rohacell®
Leichtbauhartschaumstoff

Preisliste

gültig ab 1. 6. 1977

Grundpreise (freibleibend) ohne Umsatzsteuer

Dicke mm	ROHACELL 31 DM/m²	ROHACELL 51 DM/m²	ROHACELL 71 DM/m²
1	—	9,40*)	—
2	—	9,90*)	—
3	—	10,20*)	—
4	8,40	10,60	14,30
5	10,10	12,30	17,20
6	10,80	14,20	18,60
8	14,—	16,80	22,—
10	16,50	19,90	25,80
15	22,—	28,40	35,20
20	28,60	36,60	44,50
25	35,50	45,30	55,10
30	42,40	53,80	65,50
40	55,60	71,60	—
45	—	—	95,40
50	69,40	—	—
55	—	97,50	—
65	90,10	—	—
Lieferformate:	1250 x 625 mm 1250 x 1250 mm 2500 x 1250 mm	*) Dicken 1, 2 und 3 mm nur in diesem Format lieferbar	

Dicke mm	ROHACELL 110 kg/m³ DM/m²	ROHACELL P 170 kg/m³ DM/m²	ROHACELL P 190 kg/m³ DM/m²
23	—	—	90,10
28	—	90,10	—
48	125,40	—	—
Lieferformate:	2160 x 550 mm	2500 x 600 mm	2500 x 600 mm

Lieferbedingungen: Diese Preise verstehen sich frei Haus, einschließlich Verpackung, zuzüglich Umsatzsteuer, bzw. frachtgutfrei deutsche Grenze, unverzollt, einschließlich Verpackung. Mindestauftragswert DM 1500,—.

® = registriertes Warenzeichen

röhm
GMBH CHEMISCHE FABRIK
Postfach 42 42
Kirschenallee
6100 Darmstadt 1

Proforma — Rechnung / Invoice / Facture **Nr.:** 3/89 282

Abteilung/Dep. VK Bhz — Datum/Date 11.11.1977

- [x] Versand Darmstadt
- [ ] Versand Worms
- [ ] Versand 404

Röhm GmbH Chemische Fabrik Postfach 42 42 D-6100 Darmstadt

M. Atac
Firmylab. C.O. 14 E
P.O. Box 500

Bataria/Ill. 60501 / USA

röhm
GMBH CHEMISCHE FABRIK
Kirschenallee
Postfach 42 42
D-6100 Darmstadt 1

Ihr Anruf vom 10.11.77

Pos.	Menge / Quantity / Quantité	Produkt/Product/Produit
1	3 Stck.	ROHACELL 31 300 x 300 x 60 mm

Muster ohne Berechnung
Sample without commercial Value
Echantillon Gratuit

Wert / Value / Valeur
DM 22,40

Verpackung/Markierung / Packing/Marks / Emballage/Marques

RD 3/89 282
1 Karton

brutto kg
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netto kg

Röhm GmbH

i.V. Clemens i.A. Keil

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GMBH CHEMISCHE FABRIK
KIRSCHENALLEE
POSTFACH 42 42
D-6100 DARMSTADT 1
GERMANY

DEAR SIRS,
PLEASE SEND ME YOUR PRICE LIST FOR ROHACELL 31 AND ROHACELL 51

MY ADDRESS IS: FERMILAB, CL-14E, P.O.BOX 500, BATAVIA, ILLINOIS 60510/USA.

SINCERELY
DR. M. ATAC
FERMILAB

.....
001.0 MIN

SENT 5/31/78 1546 BPO

Our technical advice and recommendations are intended to facilitate and further the work of our customers. No warranty follows, because in every case the particular circumstances and any outside proprietary rights must be allowed for.

Ⓟ Registered Trade Mark

Cy-Ro Industries
Wayne N.J.
201-839-4800
Mr. Dale Ott

No longer handle

Private residence now

ROHM GMBH CHEMISCHE FABRIK
D-61 Darmstadt
Postfach 4166
Kirschenallee
Telephone: (06151) 8061
Telex: 419485

Mr. Dirrol

No longer carry Rohacryl

Mr. Bill Hammond
241-4615

869-0013

Mr. Carleton

In Canada please contact:

Chemacryl Plastics Limited
73 Richmond Street West
Toronto 110, Ontario
Telephone: (416) ~~363-5871~~
Telex: 02-29153 chemtel

Our office in Montreal:

Chemacryl Plastics Limited
8158 Devonshire Road,
Town of Mount Royal,
Montreal 307, P.Q.
Telephone: (514) 735-4291

572/2160 Printed in Germany

ROHACELL is an acrylic, rigid, closed cell foam with a small structure, manufactured by Röhm GmbH, West Germany.

Rohacell®

chemacryl Plastics Limited
73 Richmond Street West, Suite 500, Toronto, Ontario, M5H 2A2, Tel: (416) 869-0013
8170 Montview Rd., Town of Mount Royal, Montreal, Que., H4P 2L7, Tel: (514) 735-4291

M. ATAC

PRICE LIST

ROHACELL 31 - Density 30 kg/cbm (2 lb./cu.ft.)
ROHACELL 51 - Density 50 kg/cbm (3 lb./cu.ft.)
ROHACELL 71 - Density 70 kg/cbm (4 lb./cu.ft.)

Colour: White

Thickness mm	Thickness inches (approx.)	$/sq.ft. ROHACELL 31	51	71	Sheet Size mm
1	.040	--	.51	--	625 x 1250 (24 5/8 x 49 1/4")
2	.080	--	.58	--	
3	1/8	--	.70	--	
4	5/32	.49	.64	.83	
5	3/16	.58	.77	1.00	
6	1/4	.69	.89	1.17	
8	5/16	.81	1.05	1.38	
10	3/8	1.00	1.30	1.68	
12	1/2	1.19	1.55	1.97	625 x 1250 (24 5/8 x 49 1/4")
15	5/8	1.46	1.88	2.34	1250 x 1250 (49 1/4 x 49 1/4")
20	3/4	1.90	2.42	2.95	1250 x 2500 (49 1/4 x 98 7/16")
25	1	2.35	3.01	3.66	
30	1 3/16	2.81	3.57	4.35	
40	1 5/8	3.71	4.75	5.75	
50	2	4.62	5.91	--	
60	2 3/8	5.54	--	--	

Standard Sheet Size:

The standard sheet size of: 625 x 1250 mm is charged as 24 x 48" at 8 sq.ft.
1250 x 1250 mm is charged as 48 x 48" at 16 sq.ft.
1250 x 2500 mm is charged as 48 x 96" at 32 sq.ft.

Prices and Delivery:

F.O.B. Toronto/Montreal. Federal and Provincial Sales Taxes extra.
ROHACELL 51, size 625 x 1250 mm, from stock otherwise approx. 10 - 12 weeks.

Terms:

N/30 to firms of approved credit rating.

Conditions:

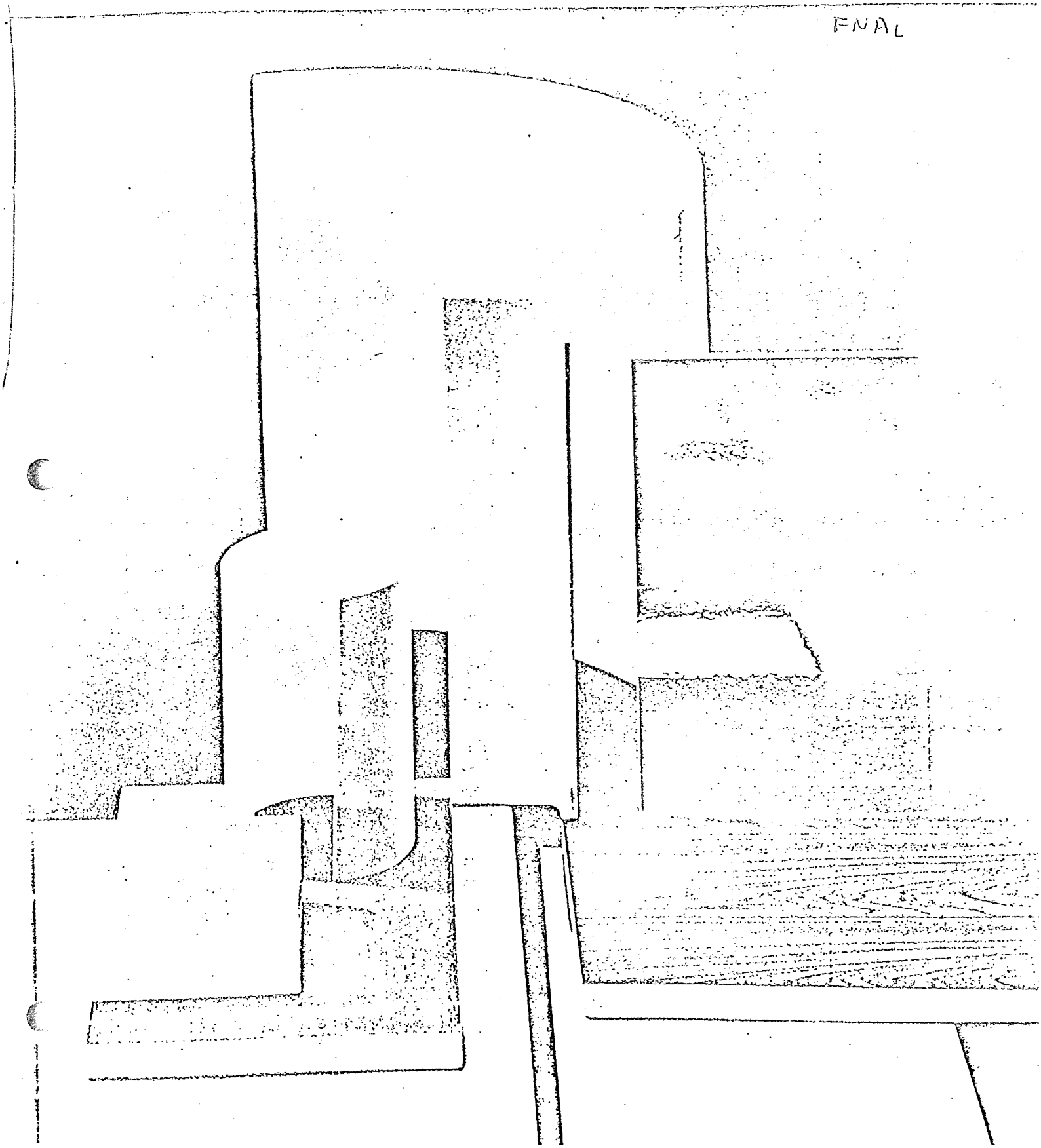
All orders are subject to availability of material and to prices, terms and conditions in effect on date of shipment. Prices are subject to change without notice.

April 1, 1975
E. & O.E.

Ronacell

Rigid Foam

J. Pfefer
35 A Shabbar
FNAL



ROHACELL is a polymethacrylimide rigid foam. Its natural colour is white, its cells are of fine texture and more than 95% closed.

Manufacture

The first step in the manufacture of ROHACELL consists in fabricating sheets based on a methacrylate copolymer. These sheets contain a dissolved blowing agent furnishing ammonia which produces foaming over the temperature range 170–230°C. During foaming the sheets expand to 2.5–4 times their linear starting dimensions. At the same time the copolymer is converted substantially into polymethacrylimide (PMI). The densities that can be obtained in this way vary between 15 and 100 kg/m^3.

Availability

Normal flammable grades of ROHACELL and grades with flame-retardant additives (coloured yellow to brown) are available in three respective densities. The normal flammable grades are identical with the former experimental product Rigid Foam 9665. ROHACELL is available exclusively in the form of sheets.

Type designation

Normal flammability

ROHACELL 31	Density 30 kg/m^3
ROHACELL 51	Density 50 kg/m^3
ROHACELL 71	Density 70 kg/m^3

With flame-retardant additives

ROHACELL 41 S	Density 35 kg/m^3
ROHACELL 61 S	Density 60 kg/m^3
ROHACELL 91 S	Density 85 kg/m^3

Standard sizes	Thicknesses
1000 mm x 500 mm 1000 mm x 1000 mm 1500 mm x 1000 mm	1, 2, 3, 5, 10, 15 20, 25, 30, 40, (50)*, (60)** mm

* 50 mm only ROHACELL 31, 51, 41 S and 61 S

** 60 mm only ROHACELL 31 and 41 S

Subject to negotiation other thicknesses and sizes can be supplied if substantial quantities are ordered. It is intended to produce sheets up to 2500 x 1250 mm in size at a later date.

Properties

ROHACELL is a brittle-hard foam with excellent mechanical properties and a high degree of heat and solvent resistance. Table 1 lists the principal property constants of the three grades ROHACELL 31, 51 and 71. Complete figures for the corresponding properties of the grades with flame-retardant additives are not yet available, but the densities of these types were selected so that their strength values are approximately equal to those of the normal flammable types.

Table 1

Properties of ROHACELL

Property	Test conditions	ROHACELL 31	ROHACELL 51	ROHACELL 71	Units	Standard
Density	23°C/50% rh	30	50	70	kg/m³	DIN 53 420
Tensile strength	23°C/50% rh	10	19	29	kgf/cm²	DIN 53 455
Compressive strength	23°C/50% rh	4	9	15	kgf/cm²	DIN 53 421
Flexural strength	23°C/50% rh	9	19	30	kgf/cm²	DIN 53 423
Shear strength	23°C/50% rh	4	8	13	kgf/cm²	internal test
Modulus in tension	23°C/50% rh	300	600	1000	kgf/cm²	DIN 53 457
Modulus in shear	23°C	130	250	400	kgf/cm²	DIN 53 445
Impact strength	23°C/50% rh	0.4	0.7	1.0	cm kgf/cm²	DIN 53 453
Heat distortion temperature		200	195	190	°C	DIN 53 424
Thermal conductivity	20°C	0.027	0.025	0.026	Kcal/m h °C	DIN 52 612
H_2O diffusion resistance factor	20°C/0–85% rh	400	650	900	1	DIN 53 122
H_2O absorption (saturation)	20°C/98% rh	0.59	0.88	1.1	Vol. %	internal test
H_2O absorption (after 50 days)	20°C, submerged	18	14	14	Vol. %	DIN 53 428
Dielectric constant	20°C, 2.8 GHz	1.04	1.07	1.10	1	internal test
Dielectric loss factor	20°C, 2.8 GHz	6×10^{-4}	8×10^{-4}	10×10^{-4}	1	internal test
Surface resistivity	23°C, 50% rh	2×10^{13}	9×10^{12}	5.5×10^{12}	Ohm	internal test

Mechanical properties

No rigid foam of the same density at present surpasses the strength values, elasticity modulus and shear modulus of ROHACELL. In terms of type classification ROHACELL is a brittle-hard rigid foam. Its elongation at break measured according to DIN 53 455 is 4–6%. The material resists vibrations and abrasion.

Heat resistance

The heat distortion temperature to DIN 53 424 is at around 190–200°C, the dynamic mechanical glass transition temperature is 200°C. These values provide little information about the maximum useful service temperature of ROHACELL and this value depends to a large extent on the particular application.

As a rule the "heat resistance" of a foam material is described adequately by the results of concrete tests aimed at evaluating its strength, constancy of weight and dimensional stability. Table 2 therefore shows how the weight, the volume and the linear dimensions of ROHACELL specimens alter on 30-day exposure in the air to various temperatures. Figures 1, 2 and 3 show the compressive strength, shear strength and shear modulus of ROHACELL plotted as a function of temperature. These illustrations reveal that ROHACELL can be used for temperatures up to 180°C (in special cases even up to 200°C) when not subject to mechanical stresses

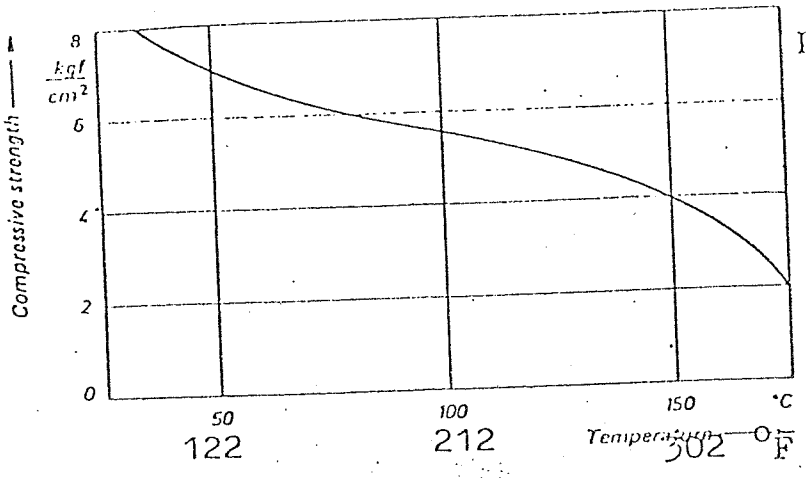


Fig. 1

Compressive strength (~~DIN 53 421~~ ASTM D 1621-64) of ROHACELL 51 as a function of temperature

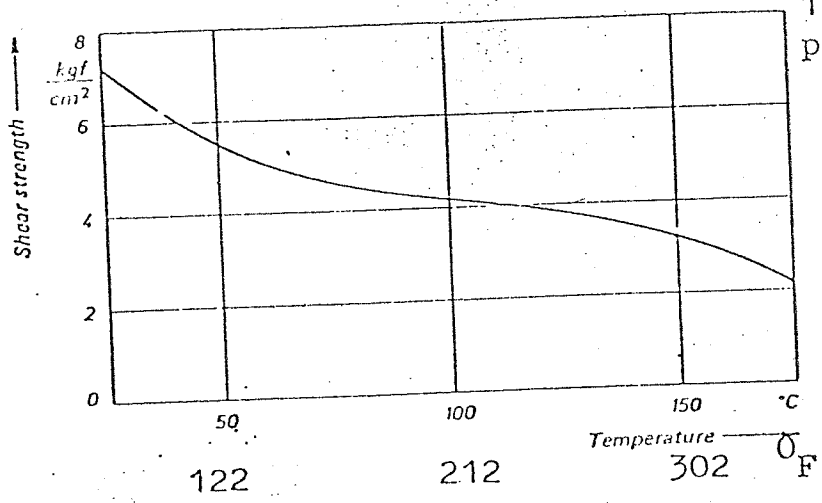


Fig. 2

Shear strength of ROHACELL 51 as a function of temperature

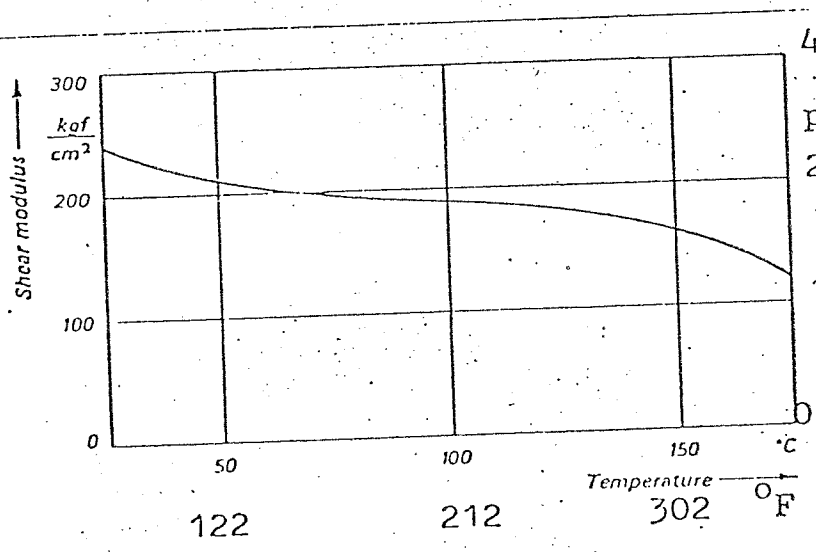


Fig. 3 ASTM D 2236-69

Shear modulus (~~DIN 53 445~~) of ROHACELL 51 as a function of temperature

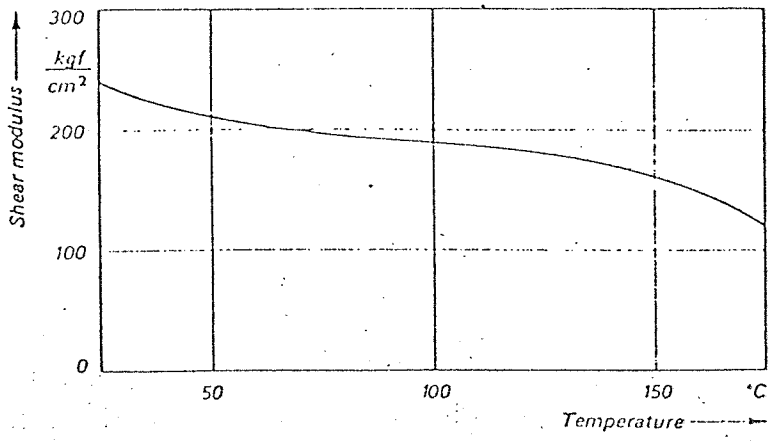


Fig. 3

Shear modulus (DIN 53 445) of ROHACELL 51 as a function of temperature

Thermal conductivity

The thermal conductivity values of the different ROHACELL types vary very little and lie within the ranges stated in Table 3 at different temperatures. These values were determined on samples that had been stored for some time and whose cells were substantially filled with air and no longer contained blowing agent. They therefore represent final values that will not display increases under normal conditions. The calculated thermal conductivity values according to DIN 4108 are 0.035 kcal/m h °C for all three types.

Table 3

Thermal conductivities of ROHACELL 31, 51 and 71 at various temperatures

Temperature °C	Thermal conductivity kcal/m h °C
−160	0.013–0.016
−100	0.016–0.018
− 40	0.020–0.024
+ 20	0.024–0.029
+ 80	0.030–0.035
+140	0.036–0.041

Flammability

ROHACELL 31, 51 and 71 sheets more than 10-mm thick display "normal flammable" behaviour (Class B 2) in the sense of DIN 4102. In terms of ASTM D-1692 – 59 T they are classified as "burning by this test". The rate of burning varies with the grade and the thickness of the material. For 10-mm thick ROHACELL 51 it is 2.4 cm/min, for example.

Normal flammable ROHACELL burns with little generation of smoke. The gases of

Types ROHACELL 41 S, 61 S and 91 S contain flame-retardant additives and display good self-extinguishing properties. Certain material thicknesses pass the test for difficult flammability (Class B 1 to DIN 4102). According to DIN 53 428 material 3 mm thick or over is classified in the sense of DIN 4102 as belonging to Classes K 1/≥ 3 mm and F 1/≥ 3 mm. Tests performed to ASTM D-1692 – 59 T bring the finding "self-extinguishing by this test". As a result the grades are allowed as a core material in the sense of MIL – S – 55 286 (EL) "Shelter Electrical Equipment S – 280".

Water vapour diffusion

The values listed in Table 1 are surprisingly high. It has been found from the measurements that the water vapour diffusion of ROHACELL increases as the relative humidity during the measurements increases. Fig. 4 shows that this effect commences at relative humidities above 65 per cent. This behaviour is undoubtedly interesting, but it is difficult to assess whether it has practical significance. It is advisable not to use the values in Table 1 obtained by the method of DIN 53 122 for making physical calculations of buildings if the relative humidity can rise to above 80 per cent.

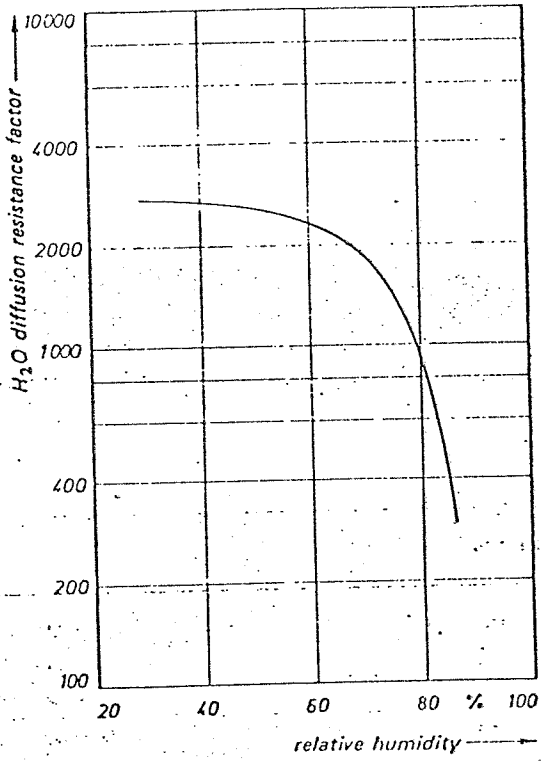


Fig. 4

H_2O diffusion resistance factor of ROHACELL 31 versus the relative humidity on the moist side of the measuring apparatus (Method of test similar to DIN 53 122)

Water absorption

Similarly to polyamides, polymethacrylimide absorbs relatively much water. Table 4 lists the 'sorption equilibria' (the water content at equilibrium on the dried sample) of ROHACELL in different relative humidities. Table 5 gives the gain in weight and the volume changes of specimens after a 50-day immersion in water. These values show that despite the relatively high water absorption the dimensional stability is [illegible] of the samples is observed only on prolonged storage at

Table 4

Sorption equilibria

Relative humidity %	% equilibrium water content ROHACELL 31	ROHACELL 51	ROHACELL 71
15	1.5	1.3	1.2
30	2.9	2.6	2.4
50	4.7	4.2	3.6
65	6.0	5.0	4.3
98	19.5	17.5	15.5

Table 5

Water absorption (DIN 53 428) and volume change after 20 days

	H_2O absorption (Vol. %) 20°C	50°C	Volume change (%) 20°C	50°C
ROHACELL 31	13	18	<1	<2
ROHACELL 51	16	23	<1	<2
ROHACELL 71	16	24	<1	<2

Chemical resistance

One of the prominent properties of ROHACELL is the resistance against organic solvents. This is true of benzene, xylene and styrene monomer as much as for the usual paint and adhesive solvents, blowing agent constituents and most other technical solvents (see Table 6). By constrast, ROHACELL is not stable in alkaline media.

Table 6

Resistance table for ROHACELL 31, 51 and 71

at 20°C				at the boiling point		
Acetone	+	Methyl isobutyl ketone	+	Carbon tetrachloride	(77°C)	+
Ether	+	Petroleum ether	+	Benzene	(80°C)	+
Benzene	+	Sulphuric acid (10%)	+	Trichloroethylene	(88°C)	+
Dibutyl phthalate	(+)	Soda solution (5%)	–	Chlorobenzene	(132°C)	–
Diesel fuel	+	Styrene	+	Xylene	(139°C)	+
Glacial acetic acid	–	High octane petrol	+	o-Dichlorobenzene	(180°C)	–
Ethyl acetate	+	Carbon tetrachloride	+			
Isopropanol	+	Tetrahydrofuran	–			
Paint solvent I	+	Toluene	+			
Paint solvent II	+	Trichloroethylene	+			
Methanol	–					

Processing

Machining

Machining can be performed on all types of high-speed woodworking and plastics processing machinery. In addition, naturally all the various special machines for rigid foams, e.g. horizontal and vertical band saws (no knives) operating at maximum speeds, can be employed. Fundamentally, no lubricant is required during working.

Hot-wire cutting

Hot-wire cutting of ROHACELL 31 can be accomplished satisfactorily, with ROHACELL 51 it is feasible to a limited extent. However, high-performance devices are required. Manufacturer's names can be supplied.

Thermoforming

Limited heat-shaping of ROHACELL sheets is possible. For this purpose the sheets are heated to 170–220°C and shaped as desired in the oven. Radii and bevels are formed with heated tools or after partial heating.

Cementing

Most commercial adhesives can be employed. Pouring, brushing or spraying viscosity epoxy and methacrylate casting resins, for example, are suitable for giving strong, rigid joints. The bond between the adhesive and ROHACELL is achieved solely by virtue of the mechanical anchorage in the cut-open cells. In order to obtain efficient filling of the cells with the resinous adhesive the curing should be carried out under adequate pressure (1–3 kgf/cm^2).

Solvent-containing adhesives based on synthetic rubber have also given good results. However, efficient ventilation must be given after applying the adhesives on both sides before pressing the components together under pressure. ROHACELL is very resistant to the diffusion of solvents.

For cementing ROHACELL to other materials, e.g. for producing sandwich structures, the adhesives that are suitable for the relevant other materials can be used, as a rule. Thus epoxy resins or rubber adhesives are suitable for metals, methacrylate resins for acrylics, polyvinyl acetate emulsions for wood, and polyester resins for GFP panels.

For producing heat-resistant joints involving metal facings the so-called 'reactive' sheet adhesives can be employed.

Universally valid statements concerning methods of application, the amount to be applied and drying and curing schedules cannot be made because of the multiplicity of adhesives available and the many different substances that are bonded to ROHACELL. To help solve particular problems, we shall gladly look for a successful solution in collaboration with the adhesive manufacturers. In all adhesion problems ROHACELL offers the very valuable advantage of solvent resistance and, for heat-curing, of thermal resistance (using epoxy resins at up to 160°C).

Painting

ROHACELL can be sprayed or brushed with all normal commercial paints (including nitrocellulose finishes). To obtain a smooth, glossy surface the foam is initially filled and sanded. Spray fillers, e.g. polyester fillers, are suitable. Particularly resistant surfaces are obtained by hot metal spraying using aluminium, bronze, copper, iron

Laminating

Sandwich elements with glass fibre reinforced plastic facings and ROHACELL cores display interesting properties. The normal laminating techniques can be employed to cover the core. To obtain satisfactory peeling strengths a pressure of at least 1 kgf/cm^2 is desirable. Heat-curing is recommended, ROHACELL withstands temperatures up to 160 °C: When polyester resins are used the resistance to styrene means that sealing of the foam surface is not necessary.

Applications

The specific properties of ROHACELL fulfil many desires for an extremely lightweight material of construction. It displays excellent strength characteristics at temperatures up to 160°C and good rigidity when hot. Processing presents no difficulties and in addition it possesses the heat insulating qualities so desirable in lightweight materials.

ROHACELL is therefore eminently suitable as a core material for sandwich components. It displays the necessary compressive strength for withstanding stresses at right angles to the facing layer and, above all, the desired high shear resistance for flexurally stressed sandwich parts. As the elasticity and shear moduli are simultaneously high in relation to the density, even very light sandwich elements yield substantial rigidity values and assurance against crumpling of the facing layer.

Aluminium and special steel, glass fibre reinforced plastic, acrylics and other plastics are all suitable materials for making the facing panels; alternatively, decorative laminate panels, wood panels and hardwood veneers are suitable. Table 7 and Fig. 5 provide information about the performance of ROHACELL-core sandwich structures.

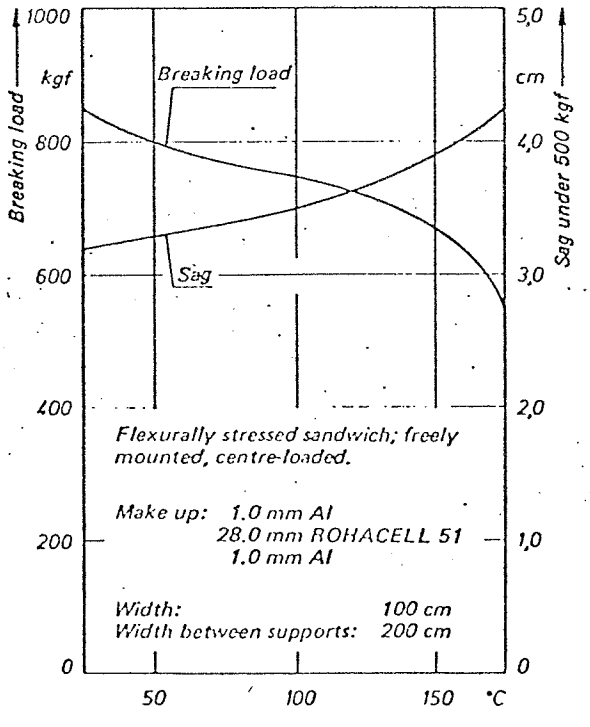


Fig. 5

ROHACELL 51 core-aluminium facing sandwich structure

Table 7

Properties of ROHACELL-core sandwich panels at 20°C (freely mounted carriers, centre-applied load, 200 cm between supports, 100-cm wide panels)

Sandwich make-up:		2-mm acrylic glass 20-mm ROHACELL 31 2-mm acrylic glass	0.5-mm aluminium 10.0-mm ROHACELL 51 0.5-mm aluminium	1.0-mm aluminium 28.0-mm ROHACELL 31 1.0-mm aluminium
Weight per unit area	[kg/m²]	5.8	3.7	6.8
Flexural torque at failure	[kgf cm]	2×10^4	7×10^3	3.5×10^4
Breaking load	[kgf]	400	140	700
Flexural stiffness	[kgf cm²]	7×10^5	9×10^5	2.4×10^7
Thickness of a solid panel of identical strength	[mm]	12.6	5.8	12.2
Weight per unit area of a solid panel of identical strength	[kg/m²]	14.9	15.7	33
Thickness of a solid panel of identical rigidity	[mm]	14.1	5.4	16
Weight per unit area of a solid panel of identical rigidity	[kg/m²]	16.6	14.4	43

Possible applications for ROHACELL-cored sandwich structures obtain in aircraft and vehicle construction, for air-freight and special types of small containers, in caravan construction, for use for tall building cladding and in dryer construction. Sandwich structures with ®ROHAGLAS and wood facings are of interest for shop construction and interior building structures, for furniture, lightweight sliding doors and door panels.

On account of its resistance to solvents ROHACELL is a suitable material for use as floats immersed in organic solvents. Specimens (50 x 50 x 20 mm) submerged in high octane petrol for 3 months gained less than 20% in weight and this increase is due almost entirely to wetting of the cut-open cells in the surface. ROHACELL is going to help to solve problems of this type. The same is true of special insulating tasks involving temperatures of up to 180°C and in particular cases even to 200°C.

The strength, finely cellular structure and white colour of this rigid foam is enabling the material to find increasing employment in industrial and architectural model-building, in mouldmaking and in the advertising and design sector.

Laminating

Sandwich elements with glass fibre reinforced plastic facings and ROHACELL cores display interesting properties. The normal laminating techniques can be employed to cover the core. To obtain satisfactory peeling strengths a pressure of at least 1 kgf/cm^2 is desirable. Heat-curing is recommended, ROHACELL withstands temperatures up to 160 °C: When polyester resins are used the resistance to styrene means that sealing of the foam surface is not necessary.

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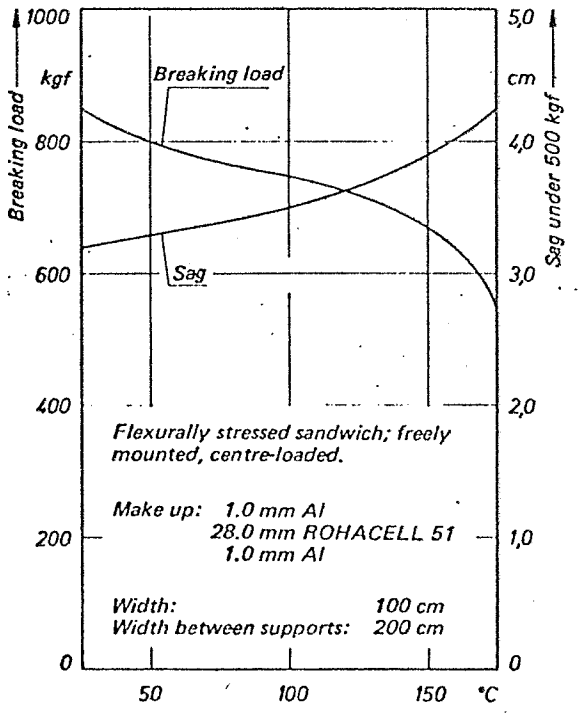

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Weight per unit area	[kg/m²]	5.8	3.7	6.8
Flexural torque at failure	[kgf cm]	2×10^4	7×10^3	3.5×10^4
Breaking load	[kgf]	400	140	700
Flexural stiffness	[kgf cm²]	7×10^5	9×10^5	2.4×10^7
Thickness of a solid panel of identical strength	[mm]	12.6	5.8	12.2
Weight per unit area of a solid panel of identical strength	[kg/m²]	14.9	15.7	33
Thickness of a solid panel of identical rigidity	[mm]	14.1	5.4	16
Weight per unit area of a solid panel of identical rigidity	[kg/m²]	16.6	14.4	43

Possible applications for ROHACELL-cored sandwich structures obtain in aircraft and vehicle construction, for air-freight and special types of small containers, in caravan construction, for use for tall building cladding and in dryer construction. Sandwich structures with ®ROHAGLAS and wood facings are of interest for shop construction and interior building structures, for furniture, lightweight sliding doors and door panels.

On account of its resistance to solvents ROHACELL is a suitable material for use as floats immersed in organic solvents. Specimens (50 x 50 x 20 mm) submerged in high octane petrol for 3 months gained less than 20% in weight and this increase is due almost entirely to wetting of the cut-open cells in the surface. ROHACELL is going to help to solve problems of this type. The same is true of special insulating tasks involving temperatures of up to 180°C and in particular cases even to 200°C.

The strength, finely cellular structure and white colour of this rigid foam is enabling the material to find increasing employment in industrial and architectural model-building, in mouldmaking and in the advertising and design sector.