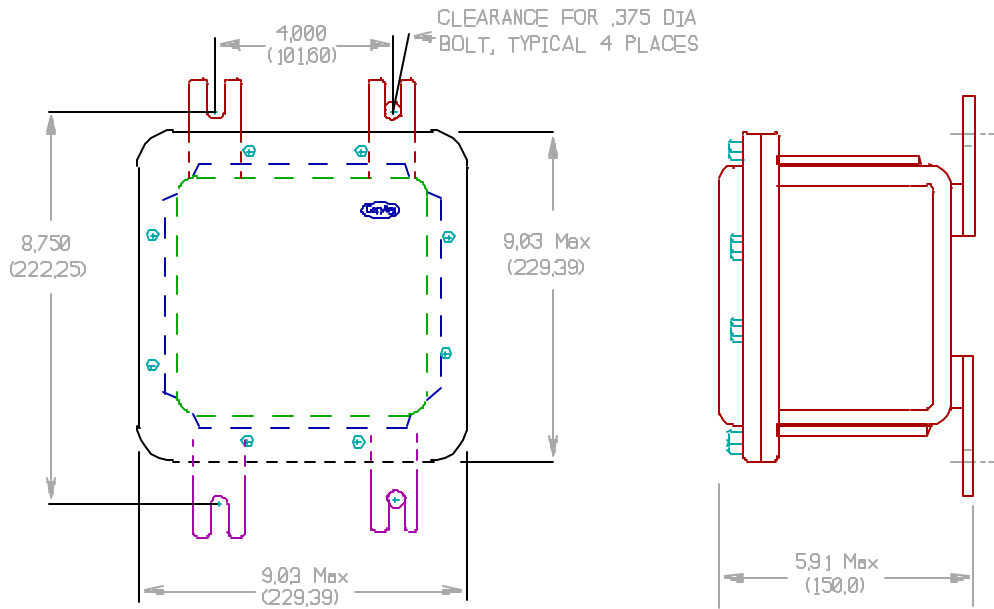


Figure 4. Explosion-proof (NEMA, Class 1, Group D) Enclosure



Model 35003-42 or 35003-43

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

C. Control Unit Specifications.

- (1) Environmental. The control unit will operate from -67° F to 167° F (-55° C to 75° C) and stay within the tolerance given at 77° F (25° C). The electronics are protected by the epoxy conformal coating against contaminants. The unit will operate satisfactorily at all humidity levels as long as condensation is not formed on the printed circuit board.
- (2) Electrical.
  - a. Connections. The screw type terminals on the terminal block will accept a #14 AWG wire or smaller. The wiring connections are clearly labelled on the printed circuit board near the connectors.
  - b. Input Power, AC (P/N 35003-38). 5W at 120, 208, 240 Vac +10%, -20%, 50 to 60 Hz through the appropriate terminal.
  - c. Input Power, DC (P/N 35003-38). 2W at 18 to 40 Vdc, full or half wave rectified with 40V peak.
  - d. Input Power, DC (P/N 35003-39). 1W at 10 to 16 Vdc, or full wave rectified.
  - e. Outputs. One alarm and one trouble SPDT relay contact rated at 5A resistive at 120 Vac/28 Vdc and 4.0A resistive at 240 Vac.
  - f. Sensing Element. Maximum element voltage 1V rms at 400 Hz in the standby mode (open circuit voltage). With a short across the elements, the maximum current is 10 Ma of short circuit current.
- (3) Functioning in the Case of Broken or Cut Sensing Elements. A sensing element that has been cut or broken at one place will not interfere with normal operation of the CFD system to alarm provided both ends of the center conductor and ground are connected to the control unit. The trouble contacts will transfer whenever the resistance of the center conductor and wiring exceeds 5.0K ohms. No trouble will occur if the resistance is less than 200 ohms.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

(4) EMI-RFI Susceptibility.

- a. The control unit will operate normally with EMI levels of 10V/Meter over a frequency band of 0-500 Mhz.
- b. Conducted Noise on Power Lines and Signal Lines. The control unit will operate normally with conducted interference up to 5V from 0-500 MHz on the power lines and up to 1V rms on the signal lines from 15 KHz to 500 MHz. The power and signal lines are protected against transients and pulses found in industrial environments.

(5) Alarm Override. Only one condition will exist at the control unit, trouble or alarm. If a trouble condition is present in the sensing loop, it will be overridden by an alarm condition. Return to trouble will occur when the alarm clears.

(6) Dielectric Strength.

- a. 1000 Vac between relay contacts and coil.
- b. 1250 Vac between transformer primary and the rest of the circuit and earth ground.

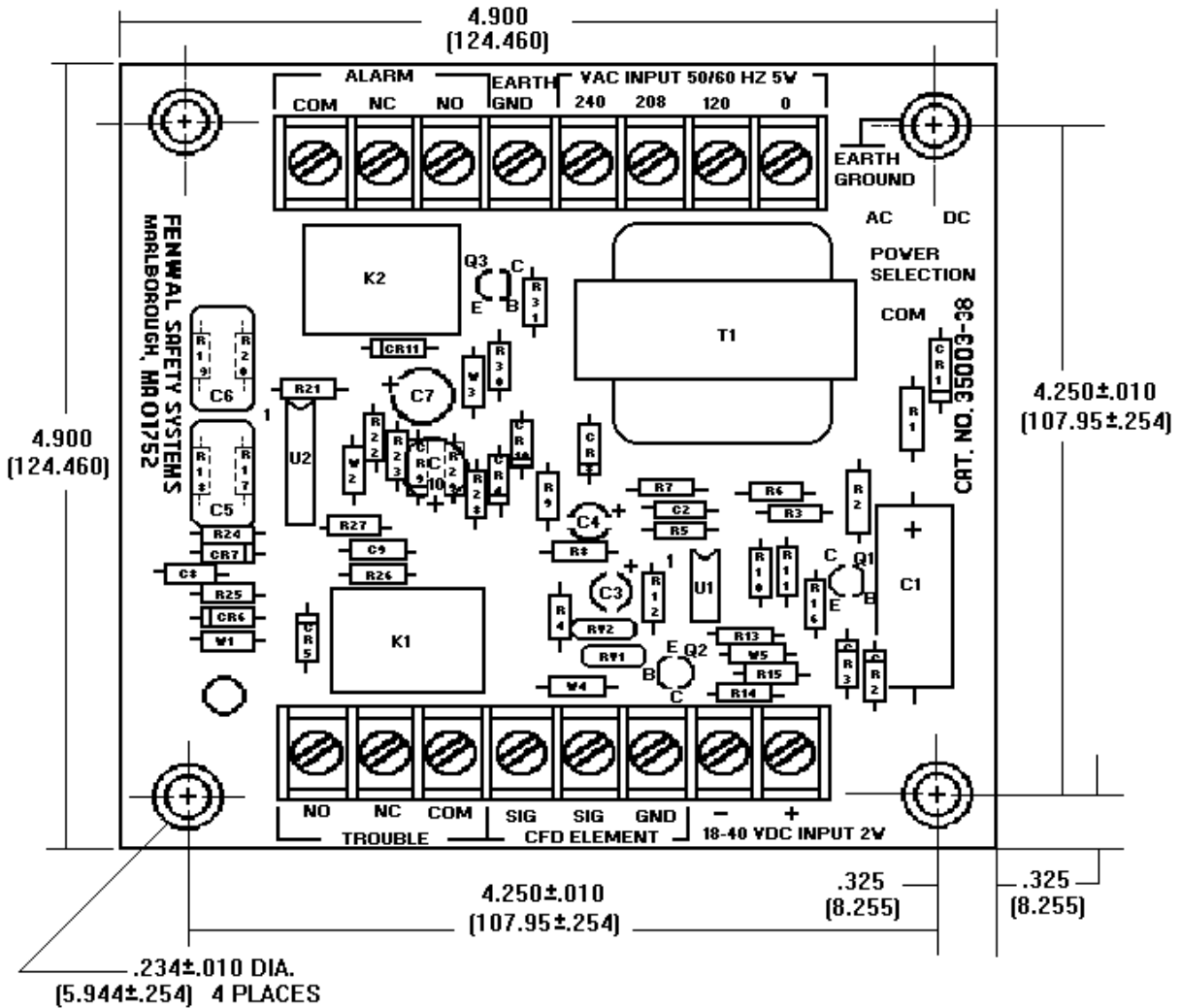
(7) Dimensions.

Figure 5, page 9/10, and Figure 6, page 11/12, are dimensioned drawings showing the size and layout of the two Fenwal control units designed for industrial applications, P/N 35003-38 for AC/DC operation and P/N 35003-39 for DC operation only.

Six variations of the Industrial CFD Control Units are available:

- a. P/N 35003-38 for AC/DC operation. (Control PC board ONLY)
- b. P/N 35003-39 for DC operation only. (Control PC board ONLY)

Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry  
 \*\*\*\*\*



**Figure 5: CFD Control Unit 35003-38. AC/DC (Front View)**

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

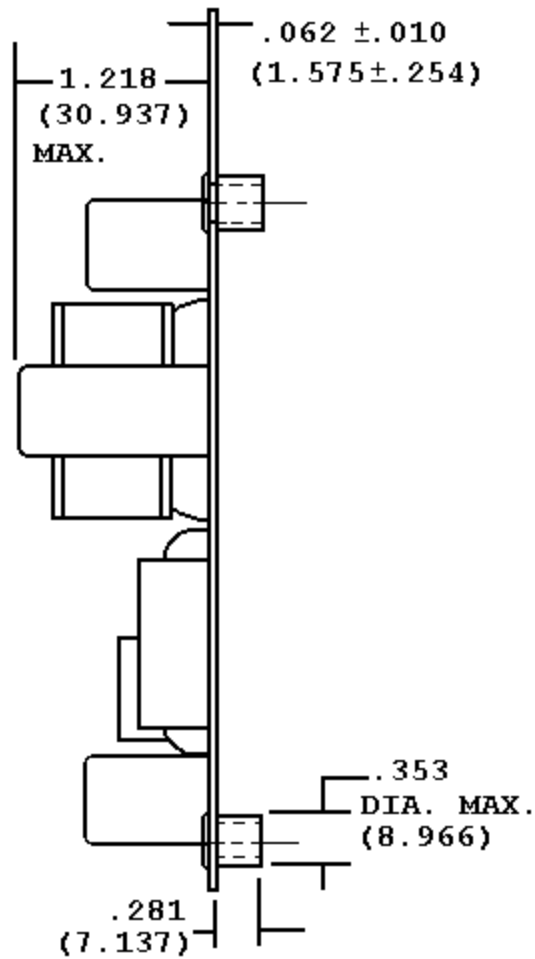
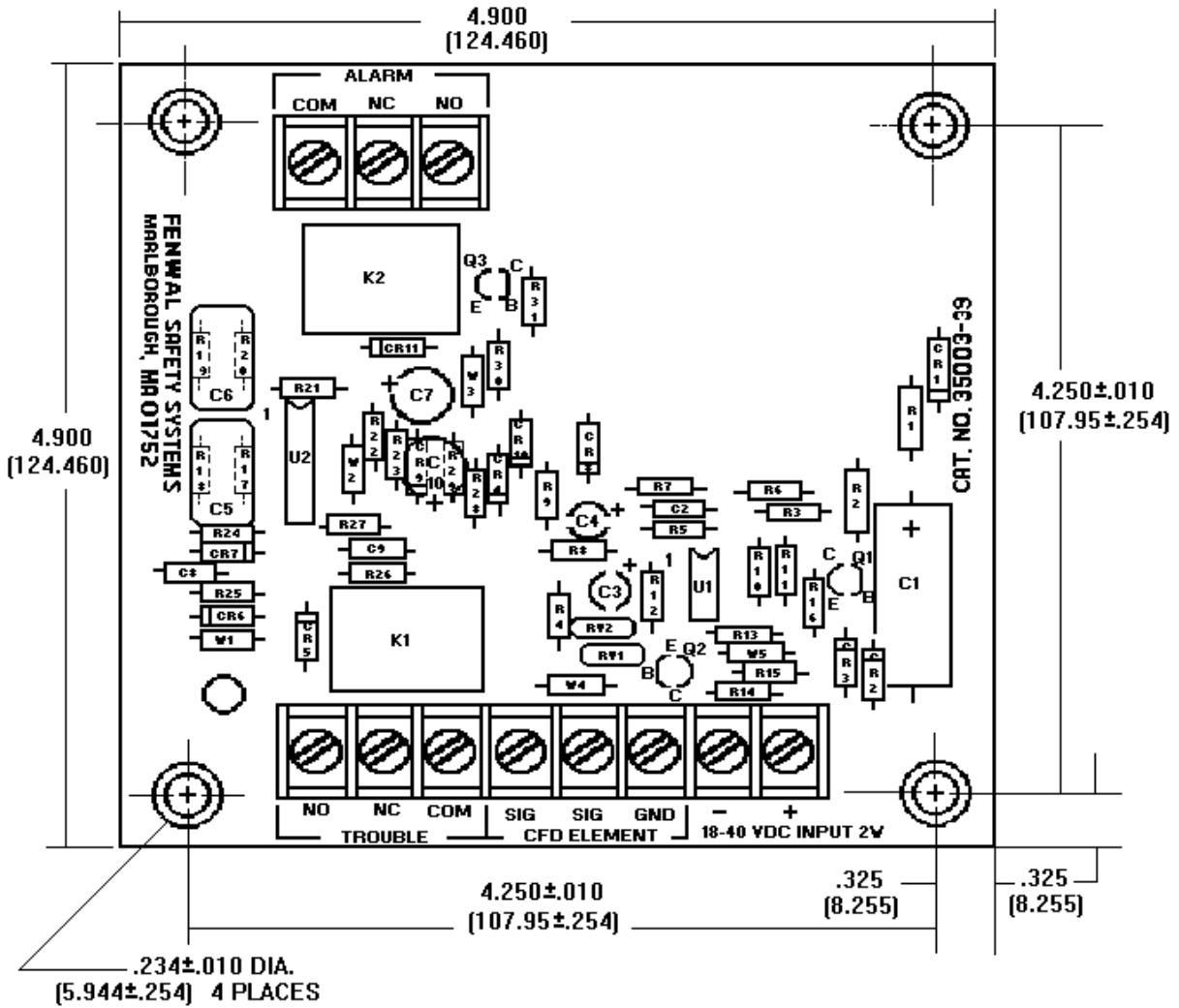


Figure 5: CFD Control Unit 35003-38. AC/DC (Side View)



Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry  
 \*\*\*\*\*



**Figure 6: CFU Control Unit 35003-39. 10-16 VDC ONLY (Front View)**

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

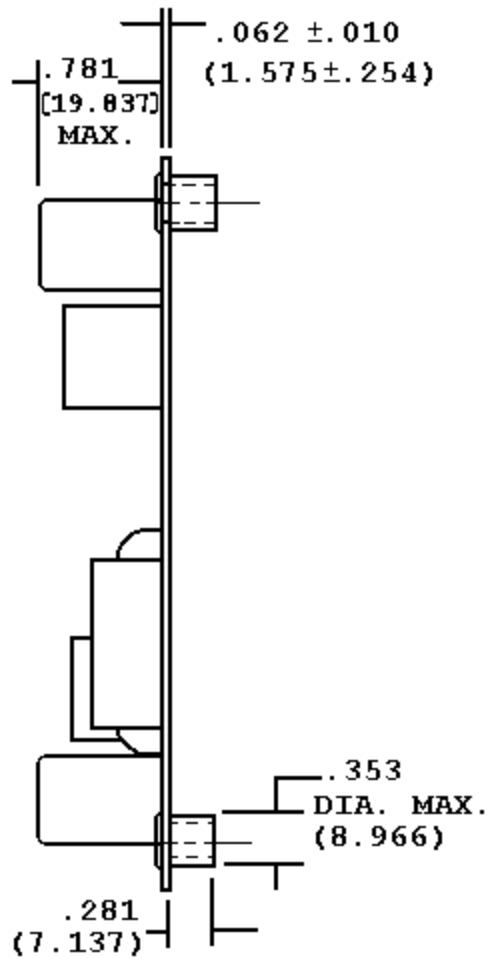


Figure 6: CFD Control Unit 35003-39. 10-16 VDC ONLY (Side View)

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- c. P/N 35003-40, which is composed of P/N 35003-38 mounted in the drip-tight 16 gauge steel enclosure shown in Figure 3, page 5.
- d. P/N 35003-41, which is composed of P/N 35003-39 mounted in the drip-tight enclosure shown in Figure 3, Page 5.
- e. P/N 35003-42 composed of P/N 35003-38 mounted in the explosion-proof, dust-tight and weather-proof cast iron enclosure shown in Figure 4, page 6.
- f. P/N 35003-43 composed of P/N 35003-39 mounted in the explosion-proof enclosure shown in Figure 4, page 6.

3. Mounting and Interconnecting Hardware.

To permit system interconnection under all conceivable conditions, FSS/KF provides the following interconnecting and mounting hardware:

- Special Sensing Element Connectors
- Wire End Fittings
- Flange and Nut Assemblies
- Mounting Clips
- Connector Plug Assemblies
- Grommets

A. Mounting Hardware.

- (1) Flange and Nut Assembly, P/N 35410-X. These units are used to support the junction of two sensing elements or a sensing element to wire end fittings. One type of flange fits flush against a bulkhead, while the other is a standoff that supports the junction point away from the surface to which it is mounted, see Figure 7.
- (2) Mounting Clips, P/N 35401-0 and 35402-0, are used to secure sensing elements to the surface of the protected structure or equipment. They serve as support points and vibration dampers. These clips are secured permanently to the structure or directly to the protected equipment with a screw or rivet through the mounting hole provided in their base, see Figure 8. The sensing elements are then clamped into them and secured by means of a 1/4-turn twist-lock stud. The elements are thus easily removed when necessary.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*



Figure 7. Flange and Nut Assembly

There are two kinds of clips, general purpose (low temperature) and high temperature. The general purpose clips are used with grommets to secure sensing elements. The high temperature clips employ built-in spring steel clamps to secure the elements and do not require grommets. High temperature clips are used in temperatures of 700° F (371° C) and above.

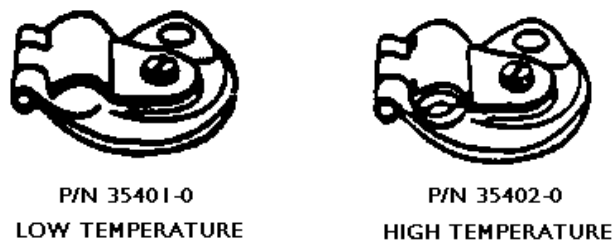


Figure 8. Mounting Clips

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- (3) Grommets, P/N 35450-1 is approximately one inch long and a quarter of an inch in diameter. The silicone rubber grommets are available for use in ambient temperatures up to 500° F (246° C). See Figure 9 for a typical unit used between a sensing element and a mounting clip.

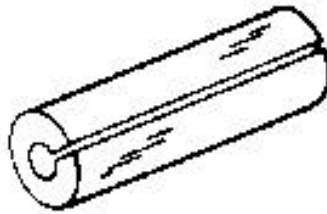


Figure 9. Grommet

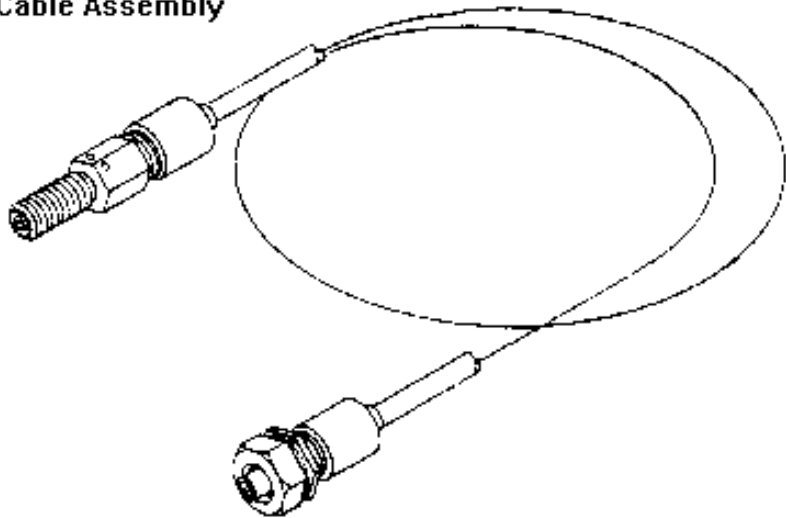
B. Interconnecting Hardware.

- (1) Cable Assemblies, P/N 35301-X and 35302-X, are single or double ended units employed to join two lengths of sensing elements through areas where protection is not required or to make connections between sensing elements and control units. Each cable assembly consists of one or two wire end fittings connected to a length of wire as shown in Figure 10. The customer must specify the length and size of the wire to be furnished in the cable assembly ordered.
- (2) Wire End Fittings, P/N 35303-X, are connectors designed to join sensing elements to remotely located control units. They are provided in either pin or socket configurations and in various sizes to accommodate different wire sizes (wire size and specifications must be provided to ensure proper components). Typical units are shown in Figure 11. These fittings are not provided with wire and come disassembled to be wired and assembled by the user.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*



Typical Single Ended Cable Assembly



Typical Double Ended Cable Assembly

Figure 10. Cable Assemblies

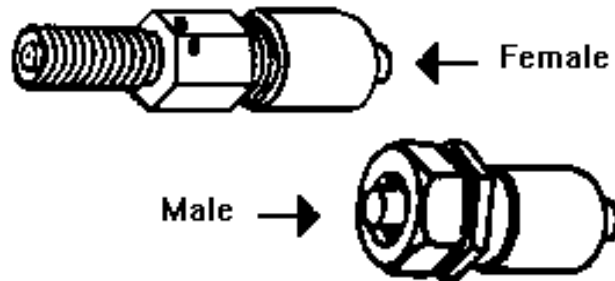
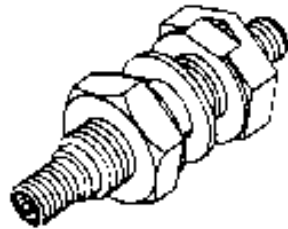


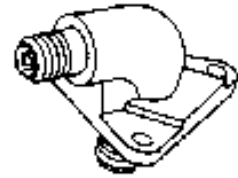
Figure 11. Wire End Fittings

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- (3) Special Sensing Element Connectors, P/N 35101-14, is a straight through connector for penetration of bulkheads, vessel walls or thin partitions no thicker than 1/2 inch (12.7 mm). It has pin connectors at each end. P/N 35201-4 is a double socket ended, right angle connector for use against thin walled vessels or bulkheads, see Figure 12.



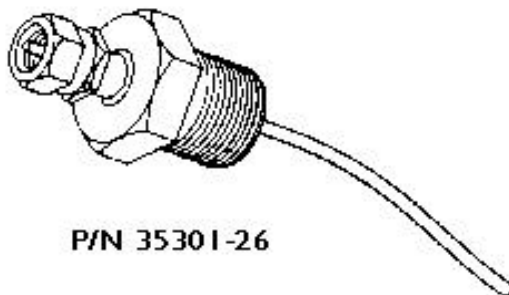
P/N 35101-14



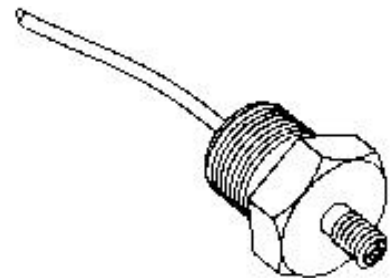
P/N 35201-4

Figure 12. Special Sensing Element Connectors

- (4) Connector Plug Assemblies, P/N 35301-26 and 35304-5, are used to connect either cable assemblies or sensing elements to standard junction boxes, conduits or explosion-proof control unit enclosures. See Figure 13.



P/N 35301-26



P/N 35304-5

Figure 13. Connector Plug Assemblies

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

SECTION II. SYSTEM DESIGN AND INSTALLATION

This section presents suggestions for designing a Continuous Fire and/or Overheat Detection System and general installation practices basic to a properly functioning system.

1. Design Recommendations for use of Fenwal CFD Systems.

- A. Location and Layout. The purchaser of a CFD system should prepare a drawing showing the needed layout of the sensing elements, the length and temperature setting needed for each, location of needed connection points (for installation of flange and nut assemblies), and the desired location of the system's control unit relative to the area to be protected.

NOTE: The location of sensing elements and connections between elements and wire end fittings must be selected with consideration for installation, maintenance and accessibility.

- (1) Lengths of sensing elements should be calculated carefully to avoid resorting to "S" bends to use up extra element length next to connections. Conversely, there must be enough element available to reach all connection points. When designing elevation changes or changes of plane in a straight run of sensing element, use two 45° bends rather than one 90° bend, or use Fenwal right angle interconnectors (see paragraph 3, Section I, Mounting and Interconnecting Hardware).
- (2) The design must ensure that the sensing element is exposed to the area or to the air flow path being protected and is not shielded by obstructions. The designer may create suitable standoffs in the area to accomplish this.
- (3) Never route sensing elements between two supports that have different motions. Whenever it is necessary to route the element loop between two such points, use a cable assembly connection from one support to the other to provide a flexible connection between the two.
- (4) The sensing element must be mounted with sufficient clearance at all points to prevent chafing against the structure on which it is mounted. A minimum of 1/4 inch between the element and structure is recommended.



Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- (5) The sensing element must remain straight and free from bends for a minimum of 1 inch (25 mm) immediately preceding or following an end fitting. Otherwise, the recommended minimum acceptable bend radius throughout the element length should be not less than 1 inch (25 mm).
- (6) Sensing elements must be properly supported with clamps or clips according to their intended use (see Section I, paragraph 3, Mounting Hardware, page 13). The clip spacing should not exceed 8 inches on straight runs, 6 inches where the element changes direction, and no more than 3 to 4 inches from connectors or termination points.

The connectors and adjacent clips mounted on either side of the sensing element should be affixed to a common structure to minimize variations in vibration.

Place mounting clips at the start and end of all bends when installing elements. When lengths of element within the bends are greater than 8 inches, place clips evenly along the bend at no more than 8 inch intervals. The slit in the grommets on bends must always face outside of the bend.

- (7) The part number identifying the sensing element and its alarm temperature is stamped on the hex nut of the end fitting. It is recommended that a record be kept of the sensing element part number and area in which it is installed as an aid to maintenance.

- B. Planning for Connector Assemblies and Mounting Hardware. Determine the need for the various items of mounting hardware and prepare a bill of materials of these items.

When connecting two lengths of sensing element in areas to be protected, determine whether cable connector assemblies are required through intervening areas not needing protection. Identify the number of cable assemblies needed throughout the sensing element network to the control unit.

Determine the number of flange and nut assemblies required. These are used at every junction of the elements and also at the junctions of elements and wire end fittings.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

Order enough mounting clips and grommets (or high temperature clips if these are being used) for installation at least every 8 inches along each sensing element run.

Make certain that elements are installed on suitably designed standoffs to direct them into the air flow path and that they are well exposed to possible flame paths that must be monitored. Keep the use of such standoffs to a necessary minimum, however, and design them so that the sensing element retains mountings at least every 8 inches.

- C. Engineering Support and Design Review. Kidde Fenwal offers engineering support during the design and installation phases to ensure that a satisfactory system is created using correct hardware, connectors, routing, etc.

2. Installation Procedures for FSS/KF CFD System.

**CAUTION:** INSTALLATION IN ANY OF THE FOLLOWING ENVIRONMENTS CAN DAMAGE THE CONTROLLER AND IS NOT RECOMMENDED WITHOUT ADDITIONAL PROTECTION: HIGH MECHANICAL VIBRATION AND SHOCK, DUST AND/OR CORROSIVE GASES, HIGH HUMIDITY, PROXIMITY TO SPLASHING LIQUIDS, PROXIMITY TO EQUIPMENT GENERATING EXCESSIVE HIGH FREQUENCY NOISE (ELECTRO-MAGNETIC INTERFERENCE) OR IN LOCATIONS WHERE THE AMBIENT TEMPERATURE IS GREATER THAN 167° F (75° C) OR BELOW -67° F (-55° C).

- A. Mounting the Control Unit. The control unit may be panel mounted by screwing four #10 screws into the four mounting holes on the printed circuit board or housed in one of the two enclosures available (see Figures 3 and 4, pages 5 & 6, respectively).

The control unit should be remotely located in relation to the protected hazard area. Its ambient temperature must be no less than -67° F (-55° C) or more than 167° F (75° C). The control unit is insensitive to mounting attitude.

**WARNING:** HIGH VOLTAGES MAY BE PRESENT AT THE CONTROL UNIT THAT COULD CAUSE SEVERE INJURY OR DEATH. WIRING SHOULD ONLY BE PERFORMED BY QUALIFIED PERSONNEL. TURN POWER

.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

OFF BEFORE WIRING.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- B. Wiring the 35003-38 AC/DC Control Unit. After mounting the control unit:
- (1) Select AC or DC voltage by positioning the power selection jumper on the printed circuit board to the appropriate terminal, see Figure 14. The unit is factory wired for AC operation.

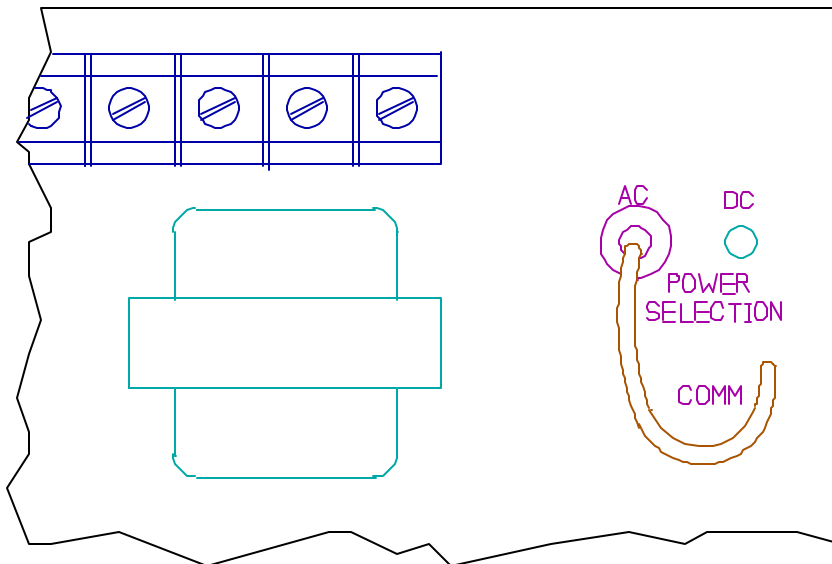


Figure 14. Power Selection Jumper

- (2) Connect input voltage, earth ground, and CFD signal to the control unit terminal blocks. See Figure 15.
- (3) Ground the outer sheath of the connector plug assembly or cable assembly to the CFD sensing element ground terminal, GRD. In applications where continuous elements are interconnected with sections of copper wire, grounding of sensing element sheaths must be insured.

Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry  
 \*\*\*\*\*

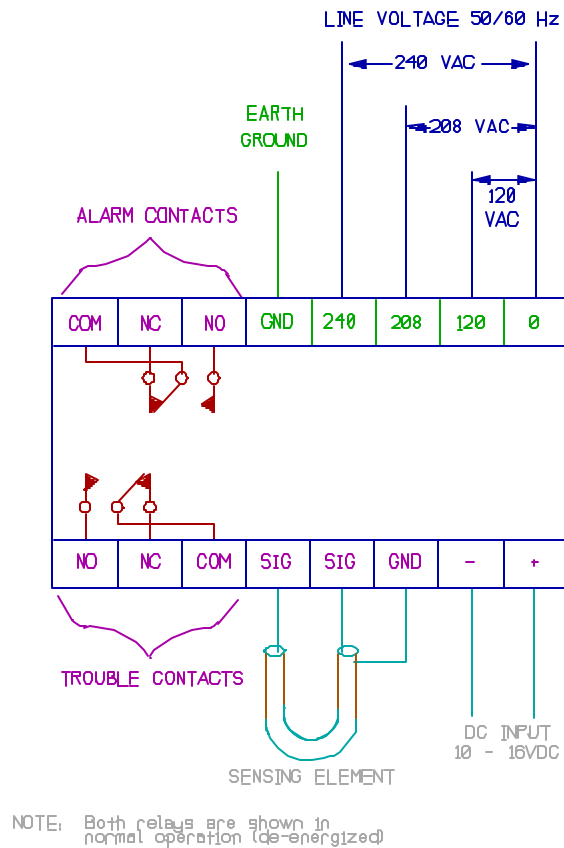


Figure 15. Terminal Block Connections for P/N 35003-38, AC/DC.

- (4) Power the alarm and trouble relay contacts externally to provide load voltage and wire the load circuit to perform the required function. Connect to control unit terminal blocks as shown in Figure 15.
- C. Wiring the 35003-39 DC only Control Unit. The unit is factory wired for DC operation. After mounting the control unit:
- (1) Connect input voltage, earth ground, and CFD signal to the control unit terminal blocks, Figure 16.

Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry  
 \*\*\*\*\*

- (2) Ground the outer sheath of the connector plug assembly or cable assembly to the CFD sensing element ground terminal, GND. In applications where continuous elements are interconnected with sections of copper wire, grounding of sensing element sheaths must be insured.
- (3) Power the alarm and trouble relay contacts externally to provide load voltage and wire the load circuit to perform the required function. Connect to control unit terminal blocks as shown in Figure 16.

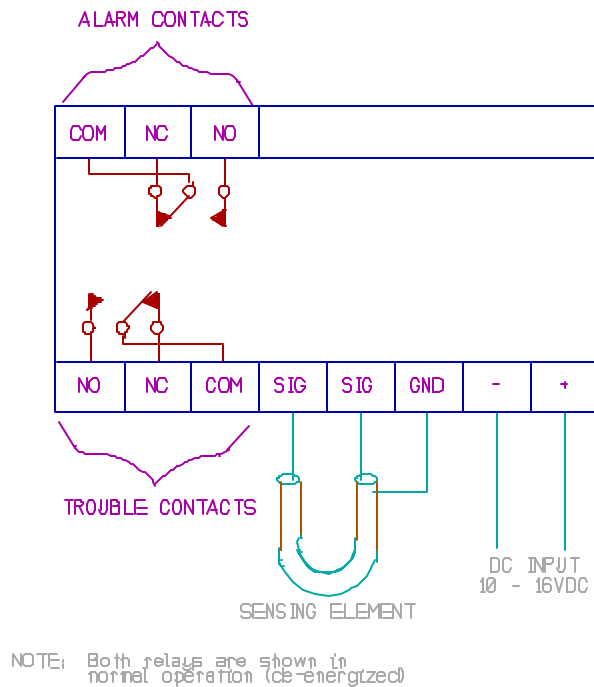


Figure 16. Terminal Block Connections for P/N 35003-39, **DC Only**.

- D. Handling and Installing the Sensing Elements. These sensing elements and their hardware are sufficiently rugged to withstand normal, intelligent handling in good professional practice. When installing and maintaining them avoid twisting, kinking, excessive bending, or otherwise mechanically shocking this equipment.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- (1) FSS sensing elements are supplied in a coil for shipping and delivery purposes. Inspect the sensing element for the proper part number. Do not rely on the part number marked on the shipping container. Uncoil each element carefully before starting installation and:
  - a. Inspect connectors, cable assemblies, mounting hardware, end fittings, and the sensing elements themselves for possible damage, such as chipped ceramic inserts or bent center pins in the fittings, damaged threads, frayed wire insulation, etc.
  - b. Follow the six important rules below in handling these sensing elements and associated hardware.
    - 1 To prevent damage or contamination of the connectors, keep all electrical components protected, using their protective dust caps and packing material until ready to assemble.
    - 2 Do not expose open connectors to drill chips or other contaminants.
    - 3 Do not allow the surface of the ceramic insulators to come in contact with fingers or contaminants.
    - 4 Keep components stored in a dry atmosphere prior to installation.
    - 5 When connecting sensing elements to connectors, should a bent center pin be encountered, do not attempt to engage the pin in the mating socket before straightening it. To realign a center pin, use a piece of tubing with an inside diameter of 0.070 inch. The tubing outer diameter should not exceed .093 inch.

**CAUTION:** DO NOT ATTEMPT TO STRAIGHTEN CENTER PINS WITH A SCREWDRIVER OR PLIERS.

- 6 Do not use lubricants on connector threads.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry

\*\*\*\*\*

- (2) Check the center conductor continuity. At room temperature, the resistance between end connectors of the sensing element shall be less than the total of 7 milliohms per inch of sensing element length, plus 45 milliohms for each connector. This resistance can be measured with a volt-ohm-milliammeter (VOM), a digital multimeter (DMM), or one of the meters recommended in 3b on page 41. With temperatures near room temperature, increases in temperature will increase resistance by 5 milliohms per degree above 25° C.
- (3) Install the flange assemblies, bulkhead connectors and mounting clips at their proper places, following the engineer's design and layout drawings for the system's installation.

**CAUTION:** ALTHOUGH THE FSS SENSING ELEMENT CONTINUES TO FUNCTION NORMALLY UNDER TESTS OF EXTREME ABUSE, IT IS A PRECISION ELECTRICAL INSTRUMENT AND SHOULD BE TREATED WITH THE ATTENTION GIVEN ALL PRECISION INSTRUMENTS.

- a. Mount the first flange assembly at the point where the sensing element loop will connect to the wiring from the control unit.

Locate the first mounting clip not more than 3 to 4 inches from the flange. After the first clip is installed, remaining clips should be spaced no more than 8 inches apart along the sensing element route, except as noted near bends. In general, clips should be placed to provide maximum support and minimum vibration.

- b. After the mounting clips are all installed, the flange assembly for the other end of the element is put in place.
- c. Use care in tightening screws to avoid damaging the connectors, especially when mounting right angle connectors.
- d. Make sure that riveted connectors are firm and cannot be moved.
- e. All clips should be fixed securely to their mounting surface to prevent clip movement or rotation.



Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

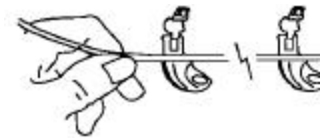
When installing, inspecting, or maintaining these sensing elements that are often mounted in exposed locations, they must **NOT** be used as hand holds, tool racks, hangers, or pressure points, or for any other use than as heat sensing elements.

E. Installation Steps.

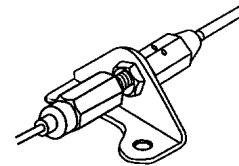
- (4) Remove the protective dust cap from the sensing element and insert the socket end connector into the first support flange installed and secure it with the hex jam nut provided. The element must be straight for the first inch from the connector. Use finger pressure only along the longitudinal axis of the connector when engaging connectors.



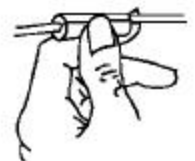
- (5) Route the element over the mounting clips.



- (6) Connect the other end of the element in the second support flange, as in (4) above and secure it.



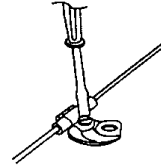
- (7) Add grommets to the elements at the mounting clip locations. Install the grommets around the sensing element and slide them inside all low temperature mounting clips. (Grommets are not used with the high temperature mounting clips.) Position the slit in each grommet toward the outside of a bend where used near a bend in the sensing element.



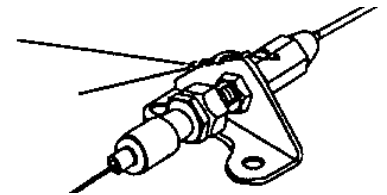
Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry

\*\*\*\*\*

- (8) Close and fasten the mounting clips. When using high temperature mounting clips, which require no grommets, make sure the element is well centered on the kidney shaped spring inside the clip.



- (9) Tighten all element hex nuts to a torque of 50 to 60 lb<sub>f</sub>-in\* and secure each nut with a 0.032 inch safety lock wire.



- (10) Install all flexible cable assemblies to sensing elements and between sensing elements as indicated in the design layout drawings. Torque to 50 to 60 lb<sub>f</sub>-in. Lockwire them, using 0.032 inch stainless steel wire to prevent loosening of connections through vibration. Support any loose cable or flexible leads at suitable intervals by tying or clamping them down with wire clamps. Avoid sharp bends in the wire, especially at the connector, to prevent wire chafe.

NOTE: To ensure proper operation, the installed sensing element must be grounded to the same ground mass as its control unit.

\* lb<sub>f</sub>-in denotes pound force inches.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

SECTION III. OPERATION AND MAINTENANCE

1. System Operation. The FSS Continuous Fire and/or Overheat Detection System is a sentry type electronic system that functions constantly in a stand-by mode fed by electric power. It is composed of the two basic components, the sensing element network, and the control unit, which is the brain through which the sensing elements must operate. The control unit operating directly from the power source impresses a small voltage on the sensing elements. When an overheat condition occurs at any point along the element length, the resistance of the eutectic salt in the sensing element drops sharply causing current to flow between the outer sheath and the center conductor. This current flow is sensed by the control unit, which produces a signal to actuate the output relay. If a break occurs in the sensing element wiring, the trouble relay is activated.

When the fire has been extinguished or the overheat temperature lowered to safe limits, the CFD system automatically returns to standby alert ready to detect a new fire or overheat condition.

2. Equipment Limitations and Restrictions. The following restrictive information appears at appropriate places in this manual, but is repeated here for emphasis.
  - A. Operating the control unit outside of specifications could result in failure of the product or other equipment with possible injury to people and property.
  - B. High voltages may be present at the control unit that could cause severe injury or death. Wiring should only be performed by qualified personnel. Turn off power before wiring.
  - C. Ambient Temperature Limitations for Sensing Element Hardware.
    - (1) The FSS supplied silicone rubber grommets, P/N 35450-1, are used in the sensing element mounting clips in ambient temperatures up to 500° F (246° C).
    - (2) In ambient temperatures above 700° F (371° C), the FSS High Temperature Spring Clip, P/N 35402-X, must be used in place of the low temperature mounting clips and their grommets.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- D. A minimum clearance of 1/4 inch (6 mm) between Fenwal sensing elements and the protected area or structure is recommended to prevent sensing element chafing.
- E. When installing FSS sensing elements, minimum clip spacing should not exceed 8 inches on straight runs, 6 inches where the element changes direction, and no more than 3 to 4 inches from connectors or termination points.
- F. The sensing element of the system must be grounded to the same ground mass as its control unit.

3. Inspection/Check of the Installed System.

A. Visual Inspection.

- (1) Verify that the alarm temperature of each CFD element is correct by checking the catalog number marked on the end fitting.

35XXX-Y-ZZZ

+ --- Alarm temperature in ° F.

- (2) Insure that all parts are securely mounted and that all wiring connections are clean and tight.

B. System Functional Check.

CAUTION: TO PREVENT ACTUATION OF EQUIPMENT CONNECTED TO THE CFD CONTROL UNIT DURING TESTING, DISCONNECT THE WIRING TO THE ALARM AND TROUBLE RELAY CONTACTS BEFORE TESTING THE SYSTEM.

WARNING: TO PREVENT ELECTRICAL SHOCK OR INSTRUMENT DAMAGE, ALL WIRING CONNECTIONS MUST BE MADE WITH THE POWER OFF.

CAUTION: IMPROPER TESTING CAN CAUSE PERMANENT DAMAGE TO THE ENTIRE HEAT SENSING SYSTEM AND COULD VOID THE MANUFACTURER'S WARRANTY.

**DO NOT** USE INSULATION RESISTANCE "MEGGER" TESTERS, OR

.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

DIELECTRIC VOLTAGE "HYPOT" TESTERS.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

**DO NOT USE A METER THAT APPLIES DC VOLTAGE TO THE CFD SENSING ELEMENT, EXCEPT WHEN MEASURING THE CENTER CONDUCTOR RESISTANCE.**  
**DO NOT TEST SENSING ELEMENTS HEATED TO WITHIN 100° F (55° C) OF THE ALARM POINT OF THE SENSOR.**

- (1) Loop Resistance Test.
  - a. Shut off all power to the system.
  - b. Disconnect the wires from the two "SIG" terminals on the control unit.
  - c. Using a multimeter on the ohms function, measure the resistance between the two removed wires. The resistance must be less than 100 ohms. If it is not, check the wiring and CFD elements.
  - d. Reconnect the wires to the two "SIG" terminals.
  
- (2) Trouble Relay Test.
  - a. Shut off all power to the system.
  - b. Create an open in the sensing loop by disconnecting one of the cable assemblies at a CFD element.
  - c. Apply power to the control unit.
  - d. Verify that there is continuity between the "N.O." and "COM" trouble contacts; if not, check the wiring and the control unit.
  - e. Remove all power to the system.
  - f. Reconnect the cable assembly to the CFD element.
  - g. Apply power to the control unit.
  - h. Verify that there is continuity between the "N.C." and "COM" trouble contacts; if not, check the wiring and the control unit.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- (3) Alarm Relay Test.
  - a. Apply power to the control unit.
  - b. Verify that there is continuity between the "N.C." and "COM" alarm contacts; if not, check the wiring, the control unit, and the CFD sensing elements.
  - c. Heat a portion of a CFD sensing element above its alarm temperature. Verify that there is a continuity between the "N.O." and "COM" alarm contacts. If there is not, check the wiring, the control unit , and the CFD sensing element.
  - d. Wait until the sensing element cools and the alarm relay returns to its normal operating state (see b. above), then repeat steps c and d for each sensing element in the system.
- (4) System Restoration.
  - a. Shut off all power to the system.
  - b. Reconnect any wires removed from the alarm and trouble relay contacts.
  - c. Apply power to the system.

C. Control Unit Check.

NOTE: The control unit is not field repairable. If found to be defective, return it to Fenwal Safety Systems for repair.

- (1) Connect the control unit as in Figure 17, page 33, or Figure 18, page 34.
- (2) Close S1. Set the decade box to 300 ohms.
- (3) Apply power to the control unit.
- (4) The unit should be in the normal operating mode with both alarm and trouble relays de-energized as shown in Figures 17 and 18.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry

\*\*\*\*\*

- (5) Open S1. The trouble relay contacts should transfer (continuity between "N.O." and "COM" terminals).
- (6) Close S1.
- (7) Reduce the decade box setting until the alarm relay contacts transfer (continuity between "N.O." and "COM" terminals). The setting should be 200  $\pm$ 50 ohms.
- (8) If the unit fails any of the above tests, return it to Fenwal Safety Systems for repair.

D. CFD Element Check.

**CAUTION:** IMPROPER TESTING CAN CAUSE PERMANENT DAMAGE TO THE ENTIRE HEAT SENSING SYSTEM AND COULD VOID THE MANUFACTURER'S WARRANTY.

**DO NOT** USE INSULATION RESISTANCE "MEGGER" TESTERS, OR DIELECTRIC VOLTAGE "HYPOT" TESTERS.

**DO NOT** USE A METER THAT APPLIES DC VOLTAGE TO THE CFD SENSING ELEMENT, EXCEPT WHEN MEASURING THE CENTER CONDUCTOR RESISTANCE.

**DO NOT** TEST SENSING ELEMENTS HEATED TO WITHIN 100° F (55° C) OF THE ALARM POINT OF THE SENSOR.

**CAUTION:** THE RECEPTACLE CONNECTORS (FEMALE) CAN BE DAMAGED BY METER LEADS. USE A 0.0625 INCH TO 0.0628 INCH DIAMETER PIN INSERTED INTO THE RECEPTACLE TO PROVIDE A TEST POINT FOR MEASUREMENTS.

- (1) Visual Inspection.
  - a. Inspect the sensing element tubing surface for dents, kinks, fractures, crushed sections and abrasions. The maximum acceptable depth of an abrasion will be 0.002 inch.



Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry  
 \*\*\*\*\*

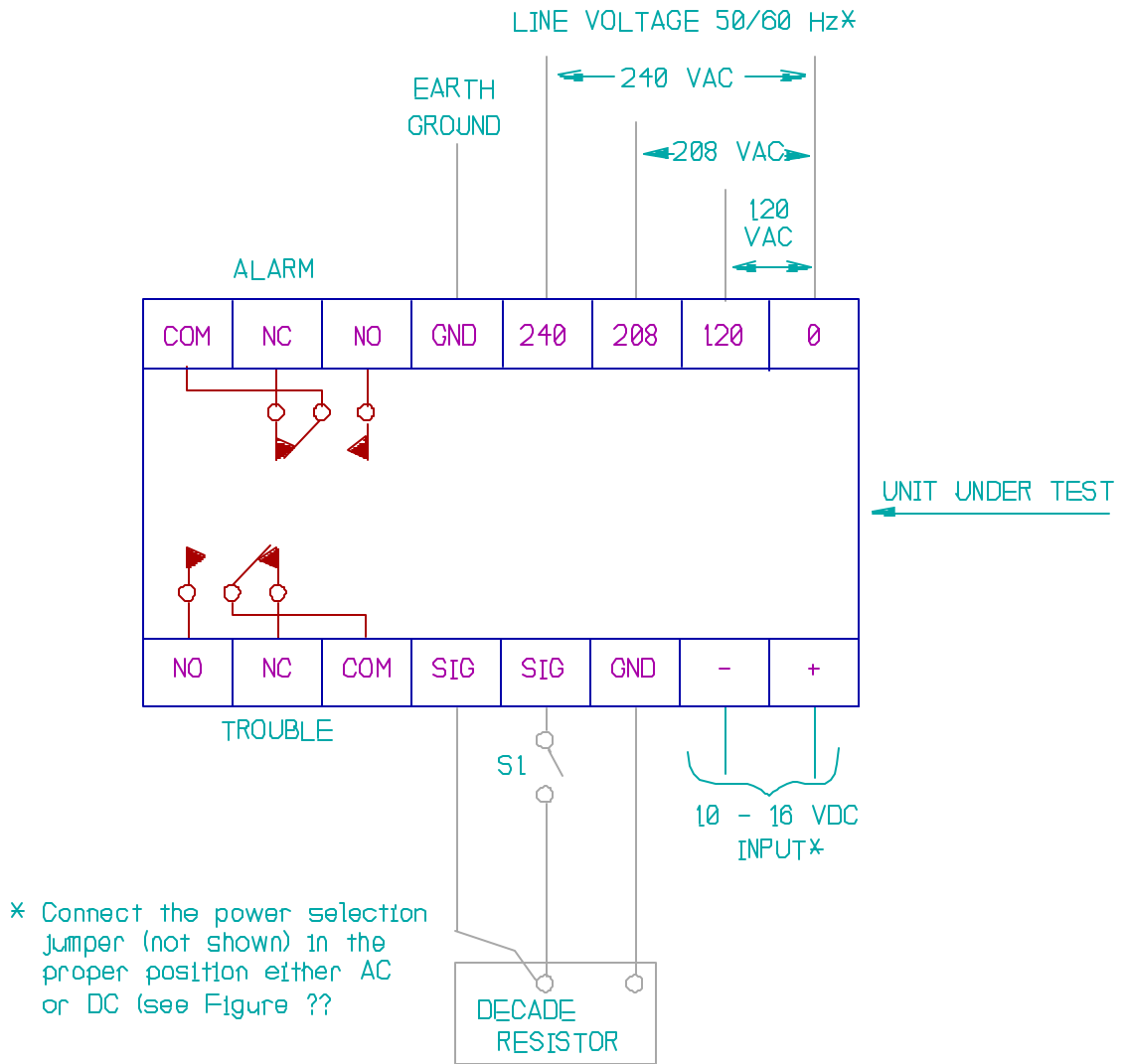


Figure 17. Terminal Block Connections for Control Unit Check, P/N 35003-38.

Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry  
 \*\*\*\*\*

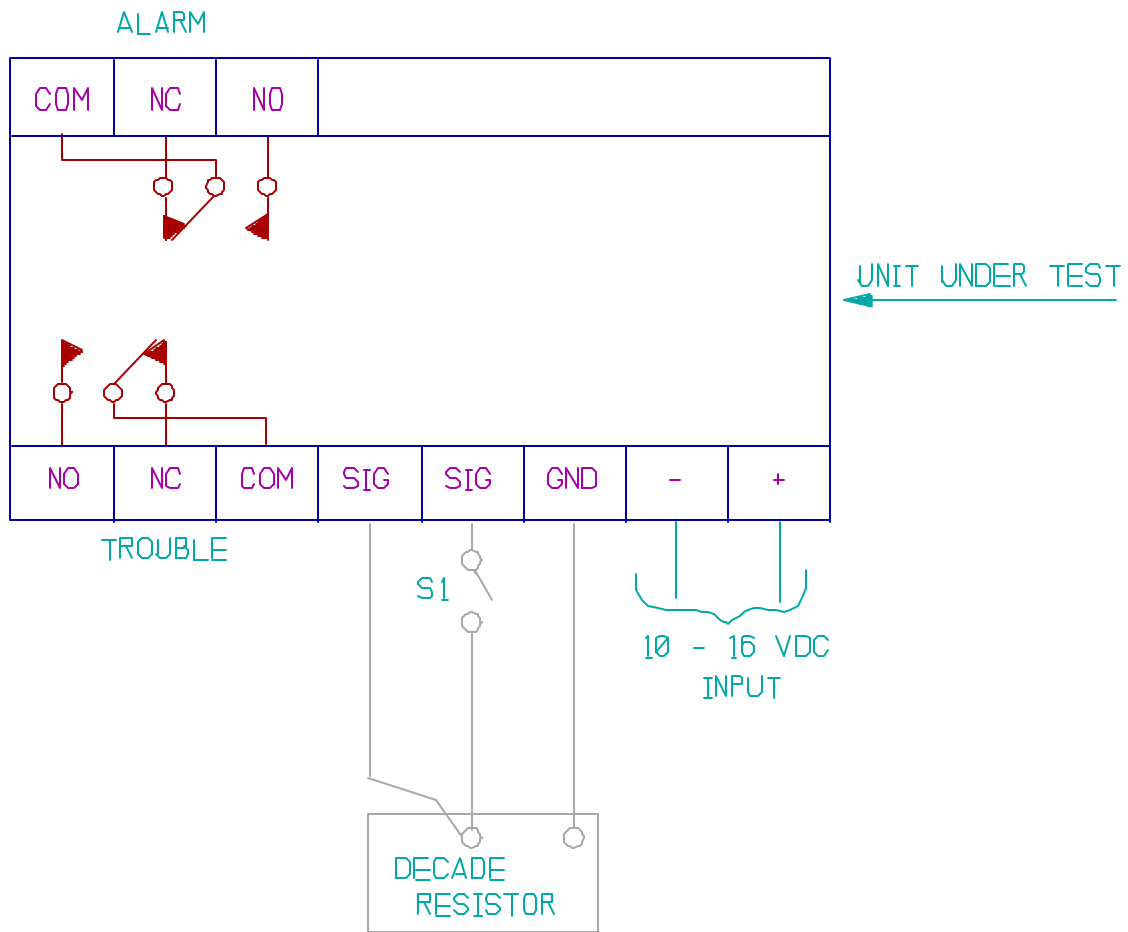


Figure 18. Terminal Block Connections for Control Unit Check, P/N 35003-39.

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- b. Inspect end fittings for damaged threads, distortion and cleanliness.
- (2) Disconnect both ends of the sensing element.
- (3) Conductance.
- a. Insure that the sensing element temperature is 80° F (27° C) or below.
  - b. Using a battery operated Tegam\* model SP 2596 or the equivalent, measure the conductance of the sensing element between the center conductor and the outer sheath on the "G" (conductance) scale.
  - c. For a new sensing element, conductance must be less than 0.050 microsiemens per inch of element length (See Figure 19). As an example, for a 100-inch long sensing element, the conductance reading must be less than  $0.050 \times 100 = 5$  microsiemens.
- (4) Center Conductor Resistance.
- a. Using a volt-ohm-milliammeter (VOM), a digital multimeter (DMM), or the meter recommended above, measure the resistance between the ends of the sensing element's center conductor.
  - b. The resistance must be less than 7 milliohms per inch of sensing element length plus 45 milliohms for each connector. (see Figure 20). As an example, for a 100-inch long CFD element, the resistance reading must be less than  $(7 \times 100) + 45 = 745$  milliohms or 0.745 ohms.

---

\* Tegam, Inc, Ten Tegam Way, Geneva, OH 44041

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

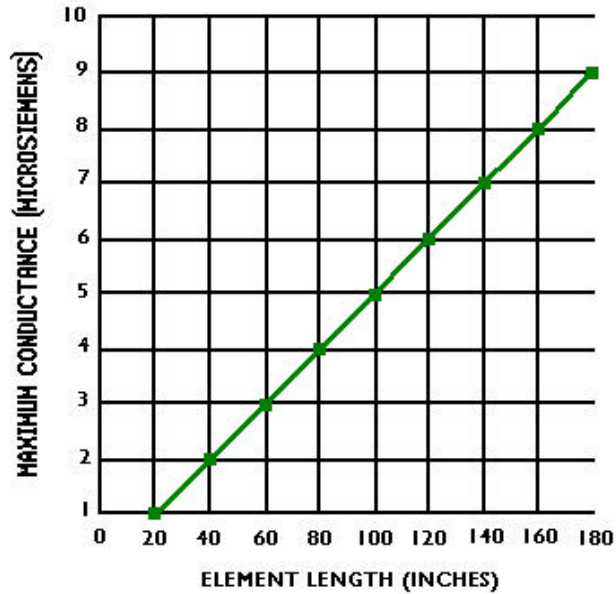


Figure 19. CFD Element Maximum Conductance

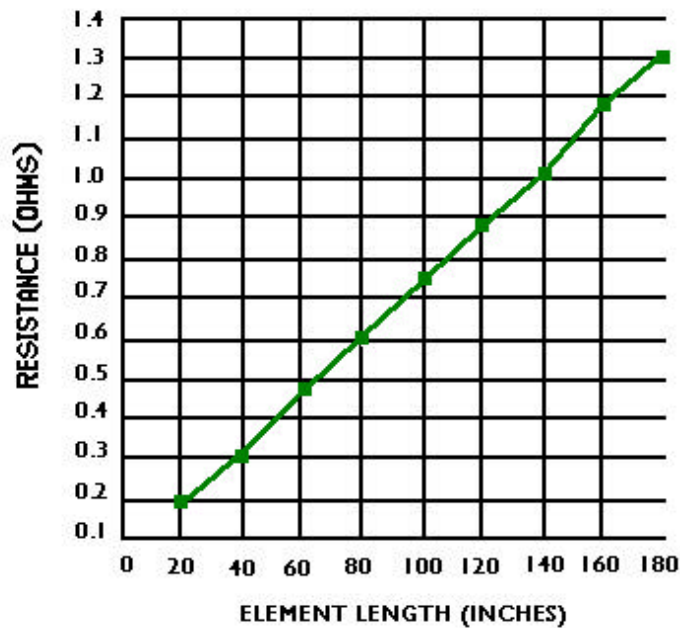


Figure 20. CFD Element Center Conductor Resistance

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry  
\*\*\*\*\*

- (5) Conductance at Alarm Temperature. It is not practical to test the sensing element in the field for conductance at alarm temperature because a constant temperature bath is required. Sensing elements may be returned to Fenwal Safety Systems for testing.

4. Line Maintenance, Cleaning and Maintenance Checks.

- A. CFD System Repair. Neither the sensing elements nor the cable assemblies are repairable. Faulty elements or assemblies must be replaced. Parts for replacement are listed in Section IV, Table 1. The control unit is not field repairable. Faulty units should be returned to Fenwal Safety Systems for repair.
- B. Handling Procedures. The following procedures are recommended for the handling of the sensing elements, connectors, and cable assemblies of the FSS Fire and Overheat Detection System. These dismantling procedures should be followed whenever problems in the system require removal and replacement of a component, or whenever inspection indicates the presence of excessive contamination by grease, oil or dirt on the system, its connection points, or on the sensing elements themselves.
  - (1) Open a minimum of three sensing element mounting clips nearest each connector point in order to have enough play in the element for disconnecting it.
  - (2) Before disconnecting, remove any accumulated oil, grease and dirt from the outside of each connector. Use a solvent (see paragraph C, Cleaning, below) with a soft bristled brush and wipe dry.
  - (3) Remove the lock wire from the connector. Then carefully unscrew each connector.
  - (4) Refer to Section II, paragraphs 2D and 2E, pages 23 through 27, Handling and Installing the Sensing Elements , for sensing element remounting and securing.
- C. Cleaning. It is recommended that a solvent such as LPS Presolve or Isopropyl Alcohol or the equivalent be used to flush out the end fittings of elements, the cable assemblies and connectors that couple all components. The solvent should be sprayed or squirted from a syringe directly into the receptacles of the components so that a flushing action takes place. The sensing elements and the

Instruction Manual  
Fenwal Continuous Fire and Overheat Detection System for Industry

\*\*\*\*\*

cable assemblies should be held so that contaminants loosened by the solvent will drain out of all cavities. It is advisable to flush the connectors from both sides, if possible. After thoroughly flushing each connector, blow it dry by blowing low pressure nitrogen or clean, dry, low pressure air into each connector to remove any contaminating material that might remain. DO NOT USE probes, swabs or any other instrument to probe or explore in the ends of the connectors when cleaning them. Cap all connectors that are to be left disconnected after cleaning.

NOTE: Compressed air normally contains many contaminants that could cause electrical shorting in the connectors. Therefore it is important that only clean, dry air or nitrogen be used to blow the connectors out when cleaning them.

WARNING: DO NOT EXCEED 30 PSIG (1.75 to 2.1 KG/CM<sup>2</sup>) OF COMPRESSION AT THE NOZZLE WHEN USING COMPRESSED AIR OR NITROGEN IN THIS CLEANING PROCESS. ALSO WEAR STURDY GOGGLES OR A FACE SHIELD. PARTICLES OR LIQUID DROPLETS PROPELLED BY HIGH PRESSURE CAN CAUSE PERMANENT EYE INJURY.

#### SECTION IV. SENSING ELEMENT IDENTIFICATION BY PART NUMBERS

The basic part number series of FSS's sensing elements is 35500 to 35740. Two series of dash numbers are added to this number, so the final number becomes 35XXX-X-XXX.

The last three digits in the five digit group signify the length of the element in inches in the following manner. For a 24 inch element, these digits become 35524 (35500 + 24), and for a ten foot element (10 ft = 120 inches) they become 35620 (35500 + 120). The second group is a single digit number that designates the type of end connectors on the element thus:

- 2 = one pin (male) end and one socket (female) end
- 3 = two pin ends (male)
- 4 = two socket ends (female)

The third part number group is a three digit number that indicates the Fahrenheit temperature setting at which an alarm will occur.

Example: Part Number 35573-3-255 indicates a sensing element 73 inches long with two pin connectors (male end) and an alarm set point of 255° F (124° C).

Sensing elements are manufactured in lengths from 18 inches to 20 feet in one inch

Instruction Manual  
 Fenwal Continuous Fire and Overheat Detection System for Industry  
 \*\*\*\*\*

increments. Connectors are hermetically sealed to each end. FSS sensing elements may be series connected in lengths up to 150 feet. Refer to Section I for further information regarding their functioning and discrete characteristics.

Table 1. Part Number Identification of FSS CFD Sensing Elements for Replacement Purposes

Sensing Element Part Number	35XXX-X-XXX
	+--+   +--+
500 plus length in inches	-----+
Type of connector	-----+
Temperature Setting*	-----+

\* 255° F, 310° F, 400° F, 575° F, or 765° F

Example: 35540-2-310 is the part number for a 40 inch element with one pin end connector and one socket end connector and a temperature setting of 310° F.

LICO Electronics GmbH  
A-2320 Kledering  
[www.mess-regeltechnik.at](http://www.mess-regeltechnik.at)  
Tel +43 1 706 43 000  
[office@lico.at](mailto:office@lico.at)