

## Non-Combustible Thermal Insulation

Johns Manville is dedicated to empowering personnel to make safe choices, strengthening the safety of processes and protecting our planet. In facilities where there is potential fire danger involving combustible process fluids and elevated temperatures, including petrochemical plants and refineries, non-combustibility of thermal insulation is an important safety and design criterion. Toxic off-gassing from organic materials is particularly hazardous, especially in confined or poorly ventilated spaces.

There are three organizations that offer test methods for rating materials as being either “Combustible” or “Non-Combustible.” They are <sup>1</sup>ASTM, <sup>1</sup>ISO, and the US Coast Guard. There are also building and mechanical codes that reference one or more of these test methods including <sup>1</sup>ICC, <sup>1</sup>NFPA 90A & B, and <sup>1</sup>NFPA 101.

The three test methods are:

- <sup>1</sup>ASTM E136 - Standard Test Method for Behavior of Materials in a Vertical Tube Furnace at 750°C
- <sup>1</sup>ISO 1182 - Reaction to Fire Tests for Building Products - Non-Combustibility Test
- US Coast Guard 164.109 (previously 164.009) – Standard for Non-Combustibility

All of these test standards are very similar. Each test method exposes a small quantity of the insulation material to a high temperature furnace operating at 1382°F (750°C). The insulation is checked for internal and external temperature rise, visible flaming, and loss of weight.

To be classified as “non-combustible,” the insulation material must meet three performance criteria:

1. Any visible flame must disappear within 30 seconds of the test start;
2. The measured sample temperature (one thermocouple placed on the sample surface and the other in the sample center) must not increase by more than 54°F (30°C) during the test;
3. After being tested, the material must not lose more than 50% of its weight.

Insulations that commonly pass these tests are solid inorganic materials containing only small amounts of organic binder and/or fillers. Insulation materials that fail to meet the criteria typically contain a high percentage of organic binders and/or fillers.

There are many different types of non-combustible insulation materials: calcium silicate, perlite, some mineral wool products and cellular glass block insulations generally meet the requirements of non-combustible materials according to the three test procedures noted above.

Those that generally do not meet the requirements are plastic foams such as polystyrene, polyisocyanurate, phenolic, polyurethane, and most types of flexible elastomeric. As such, these insulation materials may not be suitable for use in applications where the insulation is either installed in a confined space where people work, or where there is a constant fire danger, as in a petrochemical facility. In confined spaces and/or when there is a constant fire danger, safety comes first and safety can be enhanced by limiting thermal insulation to materials rated as “Non-Combustible.”

## ASTM E136 Demonstration



**Figure 1:** A test specimen of calcium silicate 35 seconds after being inserted into the center of an <sup>1</sup>ASTM E136 furnace. Notice that there is no flame visible. Further, the specimen's surface temperature and interior temperature remained close to 1382°F (750°C), the original furnace temperature.



**Figure 2:** A test specimen of commercially available blanket insulation with a particularly high organic content 35 seconds after it was inserted into the <sup>1</sup>ASTM E136 furnace. Notice the visible flame. Since this flame is still visible after 30 seconds, this material would be classified as "combustible." Further, the specimen's center temperature increased to 1490°F and the surface temperature to 1454°F, both failing the criteria that these temperatures do not exceed 1382°F + 54°F = 436°F. So, this material fails two of the three criteria for being classified as non-combustible.

<sup>1</sup> ASTM-ASTM International West Conshohocken, PA [www.astm.org](http://www.astm.org)  
ICC-International Code Council Whittier, CA [www.iccsafe.org](http://www.iccsafe.org)  
ISO-International Organization for Standards Geneva, Switzerland [www.iso.org](http://www.iso.org)  
NFPA-National Fire Protection Assoc. Boston, MA [www.nfpa.org](http://www.nfpa.org)