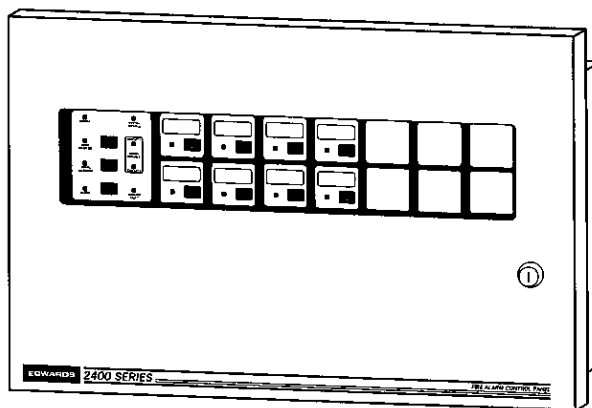
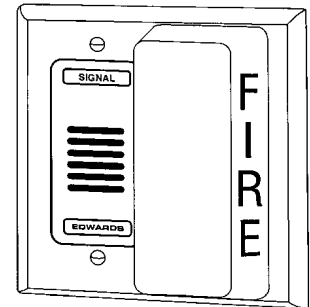
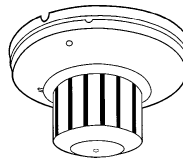
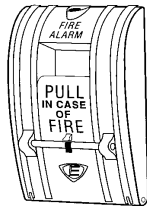
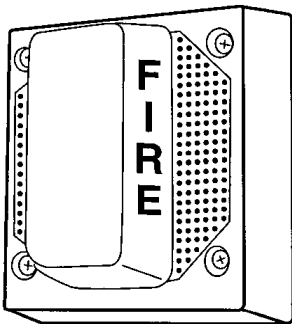


A UNIT OF GENERAL SIGNAL **GS**

**EDWARDS**

# Protective Signaling Systems Wiring Practices Manual



**Edwards Signaling Products**  
**90 Fieldstone Court, Cheshire, CT 06410-1212**

# Edwards Protective Signaling System Wiring Practices

## INTRODUCTION

The installation of fire alarm system wiring is similar in many respects to any other low voltage system wiring. Because the nature of the system affects life and property, additional measures are required during installation to insure the system is operational at all times. The most sophisticated of control panels will not operate properly if the field wiring is installed incorrectly. It is the goal of this chapter to explain why correctly installed field wiring is vital in the operation of a fire alarm system, and how to recognize proper and improper installations. The process requires four basic steps: *SELECT* the proper cable for the application; *INSTALL* the cable properly; *TEST* the cable to make sure it is free of shorts, opens, and ground faults; and *TERMINATE* the cable properly.

## BASIC CIRCUIT SUPERVISION

There are two types of circuit supervision widely used in fire alarm systems today. Direct Current (DC) continuity supervision is used extensively on small systems. Large fire alarm systems use sophisticated electronic multiplex circuitry and "electronic questions and answers" to supervise field wiring and devices.

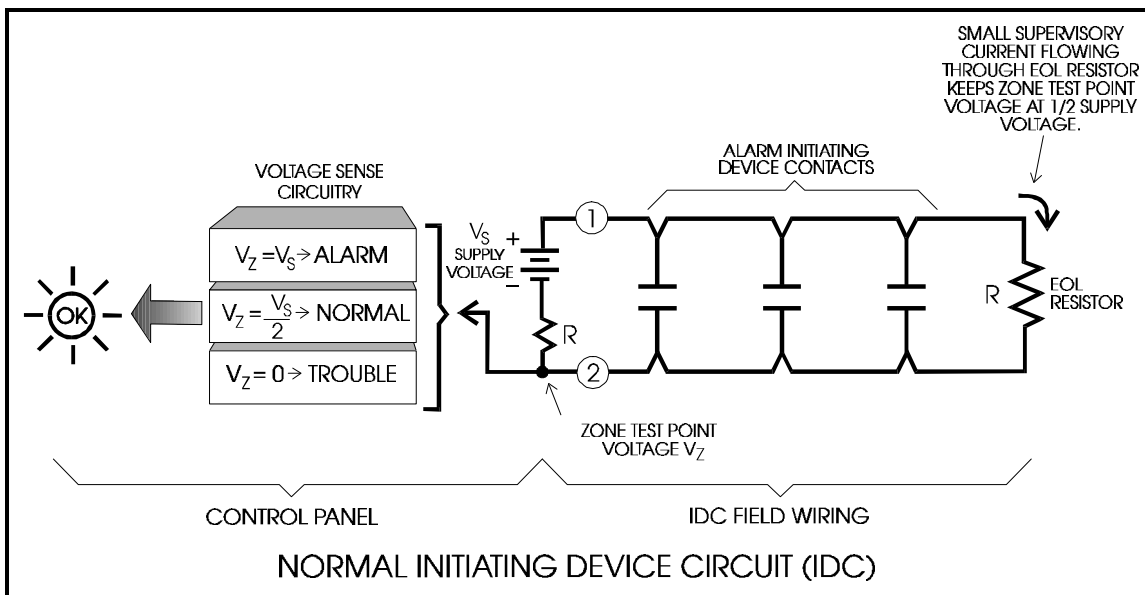


Figure 1

Figure 1 shows a simplified fire alarm panel supervising a single Initiating Device Circuit or zone using Direct Current (DC) continuity supervision. The supervisory current from the battery flows through terminal #1, the field wiring, the EOL resistor, terminal #2 of the control panel through a second resistor, and returns to the battery. The internal resistor and EOL resistor have equal resistance values. The voltage at the zone test point  $V_z$  is

measured by voltage sensing circuits. As long as the supervisory current flows through the EOL resistor, the voltage at  $V_z$  is one half the supply voltage  $V_s$ , and the voltage sense circuitry generates a normal panel response.

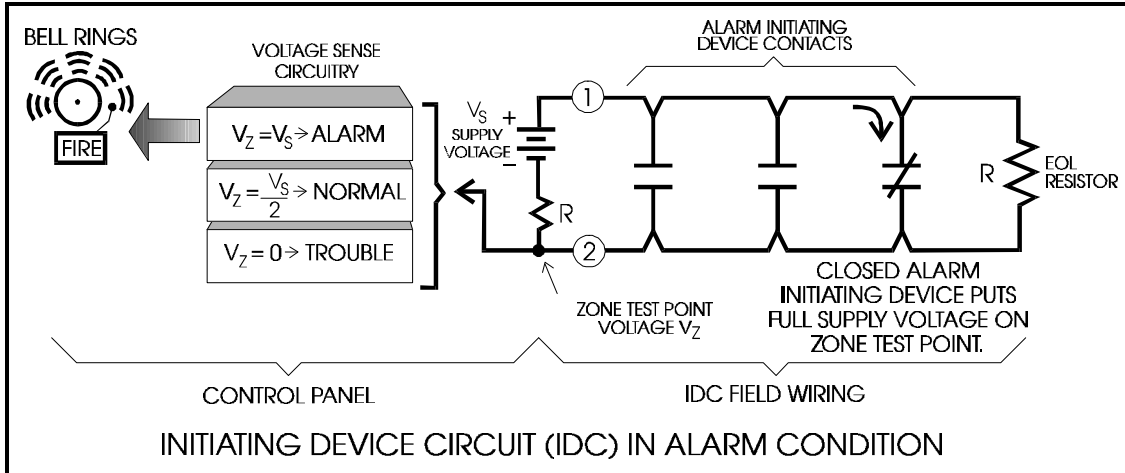


Figure 2

When a smoke detector or pull station operates, it effectively puts a **short** across terminals #1 & #2 as shown in Figure 2. This brings the zone test point voltage  $V_z$  up to the supply voltage  $V_s$ . When the voltage sense circuitry sees  $V_z = V_s$ , it generates an alarm response, such as ringing a bell.

Should the field wiring **open** as shown in Figure 3, the supervisory current no longer flows through the field wiring and EOL resistor and  $V_z$  goes to zero. When the voltage sense circuitry sees  $V_z = 0$ , it generates a trouble response, such as sounding the trouble buzzer.

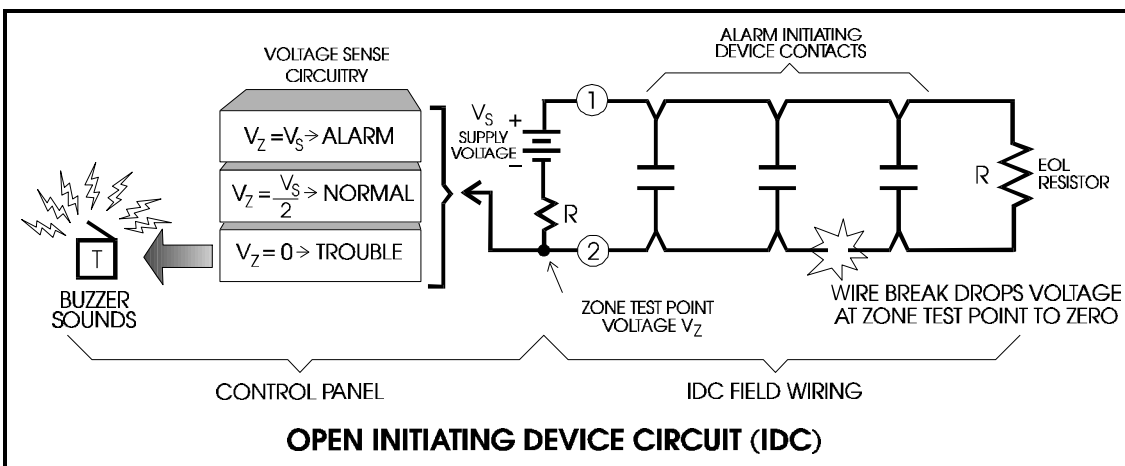


Figure 3

Figure 4 shows an improperly wired Initiating Device Circuit. Because the supervisory current is not forced to flow through the top and bottom branches, the break in the top branch doesn't interrupt the supervisory current, and there is no indication of the trouble. Should the top device detect a fire, the signal would never reach the control panel. Note that the lower device would send a fire alarm signal but would not send a trouble signal to the fire alarm panel, a classic symptom of mis-wiring.

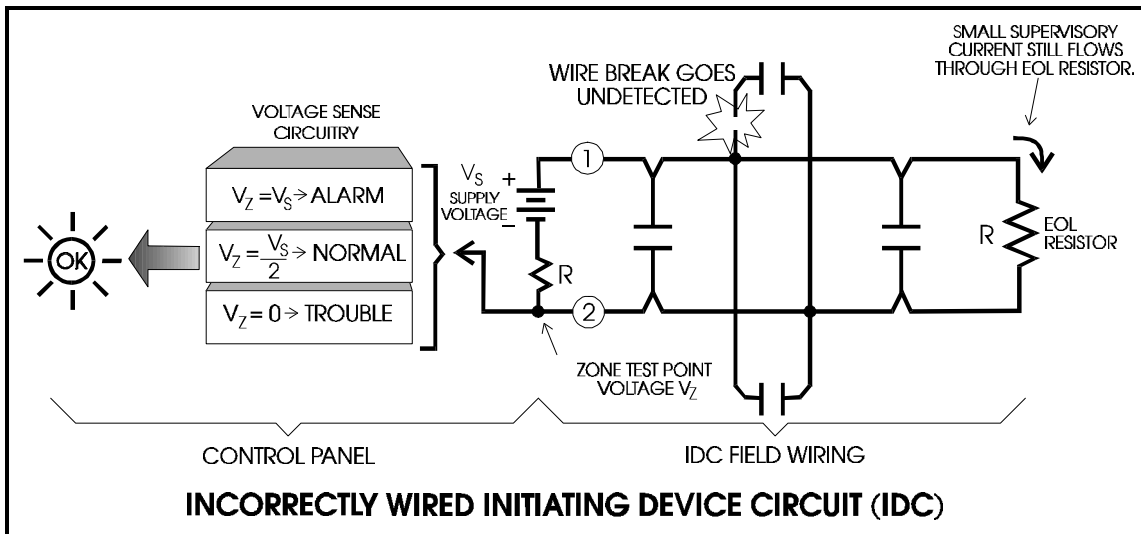


Figure 4

Large multiplex systems use sophisticated electronics that employs a system of "electronic questions and answers" to verify circuit viability. The control panel knows the "names" of all the devices that should be connected to it. After asking a "question" of each name or device on its list, the control panel must receive an answer from that device only. Failure to receive the proper answer causes the panel to generate a trouble signal. Because multiplex systems do not depend on the wiring *path* for supervision, some multiplex systems permit limited branch wiring or T-taps.

**CABLE SELECTION:**

The majority of fire alarm systems installed today use power limited circuits. These are low voltage circuits that automatically restrict the electrical current delivered to the field wiring. Power limited wiring is governed by the National Electric Code (NEC) Article 760. Field wiring size and distance limits are set by the fire alarm manufacturer. The manufacturer may also prohibit combining certain types of circuits in the same conduit. Installation requirements are set by local, state and national codes. All Power Limited Fire-Protective Signaling Cable must have its type designation marked on the cable. NEC Article 760 requires the following insulation types to be used on conductors installed as power limited wiring:

**FPL**

Type "FPL" cable may be used for general purpose fire alarm use without conduit, with the exception of riser, duct, or plenum applications.

**FPLP**

Limited energy cables installed in environmental air plenum spaces without conduit must carry a type "FPLP" designation.

**FPLR**

Limited energy cables installed in vertical riser shafts without conduit must carry the type "FPLR" or the "FPLP" designation.

Note that the cables used for power limited applications do NOT have the voltage rating stamped on the cable to avoid misapplication of power limited cable.

All wiring should use the cables approved by the fire alarm system manufacturer. Edwards recommended cables are shown in Table 1.

TABLE 1 - Edwards APPROVED CABLE MANUFACTURER'S PART NUMBERS							
MFG.	TYPE	#14 TWISTED PAIR		#16 TWISTED PAIR		#18 TWISTED PAIR	
		UNSHIELDED	SHIELDED	UNSHIELDED	SHIELDED	UNSHIELDED	SHIELDED
ATLAS	FPL	218-14-1-1TP*	218-14-1-1STP	218-16-1-1TP*	218-16-1-1STP	218-18-1-1TP*]	218-18-1-1STP
	FPLP		1762-14-1-2J	1761-16-1-2J	1762-16-1-2J	1761-18-1-2J	1762-18-1-2J
BELDEN	FPL	9580	9581	9572	9575	9571	9574
	FPLP	-	83752	-	-	-	-
WEST PENN	FPL	994	995	990	991	D980*	D975*
	FPLP	60993	60992	60991	60990	60980	60975

Fire Alarm systems use a variety of high and low level signals. Table 2 is a listing of cable functions that require shielding or physical separation in order to eliminate cross-talk and interference when bundled together.

Table 2 - Bundled or single conduit wiring considerations

	TRADITIONAL IDC	ZAS IDC	RS-232	RS-485	20 mA	FIBER OPTIC <sup>2</sup>	PHONE <sup>1</sup>	LOW LEVEL AUDIO <sup>1</sup>	25 Vrms AUDIO	70 Vrms AUDIO <sup>4</sup>	24 VDC CONTROL CIRCUITS <sup>2</sup>	120 Vac CONTROL CIRCUITS <sup>2</sup>
TRADITIONAL INDICATING DEVICE CIRCUIT	Y	Y	Y <sup>3</sup>	Y	Y	Y	Y	Y	Y <sup>3</sup>	N	Y	N
24 VDC INDICATING APPLIANCE & CONTROL CIRCUITS <sup>2</sup>	Y	Y	Y	Y	Y	Y	Y	Y	Y		Y	N
120 Vac CONTROL CIRCUITS <sup>2</sup>	N	N	N	N	N	Y	N	N	N	N	N	Y

NOTES:

Y = Yes, allowed; N = Not Allowed

All Wiring twisted pair cable unless noted.

- 1 Twisted-Shielded Cable Required.
- 2 Twisted Pair Cable not required.
- 3 Shield recommended on at least one cable.
- 4 Separate conduit recommended.

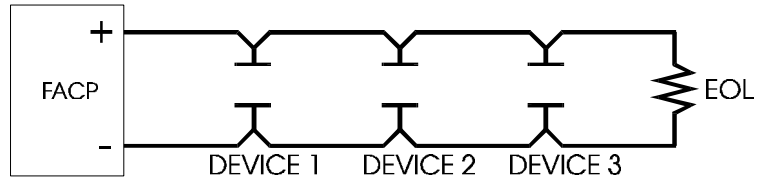
## BASIC WIRING PICTORIALS

The supervised wiring configurations commonly used when installing a fire alarm panel are referred to by function and style. The most common functions are Initiating Device Circuits (IDC), Indicating Appliance Circuits (IAC). Initiating device circuits connect the fire alarm panel to the system components that detect the fire, i.e., smoke detectors, manual pull stations, waterflow switches, etc. Indicating Appliance Circuits connect the fire alarm panel to the components which alert building occupants of the fire, i.e., bells, horns, speakers, strobe lights, etc.

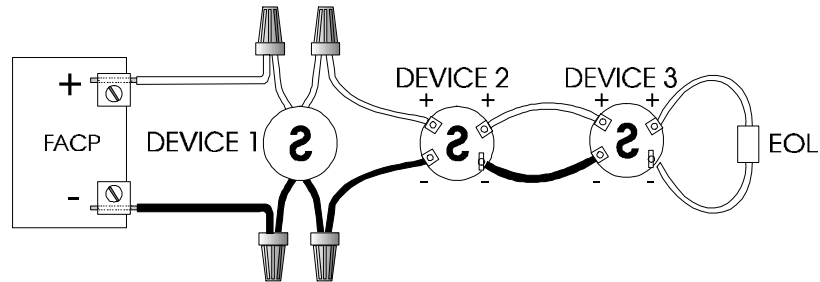
The following illustrations show schematics, wiring connections, riser diagram, and wire pull, for some commonly used fire alarm circuits.

## 2 Wire, Style B Initiating Device Circuit

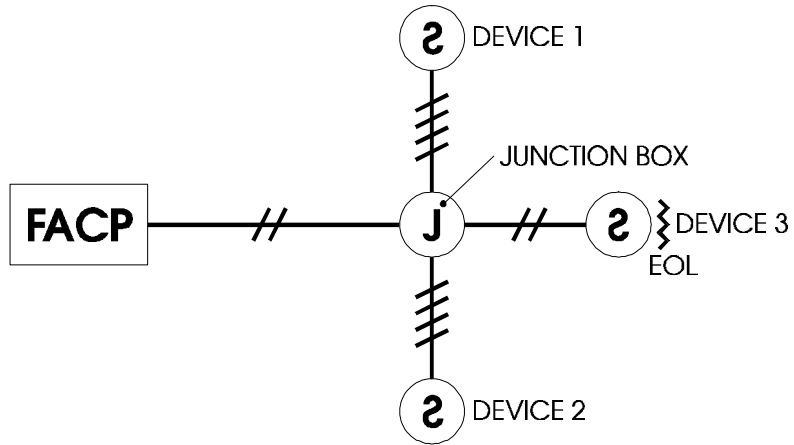
Schematic:



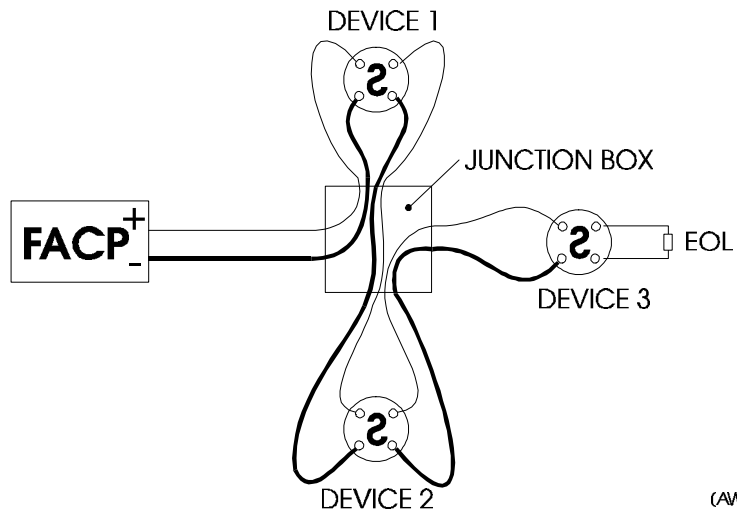
Wiring:



Riser:



Wire Pull:



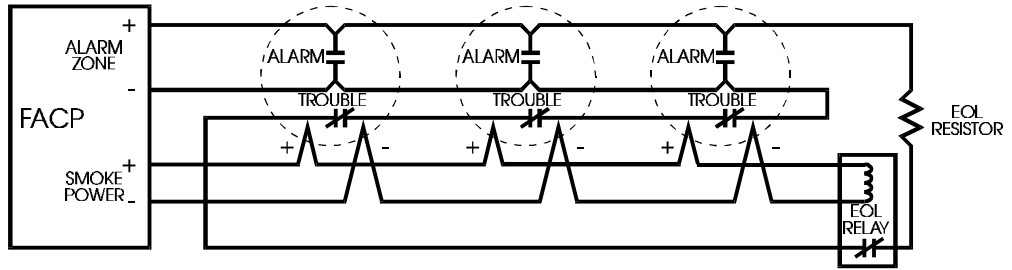
(AWIRE2.CDR)

Figure 6

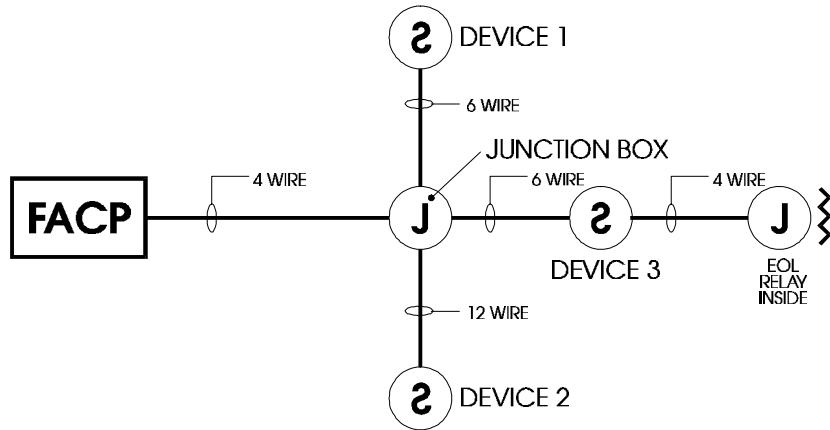


## "4 Wire", Style B Initiating Device Circuit With Trouble And Power Supervision

Schematic:



Riser:



(AWIRE4.CDR)

Figure 7

# "4 Wire", Style B Initiating Device Circuit With Trouble And Power Supervision

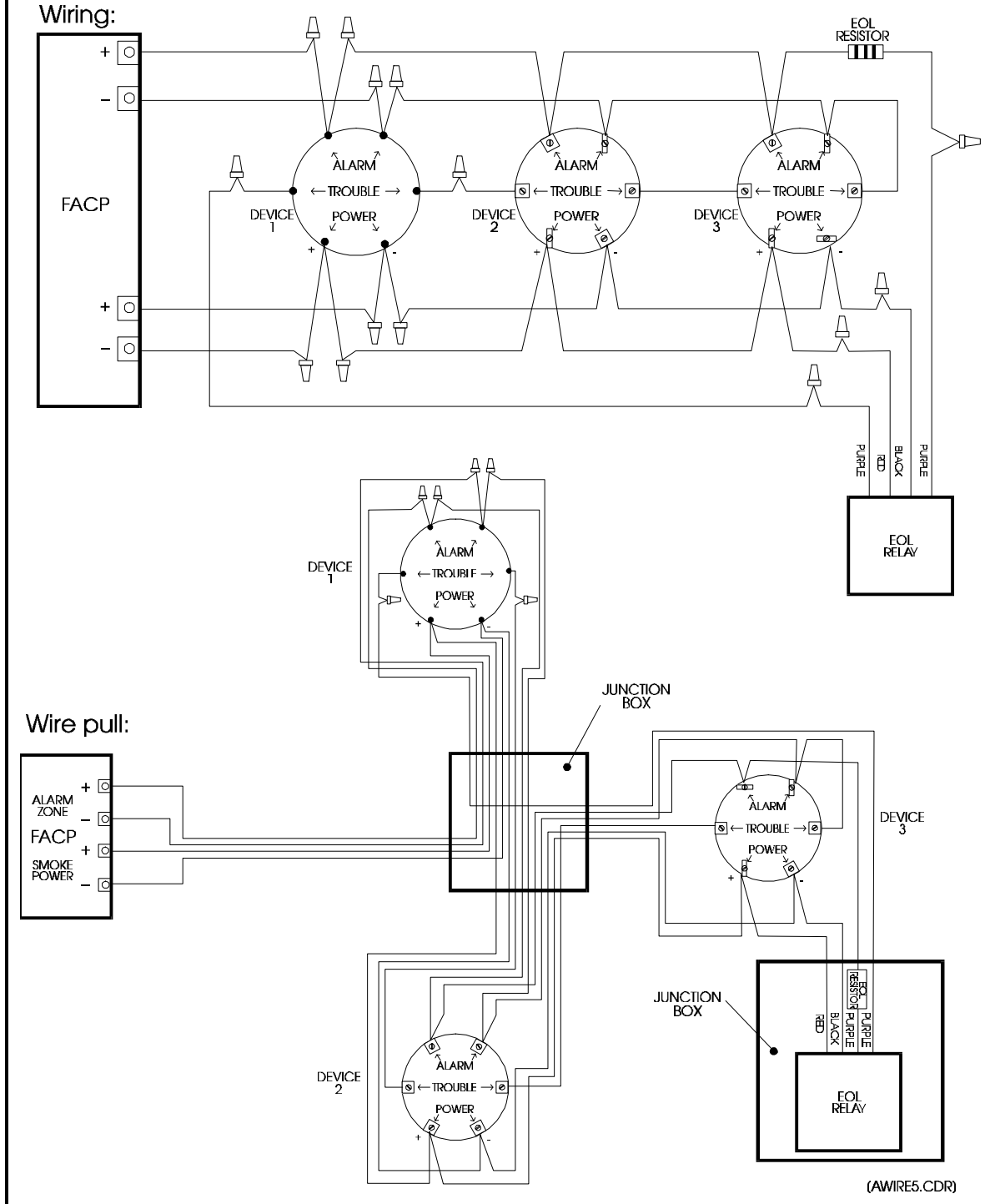
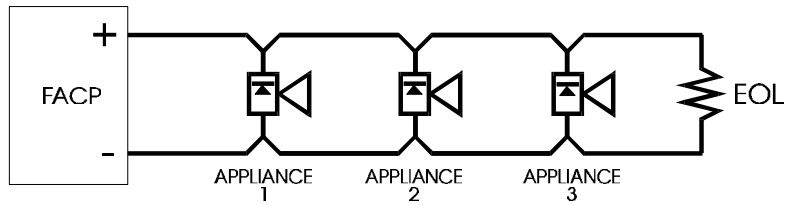


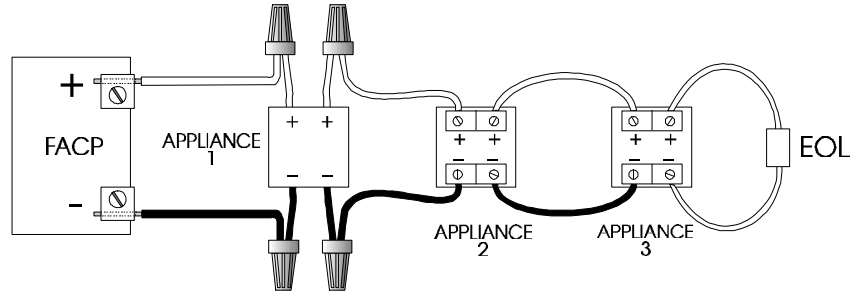
Figure 8

# Style Y Indicating Appliance Circuit

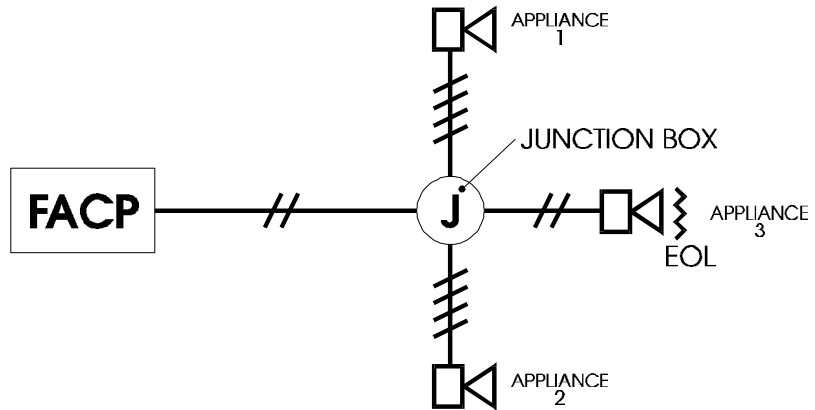
Schematic:



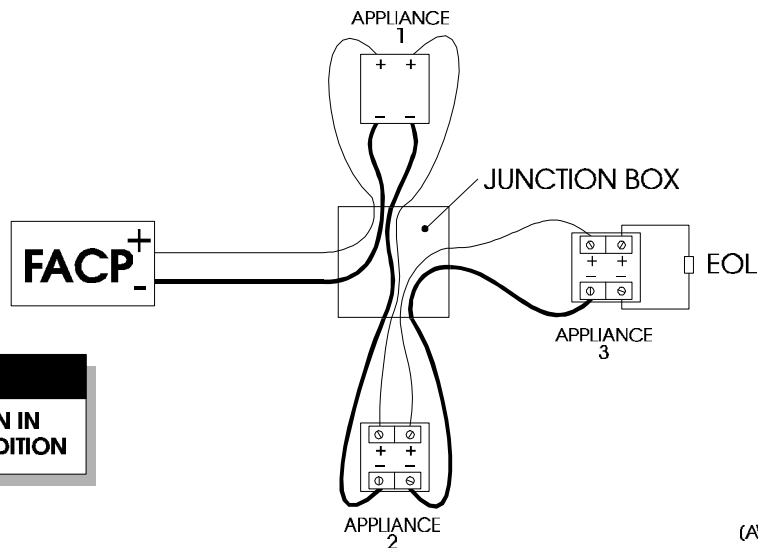
Wiring:



Riser:



Wire Pull:



**NOTE:**  
POLARITY SHOWN IN  
SUPERVISORY CONDITION

(AWIRE9.CDR)

Figure 9

# Style Z Indicating Appliance Circuit

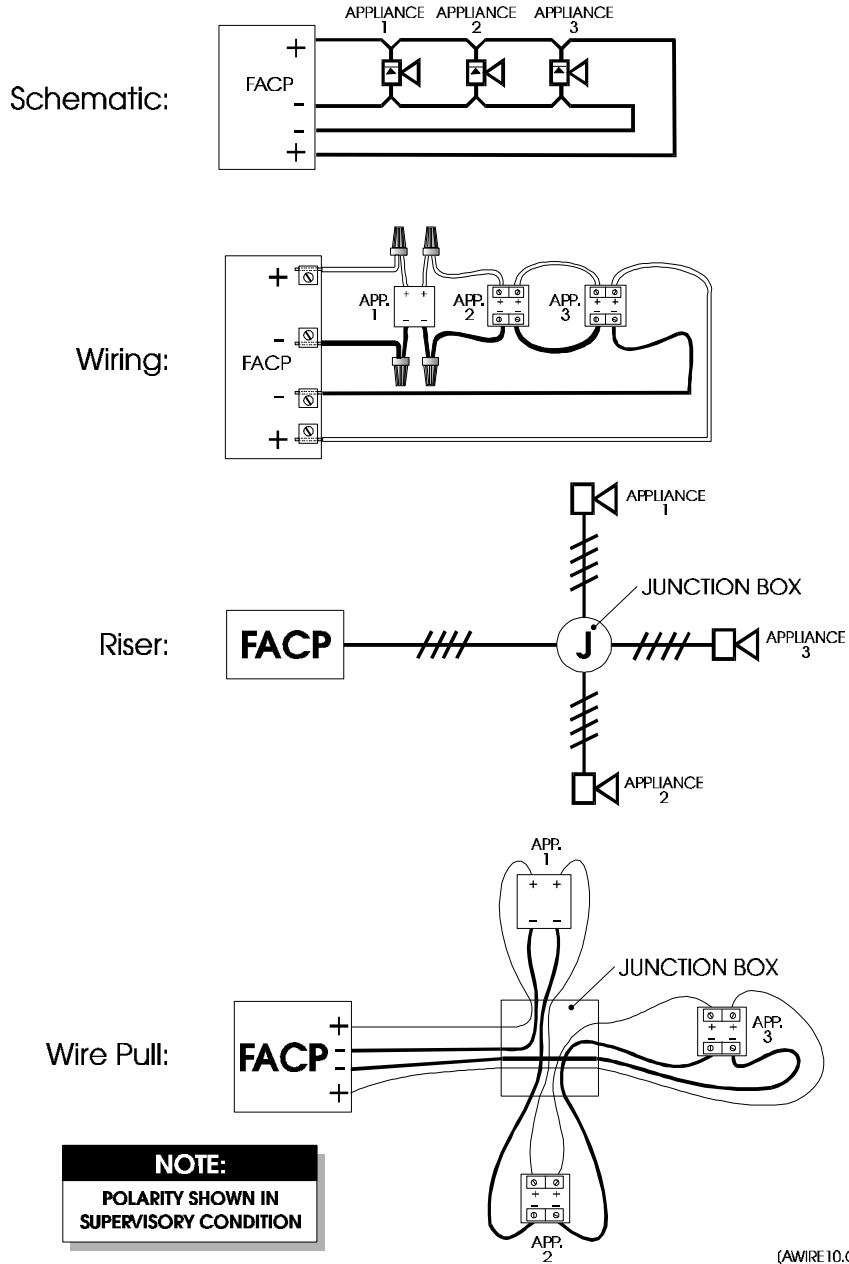


Figure 10

## TEST

Per NFPA Standard 72, *Testing Procedures for Local, Auxiliary, Remote Station and Proprietary Protective Signaling Systems*, before the cable conductors are terminated at the control panel or field devices they should be tested to verify their suitability for operation. The 72 standard requires that conductors be tested for: stray voltages, ground faults, short circuit faults, and that conductor continuity be verified and resistance values measured and recorded. The measured values should be compared with the manufacturer's requirements, to ensure compliance.

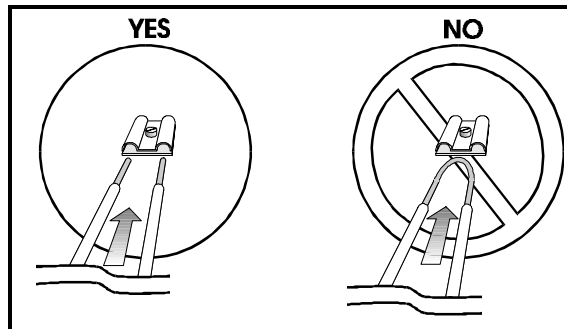
Failure to perform these simple tests can prolong the system de-bug time, and in some cases damage expensive equipment.

## TERMINATE

Fire alarm wiring and devices are required to be supervised by the electrical and fire alarm codes. This verifies the ability of the system to function properly during a fire. In order for the supervisory circuitry to operate properly, the fire alarm wiring and device installation must follow a few simple rules.

### RULE #1

ALWAYS BREAK A WIRE BEFORE CONNECTING IT TO A FIRE ALARM DEVICE. NEVER LOOP AN UNBROKEN WIRE UNDER ANY TERMINAL.



### RULE #2

CONNECT ONLY TWO (2) WIRES UNDER EACH WIRE NUT OR TERMINAL.

