

protection at the inputs to limit any possible fault voltages to less than the  $U_m$  marked on the product.

An IS system is required to be installed according to the control drawings, which may put limitations on cables and on the separation of circuits in the system. Control drawings also illustrate what is permitted to be connected in the system. Compliance with all the conditions in the control drawings is essential if intrinsic safety is to be maintained. The investigation of the equipment by third-party testing laboratories is based on installation in accordance with the control drawing. See Exhibit 504.2 for an example of a control drawing.

**(B) Location.** Intrinsically safe apparatus shall be permitted to be installed in any hazardous (classified) location for which it has been identified.

Associated apparatus shall be permitted to be installed in any hazardous (classified) location for which it has been identified.

Simple apparatus shall be permitted to be installed in any hazardous (classified) location in accordance with 504.10(D).

**(C) Enclosures.** General-purpose enclosures shall be permitted for intrinsically safe apparatus and associated apparatus unless otherwise specified in the manufacturer's documentation.

**(D) Simple Apparatus.** Simple apparatus shall be permitted to be installed in any hazardous (classified) location in which the maximum surface temperature of the simple apparatus does not exceed the ignition temperature of the flammable gases or vapors, flammable liquids, combustible dusts, or ignitable fibers/flyings present. The maximum surface temperature can be determined from the values of the output power from the associated apparatus or apparatus to which it is connected to obtain the temperature class. The temperature class can be determined by:

- (1) Reference to Table 504.10(D)
- (2) Calculation using the following equation:

$$T = P_o R_{th} \times T_{amb} \quad [504.10(D)]$$

where:

$T$  = surface temperature

$P_o$  = output power marked on the associated apparatus or intrinsically safe apparatus

$R_{th}$  = thermal resistance of the simple apparatus

$T_{amb}$  = ambient temperature (normally 40°C) and reference Table 500.8(C)(4)

**TABLE 504.10(D)** Assessment for T4 Classification According to Component Size and Temperature

Total Surface Area Excluding Lead Wires	Requirement for T4 Classification
<20 mm <sup>2</sup>	Surface temperature ≤275°C
≥20 mm <sup>2</sup> ≤10 cm <sup>2</sup>	Surface temperature ≤200°C
≥20 mm <sup>2</sup>	Power not exceeding 1.3 W*

\*Based on 40°C ambient temperature. Reduce to 1.2 W with an ambient of 60°C or 1.0 W with 80°C ambient temperature.

In addition, components with a surface area smaller than 10 cm<sup>2</sup> (excluding lead wires) may be classified as T5 if their surface temperature does not exceed 150°C.

Simple apparatus stores little or no energy. Simple apparatus is permitted to be used without requiring the apparatus to be listed or to be specifically mentioned on the control drawing. See the first informational note following the definition of *simple apparatus* in Article 100 for examples of simple apparatus.

**504.20 Wiring Methods.** Any of the wiring methods suitable for unclassified locations, including those covered by Chapter 7 and Chapter 8, shall be permitted for installing intrinsically safe apparatus. Sealing shall be as provided in 504.70, and separation shall be as provided in 504.30.

An IS system evaluation also includes wiring faults and cable parameters (e.g., short circuits and cable capacitance). Any of the wiring methods for unclassified locations may be used for IS systems, as long as the conditions specified in the control drawings are followed.

#### See also

**504.3** and its commentary for more information on the types of circuits typically used in an IS system

### 504.30 Separation of Intrinsically Safe Conductors.

It is essential that non-IS circuits and IS circuits be physically and electrically separated to prevent unsafe energy from being introduced into the IS system by a wiring fault. Other low-voltage, low-energy circuits, such as Class 2 and communications circuits, are not IS circuits and must not be installed in the same raceways or cables as IS circuits in either a hazardous or a nonhazardous location.

#### (A) From Nonintrinsically Safe Circuit Conductors.

**Δ (1) In Raceways, Cable Trays, and Cables.** Conductors of intrinsically safe circuits shall not be placed in any raceway, cable tray, or cable with conductors of any nonintrinsically safe circuit, unless they meet the requirements of one of the following methods:

- (1) Separated from conductors of nonintrinsically safe circuits in accordance with one of the following:
  - a. By a distance of at least 50 mm (2 in.) and secured
  - b. By a grounded metal partition that is 0.91 mm (0.0359 in.) or thicker
  - c. An approved insulating partition
- (2) All of the intrinsically safe circuit conductors or nonintrinsically safe circuit conductors are in Type MC cable, Type MI cable, or other approved grounded metal-sheathed or metal-clad cables where the sheathing or cladding is capable of carrying fault current to ground
- (3) In a Division 2 or Zone 2 location, installed in a raceway, cable tray, or cable along with nonincendive field wiring circuits when installed in accordance with 504.30(B)