R-MER II® Resin (Grade 27)

I. GENERAL DESCRIPTION

R-MER II® is a high performance non-modified expandable resin designed to provide enhanced fracture resistance and improved multiple drop impact properties for premium cushion foam packaging. R-MER II® has performed successfully in replacing many co-polymer applications. Flint Hills Resources, LP - R-MER II® resin may be expanded, molded, and recycled using conventional EPS technology.

II. PROPERTIES OF RMER II ® GRADE 27 EXPANDABLE RESIN

Type	Bead Size	Typical* Unexpanded Particle Size, (mm)	Blowing Agent Level	Recommended Density Range** (lbs./ft^3)	Method of Processing
5627	B	0.600 – 1.400	Nominal 6 %	1.15 – 3.0	Shape / Block +

End-Use/Application Temperature: ºF (ºC) - 165 (74) at all densities

* Typical indicates at least 90% of product falls within the given particle size range
** High densities attainable with batch pre-expansion.
+ Consult FHR Sales or Technical Staff for details of Block molding parameters

III. APPLICATIONS

R-MER II® expandable resin provides improved cushioning performance for high value electronics, instrumentation and fragile goods. R-MER II® provides enhanced fracture resistance compared to standard Expandable Polystyrene. R-MER II® may be shape molded for custom cushion packaging or block molded for fabricated packaging. The minimum recommended single pass expanded density for R-MER II® is 1.15 pcf.

R-MER II® foam is 100% recyclable per SPI polystyrene code 6, for both pre and post consumer streams.

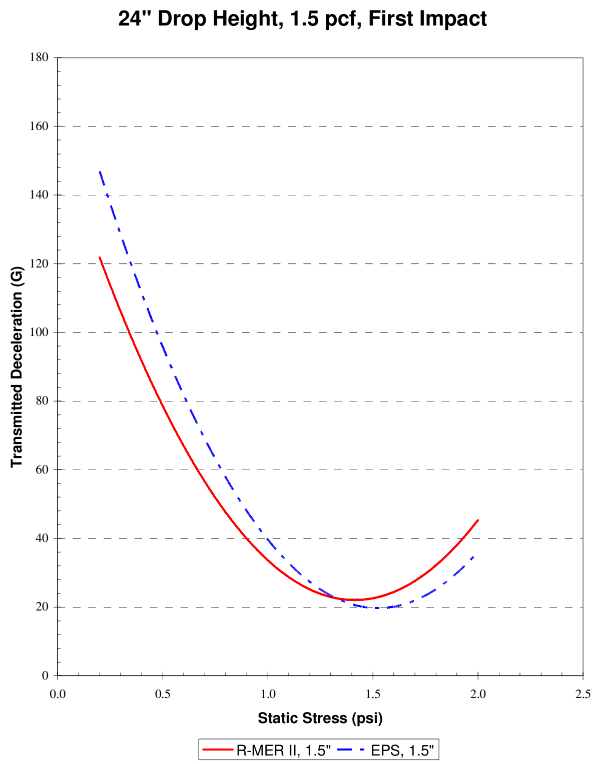
IV. PROPERTIES OF MOLDED RMER II® GRADE 27 EXPANDABLE RESIN

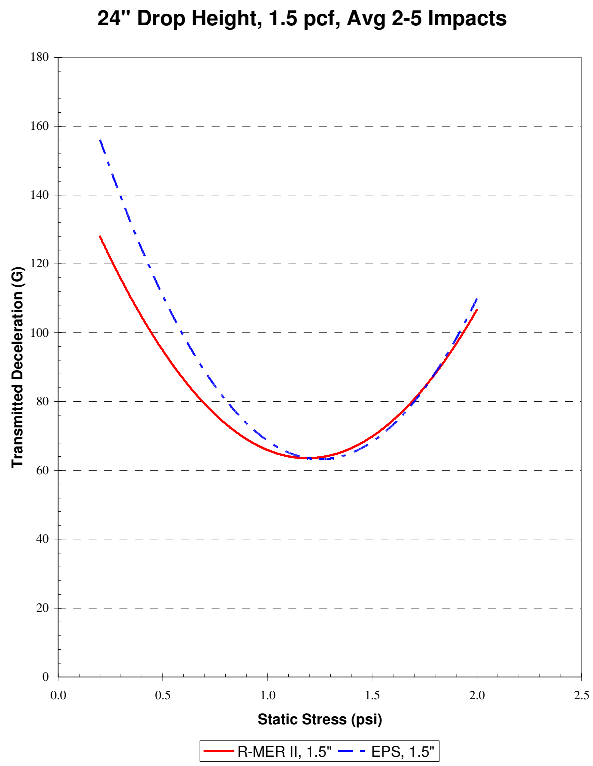
PROPERTY	UNITS	ASTM TEST	NOMINAL VALUE		
Density	lbs/ft^3(kg/m^3)	C-303	1.25(20)	1.5(24)	1.75(28)
Compressive Strength @ 10% Compression @ 20% Compression @ 50% Compression	psi (MPa)	D-1621	13 (0.09) 16 (0.11) 25 (0.17)	16 (0.11) 20 (0.14) 29 (0.20)	20 (0.13) 24 (0.17) 33 (0.23)
Flexural Strength	psi (MPa)	C-203	30 (0.21)	38 (0.26)	46 (0.32)
Flexural Deflection	in (cm)	C-203	2.0 (5.1)	2.0 (5.1)	2.0 (5.1)
Water Vapor Permeability	Maximum perm-in.	E-96	2.3	3.0	3.7
Water Absorption	% weight increase	C-272	1.1	1.1	1.2
Thermal Resistance	R-value	C-177	4	4	5
Compressive Creep 1000 hrs. @ 2.5 psi 1000 hrs. @ 5.0 psi	%	D-3575	2 2.5	1.5 1.5	1 1
Recommended End-Use Temperature	ºF (ºC)	---	165 (74)	165 (74)	165 (74)

V. DYNAMIC SHOCK CUSHIONING PERFORMANCE

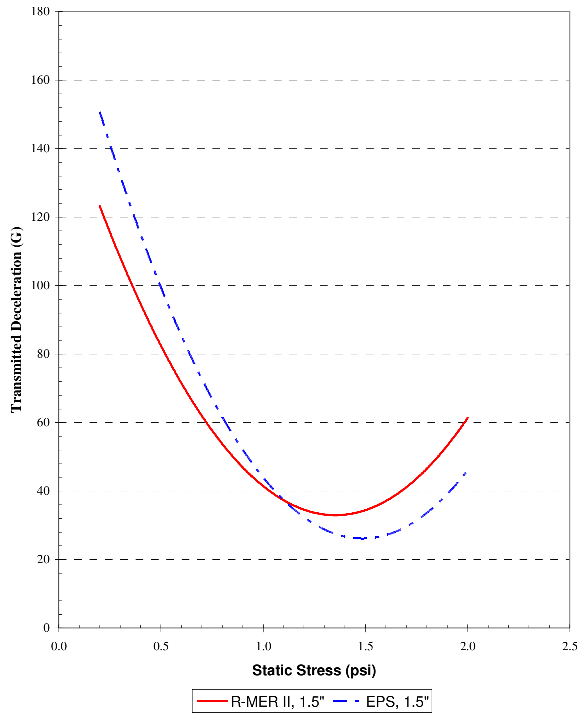
R-MER II® foam is used in high performance packaging for fragile, high-value items. Excellent cushioning properties coupled with enhanced fracture resistance make R-MER II® the material of choice for dynamic impact protection.

The following graphs illustrate the cushioning performance of R-MER II® foam as tested per ASTM D-1596 on a standard 8-inch x 8-inch sample. These shock absorption curves are general guidelines for predicting the cushioning performance of R-MER II® at the nominal densities and thickness indicated. Individual part performance will vary with design, application and molding. End-use application testing is recommended to determine the actual cushioning performance.

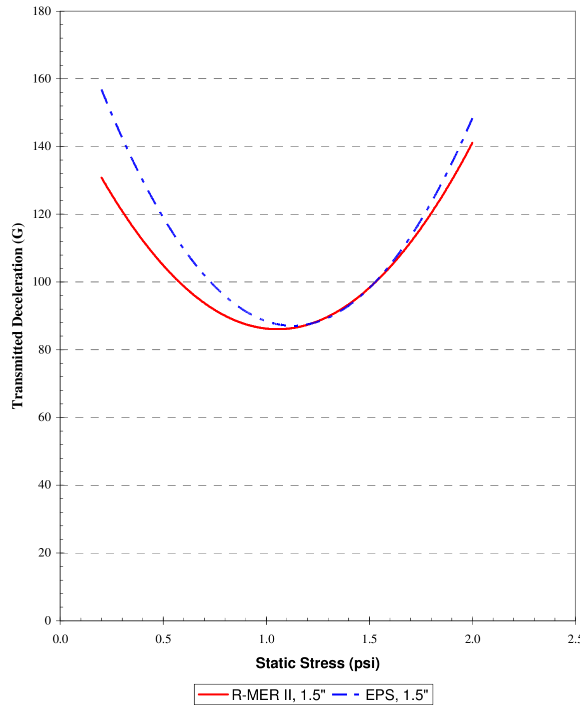




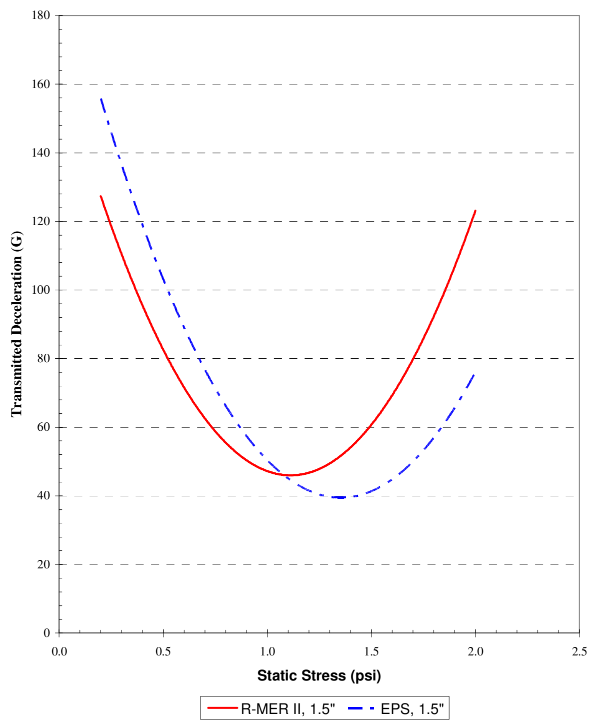
30" Drop Height, 1.5 pcf, First Impact



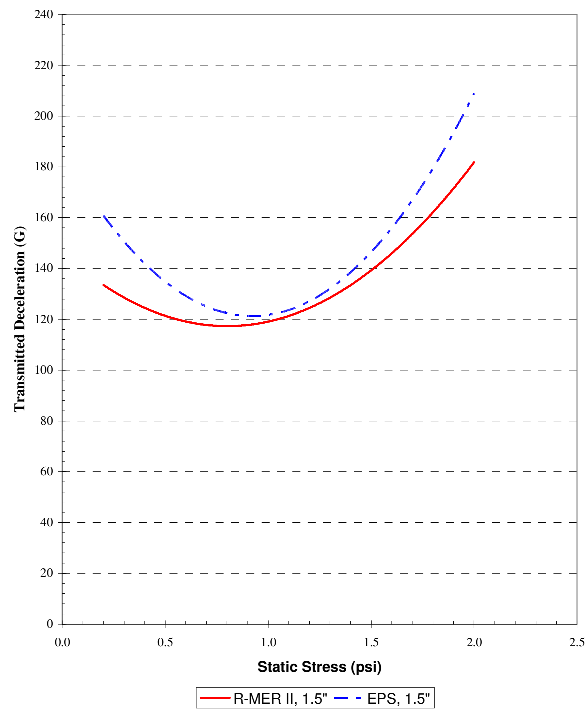
30" Drop Height, 1.5 pcf, Avg 2-5 Impacts



36" Drop Height, 1.5 pcf, First Impact



36" Drop Height, 1.5 pcf, Avg 2-5 Impacts



G. Burgess[1] (School of Packaging, Michigan State University) and M. Daum[2] (R&D Manager, Packaging, Hewlett-Packard Company) are proponents of the Stress-Energy method for determining the cushioning performance of closed-cell foams. Below are the parameters for the Stress-Energy equations, comparing R-MER II® and EPS at 1.5 pcf density:

	R-MER II ®		**EPS**	
Parameter	1^{st} Drop	Avg 2-5 Drops	1^{st} Drop	Avg 2-5 Drops
A	20.0978	24.1797	28.1950	27.8467
B	0.0442509	0.0614047	0.0276162	0.0588071

Daum's equation:

$$G * s = A * e^{\left(B * \frac{s * h}{t}\right)}$$

G - transmitted shock,
s - static loading (weight divided by the bearing area),
h - drop height,
t - cushion thickness and
A/**B** - dimensionless constants that describe the material properties of the cushion.

References:

1. Burgess, G., "Consolidation of Cushion Curves," *Packag. Technol. Sci.,* Vol. 3, 1990, pp. 189-194.
2. Daum, M., "Simplified Presentation of the Stress-Energy Method for General Commercial Use," *J. Test. Eval.,* Vol. 36, 2008, pp. 100-102.

VI. EXPANDABLE POLYSTYRENE MANUFACTURING LOCATION

Peru, Illinois, United States