AUSTRALIAN URETHANE & STYRENE

Issue Date: May 2011

Technical Data Sheet

Expanded Polystyrene (EPS)

[EPS - Expanded Polystyrene is designated by plastic resin Identification Code 6]

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What is Expanded Polystyrene (EPS)

EPS is a closed cell lightweight cellular plastics material produced from polystyrene. The material has been modified by the addition of flame retardant additives.

Polystyrene literally translated is "polymerised styrene". That is, the single styrene molecules are chemically joined together to form a large molecule which is called the polymer. Styrene is produced from benzene and ethylene, and polymerisation is accomplished in the presence of catalysts, usually organic peroxides. The expandable form is produced as small beads containing a blowing agent.

The Manufacturing Process

Step 1. Pre-Expansion

The small expandable beads are subjected to steam, which causes the thermoplastic polystyrene to soften. Increasing vapour pressure caused by the blowing agent causes the beads to expand to up to 40 times their original volume. It is this pre-foam stage which determines the final density of the expanded polystyrene block.

Step 2. Aging

After pre-expansion the pre-foam is transferred via to fluidized drying bed to large silos for aging. This process is designed to allow for the replacement of expanding agent by air in the cells of the bead. Aging also allows for stabilization and cooling of the pre-foam.

Step 3. Moulding

Once conditioned by aging, the pre-foam is blown into a mould where further steaming causes the expanded beads to fuse into a block.

Step 4. Drying

To provide dimensionally stable dry blocks it is necessary to pass them through a temperature controlled oven. This process also ensures that any residual blowing agent has been removed.

Step 5. Finishing

For most customers the manufacturing process is not complete until the EPS blocks have been cut into various shapes. This process is mainly carried out using a hot wire cutting machine that gives a fine finish to the product and enables very fine cutting tolerances to be achieved.

Australian Standard

Australian Standard AS1366, Part 3 - 1992 Physical Properties of Rigid Cellular Polystyrene sets out minimum properties for six classes (see **Table 1**) and methods for determination and compliance. Flexibility in production allows EPS to be produced to this standard or to other requirements that specialised applications may demand.

Quality Control

To ensure compliance with customer requirements our Quality Assurance process monitors and tests various key properties.

Acoustic Properties

As EPS has a closed cell structure it offers only a limited absorption of airborne sound. Structure borne sound, transmitted though such structures as walls, may be effectively isolated by the use of floating floor systems. For this type of insulation EPS with the required dynamic stiffness can be obtained by compressing the sheets by 50 to 60 percent and then allowing them to recover to 80 or 90 percent of their original thickness.

Table 1 - Physical Properties of EPS according to AS 1366, Part 3 - 1992

Physical Property	Unit	Class						Test Method
		L	SL	S	M	H	VH	
Nominal Density (kg/m³)		11	13.5	16	19	24	28	n/a
Compressive stress at 10% deformation (min)	kPa	50	70	85	105	135	165	AS2498.3
Cross-breaking strength (min)	kPa	95	135	165	200	260	320	AS2498.4
Rate of water vapour transmission (max) measured parallel to rise at 23°C	$\mu g/m^2 s$	710	630	580	520	460	400	AS2498.5
Dimensional stability of length, width, thickness (max) at 70°C, dry condition 7 days	%	1.0	1.0	1.0	1.0	1.0	1.0	AS2498.6
Thermal resistance (min) at a mean temperature of 25°C (50mm sample)	M^2K/W	1	1.13	1.17	1.20	1.25	1.28	AS2464.5 or AS2464.6
Flame propagation characteristics: - median flame duration; max - eighth value; max - median volume retained; - eighth value; min.	 seconds seconds % %	 2 3 15 12	 2 3 18 15	 2 3 22 19	 2 3 30 27	 2 3 40 37	 2 3 50 47	AS2122.1

Thermal Properties

EPS gains its exceptional insulating properties from the stabilised air trapped within its cellular structure. Since it contains no CFCs or any other gas that may leak out, it will not harm the ozone layer or decrease its insulation properties.

As Australian Standard AS1366 - Part 3 is a minimum conformance standard the thermal resistances quoted will be achieved as a minimum in 97.5% of cases in a statistical sample, when tested at a mean sample temperature of 25°C.

For design purposes the average thermal resistance is a better guide than the minimum thermal resistance (refer to **Table 3 , page 4**).

Moisture Resistance

Of all the materials used for insulation applications, EPS is one of the most resistant to the adverse effects of moisture content. At ten times its dry weight, EPS has been found to maintain 80% of its R value.

Floatation Properties

The density of EPS is low compared to water, with a normal density range of 11 to 32 kg/m³ compared to water at 1000 kg/m³.
The water "buoyancy" per cubic metre of EPS is determined by subtracting its kg/m³ density from 1000. The result is the weight in kilograms that a cubic metre of EPS can support when fully submerged in water (allowance to be made for the water absorption of the EPS product which is typically 50 - 85 kgs per cubic metre).

Temperature Cycling

EPS is able to withstand the effects of temperature cycling thereby providing long term performance in low temperature applications.

Core specimens of EPS removed from freezer walls in place for twenty years have demonstrated no deterioration in the structural integrity or physical properties.

The **k** value of EPS decreases at lower average mean temperatures, hence its popularity and success in sub-zero applications.

Toxicity

Extensive research programs have been conducted overseas [(i)] to determine if thermal decomposition products of EPS present a toxicity hazard. The test results have revealed that these decomposition products are less harmful than those of burning wood.

Gases released during combustion are predominantly carbon monoxide and, to a lesser extent, carbon dioxide. A CSIRO report [(ii)] comments that the toxicity of the gases associated with the burning of EPS is no greater than that associated with timber.

Combustibility

As with all other organic material, EPS insulation products must be considered combustible and to constitute a fire hazard if improperly used or installed.

EPS products should not be exposed to open flames or other ignition sources.

The material contains a flame retardant additive to inhibit accidental ignition from small fire sources. Table 2 shows test results for EPS and other common building materials to provide a good guide as to how these products compare.

(i) H.Hoffmann & H Oettel "Comparative Toxicity of Thermal Decomposition Products

(ii) P.R.Nicholl & K.G. Martin "Toxicity Considerations of Combustion Products from Cellular Plastics."

TABLE 2 - Comparative Testing of some materials to AS/NZS 1530.3 -1999 - Early Fire Hazard Test

Material	Ignitability Index (0-20)	Spread of Flame Index (0-10)	Heat Evolved Index (0-10)	Smoke Developed Index (0-10)
EPS	12	0	3	5
Australian Softwood	16	9	7	3
Oregon	13	6	5	3
Bluegum	11	0	3	2
Polyurethane FR Grade Sheet Foam	18	10	4	7

Source: EBS Notes on the Science of Building NSB66 + AUSTHANE BF35 AS 1530.3 -1999 Test Certificate

TABLE 3 - Thermal Conductivity Design Values – k factor [W/m.K]

(a) Determine mean temperature of insulation in °C

The simplest way to determine the mean temperature is to add the insulation warm side temperature to the insulation cold side temperature and divide by two.

(b) Select the Class of EPS from AS 1366.3

(c) Look up the relevant **k** value in the table for the mean temperature

EPS CLASS / Temperature	L	SL	S	M	H	VH
0	.0389	.0370	.0360	.0349	.0337	0321
1	.0391	.0372	.0361	.0350	.0338	.0322
2	.0393	.0374	.0363	.0351	.0339	.0323
3	.0394	.0375	.0364	.0353	.0341	.0325
4	.0396	.0377	.0366	.0354	.0342	.0326
5	.0397	.0378	.0367	.0356	.0343	.0327
6	.0399	.0380	.0369	.0359	.0344	.0328
7	.0401	.0382	.0370	.0358	.0346	.0330
8	.0402	.0383	.0372	.0360	.0347	.0331
9	.0404	.0385	.0373	.0361	.0348	.0332
10	.0406	.0386	.0375	.0362	.0349	.0333
11	.0407	.0388	.0376	.0364	.0351	.0335
12	.0409	.0389	.0378	.0365	.0352	.0336
13	.0410	.0391	.0379	.0367	.0353	.0337
14	.0412	.0393	.0381	.0368	.0354	.0338
15	.0414	.0394	.0382	.0369	.0356	.0340
16	.0415	.0396	.0384	.0371	.0357	.0341
17	.0417	.0397	.0385	.0372	.0358	.0342
18	.0419	.0399	.0387	.0373	.0359	.0343
19	.0420	.0401	.0388	.0375	.0361	.0345
20	0422	.0402	.0390	.0376	.0362	.0346
21	.0423	.0404	.0391	.0378	.0363	.0347
22	.0425	.0405	.0393	.0379	.0364	.0348
23	.0427	.0407	.0394	.0380	.0366	.0350
24	.0428	.0408	.0396	.0382	.0367	.0351
25	.0430	.0410	.0397	.0383	.0368	.0352
26	.0432	.0412	.0399	.0384	.0369	.0353
27	.0433	.0413	.0400	.0386	.0371	.0355
28	.0435	.0415	.0402	.0387	.0372	.0356
29	.0437	.0416	.0403	.0388	.0373	.0357
30	.0438	.0418	.0405	.0390	.0374	.0358
31	.0440	.0419	.0406	.0391	.0376	.0360
32	.0441	.0421	.0408	.0393	.0377	.0361
33	.0443	.0423	.0409	.0394	.0378	.0362
34	.0445	.0424	.0411	.0395	.0379	.0363
35	.0446	.0426	.0412	.0397	.0381	.0365
36	.0448	.0427	.0414	.0398	.0382	.0366
37	.0450	.0429	.0415	.0399	.0383	.0367
38	.0451	.0431	.0416	.0401	.0384	.0368
39	.0453	.0432	.0418	.0402	.0386	.0370
40	.0454	.0434	.0420	.0404	.0387	.0371
41	.0456	.0435	.0421	.0405	.0388	.0372
42	.0458	.0437	.0423	.0406	.0389	.0373
43	.0459	.0438	.0424	.0408	.0391	.0375
44	.0461	.0440	.0426	.0409	.0392	.0376
45	.0463	.0442	.0427	.0410	.0393	.0377
46	.0464	.0443	.0429	.0412	.0394	.0378
47	.0466	.0445	.0430	.0413	.0396	.0380
48	.0467	.0446	.0432	.0415	.0397	.0381
49	.0469	.0448	.0433	.0416	.0398	.0382
50	.0471	.0450	.0435	.0417	.0399	.0383
51	.0472	.0451	.0436	.0419	.0401	.0385
52	.0474	.0453	.0438	.0420	.0402	.0386
53	.0476	.0454	.0439	.0421	.0403	.0387
54	.0477	.0456	.0441	.0423	.0404	.0388
55	.0479	.0457	.0442	.0424	.0406	.0390
56	.0481	.0459	.0444	.0425	.0407	.0391
57	.0482	.0461	.0445	.0427	.0408	.0392
58	.0484	.0462	.0447	.0428	.0409	.0393
58	.0485	.0464	.0448	.0430	.0411	.0395
60	.0487	.0465	.0450	.0431	.0412	.0396