

Fixed Electric Space-Heating Equipment

INTRODUCTION TO ARTICLE 424—FIXED ELECTRIC SPACE-HEATING EQUIPMENT

Many people are surprised to see how many pages Article 424 has. This is a nine-part article on fixed electric space heaters. Why so much text for what seems to be a simple application? The answer is that Article 424 covers a variety of applications—heaters come in various configurations for various uses. Not all of these parts are for the electrician in the field—the requirements in Part IV are for manufacturers.

Most electricians should focus on Part III, Part V, and Part VI. Fixed space heaters (wall-mounted, ceiling-mounted, or free-standing) are common in many utility buildings and other small structures, as well as in some larger structures. When used to heat floors, space-heating cables address the thermal layering problem typical of forced-air systems—so it's likely you'll encounter them. Duct heaters are very common in large office and educational buildings. These provide a distributed heating scheme. Locating the heater in the ductwork, but close to the occupied space, eliminates the waste of transporting heated air through sheet metal routed in unheated spaces, so it's likely you'll encounter those as well.

PART I. GENERAL

424.1 Scope. Article 424 contains the installation requirements for fixed electrical equipment used for space heating, such as heating cables, unit heaters, boilers, or central systems.

Author's Comment: Wiring for fossil-fuel heating equipment, such as gas, oil, or coal central furnaces, must be installed in accordance with Article 422, specifically 422.12.

424.3 Branch Circuits.

(B) Branch-Circuit Sizing. For the purpose of sizing branch-circuit conductors, fixed electric space-heating equipment is considered a continuous load.

Author's Comment: The branch-circuit conductors and overcurrent devices for fixed electric space-heating equipment must have an ampacity not less than 125 percent of the total heating load [210.19(A)(1) and 210.20(A)].

Question: What size conductor and overcurrent device (with 75°C terminals) are required for a 10 kW, 240V fixed electric space heater that has a 3A blower motor? **Figure 424-1**

- | | |
|-----------------|----------------|
| (a) 10 AWG, 30A | (b) 8 AWG, 40A |
| (c) 6 AWG, 60A | (d) 4 AWG, 80A |

Answer: (c) 6 AWG, 60A

Step 1: Determine the total load:

$$I = VA/E$$

$$I = 10,000 \text{ VA}/240\text{V}$$

$$I = 41.67\text{A} + 3\text{A} = 44.67\text{A, round to } 45\text{A [220.5(B)]}$$

Step 2: Size the conductors at 125 percent of the total current load [110.14(C), 210.19(A)(1), and Table 310.16]:

$$\text{Conductor} = 45\text{A} \times 1.25$$

$$\text{Conductor} = 56\text{A, 6 AWG, rated } 65\text{A at } 75^\circ\text{C}$$

Step 3: Size the overcurrent device at 125 percent of the total current load [210.20(A), 240.4(B) and 240.6(A)]:

$$\text{Overcurrent Protection} = 45\text{A} \times 1.25$$

$$\text{Overcurrent Protection} = 56\text{A, next size up is } 60\text{A}$$