

**Chemical Boards; Tooling Materials for Design  
Development, Trial Production and Production**

# **SANMODUR Products**



***Sanyo***  
***Chemical***



## ■ Preface

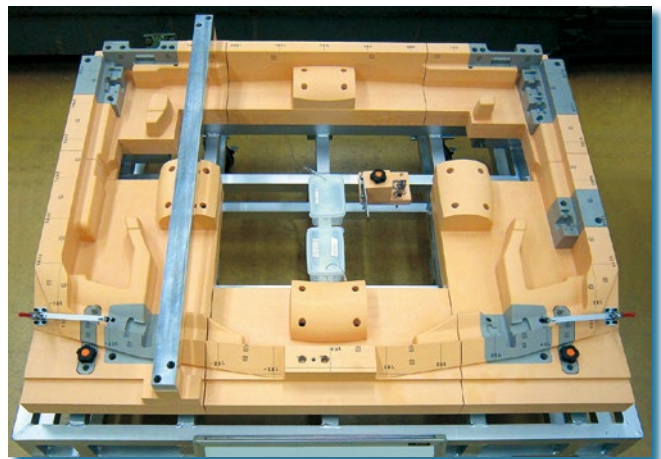
- SANMODUR products are tooling materials (chemical boards) developed by Sanyo Chemical, based on its own technological research in special resins and continuous production systems.
- To meet various requirements as a material for models and molds used in design development, trial production and small scale production, we offer a wide range of boards.
- SANMODUR products with fine cell structures, homogeneity and processability also have features required for various purposes such as light weight, strength, heat resistance, dimensional stability and little dust generation. Furthermore, some of these products with an antistatic property were developed. The dust generated from cutting is less of a problem for NC machine tools and operators.
- To reduce material loss and time required for adhesion of boards, we provide boards in a wide range of thicknesses.

## ■ Examples of Applications

SANMODUR products are used for various purposes.



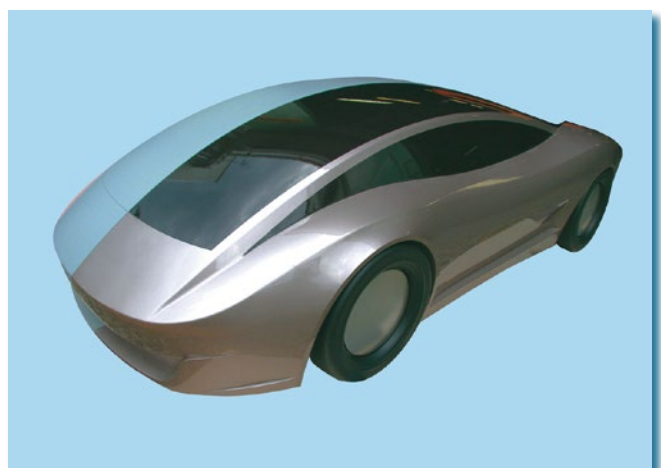
Master model for tire molds  
[Photo courtesy of NGK FINE MOLDS,INC.]



Checking fixture  
[Photo courtesy of TECHNICAL MODEL]



Precision cutting model of SANMODUR TW-E  
[Photo courtesy of TECHNICAL MODEL]



Design model (Concept car)



## ■ Processes and Recommended SANMODUR Products

Processes, the type of model and mold required for each process, the physical properties required for the materials used as the model and mold, and SANMODUR products that meet the requirement are shown below.

Please select the SANMODUR product that meets your requirements.




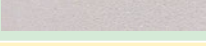
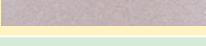


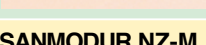



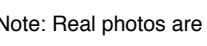
Process	Types of Models and Molds	Physical Properties Required	Recommended SANMODUR Products
Planning	(Design / CAD)		
↓			
Design	Design model <ul style="list-style-type: none"> <li>• Mock-up model</li> <li>• Styling model</li> <li>• Negative mold</li> </ul>	<ul style="list-style-type: none"> <li>• Light weight</li> <li>• Fine cell structures</li> <li>• Manual and machine processability</li> </ul>	<ul style="list-style-type: none"> <li>• SANMODUR SX</li> <li>• SANMODUR MH-E*</li> <li>• SANMODUR LC-M</li> <li>• SANMODUR MS-E*</li> <li>• SANMODUR MDX-M</li> </ul>
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Trial production	Master model <ul style="list-style-type: none"> <li>• Foundry model</li> <li>• Mold for vacuum molding</li> </ul>	<ul style="list-style-type: none"> <li>• Homogeneous fine cell structures</li> <li>• Precision</li> <li>• Strength</li> <li>• Machine processability</li> </ul>	<ul style="list-style-type: none"> <li>• SANMODUR NO7K-E*</li> <li>• SANMODUR TW-E*</li> <li>• SANMODUR VM</li> <li>• SANMODUR NV</li> <li>• SANMODUR TH</li> </ul>
↓			
Mass production	<ul style="list-style-type: none"> <li>• Checking fixture</li> <li>• Heat-resistant mold</li> </ul>	<ul style="list-style-type: none"> <li>• Extremely high precision</li> <li>• Extremely high strength</li> <li>• Extremely high hardness</li> <li>• Extremely high heat resistance</li> </ul>	<ul style="list-style-type: none"> <li>• SANMODUR TW-E*</li> <li>• SANMODUR NZ-M</li> <li>• SANMODUR HD-M</li> <li>• SANMODUR NV</li> </ul>

\* Having an antistatic property



## ■ Features and Major Physical Properties

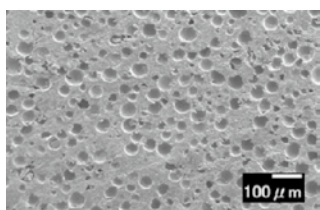
The following table shows the features and major physical properties of SANMODUR products.  
The values are representative.

Product Name Product Color	Application	Feature	
<b>SANMODUR SX</b> 	<ul style="list-style-type: none"> <li>Styling model</li> <li>Mock-up model</li> </ul>	<ul style="list-style-type: none"> <li>Extremely light weight</li> <li>Fine cell structure and high strength, considering its low density</li> </ul>	
<b>SANMODUR MH-E</b> 	<ul style="list-style-type: none"> <li>Styling model</li> <li>Design model</li> </ul>	<ul style="list-style-type: none"> <li>Light weight</li> <li>Antistatic property</li> <li>Fine cell structure, considering its low density (Painting process can be simplified.)</li> </ul>	
<b>SANMODUR LC-M</b> 	<ul style="list-style-type: none"> <li>Mock-up model</li> <li>Negative mold</li> </ul>	<ul style="list-style-type: none"> <li>Light weight</li> <li>Excellent dimensional stability, heat resistance and strength</li> <li>Excellent manual and machine processability</li> </ul>	
<b>SANMODUR MS-E</b> 	<ul style="list-style-type: none"> <li>Design model</li> <li>Master model</li> </ul>	<ul style="list-style-type: none"> <li>Fine cell structure</li> <li>Antistatic property</li> <li>Excels both in strength and dimensional stability</li> <li>Excellent manual and machine processability</li> </ul>	
<b>SANMODUR MDX-M</b> 	<ul style="list-style-type: none"> <li>Design model</li> <li>Master model</li> </ul>	<ul style="list-style-type: none"> <li>Fine cell structure</li> <li>Excellent manual and machine processability</li> </ul>	
<b>SANMODUR NO7K-E</b> 	<ul style="list-style-type: none"> <li>Foundry model</li> <li>Master model</li> </ul>	<ul style="list-style-type: none"> <li>General purpose type with well-balanced properties</li> <li>Antistatic property</li> </ul>	
<b>SANMODUR TW-E</b> 	<ul style="list-style-type: none"> <li>Foundry model</li> <li>Master model</li> <li>Checking fixture</li> </ul>	<ul style="list-style-type: none"> <li>General purpose type</li> <li>Antistatic property</li> <li>Considered to be of general purpose type despite fine cell structure and high strength</li> <li>Excellent dimensional stability</li> </ul>	
<b>SANMODUR VM</b> 	<ul style="list-style-type: none"> <li>Mold for vacuum molding</li> <li>Master model</li> </ul>	<ul style="list-style-type: none"> <li>High density and extremely fine cell structure</li> <li>Suitable for mold to produce transparent casts</li> </ul>	
<b>SANMODUR NZ-M</b> 	<ul style="list-style-type: none"> <li>Checking fixture</li> <li>Heat-resistant mold</li> </ul>	<ul style="list-style-type: none"> <li>Extremely high precision and high heat resistance</li> <li>Excellent dimensional stability</li> </ul>	
<b>SANMODUR HD-M</b> 	<ul style="list-style-type: none"> <li>Foundry model</li> <li>Master model</li> <li>Checking fixture</li> </ul>	<ul style="list-style-type: none"> <li>High hardness and fine cell structure</li> <li>Excellent flexural strength and impact strength</li> </ul>	
<b>SANMODUR NV</b> 	<ul style="list-style-type: none"> <li>Foundry model</li> <li>Master model</li> <li>Checking fixture</li> </ul>	<ul style="list-style-type: none"> <li>Excellent manual and machine processability, considering its high density</li> </ul>	
<b>SANMODUR TH</b> 	<ul style="list-style-type: none"> <li>Foundry model</li> <li>Master model</li> <li>Checking fixture</li> </ul>	<ul style="list-style-type: none"> <li>High density and strength (durable even under high pressure molding)</li> <li>Excellent machine processability</li> </ul>	

Note: Real photos are put as the product colors. However, they cannot express real colors. Please see for reference.

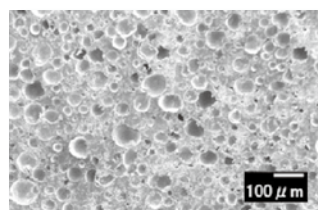
## ■ Example Exhibiting Fine Cell Structures of SANMODUR Products

As the following electron micrograph of a cross section shows, SANMODUR TW-E has a smooth surface of a cut section due to the fine cell structure compared with a conventional chemical board available on the market.



SANMODUR TW-E (cross section)

[density = 750 kg/m<sup>3</sup> average cell size = 47 μm]



Comparative (cross section)

[density = 720 kg/m<sup>3</sup> average cell size = 71 μm]



	Density kg/m <sup>3</sup>	Hardness Shore D	Flexural Strength MPa	Impact Strength kJ/m <sup>2</sup>	Coefficient of Linear Thermal Expansion °C <sup>-1</sup>	Deflection Temperature under Load °C	Surface Roughness μ m	Milling Resistance N	Abrasion of Cutter Edge mm
	ASTM D 792	ASTM D 2240	ASTM D 790	ASTM D 256	TMA	ASTM D 648	*1	*2	*3
	270	31	6.4	1.2	50×10 <sup>-6</sup>	60	15	21	0.9
	350	43	7.4	2.4	54×10 <sup>-6</sup>	54	11	35	0.9
	400	40	10.0	1.9	47×10 <sup>-6</sup>	80	13	35	0.9
	450	52	13.6	4.3	58×10 <sup>-6</sup>	65	8	64	0.9
	580	54	17.0	5.0	50×10 <sup>-6</sup>	85	8	70	1.0
	640	61	26.5	7.5	60×10 <sup>-6</sup>	90	7	98	0.7
	750	64	25.0	5.7	47×10 <sup>-6</sup>	95	4	80	1.0
	800	64	25.0	6.0	50×10 <sup>-6</sup>	85	3	90	1.0
	900	80	46.0	5.5	29×10 <sup>-6</sup>	140	3	150	4.5
	1100	81	58.0	11.0	53×10 <sup>-6</sup>	100	3	169	1.5
	1130	74	32.0	8.0	52×10 <sup>-6</sup>	93	3	150	0.8
	1450	85	68.2	9.8	47×10 <sup>-6</sup>	84	2	188	0.9

\*1 The board was cut using an NC machine. The surface roughness of the cut section was measured through the use of a non-contact three-dimensional surface roughness tester. The surface roughness is the average absolute value of irregularities; and the lower the value, the smoother the surface.

\*2 The milling resistance during cutting through the use of an NC machine driven with 4-component dynamometer under the following conditions was measured:

Edge: through-away tip of carbide tool with a diameter of 16 mm, Revolution rate: 5,000 rpm,  
Feed speed: 2,000 mm/min, Cut depth: 3 mm

\*3 The board was cut continuously for 10 m using an NC machine under the following conditions:

Edge: normal cutting edge of high-speed steel with a diameter of 10 mm, Revolution rate: 10,000 rpm,  
Feed speed: 100 mm/min, Pick: 1 mm, Cut depth: 3 mm

The degree of abrasion of the cutter edge after cutting was visually evaluated with a stereomicroscope (magnification: 50).





## ■ Example of Cutting Conditions

The following table shows an example of the conditions when SANMODUR products are cut using an NC machine.

Product Name	Cutter	Process	Cutter Diameter mm	Cutter Revolution Rate rpm	Feed Speed mm/min	Step-over Distance mm	Depth of Cut mm
SANMODUR SX	Ball end mill of high-speed steel	Rough milling	20	12,000	10,000	15	20
		Intermediate milling	20	8,000	6,000	5	8
		Finishing	10	6,000	3,000	0.8	0.5
SANMODUR MH-E	Ball end mill of high-speed steel	Rough milling	20	12,000	6,000	15	10
		Intermediate milling	20	8,000	4,000	5	5
		Finishing	10	6,000	3,000	0.8	0.5
SANMODUR LC-M	Ball end mill of high-speed steel	Rough milling	20	12,000	6,000	15	10
		Intermediate milling	20	8,000	4,000	5	5
		Finishing	10	6,000	3,000	0.8	0.5
SANMODUR MS-E	Ball end mill of high-speed steel	Rough milling	20	15,000	4,000	15	10
		Intermediate milling	20	10,000	4,000	5	5
		Finishing	10	7,000	3,000	0.8	0.5
SANMODUR MDX-M	Ball end mill of high-speed steel	Rough milling	20	16,000	4,000	15	10
		Intermediate milling	20	10,000	3,000	5	5
		Finishing	10	7,000	2,000	0.8	0.5
SANMODUR NO7K-E	Ball end mill of high-speed steel	Rough milling	20	16,000	4,000	15	10
		Intermediate milling	20	10,000	3,000	5	5
		Finishing	10	7,000	2,000	0.8	0.5
SANMODUR TW-E	Ball end mill of carbide tool	Rough milling	20	16,000	3,500	15	10
		Intermediate milling	20	10,000	2,000	5	5
		Finishing	10	8,000	2,000	0.8	0.5
SANMODUR VM	Ball end mill of carbide tool	Rough milling	20	16,000	3,500	15	10
		Intermediate milling	20	10,000	2,000	5	5
		Finishing	10	8,000	2,000	0.8	0.5
SANMODUR NZ-M	Ball end mill of carbide tool	Rough milling	16	4,000	2,000	15	10
		Intermediate milling	12	4,000	2,500	5	5
		Finishing	8	4,000	2,500	0.8	0.5
SANMODUR HD-M	Ball end mill of carbide tool	Rough milling	16	4,000	2,000	15	10
		Intermediate milling	12	4,000	2,500	5	5
		Finishing	8	4,000	2,500	0.8	0.5
SANMODUR NV	Ball end mill of carbide tool	Rough milling	16	4,000	2,000	15	10
		Intermediate milling	12	4,000	2,500	5	5
		Finishing	8	4,000	2,500	0.8	0.5
SANMODUR TH	Ball end mill of carbide tool	Rough milling	16	2,000	1,000	5	5
		Intermediate milling	12	2,000	1,300	2	2
		Finishing	8	2,000	1,300	0.3	0.5

## ■ Example of Model Making Processes Using SANMODUR Products



- Cutting: The board is cut to the desired length and width using, for example, a band saw.
- Laminating: Laminated to the desired thickness using an appropriate adhesive.
- Milling: Milled using an NC machine for rough milling, intermediate milling and finishing.
- Manual processing: Polished using a file, a sandpaper, or other tools if necessary.
- Painting: Painted if necessary.



## ■ Size and Packing

The following table shows the size and number of boards per case.

Product Name	Size mm	Number of Boards per Case
<b>SANMODUR SX-5</b>	1500 × 500 × 50	2
<b>SANMODUR SX-10</b>	1500 × 500 × 100	1
<b>SANMODUR SX-20</b>	1500 × 500 × 200	1
<b>SANMODUR MH-3E</b>	1500 × 500 × 30	2
<b>SANMODUR MH-5E</b>	1500 × 500 × 50	2
<b>SANMODUR MH-8E</b>	1500 × 500 × 80	1
<b>SANMODUR MH-10E</b>	1500 × 500 × 100	1
<b>SANMODUR MH-15E</b>	1500 × 500 × 150	1
<b>SANMODUR LC-5M</b>	1500 × 500 × 50	2
<b>SANMODUR LC-10M</b>	1500 × 500 × 100	1
<b>SANMODUR LC-15M</b>	1500 × 500 × 150	1
<b>SANMODUR LC-20M</b>	1500 × 500 × 200	1
<b>SANMODUR MS-3E</b>	1500 × 500 × 30	2
<b>SANMODUR MS-5E</b>	1500 × 500 × 50	2
<b>SANMODUR MS-8E</b>	1500 × 500 × 80	1
<b>SANMODUR MS-10E</b>	1500 × 500 × 100	1
<b>SANMODUR MS-20E</b>	1500 × 500 × 200	1
<b>SANMODUR MDX-25M</b>	1500 × 500 × 25	4
<b>SANMODUR MDX-5M</b>	1500 × 500 × 50	2
<b>SANMODUR MDX-75M</b>	1500 × 500 × 75	1
<b>SANMODUR MDX-10M</b>	1500 × 500 × 100	1
<b>SANMODUR MDX-15M</b>	1500 × 500 × 150	1
<b>SANMODUR NO7K-2E</b>	1000 × 500 × 20	4
<b>SANMODUR NO7K-3E</b>	1500 × 500 × 30	2
<b>SANMODUR NO7K-5E</b>	1500 × 500 × 50	2
<b>SANMODUR NO7K-6E</b>	1500 × 500 × 60	1
<b>SANMODUR NO7K-8E</b>	1500 × 500 × 80	1
<b>SANMODUR NO7K-10E</b>	1500 × 500 × 100	1
<b>SANMODUR TW-3E</b>	1500 × 500 × 30	2
<b>SANMODUR TW-5E</b>	1500 × 500 × 50	2
<b>SANMODUR TW-8E</b>	1500 × 500 × 80	1
<b>SANMODUR TW-10E</b>	1500 × 500 × 100	1
<b>SANMODUR TW-15E</b>	1000 × 500 × 150	1
<b>SANMODUR VM-1505F</b>	1500 × 500 × 50	1
<b>SANMODUR VM-8</b>	1500 × 500 × 80	1
<b>SANMODUR NZ-3M</b>	1000 × 500 × 30	2
<b>SANMODUR NZ-5M</b>	1000 × 500 × 50	1
<b>SANMODUR HD-3M</b>	1000 × 500 × 30	2
<b>SANMODUR HD-5M</b>	1000 × 500 × 50	1
<b>SANMODUR NV-1003</b>	1000 × 500 × 30	2
<b>SANMODUR NV-1005</b>	1000 × 500 × 50	1
<b>SANMODUR NV-1010</b>	1000 × 500 × 100	1
<b>SANMODUR TH-6504</b>	600 × 500 × 40	1

## ■ Important

Before handling SANMODUR products, refer to the current Safety Data Sheet for recommended protective equipment, and detailed precautionary and hazards information.

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## **Sanyo Chemical Industries, Ltd.**

*For detailed information, please contact Sales & Marketing Dept. of Modeling materials of Sanyo Chemical Industries, Ltd.*

E-Mail: [sales-mkt@sanyo-chemical.group](mailto:sales-mkt@sanyo-chemical.group) Fax: +81 - 3 - 3245 - 1697

URL: <https://www.sanyo-chemical.co.jp/eng/> Tel: +81 - 3 - 5200 - 3588

Address: No.10 Chuo Bldg., 1 - 5 - 6, Nihonbashi - honcho, Chuo - ku, Tokyo 103 - 0023, Japan

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