

## Expanded Polystyrene Foam (EPS) Overview

Material Overview: Expanded polystyrene foam (EPS) is a white rigid cellular foam made by expanding and molding polystyrene beads. Common applications of EPS are packaging products (often seen as packaging in electronics such as DVD players and TV's), coffee cups, coolers, and other insulation materials.

Note: Polystyrene is a broad term and may include Expanded, Extruded, and Rigid Polystyrene foams. The 3 materials are fundamentally different and are generally NOT interchangeable.

1. **Extruded Polystyrene** is formed by the expansion of polystyrene base resin in an extrusion process. Common examples of extruded material are the pink Owens Corning and blue DOW 4'x8' sheets. Because this material is extruded (versus molded) the thickness of the material is limited. \*\*\*Note: Styrofoam is a trademarked name of Dow Chemical for the blue extruded polystyrene sheets.
2. **Rigid (or High Impact) Polystyrene** is a clear thermoplastic polymer that can be commercially manufactured and molding into products. A common example of rigid polystyrene is CD jewel cases. As the name suggests, this is a solid material not suited for packaging applications.

### Key Material Properties:

There are a number of factors that influence both the cost and properties of EPS.

These factors are noted below:

1. Density – EPS is available in a range of densities and is a key differentiating characteristic of EPS. In packaging applications, the density should be matched to the application. Lower densities have greater cushioning, but less strength. Higher densities are stronger but may offer less cushioning. The size and weight of the product being packaged along with the size of the packaging part are key considerations in determining the correct density.
  - a. Density is measured in Pounds per Cubic Foot (PCF). For example, a 1' x 1' x 1' block of foam should weight at least the minimum weight of the density (see further below).
  - b. The most common densities used include:  $\frac{3}{4}\#$ , 1#, 1  $\frac{1}{4}\#$ , 1  $\frac{1}{2}\#$ , 1  $\frac{3}{4}\#$ , 2#, and 3# PCF.
  - c. Density is a significant driver of cost. Denser material requires more resin and therefore has a higher cost.
  - d. Density can be referred to as or specified as a nominal or minimum amount (see Table 1).
    - i. **Nominal Density** refers to the weight of the resin beads before the molding process occurs.
    - ii. **Minimum Density** refers to the weight of the EPS material after the molding process is complete. Due to the release of gases, the minimum amount is lower than the nominal amount. Minimum density represents the lowest cubic foot weight a material can have and still be classified at a certain density.
  - e. Technical standards, such as ASTM C 578 refer to EPS densities by "Type". The "Type" corresponds to density and is noted below. \*Note that

in the text of the ASTM standard there are more types than those noted below. These additional types are generally extruded polystyrene.

Table 1:

PROPERTY	UNITS	Type XI	Type I	Type VIII	Type II	Type IX
DENSITY (Nominal)	Lb/ft <sup>3</sup>	.75	1.00	1.25	1.50	2.00
DENSITY (Minimum)	Lb/ft <sup>3</sup>	.70	.90	1.15	1.35	1.80

2. Recycled Content – EPS foam may be molded from virgin beads, or a combination of virgin bead and recycled material content. Material specifications should include whether the material is virgin or whether it contains recycled content (and the percentage of recycled content). Common ranges are 10-15% recycled content (often referred to as Commodity Standard Grade).
  - a. Material with recycled content will be cheaper, however it will not have the same properties as virgin material. In general, material with recycled content is more brittle, does not have the same amount of “fusion” in the beads and may be more abrasive.
  - b. Material with recycled content is most often used in roofing or construction applications where the increased abrasiveness and reduced fusion do not negatively affect the end use/result.
3. Flame/Fire Retardant – EPS foam may or may not contain a flame retardant. If the material is classified or described as “modified” it contains flame retardant. If the material is classified or described as “unmodified” it does NOT contain flame retardant.
  - a. EPS is a universal product in that the same material is used for multiple applications (i.e. insulation, packaging, coolers, etc.) Due to construction requirements, flame retardants are very common in the US. However, this may be less common in developing countries due to differences in standards.

#### Chemical Properties:

- Chemical Family: Polystyrene Thermoplastic
- Chemical Formula: (C<sub>8</sub>H<sub>8</sub>)<sub>N</sub>
- CAS Registry No.: 9003536
- CAS Name: Ethenylbenzene Homopolymer
  - Further info can be found at [www.cas.org](http://www.cas.org).

#### Specifying Material:

When specifying an EPS product the following properties should be specifically identified:

1. Material Description (specifically identifying EPS)
2. Material Density (Both Nominal and Minimum)
3. Material Detail (For example, Virgin or Recycled content)
4. Material Specialty (Flame Retardant)

Example:

White Expanded Polystyrene Foam  
 1# PCF Nominal; .9# PCF Minimum  
 Virgin Material  
 Modified