Vantico Ltd.

Electronic Polymers

vantico

Heavy Electrical

®Araldite Casting Resin System

Araldite	**CY 228**	**100 pbw**
Hardener	**HY 918**	**85 pbw**
Flexibilizer	**DY 045**	**0 - 20 pbw**
Accelerator	**DY 062**	**0.5 - 1.5 pbw**
Filler	**Silica flour**	**345 - 385 pbw**

Liquid, low viscous, hot-curing casting resin system based on Bisphenol A.
Reactivity and flexibility can be adapted.

Applications

Indoor electrical insulators for medium and high voltage, such as switch and apparatus components, pin insulators, bushings, … as well as power distribution, current and voltage transformers.

Processing methods

Automatic pressure gelation process (APG)
(see our special brochure, Publ. No. 28160/e)
Conventional gravity casting process under vacuum

Properties

High mechanical and electrical properties
Good thermal shock resistance
Possibility of high filler content

Edition: **July 2000**
Replaces Edition: January 1998

Product data

(guideline values)

	Liquid, low viscous bisphenol A epoxy resin				
Araldite CY 228	Viscosity	at 25°C	DIN 53015	mPa s	4500 - 5500
	Epoxy content		ISO 3001	equiv/kg	5.0 - 5.3
	Density	at 25°C	ISO 1675	g/cm³	1.13 - 1.17
	Flash point		DIN 51758	°C	160
	Vapour pressure	at 25°C	(Knudsen)	mbar	ca. 2.10^{-2}
		at 60°C	(Knudsen)	mbar	ca. 1
	Liquid anhydride hardener				
Hardener HY 918	Viscosity	at 25°C	DIN 53015	mPa s	50 - 80
	Density	at 25°C	ISO 1675	g/cm³	1.18 - 1.24
	Flash point		DIN 51758	°C	ca. 165
	Vapour pressure	at 25°C	(Knudsen)	mbar	ca. 1
		at 60°C	(Knudsen)	mbar	ca. 10
	Solvent-free, low viscous polyglycol				
Flexibilizer DY 045	Viscosity	at 23°C	DIN 53015	mPa s	105 - 140
	Density	at 20°C	ISO 1675	g/cm³	1.10 - 1.15
	Flash point		DIN 51758	°C	ca. 235
	Liquid tertiary amine accelerator				
Accelerator DY 062	Viscosity	at 25°C	DIN 53015	mPa s	ca. 10
	Density	at 25°C	ISO 1675	g/cm³	0.88 - 0.92
		at 60°C	ISO 1675	g/cm³	0.84 - 0.89
	Flash point		DIN 51758	°C	59
	Vapour pressure	at 20°C	(Knudsen)	mbar	ca. 300
		at 60°C	(Knudsen)	mbar	ca. 1600

Remarks

End properties of this system have been tested with the silica filler, quality SUK II.
No flexibilizer is added to produce switch parts, pin insulators, … but we recommend to add some flexibilizer DY 045 (max 20ppw) for the production of instrument and distribution transformers.

Storage

Store the components at 18-25°C, in tightly sealed and dry original containers. Under these conditions, the shelf life will correspond to the expiry date stated on the label. Product specific advise regarding storage can be found on product label. After this date, the product may be processed only following reanalysis. Partly emptied containers should be closed tightly immediately after use.
For information on waste disposal and hazardous products of decomposition in the event of fire, refer to the Material Safety Data Sheets (MSDS) for these particular products

Processing

(guideline values)

System Preparation

General instructions for preparing liquid resin systems

Long pot life is desirable in the processing of any casting resin system. Mix all of the components together very thoroughly at room temperature or slightly above and under vacuum. Intensive wetting of the filler is extremely important. Proper mixing will result in:

- better flow properties and reduced tendency to shrinkage
- lower internal stresses and therefore improved mechanical properties on object
- improved partial discharge behaviour in high voltage applications.

For the mixing of medium- to high viscous casting resin systems and for mixing at lower temperatures, we recommend special thin film degassing mixers that may produce additional self-heating of 10-15 °C as a result of friction. For low viscous casting resin systems, conventional anchor mixers are usually sufficient.

In larger plants, two pre-mixers are used to mix the individual components (resin, hardener) with the respective quantities of fillers and additives under vacuum. Metering pumps then feed these premixes to the final mixer or a continuous mixer. The individual premixes can be stored at elevated temperature (about 60°C) for up to about 1 week, depending on formulation. Intermittent agitation during storage is advisable to prevent filler sedimentation.

Mixing time can vary from 0.5 to 3 hours, depending on mixing temperature, quantity, mixing equipment and the particular application. The required vacuum is 0.5 to 8 mbar. The vapor pressure of the individual components should be taken into account.

In the case of dielectrically highly stressed parts, we recommend checking the quality consistency and pre-drying of the filler. Their moisture content should be $\leq$ 0.2%.

Specific Instructions

The effective pot-life of the mix is about 1 to 2 days at temperatures below 25°C. Conventional batch mixers should be cleaned once a week or at the end of work. For longer interruptions of work, the pipes of the mixing and metering installations have to be cooled and cleaned with the resin component to prevent sedimentation and/or undesired viscosity increase. Interruptions over a week-end (approx. 48h) without cleaning are possible if the pipes are cooled at temperatures below 18°C.

For data on viscosity increase and gel time at various temperatures, refer to Figs: 4.1 and 4.4.

Mould temperature

APG process	120 - 150°C
Conventional vacuum casting	80 - 100°C

Demoulding times (depending on reactivity, mould temperature and casting volume)

APG process	10 - 45 min
Conventional vacuum casting	1 - 6 h

Cure conditions (minimal postcure)

APG process	10h at 140°C
Conventional vacuum casting	4h at 80°C + 8h at 140°C

To determine whether crosslinking has been carried to completion and the final properties are optimal, it is necessary to carry out relevant measurements on the actual object or to measure the glass transition temperature. Different gelling and cure cycles in the manufacturing process could lead to a different crosslinking and glass transition temperature respectively.

Processing Viscosities

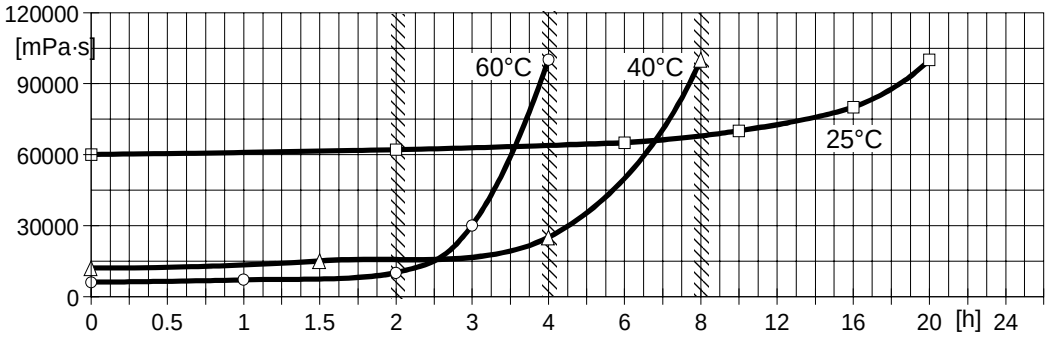

Fig.4.1: **Viscosity increase at 25, 40 and 60°C** (measurements with Rheomat 115)
(Shear rate D = 10 s^{-1})
(Accelerator DY 062, part : 0.8 pbw)

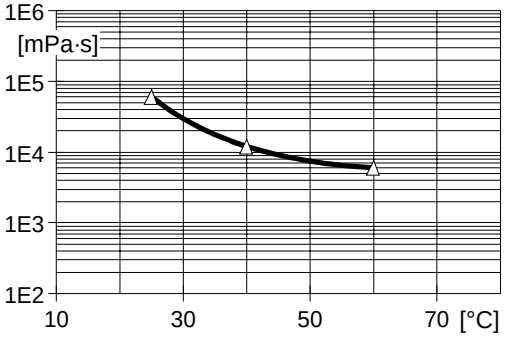

Fig.4.2: **Initial viscosity in function of temperature**
(measurements with Rheomat 115, D =10 s^{-1})
(without Flex. / Filler part : 65%)

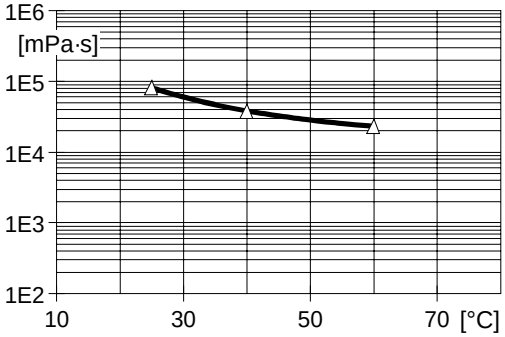

Fig.4.3: **Initial viscosity in function of temperature**
(measurements with Rheomat 115, D =10 s^{-1})
(Flex. DY 045, part : 20 pbw / Filler part : 65%)

Gelation-/Cure Times

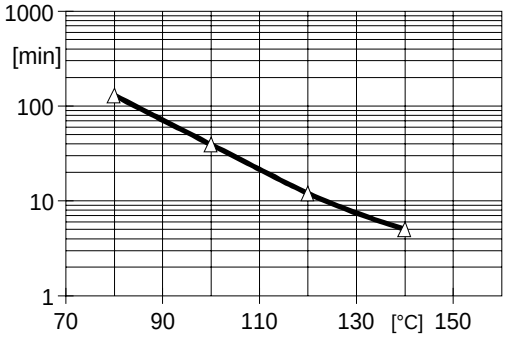

Fig.4.4: **Geltime measured with Gelnorm Instrument in function of temperature**
(DIN 16945/6.3.1) (Acc. DY 062, part : 0.8 pbw)

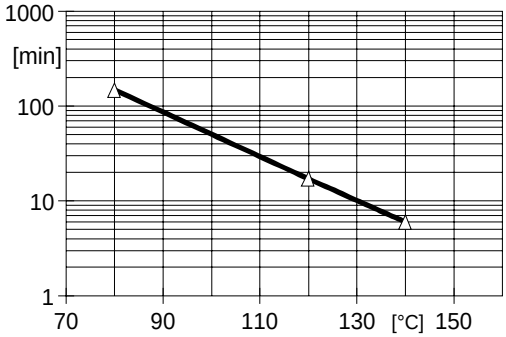

Fig.4.5: **Geltime measured with Gelnorm Instrument in function of temperature**
(DIN 16945/6.3.1) (Acc. DY 062, part : 0.8 pbw/ Flex. DY 045, part : 20 pbw)

Mechanical and Physical Properties

(guideline values)
Determined on standard test specimen at 23°C
Cured for 10h at 140°C

System tested :	Araldite CY 228	100	100
	HY 918	85	85
	DY 045	-	20
	DY 062	0.8	0.8
	Silica	345	385

Tensile strength	ISO 527	MPa	80 - 90	80 - 85
Elongation at break	ISO 527	%	0.70 - 1.00	0.80- 1.00
E modulus from tensile test	ISO 527	MPa	12000-13000	12000 - 13000
Flexural strength	ISO 178	MPa	125 - 135	130 - 140
Surface strain	ISO 178	%	1.1 - 1.3	1.3 - 1.5
E modulus from flexural test	ISO 178	MPa	11800-12100	11500 - 12500
Compressive strength	ISO 604	MPa	160 - 180	--
Compression set	ISO 604	%	9 - 11	--
Impact strength	ISO 179	kJ/m²	6 - 9	--
Double Torsion Test	CG 216-0/89			
Critical stress intensity factor (K_{IC})		$MPa \cdot m^{½}$	2.2 - 2.4	2.65 - 2.85
Specific energy at break (G_{IC})		J/m²	390 - 430	550 - 600
Martens temperature	DIN 53458	°C	105 - 110	70 - 75
Heat distortion temperature	ISO 75	°C	--	--
Glass transition temperature (DSC)	IEC 1006	°C	110 - 120	75 - 85
Coefficient of linear thermal expansion	DIN 53752		31 - $36 \cdot 10^{-6}$	40 - 12
Mean value for temperature range: 20 - 80°C		K^{-1}		
Thermal conductivity similar to	ISO 8894-1	W/mK	0.85 - 0.95	--
Glow resistance	DIN 53459	class	--	--
Flammability		UL 94	HB	--
Thickness of specimen: 4 mm		class	V1	--
Thickness of specimen: 12 mm		class		
Thermal endurance profile (TEP)	DIN/ IEC 216		Fig.7.1 - 7.2	--
Temperature index (TI): flexural strength	(20000h/ 5000h)	°C	194 - 232	--
Thermal ageing class (20000h)	IEC 85	class	H	--
Water absorption (specimen: 50×50×4 mm)	ISO 62		0.05 - 0.10	--
10 days at 23°C		% by wt.	0.05 - 0.10	--
60 min at 100°C		% by wt.		
Decomposition temperature (heating rate: 10K/min)			≤ 350	--
	DTA	°C	1.75 - 1.85	
Density	DIN 55990	g/cm³	**65**	**65**
Filler load, by wt.		%		

(guideline values)
Determined on standard test specimen at 23°C
Cured for 10 h at 140°C

System tested :	Araldite CY 228	100	100
	HY 918	85	85
	DY 045	-	20
	DY 062	0.8	0.8
	Silica	345	385

Breakdown strength	IEC 243-1	kV/mm	18 - 22	20 - 24
Diffusion breakdown strength	DIN/ VDE 0441/1	class	HD 2	HD 2
Temperature of specimen after test		°C	≤ 23	≤ 23
HV arc resistance	ASTM D 495	s	185-190	185-190
Tracking resistance	IEC 112			
with test solution A		CTI	>600-0.0	>600-0.0
with test solution B		CTI	>600M-0.0	>600M-0.0
Electrolytic corrosion	DIN 53489	grade	AN 1.2	A - 1

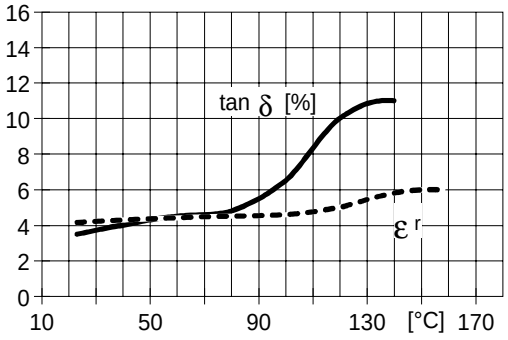

Fig.6.1: **Loss factor (tan δ) and dielectric constant (εr) in function of temperature**
(measurement frequency: 50 Hz, IEC 250/ DIN 53483)

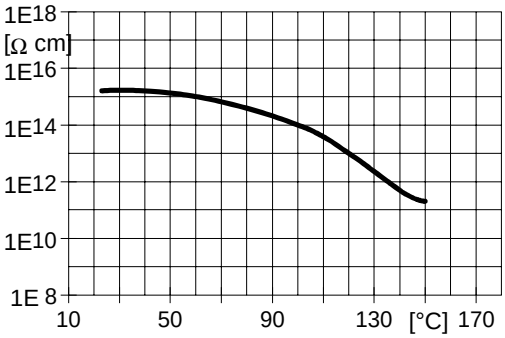

Fig.6.2: **Volume resistivity (ρ) in function of temperature**
(measurement voltage: 1000 V, IEC 93/ DIN 53482)

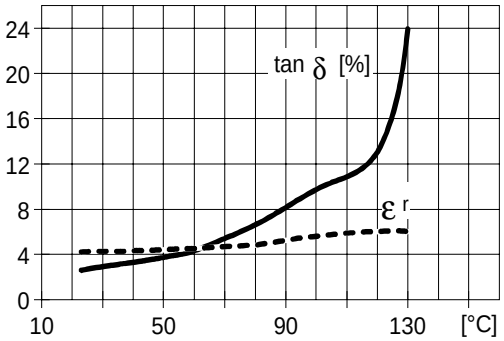

Fig.6.3: **Loss factor (tan δ) and dielectric constant (εr) in function of temperature**
(measurement frequency: 50 Hz, IEC 250/ DIN 53483)
(Acc. DY 062, part : 0.8 pbw/ Flex. DY 045 Part : 20 pbw)

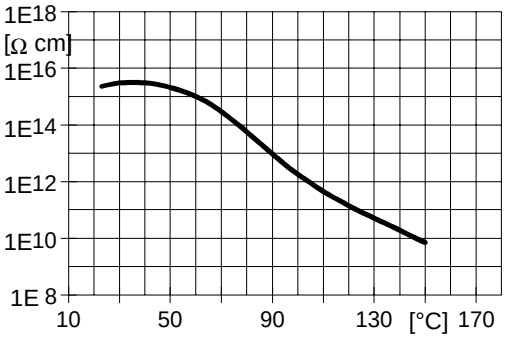

Fig.6.4: **Volume resistivity (ρ) in function of temperature**
(measurement voltage: 1000 V, IEC 93/ DIN 53482)
(Acc. DY 062, part : 0.8 pbw/ Flex. DY 045 Part : 20 pbw)

Special Properties and Values

(guideline values)

Thermal Endurance Profile acc. IEC 216

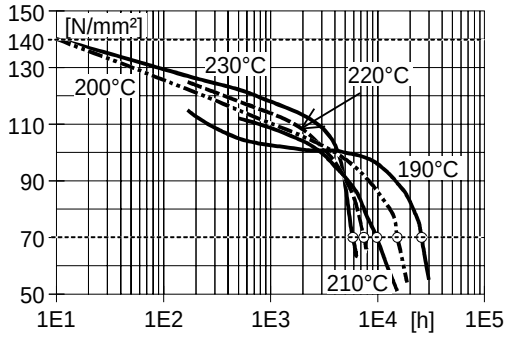

Fig.7.1: **Decrease of Flexural Strength**
(ISO 178, limit: 50%)

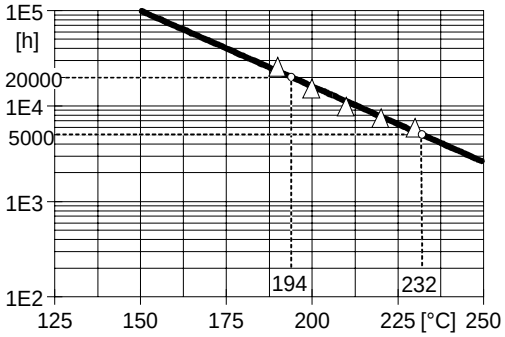

Fig.7.2: **Temperature Index 194 / 233 (Flexural Strength)**
(CY 228/ HY 918/ DY 062/ SiO2 : 100/ 85/ 1/ 350 pbw)

Influence of the Flexibilizer DY 045 on diverse properties

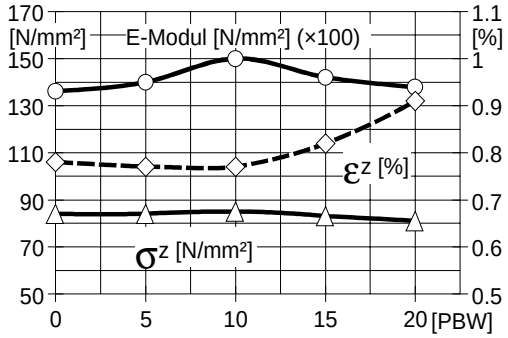

Fig.7.5: **Tensile Strength (σ_z), Elongation at break (ε_z) and E-Modulus in function of Flex part (pbw)**
(ISO 527)

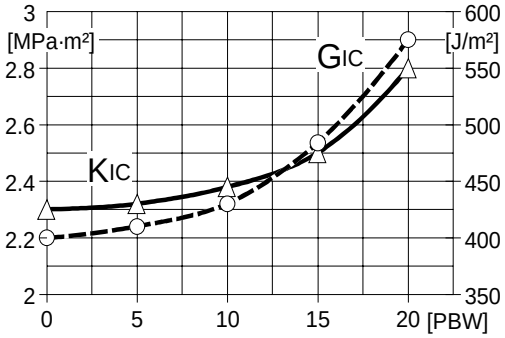

Fig.7.6: **Critical Stress Intensity Factor (K_{IC}) and specific Energy at break (G_{IC}) in function of Flex part (pbw)**

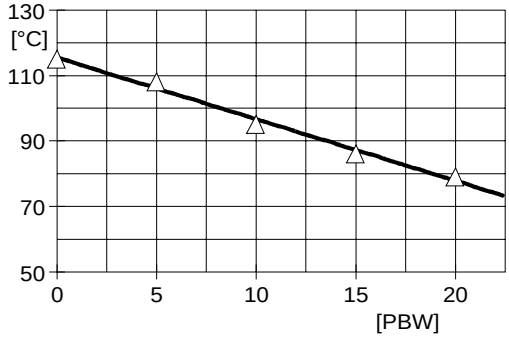

Fig.7.7: **Glass Transition Temperature (T_G) in function of Flex part (pbw)**
(IEC 1006)

Industrial hygiene

Mandatory and recommended industrial hygiene procedures should be followed whenever our products are being handled and processed. For additional information please consult the corresponding Safety Data Sheets and the brochure "Hygienic precautions for handling plastics products of Ciba Specialties Chemicals (Publ. No. 24264/e).

Handling precautions

Safety precautions at workplace:	
protective clothing	yes
gloves	essential
arm protectors	recommended when skin contact likely
goggles/ safety glasses	yes
respirator/dust mask	recommended
Skin protection	
before starting work	Apply barrier cream to exposed skin
after washing	Apply barrier or nourishing cream
Cleaning of contaminated skin	Dab off with absorbent paper, wash with warm water and alkali-free soap, then dry with disposable towels. Do not use solvents
Clean shop requirements:	Cover workbenches, etc. with light coloured paper. Use disposable breakers, etc.
Disposal of spillage	Soak up with sawdust or cotton waste and deposit in plastic-lined bin
Ventilation:	
of workshop	Renew air 3 to 5 times an hour
of workplace	Exhaust fans. Operatives should avoid inhaling vapours.

First Aid

Contamination of the **eyes** by resin, hardener or casting mix should be treated immediately by flushing with clean, running water for 10 to 15 minutes. A doctor should then be consulted.
Material smeared or splashed on the **skin** should be dabbed off, and the contaminated area then washed and treated with a cleansing cream (see above). A doctor should be consulted in the event of severe irritation or burns. Contaminated clothing should be changed immediately.
Anyone taken ill after **inhaling** vapours should be moved out of doors immediately. In all cases of doubt call for medical assistance.

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