

CHAPTER 4

COMBUSTIBILITY

1. **COMBUSTIBILITY CHARACTERISTICS** — Rigid urethane foams are organic and therefore will burn. The addition of fire retardants may reduce the susceptibility of urethane foams to ignite and may slow down the rate of combustion, but no fire retardant in current use will make urethane foam non-combustible. The terms combustible, non-combustible, flame-spread rating and fire resistance when used in this manual do not necessarily correspond to the meanings given in the National Building Code of Canada.

- 1.1 Ignition — When exposed to an exterior heat source, urethane foam can be ignited in two ways.

The first, flash ignition, occurs when a heat source impinges directly on the urethane foam. The gases evolved by the urethane when exposed to this heat will ignite at 310°C (590°F) and higher.

The second, spontaneous combustion, occurs when urethane foam is subjected to a heat source which does not actually come in contact with the urethane foam or the gases being evolved. The gases, when hot enough, will spontaneously ignite. This can occur when the gases reach a temperature of approximately 410°C (780°F) or higher.

It should be noted that temperatures in a fire normally reach at least 849°C (1200°F). Two different characteristics of the combustibility of urethane foams are of significance. These are flashover and burning rate.

Note that the following discussion of various coatings and aspects of combustibility does not imply acceptance or recommendations. Only those applications which conform to the requirements of the relevant Building Code should be undertaken.

- 1.1.1 **Flashover** — Flashover is a condition of rapid spread of flame across the surface of the foam. It is caused by the spontaneous combustion of the gases evolved by the urethane foam when heated. It is a surface phenomenon and does not usually involve the solid urethane. The heat generated may, however, char the urethane foam and cause it to ignite.

Almost any covering, from intumescent paint to thermal barriers will significantly reduce the problem of flashover. When covered, the surface burning characteristics of the coating are of paramount importance, rather than those of the urethane foam.

- 1.1.2 **Burning Rate** — When the urethane itself is burning, it evolves heat rapidly due to its low density. This, combined with its insulating properties, which contain the heat, can make a fire involving urethane foams extremely severe. The rapid build up of heat spreads the fire more rapidly to other building components.

The only way to control this aspect of urethane foam's combustibility is by covering the foam with a suitable thermal barrier.

- 1.1.3 **Thermal Barriers** — A thermal barrier is any material which is used to cover urethane foams to delay the transmission of heat from a fire source to the foam.

Thermal barriers are tested by exposing the urethane foam/thermal barrier combination to a heat source of known quantity and measuring the heat transmitted through the thermal barrier to the surface of the urethane foam. Thermal barriers are given a time rating, usually in minutes. 12.7 mm (one half inch) rated gypsum wall-board, usually regarded as the "standard" thermal barrier, has a rating of 12-15 min. Lath and plaster is also accepted.

There are numerous sprayed-on thermal barriers also available.

- 1.2 **Toxicity** — All organic materials give off toxic gases when burned. Urethane foam, when burned, gives off toxic gases that are similar to the gases given off by any organic material.

The toxic gas of main concern in a fire is carbon monoxide. Other gases given off by various organic materials such as urethane, wood, wool, nylon, etc. are carbon dioxide, hydrogen cyanide and nitrous oxides.

If the urethane foam is directly involved, it should be noted that one shortcoming in a fire is that smoke and toxic gases build up very rapidly compared to some other building materials.