Isolite®

RMAX Isolite® expanded polystyrene

NO CFC'S

TECHNICAL DATA

Rigid Cellular Plastics

A division of Huntsman Chemical Company
Australia Pty. Limited ABN 48 004 146 338

Isolite® is the brand name for RMAX block moulded flame retardant modified grade of EPS (expanded polystyrene).

It is a closed cell, resilient, lightweight rigid cellular plastics material produced in a range of densities between 10 kg/m³ and 35 kg/m³.

The main applications for products manufactured from Isolite® are thermal insulation systems (wall, roof and sub-floor), ceiling panels and other decorative surfaces, Voidforms® and blockouts, pipe insulation, protective packaging, floatation and buoyancy applications, and stage sets.

Manufacturing process

Pre expansion

Expanded polystyrene is supplied as plastic beads in which an expanding agent, usually pentane, has been dissolved. In the presence of steam the thermoplastic polystyrene softens and the increasing vapour pressure of the expanding agent causes the beads to expand up to 50 times their original volume. During this stage the degree of expansion is controlled to achieve the desired density. Expanded polystyrene does not contain any ozone depleting substance and none is used in it's manufacture.

Conditioning

From the pre-expander the beads are gently transported to large hoppers for ageing. The time of ageing is set to cool and stabilise the beads and allow for infusion of air to replace the expanding agent in the cells.

Moulding

After conditioning, the beads are charged into a closed mould where they are further expanded and fused together by steam heating.

Finishing

The freshly moulded blocks of Isolite® are passed through temperature controlled ovens to remove moisture and the final traces of the expanding agent, and to provide blocks of constant dimensional stability.

Manufactured to a standard

Isolite® EPS is manufactured to AS 1366 Part 3-1992, Rigid Cellular Plastic Sheets for Thermal Insulation, Rigid Cellular Polystyrene, in six classes. The standard designates a colour to identify each of the six classes:

Class L: Blue	Class M: Black
Class SL: Yellow	Class H: Green
Class S: Brown	Class VH: Red

The standard specifies the minimum physical property limits for each of the six classes (See Table 1) and methods for determination of compliance.

Quality control

To meet with the compliance requirements of the standard, the RMAX quality control system monitors and controls each stage of the manufacturing process and assures that Isolite® conforms to AS 1366.3 within 95% confidence limits by on site testing of density and key physical properties

Comprehensive physical testing for product development and quality assurance is carried out in the company's own laboratory, which is NATA accredited.

Properties of Isolite®

The physical properties are primarily determined by the moulded density for well made oven cured EPS.

(See Fig.1 to 4).

However, these properties will be affected by raw material and manufacturing variations, and for this reason Australian Standard 1366-3-1992 specifies the classes in terms of performance properties rather than density.

The standard lists Nominal Density for each class (See Table 2), but these densities should be regarded as a guide only as the physical properties shown in Table 1 may be achieved by EPS of other densities.

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

		Class						
Physical property	**Unit**	**L**	**SL**	**S**	**M**	**H**	**VH**	**Test method**
Compressive stress at 10% deformation (min.)	kPa	50	70	85	105	135	165	AS 2498.3
Cross-breaking strength (min.)	kPa	95	135	165	200	260	320	AS 2498.4
Rate of water vapour transmission (max.) measured parallel to rise at 23ºC	$\mu g/m^2.s$	710	630	580	520	460	400	AS 2498.5
Dimensional stability of length, width, thickness (max.) at 70ºC, dry condition 7 days	percent	1	1	1	1	1	1	AS 2498.6
Thermal resistance (min.) at a mean temperature of 23ºC (50mm sample)	$m^2.K/W$	1	1.13	1.17	1.20	1.25	1.28	AS/NZS 4859.1
Flame propagation characteristics:								AS 2122.1
- median flame duration (max.)	SD	2	2	2	2	2	2	
- eight value (max.)	SD	3	3	3	3	3	3	
- median volume retained	percent	15	18	22	30	40	50	
- eight value (min.)	percent	12	15	19	27	37	47	
1 W/m.K=6.93 Btu in/ft²h.ºF								

Table 2: Nominal Density, kg/m^3

Class					
L	SL	S	M	H	VH
11	13.5	16	19	24	28

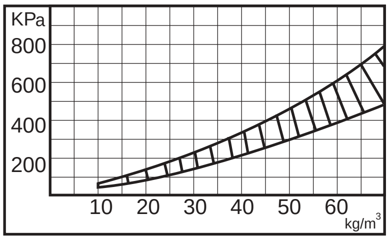

Fig. 1: Stress at 10% deformation v density

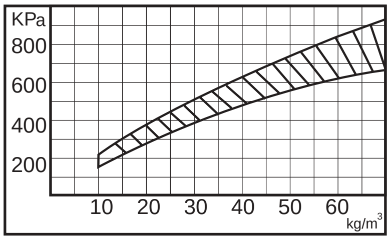

Fig. 3: Tensile strength v density

Mechanical properties

The density dependency of the main physical properties of Isolite® can be seen in (Fig.1 to 4): Compressive strength, Cross Breaking strength (flexural strength) Tensile strength and Shear strength.

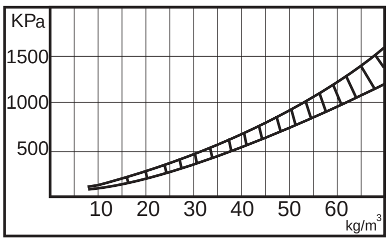

Fig. 2: Cross-breaking strength v density

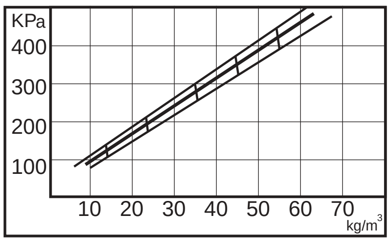

Fig. 4: Shear strength v density at 23ºC

Compressive creep

It is common to report only the compressive stress at 10% deformation but the latter is often taken from complete stress-strain curves as shown in (Fig.5). Although it appears to deform elastically over a range of comprehensive loads, Isolite® that has been stressed will, with the release of all stress, retain some permanent deformation.

(Fig.1 to 5) can be useful for short term loads where some deformation is acceptable. For long term loads (Fig.6), showing compressive creep under constant loads versus

time, should be used.

It should be noted that compressive Strength in AS 1366.3 is a performance characteristic at 10% deformation and should not be taken as a universal design loading recommendation.

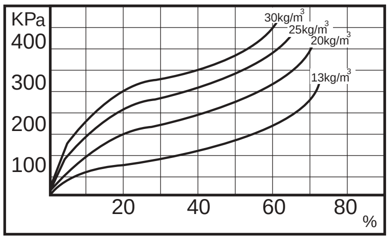

Fig. 5: Stress v compressive strain

Floatation properties

The density of Isolite® is low compared with water, with a nominal density range from 10 to 25 kg/m³ compared with water at 1000 kg/m³. The water buoyancy per cubic metre of Isolite® is determined by subtracting its kg/m³ density from 1000. The result is the weight in kilograms which a cubic metre of Isolite® can support when fully submerged in water.

Thermal properties

The low thermal conductivity (K value) of Isolite® characterises its exceptional insulating properties. (See Fig.7).

As (Fig.8) shows, EPS has a remarkably high R value compared with most other insulating material used in similar applications.

Isolite® EPS gains its thermal resistance from the stabilised air trapped within its cellular structure; it contains no fluorocarbon blowing agent that might cause depletion of ozone in the upper atmosphere.

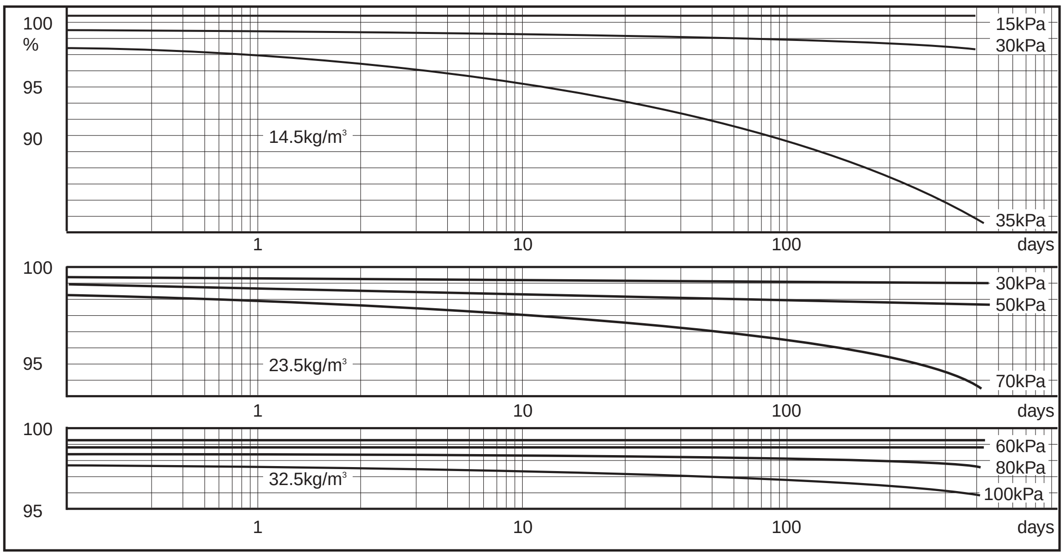

Fig. 6: Compressive creep: stress strain curves for extended periods of time

Design thermal properties

As Australian Standard 1366 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 23ºC.

Thermal resistance varies with mean insulation temperature, where mean insulation temperature is the average of the temperature on either side of the insulation.

For design purposes the average thermal resistance is a better guide than the minimum thermal resistance.

A full listing of design thermal conductivity values for each class of EPS at differing mean temperatures is shown on Table 8.

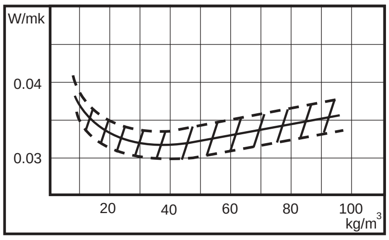

Fig. 7: Thermal conductivity at 10ºC v density

Concrete	0.04
Brick	0.043
Glass	0.048
EPS Concrete	0.12
Wood	0.35
Compressed Wood	0.83
Fibreglass	1.0
EPS – Class SL	1.13
EPS – Class VH	1.28

Fig. 8: Typical R Values, various insulating materials 50mm thick

Low temperature operation

Isolite® does not become brittle at sub-zero temperatures. The testing of specimens at –75ºC for 48 hours demonstrates no loss of impact resistance compared with specimens tested at +23ºC.

It is able to withstand temperature cycling and thereby assure long term performance without the loss of structural integrity of physical properties; core specimens taken from 20 year old freezer rooms show no deterioration.

Unlike some other insulating materials, the K value of Isolite® decreases at lower average mean temperatures (See Fig.9).

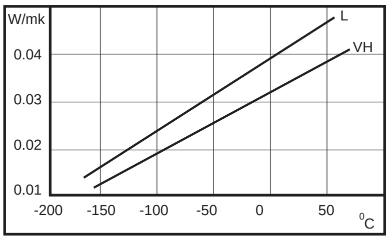

Fig. 9: Indicative thermal conductivity v temperature

High temperature operation

The effect of elevated temperatures on the mechanical properties is an accelerating decline in the values shown in (Fig.1 to 5) until at approximately 85ºC the so-called zero strength is reached. (See Fig.10).

Isolite® should not be continuously exposed to temperatures in excess of 80ºC as expansion and blistering may occur.

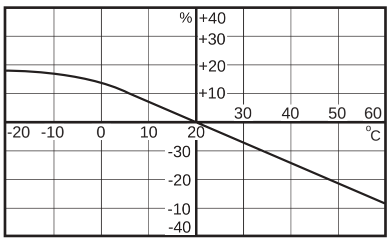

Fig. 10: Change in stress at 10% deformation, relative to K value at 20ºC, v temperature

Table 3: Moisture gain of EPS by liquid water absorption

Time Period	Test Condition	% by volume
1 day	ASTM C-272	2.5
7 days	Submersion	3.0
7 days	10 metre submersion	3.0
90 days	Submersion	6.0
550 days	Submersion	7.8
1000 days	Burial in wetted soil	1.7

Table 4: Typical thermal performance by EPS thickness after vapour induced moisture gain.

Moisture Gain (% by volume at 25mm)	R value retention%			
	25mm	50mm	75mm	100mm
2	96	98	99	99
4	92	96	97	98
6	89	94	96	97
8	86	92	95	96
10	84	90	93	95
12	82	89	92	94
14	80	88	91	93

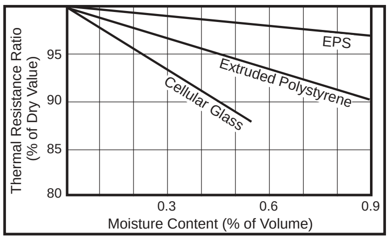

Fig. 11: Thermal resistance v's moisture content curves for EPS, extruded polystyrene and cellular glass

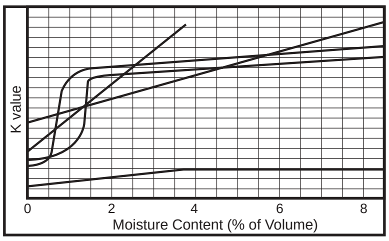

Fig. 12: The effect of moisture on K values, various insulating materials

Effect of moisture on K value

The dimensional stability and mechanical properties of Isolite® are not affected by water but because absorbed water will increase the K value, as with all insulating materials, care should be taken in designing insulated structures to take account of water and water vapour that may be present.

While Table 3 shows that certain amounts of water are absorbed by EPS under various conditions, Table 4 demonstrates that the loss of R values in EPS as a result of this moisture absorption is minimal. Overseas research [Ref(i)] has so revealed that the decay in thermal resistance caused by moisture is considerably less for EPS than for either extruded polystyrene foam or cellular glass. (See Fig.11).

As with other building materials care should always be taken to keep Isolite® dry before and during installation.

Water vapour transmission properties

Although Isolite® has a low water vapour transmission rate it is not considered a vapour barrier. This breatheability characteristic reduces any tendency towards the formation of vapour dams.

As (Fig.12) shows, of all the material used for insulation purposes, EPS is one of the most resistant to the adverse affects of moisture.

In applications where the high humidity and high temperature differentials are likely a vapour barrier should be installed. Normally the vapour barrier should be installed on the warm side of the structure with the insulation as near as possible to the cold side.

Acoustic properties

Because Isolite® has a closed cell structure, it offers only a limited absorption of airborne sound.

Structure borne sounds, transmitted through such structures as walls and pipes, may be effectively isolated by the use of floating floor systems. For this type of sound insulation, Isolite® 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 to 90 per cent of their original thickness.

Chemical properties

Isolite® is resistant to virtually all aqueous media including dilute acid and alkalis. In addition, it is resistant to water-miscible alcohols such as methanol, ethanol and i-propanol, and also to silicon oils.

Isolite® has limited resistance to paraffin oil, vegetable oils, diesel fuel and vaseline. These substances may attack the surface of Isolite® after long term contact. Isolite® is not resistant to hydrocarbons, chlorinated hydrocarbons, ketones and esters.

Paint containing thinners and solutions of synthetic adhesives naturally fall in to the same category, and this should be taken into account in any painting or bonding operation.

Anhydrous acids such as glacial acetic acid or fuming sulphuric acid destroy Isolite®.

Prolonged exposure to UV light causes yellowing and embrittlement of Isolite®, which should therefore be protected from direct outdoor exposure.

Resistance to specific reagents is given in the RMAX technical data sheet **Isolite® Chemical Resistance.**

Table 5: Electrical properties (Normal density 16kg/m^3)

Frequency cps.	Dielectric Constant	Dissipation Factor	Loss Factor	Volume Resistivity	Surface Restivity	Dialectric Strength
60	1.19	.0005	.0006			
1000	1.07	.0005	.0006	3.8×10^{13}	9.18×10^{6}	49
1000000	1.02	.0005	.0006			

Table 6: Comparative testing of Early Fire Hazard properties for selected materials

Material	Ignitability Index (0 -20)	Spread of Flame Index (0-10)	Heat Evolved Index (0-10)	Smoke Produced Index (0-10)
Isolite® with sisalation 450 facing	0	0	0	0-1
Isolite® sandwhich panel faced both sides with 0.65mm Steel	0	0	0	0
Isolite® expanded polystyrene	12	0	3	5
Isothane® rigid polyurethane	18	10	4	7
An Australian Hardboard (4.75mm)				
- Bare	14	6	7	3
- Impregnated with fire retardant	0	0	0	7
An Australian Softboard (12.70mm)				
- Bare	16	9	7	3
- Impregnated with fire retardant	4	0	0	7
T&G Boarding (25 x 100mm)				
- Bluegum	11	0	3	2
- Oregon	13	6	5	3
Plywood, Coachwood Veneer (4.75mm)				
- Bare	15	7	7	4
- Impregnated with fire retardant	12	0	3	5

Resistance to fungi and bacteria

Fungus attack has not been observed on Isolite®, and it does not support bacterial growth. Surface spoilage (in the form of spilt soft drink, sugar, etc) can however supply the nutrient for fungal or bacterial growth.

Resistance to ants, termites, rodents and marine borers

Since is has no food value, Isolite® does not attract ants, termites, or rodents, however, it is not a barrier to them. Ants, termites and rodents will chew through Isolite® to reach food or establish a comfortable home.

Marine borers can attack EPS, as they do wood and Isolite® should be protected by an anti-fouling paint over a suitable primer.

Electrical properties

The electrical characteristics of Isolite® (See Table 5) and air are similar. This applies to arc resistance, as well as other electrical properties. The EPS melts about the path of an arc as soon as the arc penetrates it.

Dielectric loss of Isolite® is quite low.

Table 7: Maximum Toxicity Index

	Toxicity Index due to:				
Material	HCN	CO	CO2	HC1	Total
Acrylic fibre	1.19	0.02	<0.01	-	1.21
Nylon	0.43	0.08	0.01	-	0.52
Wool	0.33	0.04	0.01	-	0.38
PVC	-	0.27	<0.01	0.29	0.36
Urea-formaldehyde foam	0.26	0.01	<0.01	-	0.27
Rigid polyurethane foam	0.05	0.05	<0.01	-	0.10
Polystyrene	-	0.09	0.01	-	0.10
White pine	-	0.09	0.003	-	0.09

Flammability properties

Expanded polystyrene products are combustible and should not be exposed to open flame or other ignition sources.

As with all other organic material, insulation products must be considered combustible and to constitute a fire hazard if improperly used or installed. The material contains a flame retardant additive to inhibit accidental ignition from small fire sources.Table 6 shows test results for Isolite® and other common building materials to provide a guide as to how these products compare.

Intending users of Isolite® should obtain a copy of 'Recommendations for the storage and handling of EPS', available from any RMAX office.

Coefficient of linear thermal expansion

The coefficient of linear thermal expansion for Isolite® is 6.3 x 10^{-5} m/m deg K.

Toxicity

The heat of combustion of solid polystyrene polymer is 40, 472kJ/kg; combustion products are carbon dioxide, water, soot (carbon), and to a lesser extent carbon monoxide.

A CSIRO report [Ref (ii)] comments that the toxicity of gases associated with the burning of EPS is no greater than that associated with timber. Extensive research programs have been conducted overseas [Ref (iii)] to determine if thermal decomposition products of EPS present toxicity hazard. The test results have revealed that the toxicity of the decomposition products appears to be no greater than for wood and decidedly less than other conventional building products.

References

(i) Wayne Tobiasson and John Ricard, US Army Cold Regions Research and Engineering Laboratory, 'Moisture gain and its thermal consequences for common roof insulations'.

(ii) P.R. Nicholl and K.G. Martin, 'Toxicity considerations of combustion products from cellular plastics'.

(iii) H.Th Hofmann and H. Oettel, 'Comparative toxicity of thermal decomposition products'.

Thermal conductivity design values – W/m K

(a) Determine mean temperature of insulation in ⁰C
To = Temperature on outside surface of insulation
Ti = Temperature on inside surface of insulation
(b) Select the class of EPS from AS 1366.3
(c) Look up relevant K value in the table for the mean temperature in ⁰C Thermal conductivitiy quoted in W/mK

$$T\ mean = \frac{To + Ti}{2}$$

Table 8: Thermal Conductivity W/mK

Class – Temperature	L	SL	S	M	H	VH
0	.0398	.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	.0357	.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
59	.0485	.0464	.0448	.0430	.0411	.0395
60	.0487	.0465	.0450	.0431	.0412	.0396

Notes

Isolite® insulation

Isolite® flame retardant modified EPS is manufactured by RMAX for use in a variety of insulation applications including metal skin sandwich panels, prefabricated building components and composite ceiling panels. It is also manufactured into a wide range of roof, wall and floor slab products.

EPS in packaging

One of the many other important applications for EPS is packaging, The properties of lightness, shock absorption, low thermal conductance, resistance to moisture and weathering, absence of taste and odour, a soft satiny surface and attractive appearance make EPS an excellent packaging material for sensitive and high unit value products.

RMAX services

As the largest manufacturer of EPS in Australia, RMAX is able to offer customers a range of design, testing and other services together with advice on the processing of EPS by the block moulding, shape moulding, hot wire cut, cavity cutting and computerised profile cutting processes. Enquiries are welcome and should be directed to your nearest RMAX office.

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Notes

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Australia's Largest
Rigid Cellular Plastics Manufacturer

RMAX pursues a policy of continuous improvement in the design and performance of its products. The right is therefore reserved to vary specifications without notice.

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