

The Expanded Polystyrene
Packaging Group

Buyers' Guide



Environment

EPS packaging has a positive environmental record:

- Ozone-depleting CFCs or HCFCs have never been used in the manufacture of EPS
- The manufacture of EPS packaging is a low-pollution process
- Computer-aided design ensures that the minimum amount of material is used to make an appropriate EPS pack
- The excellent protection and insulation offered by EPS helps to prevent wastage and spoilage
- EPS is 100 per cent recyclable and 100s of tonnes of EPS are recycled each month in the UK
- EPS is inert and innocuous and provides stability in landfill because it does not biodegrade and leach chemicals into the water system or gases into the air that could contribute to global warming
- The use of EPS for insulation in the construction industry helps to reduce the energy used to heat and cool buildings

Performance

EPS packaging offers outstanding performance that is cost-effective and totally reliable:

- A moulded EPS pack is not damaged by moisture, damp or heat and continues to protect products whatever the external conditions
- EPS is 98 per cent air making it one of the lightest packaging materials available anywhere
- Outstanding shock absorption and compression resistance can be designed into an EPS package
- EPS is an excellent insulator providing a thermal conductivity of 0.038 W/mK at 15g/l density and in-pack coolants can increase insulation performance
- Fruits and vegetables retain their vitamin C content longer if they are packed in EPS

Safety

Every day of our lives EPS contributes to our safety:

- EPS is used to make cycle helmets and child car seats because of its ability to absorb shock
- EPS is used to package shellfish, fresh fish and other vulnerable foodstuffs ensuring that they arrive in our homes fresh and safe to eat
- Vaccines and other temperature sensitive medicines are packed in tested EPS packs; guaranteeing that the vaccines are both effective and safe to use
- EPS is used in lifebelts and lifejackets to provide buoyancy
- In combustion the amount of carbon monoxide and particulates given off by EPS is a small fraction compared to that of wood or cardboard
- EPS can be used by children in art and science classes — it is light, has no sharp edges and can be safely cut, scraped and painted

The predictable performance of moulded EPS makes it a useful material for an enormous range of requirements. EPS is used for:

Fish Providing protection and insulation, EPS boxes keep fish and seafood fresh during transit.

Fresh produce Delicate fruits, vegetables and mushrooms are protected from bruising in EPS boxes. The boxes insulate to maintain optimum freshness, are resistant to moisture and do not break apart in unfavourable conditions.

Cookers, fridges, dish/washing machines are cost effectively protected by cleverly-designed, minimal EPS packaging, often used in combination with other plastics. The result is improved warehouse handling, reduced returns and customer satisfaction when a product arrives at their home in perfect condition.

Computers, TVs and other fragile, high value items are protected by EPS packs, not only from being dropped in transit, but also from damage whilst they are stacked in the warehouse.

Automotives EPS moulds are individually designed to fill complex voids in floors, door and roof linings. This allows the designer to change the height and shape of the interior.

Electrical EPS protects against dust, damp and rough handling. It can be given anti-static coating to protect sensitive microchips.

Medical & Pharmaceutical Life-saving items such as vaccines and internal organs are kept safe and insulated when transported in EPS packs.

Horticulture Plants are raised in EPS trays because they retain warmth, maintain an ambient temperature and are water resistant. And, their rigidity makes them easy to handle.

Bicycle Helmets The same shock absorption properties of EPS make it perfect for bicycle helmets and infant car seats.

Inspiration Sir Paul Smith, one of UK's top designers, used a complex EPS mould to create unusual covers for his book 'You Can Find Inspiration In Everything'.

Housing EPS moulds are used to form a Lego-style framework into which concrete is poured. Buildings can be erected quickly and enjoy high levels of acoustic and thermal insulation.

A comparison of EPS packaging with other cushioning materials

Material	Density	Cushioning factor	Specific potential energy
Substance	xxx kg/m ³	C* -	e* cN cm/cm ³
EPS mould	30	2.2	2400
PS loose-fill material	8	4	400
Foam rubber*	200	4.3	350
Coconut fibres rubberised*	80	3.8	70
Corrugated board single corrugation	800 g/m ²	2.4	530
Corrugated board twin corrugation	1050 g/m ²	2.6	800

* measured by ILV, Munich

Comparisons of ideal with actual cushions

Assuming the ideal cushion is completely compressed, that impact force and deceleration remain constant during deformation and, after deformation the pack is at rest, then under ideal conditions $G=h/d$. The theoretical term G then describes the quality of the material, and is related to the actual quality per unit volume of a real material by the factor C , where $C = G_{act}/G = G_{act}/h/d$.

The potential energy of a dynamic load (e) that must be applied to a cushioning material to obtain a given value of C is given by $e=mgh/Ad$ where A is length x width of the pack.

Minimum values for C and e are asterisked. Figures for the cushioning material are listed in the table and show an EPS mould provides the best cushioning.

EPS is an exceptionally versatile packaging material. It can be moulded into any shape or size — as intricately delicate or as large and solid — as you require.

Some important facts about the mechanical properties of EPS are:

- Varying the density of the bead in the EPS mould gives you a range of different strengths and performances. EPS can be moulded in densities from 12 – 60 grams per litre — 60 grams per litre is similar to a soft pine wood — depending on the levels of stress that you expect the package to undergo and the fragility of the goods you are packaging.

- Extra components such as wood, plastic or metal can be moulded into the pack to add extra strength for large objects such as washing machines or for multiple stacking in the warehouse.

- Being 98 per cent air, EPS is extremely lightweight. A thin wall package around 5 mm thick might weigh less than 4 grams; a thick wall pack about 150 mm thick could weigh over 2Kg.

- EPS is unaffected by damp, moisture and heat and its soft surface protects against damage and dirt. If further strengthening or resistance is required, EPS can be given abrasion resistant, waterproof coatings.

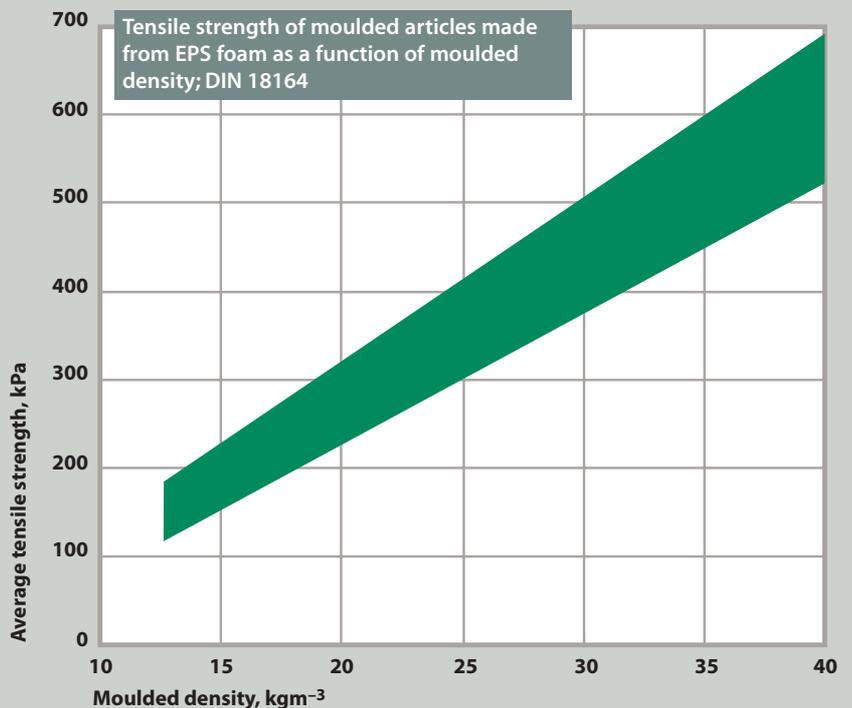
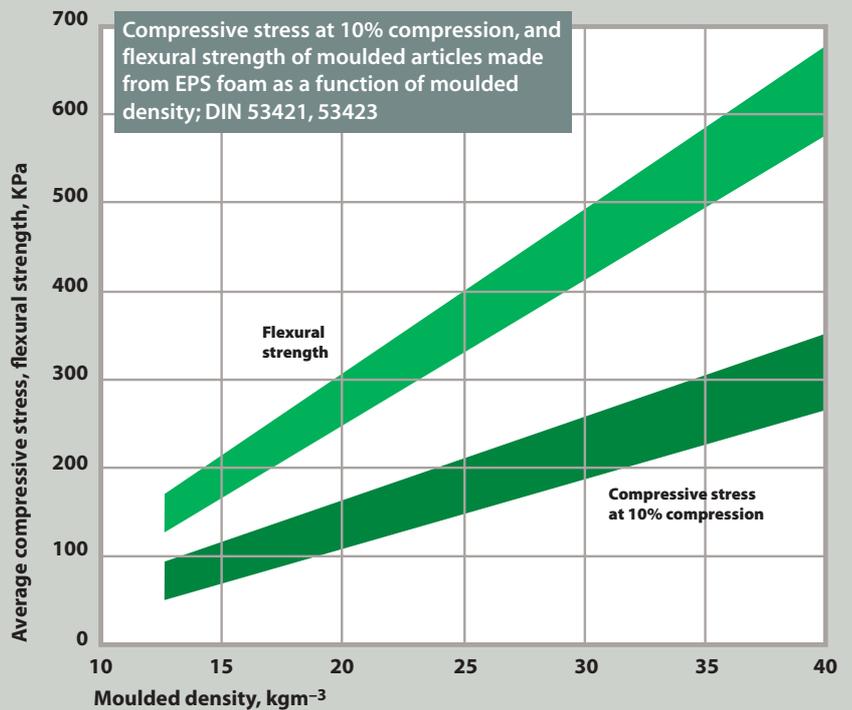
- A water-based coating can be applied to give EPS anti-static properties.

- EPS packs may be self coloured or may be coated with colour prior to the moulding stage giving full or pastel shades respectively.

- Your logo and branding can be moulded in or silk-screen or flexographically printed onto EPS boxes and trays.

- Flame retardant additives can be used in EPS. And, it is worth noting that in combustion, the amount of carbon monoxide and particulates given off by EPS is a small fraction compared to that given off by wood or cardboard.

Mechanical Properties of EPS



Designing & testing EPS packaging

EPS boxes can be bought as standard items — you can choose from a selection of pre-produced sizes.

Or an EPS packaging manufacturer can design an individual pack for your product. This is usually done for high-value items such as computers and ensures that you get optimum protection levels with no wasted material. Before a pack can be mass-produced, a sample will be produced, tested and refined and then a mould tool commissioned.

■ Tools

A mould tool has to be produced by a toolmaker before you can be supplied with designed packs for shipping your products. Tools are usually made to fit the specific

requirements of one item and, once produced, cannot be altered to fit another similar product. The tool itself is a high value article and can take between four to six weeks to make.

■ Design

The first stage of the design process — before a tool is ordered — is to make a sample that can be tested on your product. A three-dimensional image and initial costs can often be emailed to you within 24 hours of your query.

A CNC (computer numerically controlled) machine can be used to cut your sample out of a solid block; with total accuracy to the original design dimensions or an equally accurate sample can be hand cut.

■ Testing

EPS packaging manufacturers can test the protective performance to ensure the product is protected against all typical eventualities in your distribution cycle.

You can also send products to independent testing centres for more complicated testing processes such as temperature control during long journeys or for safety items such as car seats or bicycle helmets.

Testing the pack to ensure it provides the required performance is an essential part of the development of an EPS packaging mould. It removes any uncertainty about the package before the tool is made and the manufacturer goes into mass production for you.

Three commonly used tests:

1 Drop Test

This test simulates your packaged product dropping to the ground to find out if the package protects it from damage. The package is dropped onto a concrete floor from the height at which it might fall from during sales and distribution.

A lightweight item such as a computer might fall from hand height so is typically drop tested from 700mm. A heavy item, like a washing machine, is more likely to fall from the lowered tailgate of a delivery truck, so is typically dropped from 250mm.

The test regime may involve dropping on one or more faces, an edge or a corner of the pack

depending on the perceived risks inherent in your distribution cycle.

The effectiveness of the packaging is measured in two ways:

a) By removing the product from its packaging after the test, visually inspecting for damage and then checking that it still works — a function test.

b) By using an accelerometer attached to the most fragile part of the product to measure the maximum deceleration (often referred to as the maximum G force) experienced in the drop. In the case of very fragile items, you may already know the maximum acceptable G force for the avoidance of damage. To be effective, the pack must absorb shock

and reduce the measured G force below this level in the drop test.

2 Oscillating table

The oscillating table simulates travelling in the back of a lorry. As with the drop test it is designed to find out if the package protects the product from damage. The normal evaluation of effectiveness is visual inspection and function test.

3 Shunt Test

A less-common test, this re-creates a sudden stop or accident occurring and the packs being thrown in the truck. Again, pack effectiveness is measured by visual examination and function test.

Thermal properties

The composition of EPS — it is 98 per cent air and is formed of a closed-cell foam structure consisting of microscopically small air bubbles — makes it the simplest and lowest cost thermal insulator compared to other commonly used packaging materials.

The average thermal conductivity of EPS is 0.038 W/mK at 15g/l density.

EPS offers totally reliable insulation because its strength and insulation properties are unaffected by wet or damp conditions and it does not become brittle in low temperatures.

Leading food companies use EPS boxes to keep fish fresh and safe for consumption, to deliver food over the Internet and to package other perishable items.

Drug companies select EPS to package pharmaceutical products that require a secure cold chain

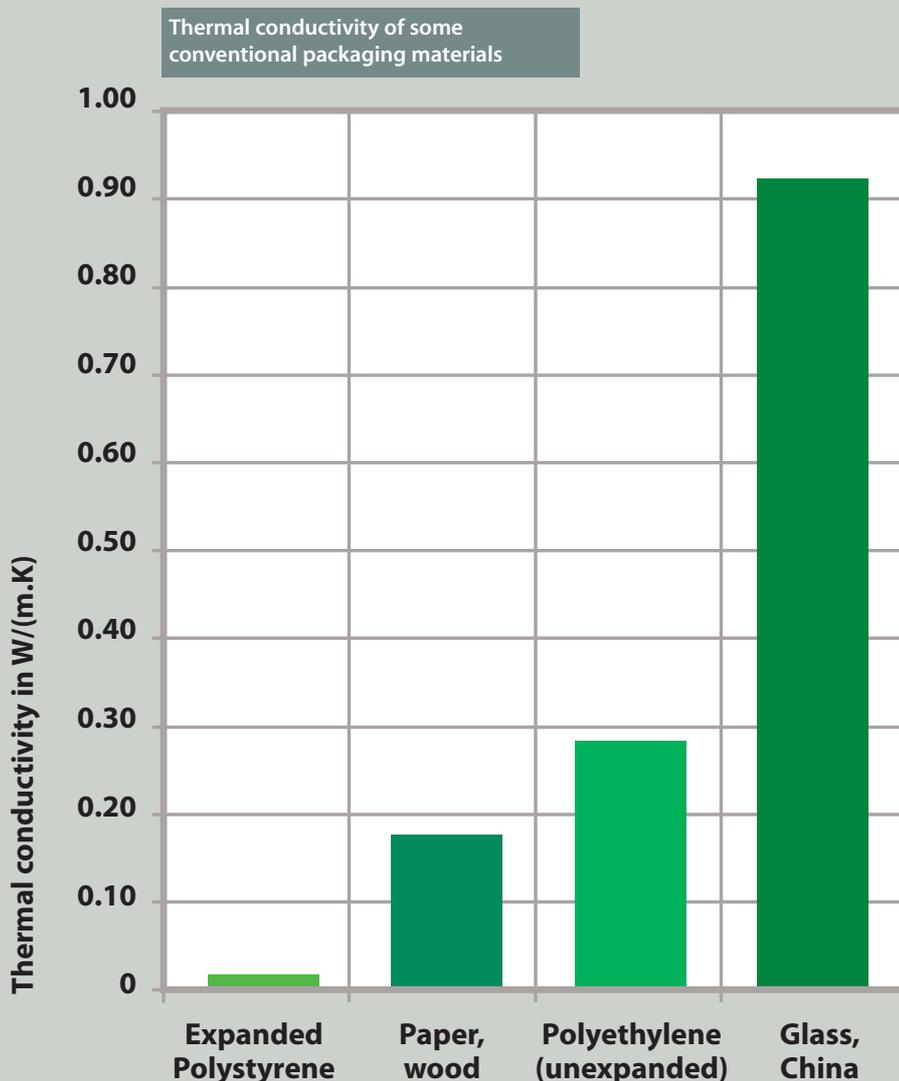
during transit. Its hygienic appearance, protective abilities and lightweight character also recommend the material to this sector.

EPS can safely be used in conjunction with ice or other coolant devices to extend the time period in which it can maintain low temperatures. In this context EPS packaging can be tested in special chambers designed to mimic temperature changes over several days, allowing for temperature drops at night. In this way, any design alterations that are required, can be made to ensure that temperature sensitive items such as vaccines or live medicines arrive in a condition that is safe to use.

The insulating properties of an EPS pack can be augmented by:

- Increasing the thickness of the package wall
- Reducing the internal surface area by designing the pack to fit tightly around the product
- Increasing the bulk density of EPS up to 28 gms per litre, after which, there is no additional benefit to further increasing the density.
- Ensuring the connections between the upper and lower parts of the pack are airtight by designing well-fitting tongue and groove joints
- Controlling air circulation in the pack by inbuilt internal ribs.

Your manufacturer of EPS packaging will be able to advise you on designing an EPS pack to meet your insulation requirements.



**Packaging and the Environment
Statement by Incpen
(Industry Council for Packaging
and the Environment
www.incpen.org)**

“Packaging is an integral and essential part of the industrial and commercial supply chain. It protects goods from damage, allows efficient transport distribution, offers convenience, prolongs shelf-life, enables easy use, informs the consumer and helps to promote goods in a competitive market place.

“The popularly presented image of packaging often fails to recognise the contribution that it makes to our modern lifestyle and exaggerates its environmental impact. Attention is usually focused on the waste generated by used sales packaging and ignores the fact that packaging protects far more resources than it uses and that it reduces overall waste.”

All manufacturing processes have an impact on the environment. However, the manufacturing of EPS packaging has a significantly lower impact on the environment during production than many commonly used packaging materials. Especially in terms of atmospheric pollution, energy consumption, water pollution and global warming potential.

EPS and the Environment

Manufacturing EPS packaging uses the clean technology of steam and the water is reused many times. It does not generate waste material as all cut-offs or rejects are broken up and put back into the process.

EPS does not, and never has, contained or used in its manufacture, CFCs or HCFCs, both of which diminish the ozone layer.

Styrene is used to manufacture EPS packaging. It has been used in the manufacture of a wide range of plastics and plastic products for more than 60 years. Styrene also exists naturally and can be found in strawberries, beans, nuts, beer, wine, coffee beans and cinnamon.

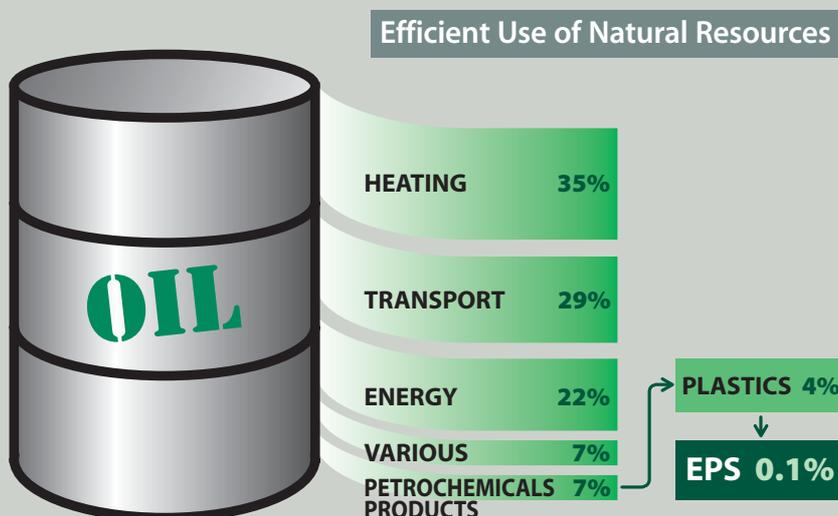
Pentane is used during the manufacture of EPS packaging; it belongs to the same chemical family as methane, propane and butane. Pentane is not considered to be a substance hazardous to health or the environment by European authorities.

Like other plastics, EPS is obtained from oil. The diagram, ‘Efficient Uses of Natural Resources’ shows

that total consumption of oil is accounted for as follows: 35% heating, 29% transport, 22% energy production, 7% various and 7% petrochemicals with 4% of that used for plastics. EPS itself accounts for 2% of all plastics, so only 0.1 % of oil is used to manufacture EPS.

EPS packaging makes a positive contribution to sustainability and the environment:

- Its lightweight character means that it helps to reduce fuel consumption.
- EPS is an inert and innocuous material, it responds reliably in situations where a package is put under stress. These protective capabilities help to cut waste across many sectors by reducing breakages and other damage during delivery.
- EPS is 100 per cent recyclable and is being recycled throughout the UK by a network of recognised recyclers.
- EPS helps to protect people. It is used for cycle helmets, for child car seats, for floats and lifebelts and to package medicines, vaccines and vital organs.
- EPS is completely safe in landfill sites. Its inert nature means that it does not leach chemicals into the water system or leak gases into the air that could contribute to climate change. Its stability is an advantage in landfill sites because they are not meant to decompose like compost heaps, but to stay firm so that they can be reclaimed and used as parkland or for leisure activities.



Recycling of EPS Packaging

EPS packaging is 100 per cent recyclable and hundreds of tonnes of EPS are recycled each month in the UK. Almost of all this is done by the commercial sector. The EPS Packaging Group runs a proactive campaign to increase the recycling of EPS packaging and supports and advises business and recyclers that are working with EPS packaging. As a result of this work, EPS packaging is currently being recycled at levels that are equal to, or more than, the overall target for plastics recycling.

Legislation

As a signatory of the EU Producer Responsibility Obligations (Packaging Waste) Regulations 1997, the UK has a responsibility to increase the recycling of used packaging. The UK Government has announced business recovery and recycling targets for 2004-2008. EPS packaging is included as part of the overall plastics target.

Packaging recovery and recycling business targets (%)

	2004	2005	2006	2007	2008
Paper	65	66	68	69	70
Glass	49	55	61	66	71
Aluminium	26	28	30.5	33	35.5
Steel	52.5	55	58	60	61.5
Plastic	21.5	22	22.5	23	23.5
Wood	18	19	20	20.5	21
Overall Recovery	63	65	67	69	70

Recycling EPS Packaging by businesses

For recycling purposes EPS packaging is categorised as clean (usually ex-computer, TV packs) or contaminated (fish boxes, horticultural trays or with labels).

There are typically three ways in which EPS packaging is recycled:

1 A large company has an IT refit and acquires hundreds of EPS boxes. In this instance, there are several recyclers in the UK who will collect clean EPS boxes to recycle them into insulation board. Some manufacturers of EPS packaging will take this material and recycle it into new packaging.

2 If a site has regular, but small deliveries of items in EPS packaging, it might take a few weeks to store enough EPS boxes before a collection by a recycler can be arranged. The recycler will want a load large enough to fill a standard size articulated truck. This kind of material is usually recycled into insulation board or new packaging and regular collection arrangements can be made with a recycler.

3 Large amounts of components or fish are packed in EPS and delivered to a company each week. The company leases or purchases an EPS compactor that reduces the material in volume. The material is shrink wrapped, stored and collected by a recycler on a regular basis. This kind of material can be re-processed into clean polystyrene that can be used to make coat hangers, disposable cameras or replacement hardwood.

Householders

For householders, who may have an EPS box after a computer or TV purchase, it is much harder to recycle the leftover EPS pack. Some of the UK manufacturers of EPS packaging have set up recycling points for consumers on their sites. If you live or work near one of these you can deliver your EPS packaging and it will be recycled into new packaging (you can find the locations of these on www.eps.co.uk). Currently, no local authorities collect EPS packaging for recycling.

A practical way for householders to re-use their waste EPS packaging is by breaking it up and using it in window boxes, pots, tubs and hanging baskets. This helps with drainage in exactly the same way as broken ceramic or terracotta pots. The additional advantage is that EPS provides some extra insulation.

Further Information

If you would like to know more about the recycling of EPS packaging you can find information on our website www.eps.co.uk or call 020 7457 5014 for information and advice.

Introducing the British Plastics Federation



The EPS Packaging Group is a member-group of the British Plastics Federation (BPF), the leading trade association of the UK plastics industry (representing approximately 80% of turnover).

The BPF exists to maximise common opportunities and to resolve shared problems. The membership encompasses polymer producers, suppliers and processors in addition to additive and machinery suppliers and manufacturers.

Since 1933 the BPF has promoted and defended the UK plastics industry. Today it is a well-respected source of information, views and commentary.



BPF Online www.bpf.co.uk

Dubbed the "Home Page of the UK Plastics Industry", BPF Online is the platform for the promotion of plastics use and UK plastic businesses.

The BPF Online Directory has the most detailed listing for plastics products in the world. The Directory facilitates the customer's search for specific manufacturers, suppliers, recyclers and other service providers.

BPF Online provides educational and training information on plastics materials and animations of production processes. Publications, statistical information and commentary can be found in the fully-searchable BPF Bookshop.

BPF Online also provides a questions and answers forum sponsored by the Plastics and Rubber Advisory Service (PRAS). This offers expert advice on specific queries on plastics use, material selection, process selection and design.

Committees and Groups

Currently there are four market sector groups and four central committees. The EPS Packaging Group is one of the BPF's seventeen business groups.

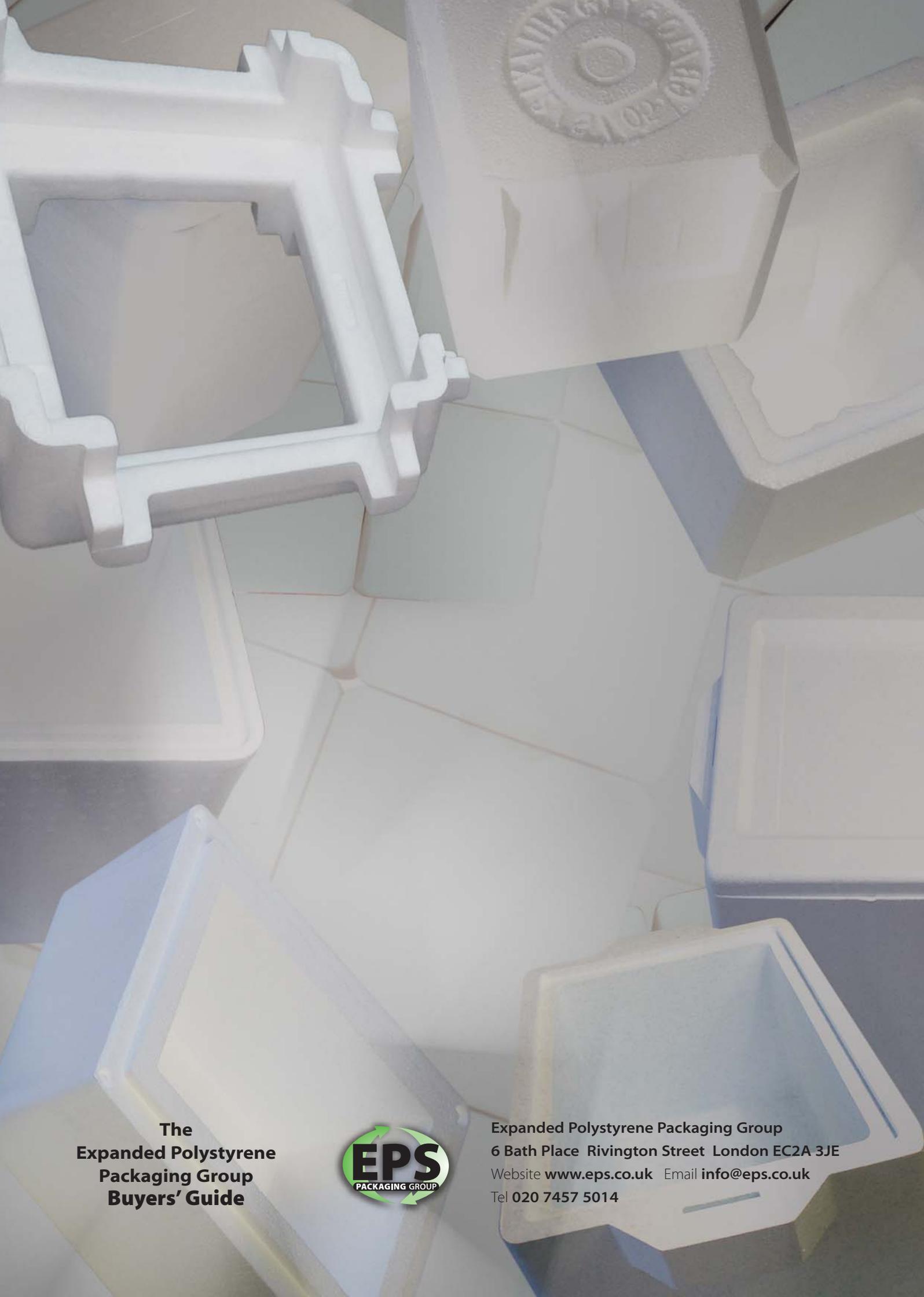
The BPF's central expert committees address industry-wide concerns including environment, fire, product safety and industrial health & safety. These provide opportunities for the

exchange of industry experience and the formulation of common policy and action programmes.

Nine Association Alliance

The BPF spearheads a lobbying alliance of nine associations: British Rubber Manufacturers' Association, Packaging and Industrial Films Association, Flexible Packaging Association, Scottish Plastics and Rubber Association, Northern Ireland Polymers Association, Gauge and Toolmaking Industries Association, Polymer Machinery Manufacturers and Distributors Association and the British Coatings Federation.

This Nine Association Alliance represents over 6000 companies, 315,000 employees and £22.2bn sales turnover per annum. Consequently it provides a strong, cohesive voice to influence the UK and EU Government bodies on behalf of industry.



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